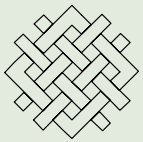
World Resources Institute

Working 9 to 5 on Climate Change: An Office Guide

Samantha Putt del Pino

Pankaj Bhatia



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December 2002

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ISBN 1-56973-530-1

Library of Congress Control Number: _____

Printed in the United States on recycled paper.
Cover stock contains 100% postconsumer fiber;
text stock contains 30% postconsumer fiber.

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acknowledgments

We would like to thank our colleagues within the World Resources Institute and those from other organizations and businesses that peer-reviewed this Guide and provided valuable feedback.

Reviewers
Gretchen Hoff, Frances Irwin, Nancy J. Kiefer, and James J. MacKenzie, *World Resources Institute*; William Burnidge; Lily Donge, *Calvert Asset Management Co.*; Jill Gravender, *California Climate Action Registry*; Markus Ohndorf, *World Business Council for Sustainable Development*; J.P. Ross, *Greenpeace Clean Energy Now!*; Timothy Roskelley, *NESCAUM*; Holly S. Siprelle, *American Psychological Association*.

Special thanks also to
Rob Day and Gwen Parker for getting the idea of WRI's CO_2 commitment off the ground; Elizabeth Cook, Christian Layke, Janet Ranganathan, and the GHG Protocol Initiative partners for their continued guidance and support; Hyacinth Billings, Bill LaRocque, Maggie Powell, Martha Schultz, and Wendy Vanasselt for their editorial, design, and production expertise.

This publication is a joint activity of WRI's GHG Protocol and SafeClimate projects. We would like to thank the following organizations for their generous financial support of these two initiatives: Anglo American, AT&T Foundation, Baxter International, BP, Conservation International, Det Norske Veritas, The Dow Chemical Company, DuPont, Energy Foundation, Environment Canada, Ford Motor Company, General Motors, Green Mountain Energy, International Paper, SC Johnson & Son, Steven and Michele Kirsch Foundation, Lafarge, Norsk Hydro, John D. and Catherine T. MacArthur Foundation, Monsanto Company, Charles Stewart Mott Foundation, The New York Community Trust, Spencer T. and Ann W. Olin Foundation, Ontario Power Generation, Petro-Canada, PowerGen, SGS, Shell, Statoil, STMicroelectronics, Sulzer, Suncor, Swiss Re, Texaco, Tokyo Electric Power Company, Total Fina Elf, Toyota, TransAlta, U.S. Agency for International Development, U.S. Environmental Protection Agency, Volkswagen, and the World Business Council for Sustainable Development.

We would also like to express our special thanks to Nancy J. Kiefer and Bill LaRocque for their generous financial and in-kind support that made the illustrations in this Guide possible.

INTRODUCTION

What Does the Guide Provide?

- An introduction to climate change and the ways that offices contribute to this global problem
- Seven simple steps you can take to measure your office's carbon dioxide (CO_2) emissions
- Suggestions for reducing your office's CO_2 emissions

Who Should Use This Guide?

This Guide is for office-based organizations ("offices") that do not undertake any manufacturing activities. Examples include consulting companies, research and educational institutions, government agencies, and nongovernmental organizations (NGOs). The methodologies and ideas for reducing your office's emissions are applicable to a variety of office sizes, types, and locations. And, don't worry, you won't need advanced statistics skills to use this Guide, just basic math skills, a calculator, and a spreadsheet program.

Organizations that undertake manufacturing activities or have complex organizational and ownership structures, such as partly owned entities or subsidiaries, should refer to *The Greenhouse Gas (GHG) Protocol Initiative* (GHG Protocol) for guidance on measuring and reporting emissions (See Box 1).

The information contained in this Guide, as well as the calculation spreadsheets provided on-line, build on and are consistent with the GHG Protocol. For more detailed guidance on measuring and reporting greenhouse gas emissions, see the GHG Protocol. The GHG Protocol standards, guidance, and calculation tools can be downloaded from the Protocol website at http://www.ghgprotocol.org.

BOX 1 THE GHG PROTOCOL

The GHG Protocol is a unique multi-stakeholder partnership of businesses, NGOs, and governments, led by the World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSD). It serves as the premier source of knowledge on corporate GHG accounting and reporting and draws on the expertise and contributions of individuals and organizations from around the world. The first edition was published in 2001 and a second edition will be released in 2003 (http://www.ghgprotocol.org).

According to the U.S. Department of Energy, 35 percent of the commercial workforce, or approximately 29 million people, work in office buildings across the country.

—U.S. Department of Energy, Energy Information Administration, 1999

WHAT IS CLIMATE CHANGE?

Climate change is a gradual change in the global temperature caused by the accumulation of greenhouse gases (GHGs) in the atmosphere. (See Box 2.) These gases absorb infrared radiation as it is reflected from the Earth's surface. The effect is similar to having a "blanket" of gases around the Earth keeping it warm. Increasing atmospheric GHG concentrations are causing the Earth's temperature to rise as more and more infrared radiation is trapped in the atmosphere.

BOX 2 GREENHOUSE GASES

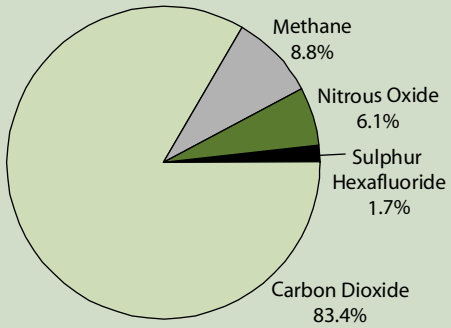
The six main gases are:

CO_2	Carbon dioxide
CH_4	Methane
N_2O	Nitrous oxide
HFCs	Hydrofluorocarbons
PFCs	Perfluorocarbons
SF_6	Sulphur hexafluoride

Although climate change is often referred to as global warming, "climate change" is a more accurate term because although overall temperatures are rising, some regions may become colder. Scientists predict such changes will disrupt weather systems, generating floods and droughts, and cause an increase in violent storms and disease. The result is widespread harm to ecosystems.

The most significant greenhouse gas is carbon dioxide (CO_2), which makes up approximately 83 percent of U.S. GHG emissions. (See Figure 1.)

FIGURE 1 U.S. GHG EMISSIONS BY GAS *(in CO_2 equivalent)* 2000



Source: Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2000

Current atmospheric CO_2 concentrations are roughly 30 percent higher than pre-industrial levels. Although carbon is naturally occurring and essential to life, ever-increasing emissions of carbon from fossil fuel combustion and deforestation are upsetting the Earth's natural balance; consequently, there is less carbon in the soil and vegetation and more in the atmosphere. Because CO_2 in the atmosphere captures the sun's heat, increasing amounts destabilize the global climate.[1] The Intergovernmental Panel on Climate Change (IPCC, http://www.ipcc.ch), the world's most authoritative voice on climate change science, has stated that "the balance of evidence suggests a discernible human influence on global climate." Nearly 85 percent of human-induced GHGs in the United States comes from the burning of fossil fuels (coal, natural gas, and petroleum).[2]

Greenhouse gases remain in the atmosphere for decades or centuries[3] (depending on the type of gas), and their potential impacts may escalate over time. Even if we start reducing global emissions today, atmospheric CO_2 concentrations (the most prevalent GHG) will continue to grow for years to come. To minimize risks, all sectors need to act now to reduce their CO_2 emissions.

For on-line resources and data on climate change, see Appendix III.

Footnotes

[1] *World Resources 2000–01*, World Resources Institute.

[2] *Greenhouse Gases, Global Climate Change and Energy,* Energy Information Administration, U.S. Department of Energy, http://www.eia.doe.gov/oiaf/1605/ggccebrochapter1.html.

[3] U.S. Environmental Protection Agency, http://yosemite.epa.gov/oar/globalwarming.nsf.

WHAT ARE THE IMPACTS OF CLIMATE CHANGE?

The impacts of climate change are manifold, and affect every aspect of our lives. Below is an overview of these impacts.

Negative Economic Impacts

The insurance industry has lost billions of dollars over the last few years as a result of extreme weather. Climate change will likely subject some regions to even more frequent storms and precipitation. Growing populations in areas considered vulnerable to flooding, like Florida, could exacerbate the economic impact of extreme weather events (EPA, http://yosemite.epa.gov/oar/globalwarming.nsf).

Depletion of Natural Resources

Climate change could magnify the cumulative impacts of other ecosystem stresses caused by human development, such as air and water pollution and habitat destruction, with costly repercussions. For some systems, such as coral reefs, the combined effects of climate change and other stresses are likely to bring large-scale irreversible impacts (U.S. Global Change Research Program, http://www.usgcrp.gov/). Fifty-eight percent of the world's reefs are already at risk from over fishing, pollution, and fishing with poisons or dynamite,[1] jeopardizing fish, tourism, and the natural coastal protection that reefs provide—a potential loss of about $375 billion a year.[2]

Flooding

A rise in sea level from climate change will threaten buildings, roads, and other infrastructure in vulnerable places. For example, infrastructure damage in Alaska is related to permafrost melting, sea level rise, and storm surge in low-lying coastal areas (U.S. Global Change Research Program, http://www.usgcrp.gov/).

Disease

Climate change could increase the prevalence of some infectious diseases, like malaria, dengue fever, yellow fever, and encephalitis, which are carried by mosquitoes and other insects, if warmer weather allows those insects to travel farther north (EPA, http://yosemite.epa.gov/oar/globalwarming.nsf).

Water Shortages

Many regions are already water-scarce because of drought, floods, or water pollution. Climate change will cause further water shortages in regions where summer water supplies are dependent on winter snowfall. Receding winter snow pack levels will leave less snow to melt and supply water in the summer (U.S. Global Change Research Program, http://www.usgcrp.gov/).

Habitat Destruction

Some major mammals may be seriously threatened by reductions of sea ice from warming in 50 to100 years. Whales in the Southern Hemisphere, for example, will be jeopardized by decreased abundance of krill, their primary food source.[3] Local extinctions of polar bears are possible; as ice melts sooner in the spring in the northern ocean, and forms later in the fall, their hunting season will be reduced and they will be forced to rely on fat reserves longer. Studies show that females and their cubs at the southern edge of their range already have lower body weights, and lighter cubs are less likely to survive than heavier ones.[4]

Ecosystem Disruption

Some ecosystems, such as alpine meadows, could disappear entirely, replaced by forests as tree lines move higher. Barrier islands could be flooded by rising sea levels (U.S. Global Change Research Program, http://www.usgcrp.gov/).

Glacial Melting

Increased temperatures over the last century have accelerated glacier loss worldwide. In Montana's Glacier National Park, the largest remaining glaciers are now only a third as large as they were in 1850. Experts predict that under current rates of warming, all the glaciers in the park will melt by 2030 (EPA, http://yosemite.epa.gov/oar/globalwarming.nsf).

For more resources detailing the impact of climate change, see *Appendix III.*

Footnotes

[1] World Resources Institute, *Reefs at Risk*, 1998.

[2] Robert Costanza et al. "The Value of the World's Ecosystem Services and Natural Capital," *Nature* 387 (May 15, 1997), 256 as cited in *Reefs at Risk*, WRI, 1998.

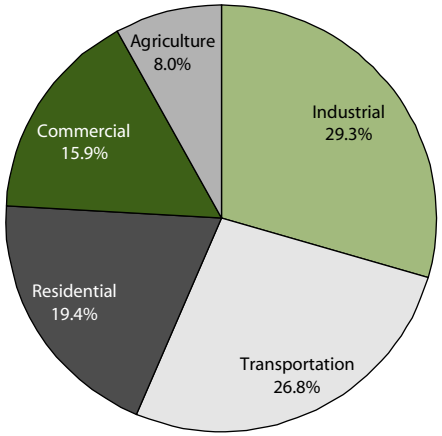
[3] Pacific Institute, *From the Harpoon to the Heat: Climate Change and the International Whaling Commission in the 21st Century,* 2000. http://www.pacinst.org/IWCOP.pdf.

[4] International Panel on Climate Change, 2001; World Wildlife Fund, 1999; *Climate Change and Polar Regions,* EPA.

WRI's Climate Goal

Protect the global climate system from further harm due to emissions of greenhouse gases and help humanity and the natural world adapt to unavoidable climate change.

FIGURE 2 U.S. GHG EMISSIONS BY ECONOMIC SECTOR



Source: Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2000

OFFICES AND CLIMATE CHANGE: *UNDERSTANDING THE CONNECTION*

Lights, heating and cooling, computers, printers, copiers, business travel, and commuting—these are all ways that your office, even if it is small, contributes to global climate change, the gradual warming in global temperature which looms as one of the world's most vexing environmental and economic problems.

Usually we think of *industry*—of factories with smokestacks—when we consider the major sources of the carbon dioxide emissions that contribute to climate change. And that's right: The industrial sector is the largest source of emissions in the United States. (See Figure 2.) However, offices account for a surprisingly large part of the climate change problem. Here are some statistics provided by the United States Department of Energy (DOE):[1]

- Office buildings account for 19 percent of all commercial energy consumption.
- Seventy percent of office building energy consumption is electricity, which is used for lighting, heating, cooling, and office equipment.
- Office buildings account for 21.8 percent of energy expenditures in commercial buildings, at a cost of approximately $17.8 billion annually.
- More than one-fourth of U.S. GHG emissions are from transportation sources. This includes travel by road, rail, and air, including the transportation-related emissions generated by employees traveling for office-related business and commuting to and from their jobs.
- Eighty percent of transportation-related fossil fuel use comes from road transportation and 13 percent from aviation.[2] Forty-seven percent of passengers on U.S. domestic flights are traveling for business.[3]

WRI'S CLIMATE COMMITMENT: *A CALL TO ACTION*

When WRI moved to new, "green" office space in 1999, two forward-thinking staff members suggested the organization could do even more to help the environment, and proposed the idea of publicly committing WRI to taking action on climate change by reducing its CO_2 emissions. After an Institute-wide staff meeting to present the idea, staff were given opportunities to discuss the suggestion and consider what WRI's emissions reduction target should be before the idea was put to a staff vote.

To prepare for the vote, staff developed a list of possible target areas and actions for CO_2 emissions reductions, along with a list of possible reduction targets and the justification for each. To help colleagues understand the degree to which each action would benefit the environment and affect the Institute's bottom line, WRI estimated the potential cost savings and emissions reductions for each proposed activity. Some proposed actions were achievable at *no cost*, such as encouraging staff to use mass transit; some would *potentially* save WRI money, such as turning off equipment when not in use; and others would be at *some cost* to the Institute, such as purchasing green power.

With overwhelming approval from staff and senior management, WRI committed to reduce the organization's emissions to "net" zero by 2005. This means that our total emissions would equal zero, after making *internal reductions*, such as reducing energy use in our office, and after purchasing *offsets*—that is, emissions reduction projects that reduce another organization's emissions.

To engage staff in its new commitment, a contest was organized to solicit the best ideas to achieve emissions reductions. Ideas submitted ranged from providing incentives for staff to walk or bike to work to regularly featuring the emissions reduction efforts of each WRI program on the organization's intranet. Gift certificates were provided to contest winners.

Three years later, WRI has reduced its emissions by 12.7 percent. Each year the Institute has "offset" its remaining emissions to achieve the target of net zero emissions. Since WRI had already moved into a green, energy-efficient office when the decision was made to reduce emissions, we've found it challenging to make further reductions. However, there are still many opportunities available to us that we are continuing to pursue, such as purchasing green "emissions free" electricity for our office.

WRI's commitment was based on four basic principles:

1 TAKING RESPONSIBILITY

WRI staff wanted to demonstrate responsibility for our contribution to climate change by measuring and reducing our emissions.

2 SETTING AN EXAMPLE

As an environmental organization that encourages business and others to address climate change, we felt it was important to lead by example.

3 LEARNING BY DOING

WRI helps design accounting standards and policy instruments to address climate change, including the Kyoto Protocol *(See Box 3), so* we wanted to learn first-hand about the potential challenges and opportunities involved for businesses.

4 LEARNING BY SHARING

WRI wanted to help other organizations initiate their own CO_2 reduction programs and innovate based on an exchange of experiences.

BOX 3 THE KYOTO PROTOCOL

The Kyoto Protocol is an international agreement to reduce global GHGs that governments are currently ratifying. If entered into force, it will require developed nations to reduce their GHG emissions an average of 5.2 percent relative to their 1990 emission levels during the period from 2008 to 2012.

TIP! Guidance and standards for accounting for offsets are being developed as part of the GHG Protocol. See "Accounting for GHG Reduction Projects" on page 50.

The following pages will help you initiate, plan, and implement an organizational commitment to reduce CO_2 emissions. "S&P Enterprises," a fictional organization, is used to demonstrate each step.

STEP-BY-STEP SUMMARY

STEP 1 Secure employee and senior management support for your office's CO_2 reduction initiative.

STEP 2 Learn what a CO_2 inventory is and how to plan yours.

STEP 3 Learn what data you need to calculate your emissions and where to find it.

STEP 4 Calculate your organization's emissions using the simple formulae in this handbook, or spreadsheets provided on-line at http://www.safeclimate.net or http://www.ghgprotocol.org.

STEP 5 Agree on an emissions reduction target.

STEP 6 Take action! Identify and implement opportunities to reduce your office's emissions. If necessary and/or appropriate, pursue options for investing in offsets—projects that help another organization reduce their emissions.

STEP 7 Reap benefits and be a leader! Report your organization's commitment and CO_2 inventory publicly.

Step 1: SECURE ORGANIZATIONAL SUPPORT

No one person—office manager, concerned employee, or member of senior management—can undertake an office CO_2 emissions reduction program alone. Successful reduction of CO_2 emissions requires (a) changes in an office's administrative procedures, (b) participation by as many people as possible (in efforts to track use of energy or to use less energy), and (c) regular and effective communication among staff. That's why your first step will be to build support for this endeavor throughout the organization as a whole, as well as among senior management.

MAKE THE CASE FOR TAKING ACTION

You and your colleagues will want to consider the following reasons for launching an organizational climate commitment:

Achieving Cost Savings

For many companies reducing emissions not only results in environmental benefit but can translate into significant cost savings. For example, in the long term, investing in energy-efficient office equipment and appliances will benefit your organization's

HEALTH BENEFITS OF GHG REDUCTION

Reducing GHG emissions could benefit public health by reducing the negative effects of particulate matter and ozone that result from the burning of fossil fuels. In a 1997 study, WRI, the World Health Organization (WHO), and others estimated that eight million avoidable air pollution-related deaths will occur worldwide by the year 2020.

More recently, researchers evaluated the health benefits in the next 20 years from reductions of GHG emissions from fossil fuels in four heavily populated cities—Mexico City, New York City, Santiago (Chile), and São Paulo (Brazil). The researchers calculated that adopting GHG mitigation technologies would reduce particulate matter and ambient ozone concentrations by about 10 percent. Conservative estimates suggest these cities could avoid:

- 64,000 premature deaths (including infants)
- 65,000 cases of chronic bronchitis
- 37 million lost or restricted work days

Given that three billion people live in urban areas around the world, this makes a powerful argument for taking early action to address climate change.

To obtain the full article, visit http://www.sciencemag.org (access requires a subscription).

bottom line. According to the EPA, energy costs for a typical office building in the United States are $1.50 per square foot. Energy-efficient equipment can reduce those costs by 30 percent.[4] The Center for Energy and Climate Solutions,[5] a nonprofit organization, has documented numerous companies[6] of all sizes and types that are earning 40 to 50 percent returns on energy-saving investments. For example, the office tower at Four Times Square in New York utilized a variety of energy efficiency technologies to realize energy savings of $500,000. The Parker Chiropractic College in Dallas, Texas, reduced its electricity use by 43 percent by upgrading its chiller plant and control system. Reducing the need to travel can also translate into reduced expenses.

KINKO'S: LEADERSHIP IN THE OFFICE SUPPORT SECTOR

As a result of our physical footprint and the nature of our business, Kinko's has the potential to leave a substantial impact on the environment. That means we must do more than our share of the work to leave the world in a better place than when we found it.

— Gary Kusin, President and CEO, Kinko's

Kinko's pledged in 1997 to transition its offices and business to energy-efficient technologies and renewable energy sources. As a partner in the EPA's Green Lights and Energy Star programs, Kinko's has installed energy-efficient lighting at all new store locations and retrofitted more than 1,000 existing stores with energy-efficient lighting. Kinko's now prevents up to 66 million pounds of CO_2 from being emitted each year—that's about the same as taking 5,600 cars off the road. Kinko's is also a founding member of WRI's Green Power Market Development Group (http://www.thegreenpowergroup.org), which seeks to develop corporate markets for green power—power produced by clean, renewable sources like wind and solar. As of mid-2002, 93 Kinko's stores nationwide are powered by renewable energy. The company buys 7.7 million kilowatt hours per year of green power, effectively displacing the energy usage of about 770 average American households. Thanks to such efforts, Kinko's has earned its place as a leader among businesses committed to sustainability. For more information about Kinko's environmental activities, visit http://www.kinkos.com/about_us/environment/environment.php.

Taking Responsibility for the Environment

This is an opportunity for your organization to take responsibility for its impact on the Earth's climate. Potential climate change impacts are far-reaching and widespread action is required to address the problem.

Demonstrating Leadership

Your organization can set an example within your sector. Many leading companies, including SC Johnson & Son, IBM, Kinko's, Ben and Jerry's, DuPont, Shell, BP, and Alcoa have already made public commitments and/or are taking action to reduce their GHG emissions. The benefits include cost savings and great public relations for your firm.

Becoming Informed Advocates

Calculating and reducing your organization's CO_2 emissions will help you, your staff, and colleagues better understand the issues involved and help others understand them as well.

Improving Employee Morale

You likely already have advocates for a CO_2 emissions project within your office. Polls show

that a majority of Americans across the political spectrum believe that climate change is a serious problem and that it requires action.[7] Employees like working for a company that demonstrates itself as a leader and a good citizen. Improved employee morale can lead to higher employee retention rates, an important factor in competitive labor markets. And, a CO_2 emissions reduction effort can build and reinforce office teamwork.

MAKE KEY MANAGEMENT DECISIONS

Once your organization has decided to take action, the following key management decisions will need to be made at the outset:

Designating the Climate Champion(s)

It is important to identify a "climate champion" to lead the effort and to include the related activities in his or her job description. Formalizing the job of climate champion makes it more likely that it will be taken seriously and that the effort will be sustained. Although this may seem like a big step, ideally this will someday be a standard part of office/organizational administration, and offices will routinely track their climate emissions the way they track vacation days available to staff, their financial portfolios, and the depreciation of their capital.

What kind of person makes an ideal "climate champion"?

Enthusiasm is the most important criterion for selecting the person who will champion the project, since generating interest is key to widespread participation and successful implementation. You also want to find someone who is both responsible and a skillful communicator (both orally and in writing), since he or she will need to work closely with staff and share findings and progress with the organization as a whole. A champion doesn't need to be the company accountant, or someone with advanced math skills, but should be capable of basic calculations. It can be helpful if the champion is someone whose daily schedule is not rigid. The front desk receptionist, for example, may not have enough uninterrupted time to focus on tracking an inventory and making calculations, and an employee who travels extensively or is already overworked might not be in the office enough or adequately available to engage organizational support and keep the project on track.

"Pick an advocate within your organization. To succeed, your organization must make someone responsible, empowered, and accountable."

—Gary Kusin, President and CEO, Kinkos

STEP ONE CHECKLIST

✔ Have you…

- Identified a "climate champion" for your organization?
- Developed and received approval for the budget?
- Confirmed that your senior management has agreed this is an important and worthwhile undertaking for the organization?

Preparing a Budget

Prepare a budget that includes the staff time of your climate champion(s). The number of hours to budget will vary depending on the phase of the project, the size of your organization, and the complexity of your operations. Staff time requirements will significantly decrease once the champion is educated and informed, the project is better established, and new or modified office procedures are in place. An efficient and centralized data gathering process also will help reduce the time needed. Keep in mind that if your organization is large—say several hundred people occupying multiple spaces in multiple buildings—the climate champion's job will be more time-consuming than if you have a small staff housed in one or two offices. You may need to budget some basic resources for the project, such as a computer, a spreadsheet program, and office supplies. As you begin to implement emissions reduction activities, you may also decide to include the cost of these activities in the budget (for example, the purchase of energy-efficient lighting).

Making an Organizational Commitment

Calculating your organization's emissions is not a small undertaking. It will require time for research and data compilation. Before you begin, ensure that your organization is prepared to commit to a long-term plan to reduce CO_2 emissions.

Step 2: PLAN YOUR CO_2 INVENTORY

Once you've secured organizational support for your effort, your next task is to plan a CO_2 "inventory" for your office—that is, a list of your office's CO_2 emissions sources and their quantities. A CO_2 inventory enables you to identify reduction opportunities, set a reduction target, and manage and reduce your office's CO_2 emissions to meet your goal.

First you need to set the "organizational boundary" for the inventory. Put simply, this means deciding which of your office spaces, facilities, or entities (if you have more than one) will be part of your inventory. Second, you need to consider all the ways your operations generate emissions—i.e., through business travel, heating, cooling, or employee commuting—and decide which of these you will track and try to reduce. This is called setting the "operational boundary" for the inventory.

NOTE: Some terms used in this Guide—*boundaries*, *scopes*, *direct* and *indirect emissions*—may seem highly technical, but we use them here because the terminology is part of the language of GHG Protocol. *(See Box 1.)* Promoting uniform standards, including consistent methods and terminology, improves the usefulness and credibility of inventory information.

ORGANIZATIONAL BOUNDARIES

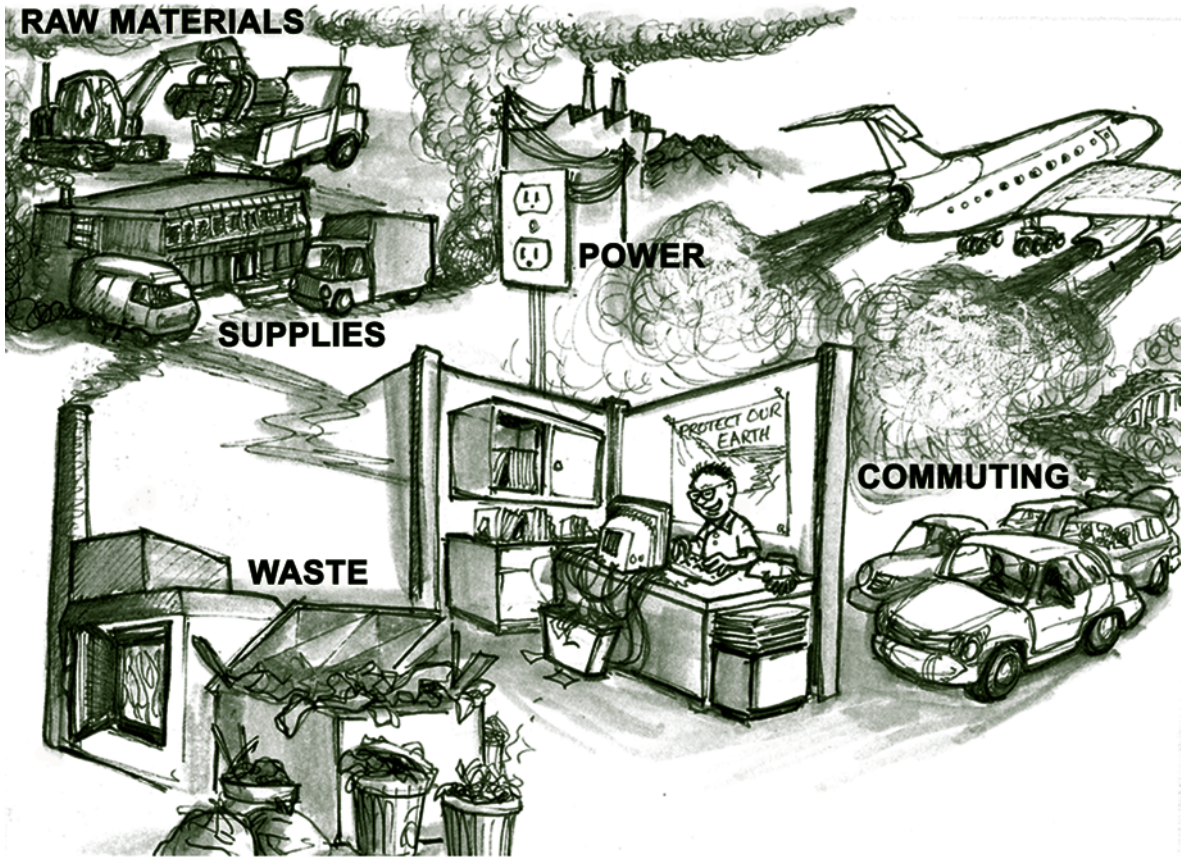
An organizational boundary defines the facilities/entities that will be included in your CO_2 inventory. For example, if your organization has more than one location, decide if you will report on the CO_2 emissions generated at each, or the headquarters office only. Will you report on space that you do not own, but lease and occupy? Does your organization lease or sublease space to another organization? If it does, will your organization report the emissions from the subleased space also? The more inclusive your boundary, the more opportunities you are likely to find to reduce emissions.

Keep in mind that you can revisit your choice of an organizational boundary each time you update your inventory. So, for example, if you have limited resources at the project's outset, you may decide to limit your organizational boundary to one location and expand it to include other locations in subsequent years.

Example:

S&P Enterprises operates out of two locations. It owns one location and leases space at the other. In the building it owns, S&P subleases an office to another organization. S&P decides to include both locations in its organizational boundary to ensure its inventory is as complete as possible. It also opts to include the subleased space because it realized it can influence emissions there also by installing energy-efficient equipment and lighting, for example. However, if the tenants of the space ever decide to conduct their own inventory, S&P would need to notify them of which emissions sources are already tallied in S&P's inventory to acknowledge double-counting.

BOX 4 COMMON EMISSIONS SOURCES FOR AN OFFICE



OPERATIONAL BOUNDARIES

Emissions result from a variety of activities undertaken by your office—from using the photocopier to traveling to meetings (See Box 4 for a visual depiction). Of all these activities, which will you include in your inventory? Making these selections is called defining your operational boundary.

To determine your operational boundary, you need to understand that there are two categories of greenhouse gas emissions—"direct" emissions and "indirect" emissions—as well as the concept of "scope" developed by the GHG Protocol.

Direct Emissions

These are emissions from sources that you own or control, like a furnace in the basement of your office building, or business travel in a company car. If your organization leases vehicles or equipment and pays for the fuel used, these emissions are also counted as direct emissions for your organization, even though it does not own the vehicle or equipment. Other typical examples are listed in Table 1. Accounting for and reporting on direct emissions is required under the framework of the GHG Protocol. For reporting purposes, direct emissions are called "Scope 1" emissions.

Indirect Emissions

These emissions are consequences of your organization's activities but occur from sources owned or controlled by another organization. For example, although your organization may own its

photocopier, the emissions produced by the photocopier are indirect for your organization. That is because the emissions source—electricity—is at the power plant, not the photocopier. (See Table 1 for other examples.)

For reporting purposes, indirect emissions are divided into "Scope 2" emissions—those from the generation of purchased electricity, steam, or heat—and "Scope 3" emissions—a label which covers everything else. Accounting for and reporting on Scope 2 emissions is required under the GHG Protocol because these are likely to make up a significant percentage of any organization's inventory and are relatively easy to quantify. Accounting for and reporting on relevant Scope 3 emissions is not mandatory in the GHG Protocol but is encouraged because it increases emissions reduction opportunities.

Why is the distinction between direct and indirect emissions important?

If emissions by businesses are regulated by the government in the future, those regulations will likely distinguish between direct and indirect emissions to ensure that different organizations don't double-count the same emissions as direct emissions. For this reason, emissions are specifically defined to help clarify which emissions an organization owns (direct), and which it does not (indirect). The GHG Protocol developed the concept of "scope" to add further clarity to direct and indirect emissions and how an organization should report them.

TABLE 1 EXAMPLES OF OFFICE EMISSIONS SOURCES

SCOPE 1 Direct emissions from…	• Combustion of fuel in boilers or furnaces that are owned by the reporting organization • Generation of electricity, steam, or heat in equipment that is owned by the reporting organization • Business travel in vehicles that are owned by the reporting company, such as company cars or corporate jets • Employee commuting in company-owned vehicles, such as a van pool or company car
SCOPE 2 Indirect emissions from…	• Generation of purchased electricity, steam, or heat
SCOPE 3 Indirect emissions from…	• Business travel in non-company-owned vehicles such as rental cars, employee cars, trains, and commercial planes • Combustion of fuel in boilers or furnaces not owned by the reporting organization • Employee commuting in vehicles not owned by the reporting organization, such as light rail, train, buses, and employee cars • Production or manufacture of materials and resources used by an office organization, such as furniture, paper, equipment, toner cartridges, etc. • Incineration of office waste or decomposition in a landfill when the facilities are not owned by the reporting organization* • Outsourced activities such as shipping, courier services, and printing services

* GHG emissions that result from the manufacture and disposal of paper include CO_2 and methane (CH_4). A methodology for calculating these emissions is provided in Appendix IV.

Emissions from most office-based organizations are indirect. Although you do not own the emissions source, you can still achieve reductions through, for example, energy-efficient lighting, reduced air travel, and reduced use of materials.

BOX 5 GUIDING PRINCIPLES

As you develop your inventory, refer to the principles established by the GHG Protocol:

Relevance Define boundaries that appropriately reflect the GHG emissions of your business and the decision-making needs of inventory users.

Completeness Account for all emissions sources and activities within your chosen organizational and operational boundaries. Justify specific exclusions.

Consistency Allow for meaningful comparison of emissions performance over time. Clearly state any changes to the basis of reporting to enable continued valid comparison.

Transparency Address all relevant issues in a factual and coherent manner, based on a clear audit trail. Disclose any important assumptions and cite the calculation methodologies used.

Accuracy Strive for precise GHG calculations and seek to provide reasonable assurance of the integrity of reported GHG information.

Deciding what to report

Deciding which emissions sources to include in your operational boundary requires careful thought. For example, if you include business travel in your boundary, you must decide if you will include only the business travel undertaken by your staff, or also business travel by consultants, partners, or other non-employee colleagues with whom you work. Reporting on emissions from non-employee travel requires more record keeping by your organization's staff—the people whose projects generate the trips by those outside parties—and, occasionally, the cooperation of your partners and consultants to help you track the emissions they generated working for or with your organization. Of course, tracking all the travel-related emissions you're generating as a result of your organization's business—directly and indirectly—makes your inventory more complete. Sometimes the best choice is a manageable middle ground.

In its inventory, WRI reports on air travel by staff, consultants, and partners if WRI makes the travel arrangements. We do not account for and report on business travel by car and train because it is such a small percentage of our total miles traveled. Nor do we account for and report on business travel if WRI did not make the travel arrangements because we don't yet have an efficient method of capturing this information. However, we anticipate expanding our inventory to include these categories so our reporting will be more complete.

Whether to include emissions generated by employees commuting to work is another example of a difficult operational boundary decision. Some employees consider their commuting arrangements to be a matter of personal privacy and fear they'll be pressured to give up their SUV, ride the bus, or join a carpool. However, organizations that choose to include employee commuting in their inventory will create an additional opportunity for achieving emissions reductions and the employees can reap some benefits too, even beyond awareness of their impact. Businesses that have a large proportion of their CO_2 emissions generated by employee commutes may choose to move their offices closer to mass transportation options, or opt to implement a telework or rideshare program (less dramatic but very useful alternatives from an employee perspective). Some businesses offer incentive programs to encourage employees to use mass transit or carpooling, which benefits employees financially and can be implemented in a nonjudgmental way.

In general, you may find it simpler to draw narrow boundaries. However, a more comprehensive inventory provides greater opportunities for emissions reductions. Let the GHG Protocol accounting principles guide your decisions on what to include in your inventory. (See Box 5.) In other words, obtain the most accurate, complete, and relevant data possible and be transparent and consistent in your choices.

Example:

S&P Enterprises' operational boundary includes emissions from the following sources:

- ***a natural gas-powered water heater in the building it owns***
- ***electricity use in both of its business locations***
- ***business travel via car, train, and air***
- ***employee commuting***

These emissions are reported as follows:

- ***Scope 1 (direct emissions):*** *emissions from the natural gas-powered water heater in the building it owns. Emissions from air travel in the company jet.*
- ***Scope 2 (indirect emissions from purchased electricity, steam, or heat):*** *emissions from electricity use in both locations.*
- ***Scope 3 (other indirect emissions):*** *emissions from business travel by employees via train, commercial plane, and non-company-owned cars, and employee commuting.*

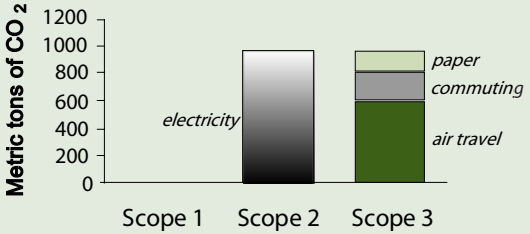
Deciding How Often to Report

Depending on your objectives and available resources, we recommend compiling your CO_2 inventory at least once a year. WRI gathers its data quarterly to make regular comparisons. A full report is made annually. These reports will soon be available for review on the SafeClimate website (http://www.safeclimate.net).

WRI'S CO_2 EMISSIONS

Fifty percent of WRI's emissions in 2001 were from electricity (Scope 2). Air travel (Scope 3) was the next most significant source, followed by employee commuting and paper production and manufacture (Scope 3). WRI does not produce any Scope 1 emissions.

WRI's CO_2 Equivalent Emissions, 2001

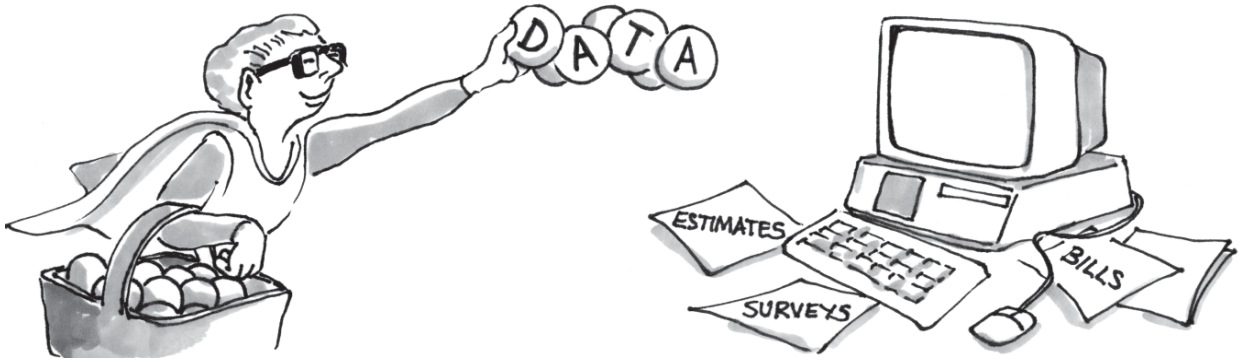


STEP TWO CHECKLIST

Have you…

- Defined your organizational boundary—that is, decided which facilities/entities of your company or organization you will include in your inventory?
- Defined your operational boundary—that is, chosen which direct and indirect emissions sources you will include in your inventory, from fuel use, to power purchased from outside sources to employee commuting?
- Checked your choices against the guiding principles of GHG accounting and reporting (Box 5)?
- Decided how often to compile and report on your inventory?


WHAT CAN WE DO?
WHAT CAN WE DO?



Step 3: GATHER DATA

Now that you have planned your CO_2 inventory, this step will help you identify exactly what data you need to develop your inventory, and will help you find it.

IDENTIFY THE DATA YOU NEED

You need two kinds of data to calculate your organization's CO_2 emissions. For each emissions source you identified in Step Two, you need to find the appropriate "activity data" and "emissions factor" to help you apply the following equation:

activity data × emissions factor
=
CO_2 emissions

Let's break down this equation into its basic parts. Despite the technical names, the data you need is actually quite simple to identify.

Activity Data

This quantifies an activity—say, employee business trips—in units that will help us calculate the emissions generated. Each activity is presented in a specific unit, for example:

- therms or cubic meters of natural gas
- gallons or liters of heating oil
- kilowatt hours of electricity
- business air miles or kilometers traveled
- business train miles or kilometers traveled

Develop a simple, efficient method of capturing the data on a regular basis. One approach is to centralize a system through your Accounting Department. Guidance on where to look for the data you need is provided later in this Guide, along with tips for how to develop a good estimate if the exact data are unavailable.

Emissions Factors

Emissions factors convert activity data to emissions values. Emissions factors are published by various entities such as local, state, or national government agencies and intergovernmental agencies. More information is provided later in this Guide and a list of emissions factor sources is contained in *Appendix II*. A current list of emissions factors can also be found in the GHG Protocol's calculation tools at http://www.ghgprotocol.org.

Emissions factors are source-specific. For example, the emissions factors for electricity produced by coal will be higher than for electricity produced by natural gas. Similarly, emissions factors for car travel vary depending on if the car is powered by gasoline, diesel fuel, or electricity, and on how efficiently the car uses fuel. Select the most relevant emissions factor available for each of the activities you've defined.

Emissions factors are frequently updated to reflect new information or technologies. Use the most up-to-date emissions factor available.

GATHER ACTIVITY DATA

This section will help you find activity data for a variety of direct and indirect emissions sources common to offices. Sample information is provided for S&P Enterprises.

Activity Data for Direct Emissions (Scope 1)

As discussed in Step Two, direct emissions occur from company-owned vehicles or from combustion of fossil fuels such as natural gas, heating oil, coal, fuel oil, diesel, etc. in company-owned equipment. Emissions are a result of the combustion of these fuels. Here's how you would gather activity data—in this case fuel usage—for combustion of natural gas or heating oil and travel by corporate jet:

- Figure out what units you should be using in your calculations. For natural gas, the common units are therms, cubic meters, or cubic feet. For heating oil, the units are gallons or liters. For travel in a company-owned jet, the relevant units are gallons or liters of jet fuel.
- Obtain the activity data in the appropriate units from your organization's monthly fuel-use records, or convert the data in your organization's records to the appropriate unit. (See Appendix I for a listing of conversion factors.)

Example:

S&P Enterprises does not use heating oil but does have a gas-powered water heater in the building it owns. This year, 4,139.59 therms of natural gas were used by S&P Enterprises and the company to which it leases space at this location. The corporate jet used 450 gallons of jet fuel.

TIP! If your company owns other vehicles, the data are collected using the same data collection methods described in "Scope 3: Business Travel", however emissions from company-owned vehicles should be reported as Scope 1.

TIP! Designing a good data collection system can reduce errors caused by inaccurate data and/or data input mistakes. Some good data collection practices include:

- requesting data in familiar units
- requesting data from metered or measured sources when possible; they may be more accurate than purchase records
- establishing internal control systems to catch errors
- undertaking regular checks for technical errors. Technical errors include incomplete identification of emissions sources, use of incorrect methods or assumptions, use of incorrect data, and mistakes in data entry.

For more tips on managing the quality of your inventory, see the GHG Protocol.

Activity Data for Indirect Emissions from Purchased Electricity (Scope 2)

When coal, gas, and other fossil fuels are combusted to generate electricity, CO_2 and other GHGs are emitted. The emissions take place at the point of combustion (the power plant), not at the location the electricity is used, like your office. However, you share responsibility because you generated the demand and used the power. On the other hand, if you use non-fossil fuel-based energy, such as wind and solar power, you are not responsible for any CO_2 emissions, because none are generated.

The activity data you need to calculate the CO_2 emissions generated by your office's electricity use is kilowatt hours (kWh). If your organization owns and occupies the entire building, or if your utilities are separately metered, all the information you need can be obtained from your monthly electric bill. If your organization does not occupy the whole building or if it occupies leased office space, you will need to estimate your electricity use based on information from your property manager:

- total area of the building
- total area occupied by your organization
- total building energy use in kWh

Using this information and the following formula, you can estimate the approximate kWh of electricity attributable to your organization:

(area of organization's space ÷ total building area) × total building usage of electricity = approximate kWh used by your organization

TIP! Try to obtain activity data on your electricity use from fuel-use records (such as an electric utility bill) because the information will be more accurate. If that is not possible, try to determine the total area of the building that is occupied to improve the accuracy of your estimate. If that information is not available, find out the total area of the building and use that number instead. Your property management company may be very helpful in providing the data you need. (See Box 6.)

BOX 6 ESTIMATING AND REDUCING ELECTRICITY USE AT WRI

For budgeting purposes, WRI's property management company keeps a detailed accounting of the building's monthly electricity use and associated expenses. Fortunately, WRI found that the company is willing to share their spreadsheet of electricity data with us. WRI uses this information to estimate its approximate share of electricity use in the building, using the method described in this section of the Guide.

Compared to other building tenants, WRI has a highly energy-efficient office—for example, in addition to using energy-efficient lighting, it also utilizes motion sensors in all office spaces so that lights are used only when a space is occupied—so the standard formula probably over estimates our electricity use. To obtain more accurate information on electricity use, WRI explored separately metering its office space, but couldn't due to cost and infrastructure constraints.

Since we cannot accurately track our electricity use—and therefore, any emissions reductions we might achieve—WRI is trying to reduce the building's overall electricity use. We will host a meeting for other building tenants to educate them about actions they could take in their offices to reduce electricity use, and we are encouraging our property management company and the building's owners to purchase clean, renewable power for the building. This would not only eliminate WRI's emissions from energy—currently about half of its total emissions—but also greatly reduce the building's environmental impact.

Example:

In the building S&P Enterprises owns, activity data is obtained from the organization's electric bill. The annual electricity usage for this building is 980,326 kWh.

S&P Enterprises occupies 38,018 square feet of leased office space in its second location. The total building area is 252,781 square feet. According to the property manager, the building used 5,753,100 kWh of electricity this year. S&P's climate champion uses the calculation described to estimate the organization's approximate share of kWh in this location:

(area of organization's space ÷ total building area) × total building usage of electricity
=
approximate kWh used by your organization

38,018 square feet ÷ 252,781 square feet X 5,753,100 kWh = 865,260 kWh

To calculate its total electricity usage this year, combine the annual usage from both locations.

electricity used at location 1 + electricity used at location 2 = total kWh usage

980,326 kWh + 865,260 kWh = 1,845,586 kWh

Activity Data for Other Indirect Emissions (Scope 3)

A variety of emissions fall under this category. We describe methods of collecting activity data for business travel in non-company-owned vehicles (car, plane, and train) and employee commuting.

Business Travel in Non-Company-Owned Vehicles

- **Car travel**
  The activity data required for calculating emissions from car travel include:
  - Total fuel use in gallons or liters
  - Type of fuel (e.g., gasoline or diesel)
  - Number of occupants if non-company staff are in the vehicle. Your goal is to calculate the amount of fuel attributed to *your organization's* employees, so if all occupants are employees of your organization, you won't need this data. If some are non-company staff, you'll need to calculate the share of emissions attributable to your office's staff.

There are two ways to obtain fuel-use data. The most accurate and simple method is to obtain the data from fuel purchase receipts. If you do not have access to fuel purchase receipts, estimate fuel use using the following:

- Total distance traveled
- Average fuel efficiency of the vehicle
- Number of occupants if non-company staff are in the vehicle

The calculation to estimate fuel used is:

distance traveled ÷ fuel efficiency ÷ number of occupants = approximate fuel use per occupant

For example, if an employee travels 300 miles and the fuel efficiency of the car is 28 miles per gallon (mpg), the calculation is:

300 miles ÷ 28 mpg ÷ 1 occupant = 10.7 gallons of fuel per occupant

If the same employee has decided to carpool with a colleague from another organization headed to the same destination the calculation is:

300 miles ÷ 28 mpg ÷ 2 occupants = 5.36 gallons of fuel per occupant

If the fuel efficiency of the vehicle is unknown, emissions can be calculated using distance traveled activity data and an emissions factor that assumes a default fuel efficiency value for the size of car. This is a less accurate method.

If an employee uses his/her own car for business travel, distance traveled will usually be indicated on the form submitted for reimbursement of travel expenses. If a rental car is used, information on distance traveled and type of car can often be obtained from the receipt.

CAUTION!

If two or more employees are in the car, along with at least one non-employee, you will need to multiply the total number of employees in the car by the gallons of fuel used per occupant to calculate the total fuel use attributed to your organization.

TIP! Business travel falls under the "Scope 1: Direct Emissions" category if the organization owns the transportation device, such as a fleet of company cars, delivery vans, corporate jets, etc.

CAUTION

Fuel use for gasoline- and diesel-powered cars must be recorded separately because each fuel has a different emissions factor.

TIP! Make sure your measures of distance and fuel efficiency are based on the same measurement units. For example, if you measure distance in miles, fuel efficiency should also be measured in miles (miles per gallon or liter). If the fuel efficiency of the vehicle is unknown, you may use the EPA's fuel efficiency ratings for U.S. cars, available at http://www.epa.gov/autoemissions. If a similar guide is not available for your country, base your emissions calculations on distance traveled, as described above.

TIP! Add a line to your organization's reimbursement forms that requires employees to state the vehicle's average fuel efficiency and number of occupants in the car, along with distance traveled. This will save your climate champion some accounting work and will help educate your employees about fuel efficiency.

Example:

If fuel purchase receipts are unavailable, S&P Enterprises uses distance traveled, fuel efficiency, and vehicle occupancy to estimate fuel use for each car trip. S&P requires employees to enter this information on their travel reimbursement forms.

Six trips have been taken by employees this year. Fuel purchase receipts were not available for any. Five were in gasoline-powered cars and one was in a diesel-powered car. The diesel car was used in a country for which fuel efficiency data are unavailable; therefore, only distance traveled and vehicle occupancy activity data were collected for this trip.

TRIPS IN GASOLINE-POWERED CARS							
Trip	Distance traveled in miles	÷	Fuel efficiency	÷	# of occupants *(if any are not employees)*	=	Total in gallons of gasoline per occupant
Trip 1	49 miles	÷	17 mpg	÷	1 occupant	=	2.88
Trip 2	110 miles	÷	32 mpg	÷	1 occupant	=	3.44
Trip 3	230 miles	÷	28 mpg	÷	2 occupants	=	4.10
Trip 4	90 miles	÷	15 mpg	÷	1 occupant	=	6.00
Trip 5	176 miles	÷	28 mpg	÷	2 occupants	=	3.14
					Total gallons of gasoline used:		19.56
					Total distance traveled if fuel efficiency is unknown:		n/a
TRIPS IN DIESEL-POWERED CARS							
Trip 1	270 miles	÷	unknown	÷	1 occupant	=	unknown
					Total gallons of diesel used:		unknown
					Total distance traveled if fuel efficiency is unknown:		270
S&P Enterprises' activity data for business car travel is 19.56 gallons of gasoline and 270 miles in a diesel car.							

Air Travel

The activity data you need to determine for commercial air travel is distance traveled. The units are either miles or kilometers. This information can sometimes be found on flight itineraries. If you are unable to determine actual distance traveled, refer to a guide or website. (See Appendix III for some sources.)

A large portion of CO_2 emissions from air travel occur during takeoff and landing. Therefore, emissions per mile or kilometer traveled for short flights are higher than emissions for long flights. Ideally, you should implement a tracking system to distinguish short, medium, and long flights, since different emissions factors apply for each. Short, medium, and long flights are defined in the spreadsheet template for business travel available for download from SafeClimate (http://www.safeclimate.net). This spreadsheet also automatically identifies short, medium, and long flights.

WRI'S METHOD OF TRACKING AIR MILES

In 2001, WRI staff flew approximately 3 million business air miles. Most trips were booked through one travel agency. Through the travel agency's website, WRI is able to download a spreadsheet that tracks miles flown per month per staff person. This provides WRI with easily accessible information for its CO_2 inventory.

If your travel agency doesn't track miles, you can, and quite easily. For example, WRI requires all staff to complete a "Travel Authorization" form before trips for authorization and insurance purposes. WRI adapted its standard form so staff must indicate the number of miles they fly per trip if their travel is not booked through WRI's travel agency (See Box 7). This information is added to the spreadsheet and helps give WRI a more complete accounting of its air travel.

TIP! Contact your in-house travel staff or travel agency. They may already be tracking miles traveled per flight. Alternatively, add a question to your organization's travel authorization or expense forms requesting round trip air miles or kilometers for each trip.

TIP! If a company-owned plane is used for air travel, the activity data collected is fuel use. These emissions are reported as Scope 1, not Scope 3.

CAUTION!

Air travel is measured either in land miles or kilometers, or nautical miles or kilometers. A land mile is the distance between two points over land. A nautical mile is the average distance on the Earth's surface represented by one minute of latitude. Since the Earth is not a perfect sphere, a nautical mile does not equal a land mile. Air travel emissions factors are usually in CO_2 per passenger land mile or kilometer. If you have calculated distance traveled in nautical miles or kilometers, convert the data to land miles or kilometers. Conversion factors are supplied in Appendix I. Also, when estimating distance traveled, remember to make sure your numbers include total round trip miles or kilometers.

Example:

From information obtained from its travel agent and collected from travel reimbursement forms, S&P Enterprises calculates that its employees have flown 2,896,345 business air miles on commercial planes this year. 980,562 miles are short trips, 797,412 miles are medium trips, and 1,118,371 are long trips.

BOX 7 SECTION OF WRI'S TRAVEL AUTHORIZATION FORM

As part of WRI's commitment to reduce its CO_2 emissions, we track all staff air miles. To help us keep a more accurate account, please complete the following:

Air travel is booked through WRI's travel agency: YES NO *(circle one)*

If NO:

What are your round trip air miles?

(*for calculation, visit http://www.indo.com/cgi-bin/dist)*

- **Train Travel**

Activity data for train travel is distance traveled, measured in either miles or kilometers. This information is collected in the same way as air travel—that is, check with your in-house travel staff or your organization's travel agent, refer to an on-line distance guide (an example is provided in Appendix III), and/or add a question to your organization's travel authorization or travel reimbursement forms that requests the information from the employee. As with air travel, make sure the distance includes round trip miles or kilometers traveled.

Example:

From information obtained from travel reimbursement forms, S&P Enterprises calculates that its employees have traveled 1,200 business miles by train this year.

Employee Commuting in Non-Company-Owned Vehicles

To calculate commuting emissions, you will need to obtain activity data on the distance employees travel to and from work and the mode of transportation they use. For relatively small organizations, you may be able to obtain this information from each employee. For larger organizations, it may be more efficient to take a sample and estimate total activity data from it. Using a sample will lead to a less accurate estimate of emissions, so make the sample as large as possible. WRI surveys its employees and gets a 60 percent response rate. The survey template we use, which contains automatic calculations, is available for download at http://www.safeclimate.net or http://www.ghgprotocol.org. The activity data for employee commuting is described below.

For each employee in your organization or survey group, gather the following information:

- Round trip distance traveled by employee to work and home each day
- Number of days per week employee commutes
- If the employee drives to work on any day, the fuel efficiency of the employee's vehicle, fuel type, and the number of people who travel with the employee
- Distance traveled by the employee in various commuting combinations. In the S&P Enterprises example on page 27, all employees except one use the same combination of transportation each day. Employee 3 uses two different combinations of transportation. Two days a week, Employee 3 takes the bus for 6 miles round trip and the other three days rides a bike 6 miles round trip.

Once you have collected this information, use the following method to estimate annual activity data for each mode of transport, except cars:

number of days per week vehicle is used X *distance traveled* X *number of weeks worked by the organization per year* = *total annual distance traveled by survey group for each mode of transport*

TIP! Employee commuting falls under the "Scope 1: Direct Emissions" category if the employee travels to work in a company-owned vehicle such as a company car or van pool.

TIP! Ask all employees who use a car for commuting to provide information about their vehicle's fuel efficiency and fuel type. If an employee is uncertain about this data, consult the EPA's fuel efficiency ratings for U.S. cars, available at http://www.epa.gov/autoemissions. If this information is not available, you will need to estimate these emissions based on distance traveled only.

Car Travel

Employees are unlikely to use their cars exclusively for commuting, so obtaining fuel use activity data from fuel purchase receipts is not usually possible. Instead, use a three-step calculation to estimate fuel use for commuting. Fuel efficiency and fuel type differs for each car, so the calculations are made separately for each employee who drives to work:

[1]

# of days used per week
×
distance traveled
×
number of weeks worked by the organization per year
=
total annual distance traveled by employee

[2]

total annual distance traveled by employee ÷ *fuel economy of employee's car*
=
approximate fuel used

[3]

approximate fuel use ÷ *number of people in car*
=
approximate fuel use attributable to employee

Add the total quantity of fuel used by each employee who drives to work to obtain the total fuel use for all employees.

Example:

Below is a sample of how S&P Enterprises compiles activity data for employee commuting based on information collected in an employee survey.

	GENERAL INFORMATION		FOR CAR COMMUTERS ONLY		
Employee	Commuting distance (round trip miles)	Number of commuting days per week	Fuel economy (in miles per gallon)	Fuel type	Average vehicle occupancy
#1	20	5	—	—	—
#2	44	5	—	—	—
#3	6	5	—	—	—
#4	16	5	28	Gasoline	2

COMBINATION ONE						
Employee	Number of days using this combination	Car miles	Bus miles	Light rail miles	Train miles	Walk/Bike miles
#1	5	—	—	20	—	—
#2	5	—	4	—	40	—
#3	2	—	6	—	—	—
#4	5	16	—	—	—	—

COMBINATION TWO						
#1	—	—	—	—	—	—
#2	—	—	—	—	—	—
#3	3	—	—	—	—	6
#4	—	—	—	—	—	—

TIP! If your company owns transportation devices not covered by this Guide, such as ships, or if your company uses vehicles to transport products or raw materials, refer instead to the GHG Protocol website.

Using the information provided and the estimation methods described, activity data for S&P Enterprises is calculated as follows:

Employee 1 travels 20 round trip miles by light rail 5 days a week

20 light rail miles x 5 days x 46 weeks worked per year = 4,600 light rail miles/year

Employee 2 travels 2 miles by bus to the train station and takes the train the remaining 20 miles to the office 5 days a week. Employee 2 travels the same way on the way home for a total of 4 bus miles each day and 40 train miles.

4 bus miles x 5 days x 46 weeks worked per year = 920 bus miles/year

40 train miles x 5 days x 46 weeks worked per year = 9,200 train miles/year

Employee 3 rides the bus 6 miles round trip 2 times a week and rides a bicycle 6 miles round trip 3 days a week.

6 bus miles x 2 days x 46 weeks worked per year = 552 bus miles/year

6 bicycle miles x 3 days x 46 weeks worked per year = 828 bicycle miles/year

Employee 4 drives a gasoline-powered car 16 miles round trip 5 days a week. The fuel efficiency of Employee 4's car is 28 miles per gallon. There are usually 2 occupants in the car.

16 car miles x 5 days x 46 weeks worked per year = 3,680 car miles/year

3,680 car miles ÷ 28 miles per gallon = 131.4 gallons of gasoline

131.4 gallons of fuel ÷ 2 occupants = 65.7 gallons of gasoline

S&P Enterprises has 350 employees. Using a survey as demonstrated, it has collected the following annual employee commuting activity data:

- ***976,472 light rail miles***
- ***150,769 train miles***
- ***671,498 walk/bicycle miles***
- ***897 bus miles***
- ***3,527.6 gallons of gasoline***

GATHER THE EMISSIONS FACTORS

Now that you have collected activity data for each emissions source, you need to find emissions factors. Emissions factors are published by various entities such as local, state, or national government entities and intergovernmental organizations such as the Intergovernmental Panel on Climate Change (IPCC). Emissions factors are frequently updated. Use the most up-to-date and relevant emissions factor available. Continuously updated emissions factors for electricity and bus, train, and air travel can be found in the calculation tools on the GHG Protocol website and in the spreadsheets that accompany this Guide, available for download from http://www.safeclimate.net. Emissions factors for fossil fuels such as coal, natural gas, and gasoline remain constant and are provided in Appendix II.

Electricity

Emissions factors for electricity vary depending on the fuel used to generate the electricity and the technologies employed by the power plant. You can obtain the most accurate emissions factor directly from your electric company. The EPA also provides a database of emissions information for power plants around the country, called "E-GRID," which can be downloaded from http://www.epa.gov/airmarkets/egrid/. If an emissions factor is not available for your provider, use a published emissions factor for your state, province, or region. This may be available from your national government agency in charge of energy. In the United States, this information can be obtained from the DOE at ftp://ftp.eia.doe.gov/pub/oiaf/1605/cdrom/pdf/e-supdoc.pdf. The last (and least accurate) choice is to use a national average emissions factor for your country; this can be obtained from the International Energy Agency (http://www.iea.org/).

Car Travel

Car travel emissions factors are based on fuel use. If you do not have access to fuel purchase receipts and must estimate fuel efficiency, refer to a guide such as the one available from the EPA at http://www.epa.gov/autoemissions. Note that fuel efficiencies for cars vary depending on highway versus city travel. If the trip is a combination of both, use the average of the two to determine the car's approximate fuel efficiency. If you do not have a guide in your country to reference, then use an emissions factor that incorporates default fuel efficiency values based on the size of car. See those published by the UK Department of Environment, Food, and Rural Affairs (UK DEFRA) as an example; they are available at http://www.defra.gov.uk/environment/envrp/gas/10.htm.

These emissions factors may be expressed in *vehicle miles or kilometers,* or *passenger miles or kilometers*. An emissions factor for vehicle miles or kilometers is used to calculate emissions if there is only one occupant in the vehicle. A passenger miles or kilometers emissions factor is used to calculate emissions if there is more than one occupant in the vehicle (and therefore fewer per-person emissions). It is also acceptable to divide the distance traveled by the number of occupants and then use a vehicle miles or kilometers emissions factor to complete the calculation.

CAUTION!

Remember that emissions factors and activity data MUST be expressed in the same measurement units. If not, you must perform the appropriate conversion. For example, to calculate the CO_2 emitted from flying a certain number of miles, the calculation is:

miles traveled × emissions factor
=
quantity of CO_2 emissions

If the emissions factor is for CO_2 per kilometer, you need to convert the activity data—miles traveled—to kilometers before completing the calculation. Common unit conversion factors are supplied in Appendix I. Be consistent in the unit of measure you choose for reporting emissions. The standard unit is metric tons (tonnes). Be careful not to confuse this with "short tons" or "long tons"! A metric ton equals 2,205 pounds, a short ton equals 2,000 pounds, and a long ton equals 2,240 pounds. Short tons are used in the U.S. and long tons are used in the U.K. If your emissions factor is expressed in a different unit, once you have completed your calculation, you must convert the answer to metric tons. (Refer to the unit conversion table in Appendix I.)

STEP 3 CHECKLIST

✔ **Have you…**

- Collected activity data for each emissions source?
- Obtained the most up-to-date emissions factor available for each source?

Train, Light Rail, and Bus Travel

These emissions are measured in CO_2 per passenger mile or kilometer. The emissions factor assumes an average level of occupancy. Rail and bus emissions factors for the United States are available from the Bureau of Transportation Statistics (http://www.bts.gov/). Rail emissions factors for the United Kingdom are available from the UK DEFRA at http://www.defra.gov.uk/environment/envrp/gas/10.htm.

Air Travel

Emissions factors for air travel in commercial planes assume an average level of occupancy on the plane. Additionally, airplane type affects the amount of emissions that occur. The emissions factors recommended for air travel in the GHG Protocol are from UK DEFRA (http://www.defra.gov.uk/environment/envrp/gas/10.htm) and do not take airplane type into consideration. This is partly for simplicity and partly because comprehensive information is not yet available.

Emissions factors for jet fuel and aviation gasoline are available from the Energy Information Administration (http://www.eia.doe.gov/). Note that jet fuel is used by jet engines only. Aviation gasoline is used in piston-powered airplanes. Jet fuel is more common.

Step 4: CALCULATE YOUR EMISSIONS

Once you've gathered your emissions inventory data you can calculate your office's CO_2 emissions using the following formula:

activity data × emissions factor = CO_2 emissions

As noted earlier, report all emissions in metric tons of CO_2. This may require unit conversions. You may also need to perform unit conversions to ensure that your activity data is expressed in the same units as your emissions factor. Appendix I includes a conversion table.

This step describes how to perform emissions calculations and unit conversions using the examples given for S&P Enterprises. Sources for all emissions factors used can be found in Appendix II. The formulae demonstrate how units are "canceled out." This method helps avoid potential errors that will occur if activity data and emissions factor units are not consistent. For example, the following calculation:

Calculate emissions:	*100 km × 0.18 kg of CO_2 per km = 18 kg of CO_2*
Convert to metric tons (1,000 kg = 1 metric ton):	*18 kg of CO_2 ÷ 1,000 = 0.018 metric tons of CO_2*

Is expressed as:

Calculate emissions:	$100\ \cancel{km} \times \frac{0.18\ kg\ of\ CO_2}{\cancel{km}} = 18\ kg\ of\ CO_2$
Convert to metric tons:	*18 ~~kg of CO_2~~ ÷ 1,000 ~~kg~~/metric ton = 0.018 metric tons of CO_2*

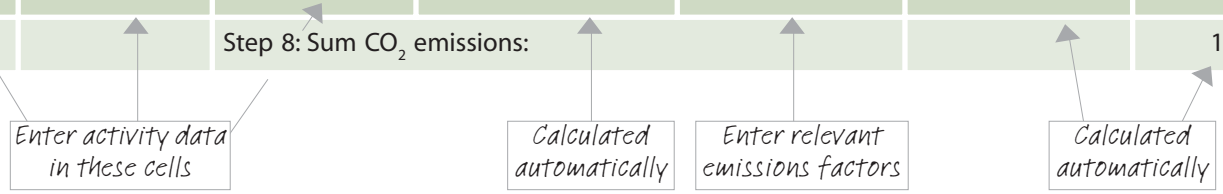
TIP!

Try to minimize inaccuracies in your inventory:

- Check regularly for technical errors. It's easy to make mistakes when converting measurement units, finding the right data, entering data, and using spreadsheets, calculation tools, and formulae.
- Ask someone at your organization who is not directly involved with the development of your inventory to double-check your calculations.
- Ask management to review your inventory to help identify misreporting and inaccuracies and to enhance the usefulness of the organization's inventory.
- Easy-to-use Excel spreadsheets for calculating emissions from electricity use, fuel combustion, air travel, and employee commuting are available for download at http://www.safeclimate.net or http://www.ghgprotocol.org. (See Box 8 for an example of the spreadsheets.)

BOX 8 SAMPLE SPREADSHEET TEMPLATE FOR CALCULATING INDIRECT EMISSIONS FROM ELECTRICITY USE

	Step 1	Step 2	Step 3	Step 4	Step 5	Step 6	Step 7
	A	B	C	D	E	F	G
	Annual Electricity Used in the Building	Total Area of the Building	Total Area of the Office Organization	Annual Electricity Used by the Office Organization	CO_2 Emissions Factor	Indirect CO_2 Emissions in lbs	Indirect CO_2 Emissions in Metric Tons
	kWh			D = A*(C/B) kWh	lbs CO_2 / kWh	F = D*E lbs CO_2	G = F/2205 metric tons CO_2
Office Organization 'Name'							
Location 1	980,326.00	300,000.00	300,000.00	980,326.00	0.193	189,202.92	85.81
Location 2	5,753,100.00	252,781.00	38,018.00	965,260.27	0.280	242,272.88	109.87
Location 3	0.00	0.00	0.00	0.00	0.000	0.00	0.00
Location 4	0.00	0.00	0.00	0.00	0.000	0.00	0.00
Location 5	0.00	0.00	0.00	0.00	0.000	0.00	0.00
Location 6	0.00	0.00	0.00	0.00	0.000	0.00	0.00
Location 7	0.00	0.00	0.00	0.00	0.000	0.00	0.00
Location 8	0.00	0.00	0.00	0.00	0.000	0.00	0.00
Location 9	0.00	0.00	0.00	0.00	0.000	0.00	0.00
Location 10	0.00	0.00	0.00	0.00	0.000	0.00	0.00
Location 11	0.00	0.00	0.00	0.00	0.000	0.00	0.00
Location 12	0.00	0.00	0.00	0.00	0.000	0.00	0.00
			Step 8: Sum CO_2 emissions:				198.68



CALCULATING EMISSIONS FROM NATURAL GAS

units of natural gas used by your organization × emissions factor = CO_2 emissions

Example:

S&P Enterprises used 4,139.59 therms of natural gas this year. The emissions factor is expressed in metric tons of CO_2 per terajoule (tCO_2/TJ). (See Appendix II, Table 1, for emissions factors.) Therefore, the activity data must first be converted from therms to terajoules. This is a two-part calculation.

First, therms are converted to gigajoules (GJ) using the conversion factor supplied in *Appendix I* (0.1055 GJ/therm):

[1] $4{,}139.59\ \cancel{\text{therms}} \times \frac{0.1055\ \text{GJ}}{\cancel{\text{therm}}} = 436.73\ \text{gigajoules (GJ)}$

Next, GJ are converted to terajoules (TJ) by dividing by 1,000:

[2] $436.73\ \cancel{\text{GJ}} \div 1{,}000\ \cancel{\text{GJ}}/\text{terajoule} = 0.437\ \text{TJ}$

The emissions calculation can now be completed as follows:

$$0.437\ \cancel{\text{TJ}} \times \frac{56.0\ tCO_2}{\cancel{\text{TJ}}} = 24.47\ tCO_2\ \text{(metric tons of } CO_2\text{)}$$

S&P's emissions from natural gas this year are 24.47 metric tons of CO_2. These are reported as Scope 1 emissions.

CALCULATING EMISSIONS FROM PURCHASED ELECTRICITY

kWh of electricity used by your organization × emissions factor = CO_2 emissions

Example:

S&P Enterprise's two locations are in New York City and Portland, Oregon. It uses a total of 1,845,586 kWh per year but makes the emissions calculations separately for each location because power is supplied by two different providers and therefore requires two different emissions factors. First the emissions calculation is performed, and then the result is converted to metric tons.

New York City	
Calculate emissions:	980,326 ~~kWh~~ × $\frac{0.193^{*} \text{ lbs of } CO_2}{\text{~~kWh~~}}$ = 189,202.9 lbs of CO_2
Convert to metric tons:	189,202.9 ~~lbs of CO_2~~ ÷ 2,205 ~~lbs~~/metric ton = 85.80 metric tons of CO_2
Portland, Oregon	
Calculate emissions:	865,260 ~~kWh~~ × $\frac{0.28^{*} \text{ lbs of } CO_2}{\text{~~kWh~~}}$ = 242,272.8 lbs of CO_2
Convert to metric tons:	242,272.8 ~~lbs of CO_2~~ ÷ 2,205 ~~lbs~~/metric ton = 109.87 metric tons of CO_2

* This emissions factor is from the EPA's E-Grid database (http://www.epa.gov/airmarkets/egrid/). The emissions in this database are expressed in lbs of CO_2/megawatt hour (MWh). The activity data is in kWh, so the emissions factor is first converted into CO_2/kWh by dividing by 1,000.

* S&P Enterprises could not find an emissions factor from its local power plant or on E-Grid for this location so it used the average electricity emissions factor for the state of Oregon as provided by the DOE.

Total CO_2 emissions from purchased electricity:

85.80 metric tons of CO_2 + 109.87 metric tons of CO_2 = 195.67 metric tons of CO_2

S&P Enterprises' total CO_2 emissions from purchased electricity for this year are 195.67 metric tons of CO_2. This is reported as S&P Enterprises' Scope 2 emissions.

CALCULATING EMISSIONS FROM CAR TRAVEL

[1] quantity of fuel × emissions factor = CO_2 emissions (preferred method)

OR

[2] distance traveled × emissions factor incorporating default fuel efficiency value = CO_2 emissions

Example:

S&P Enterprises used 19.56 gallons of gasoline for business travel in non-company-owned cars this year and traveled 270 miles in a diesel car. The emissions calculations are performed separately for each type of activity data and the results are converted to metric tons.

Fuel-based calculation:	19.56 ~~gallons~~ × $\frac{8.87^{*}\ \text{kg of } CO_2}{\text{~~gallon~~}}$ = 173.50 kg of CO_2
Convert to metric tons:	173.50 ~~kg of CO_2~~ ÷ 1,000 ~~kg~~/metric ton = 0.17 metric tons of CO_2
Calculation using emissions factor incorporating default fuel efficiency:	270 ~~miles~~ × $\frac{0.19^{*}\ \text{kg of } CO_2}{\text{~~mile~~}}$ = 51.3 kg of CO_2
Convert to metric tons:	51.3 kg of CO_2 ÷ 1,000 = 0.05 metric tons of CO_2

* This emissions factor is from the Energy Information Administration, DOE.

* This emissions factor for diesel cars is from *Environmental Reporting—Guidelines for Company Reporting on GHG Emissions,* UK DEFRA.

Total CO_2 Emissions from Car Travel in Non-Company-Owned Vehicles:

0.17 metric tons of CO_2 + 0.05 metric tons of CO_2 = 0.22 metric tons of CO_2

S&P Enterprises' total CO_2 emissions from car travel in non-company-owned vehicles this year are 0.22 metric tons of CO_2. These are reported as Scope 3 emissions.

CALCULATING EMISSIONS FROM AIR TRAVEL

[1] distance traveled × emissions factor = CO_2 emissions *[for travel in commercial planes]*

OR

[2] fuel used × emissions factor = CO_2 emissions *[for travel in corporate jets]*

Example:

S&P Enterprises flew 2,896,345 business air miles in commercial planes this year in a combination of short (980,562 miles), medium (797,412 miles), and long (1,118,371 miles) flights. The emissions factors used are expressed in kilograms (kg) of CO_2 per passenger kilometer (km). Therefore, the activity data is first converted from miles to kilometers. The result is multiplied by the emissions factor and then converted to metric tons.

Short Flights

Convert miles to kilometers:	$980{,}562\ \cancel{\text{miles}} \times \frac{1.609\ \text{km}}{\cancel{\text{mile}}} = 1{,}577{,}724.2\ \text{km}$
Calculate emissions:	$1{,}577{,}724.2\ \cancel{\text{km}} \times \frac{0.18\ \text{kg of } CO_2}{\cancel{\text{km}}} = 283{,}990.35\ \text{kg of } CO_2$
Convert to metric tons:	$283{,}990.35\ \cancel{\text{kg of } CO_2} \div 1{,}000\ \cancel{\text{kg}}/\text{metric ton} = 283.99\ \text{metric tons of } CO_2$

Medium Flights

Convert miles to kilometers:	$797{,}412\ \cancel{\text{miles}} \times \frac{1.609\ \text{km}}{\cancel{\text{mile}}} = 1{,}283{,}035.9\ \text{km}$
Calculate emissions:	$1{,}283{,}035.9\ \cancel{\text{km}} \times \frac{0.126\ \text{kg of } CO_2}{\cancel{\text{km}}} = 161{,}662.52\ \text{kg of } CO_2$
Convert to metric tons:	$161{,}662.52\ \cancel{\text{kg of } CO_2} \div 1{,}000\ \cancel{\text{kg}}/\text{metric ton} = 161.66\ \text{metric tons of } CO_2$

Long Flights

Convert miles to kilometers:	$1{,}118{,}371\ \cancel{\text{miles}} \times \frac{1.609\ \text{km}}{\cancel{\text{mile}}} = 1{,}799{,}458.9\ \text{km}$
Calculate emissions:	$1{,}799{,}458.9\ \cancel{\text{km}} \times \frac{0.11\ \text{kg of } CO_2}{\cancel{\text{km}}} = 197{,}940.47\ \text{kg of } CO_2$
Convert to metric tons:	$197{,}940.47\ \cancel{\text{kg of } CO_2} \div 1{,}000\ \cancel{\text{kg}}/\text{metric ton} = 197.94\ \text{metric tons of } CO_2$

S&P Enterprises also used 450 gallons of jet fuel on trips made in the company's plane. The emissions calculation is made as follows:

Calculate emissions:	$450\ \cancel{\text{gallons}} \times \frac{9.57^{*}\text{kg of } CO_2}{\cancel{\text{gallon}}} = 4{,}306.50\ \text{kg of } CO_2$
Convert to metric tons:	$4{,}306.50\ \cancel{\text{kg of } CO_2} \div 1{,}000\ \cancel{\text{kg}}/\text{metric ton} = 4.3\ \text{metric tons of } CO_2$

* This emissions factor is from the Energy Information Administration.

Total CO_2 Emissions from Air Travel

283.99 metric tons of CO_2 + 161.66 metric tons of CO_2 + 197.94 metric tons of CO_2 = 643.59 metric tons of CO_2

S&P Enterprises' total CO_2 emissions from air travel in commercial planes this year are 643.59 metric tons of CO_2. These are reported as Scope 3 emissions. S&P Enterprises' total emissions from travel in the company-owned plane are 4.3 metric tons of CO_2. These are reported as Scope 1 emissions.

CALCULATING EMISSIONS FROM TRAIN TRAVEL

distance traveled × emissions factor = CO_2 emissions

Example:

S&P Enterprises' employees traveled 1,200 business train miles this year. The emissions factor used is expressed in kilograms (kg) of CO_2 per passenger mile. The emissions calculation is made and the result is converted to metric tons.

* The emissions factor is from the U.S. Bureau of Transportation Statistics, 2000.

Calculate emissions:	1,200 ~~miles~~ × $\frac{0.1719^{*}\ \text{kg of } CO_2}{\sout{\text{mile}}}$ = 206.28 kg of CO_2
Convert to metric tons:	206.28 ~~kg of CO_2~~ ÷ 1,000 ~~kg~~/metric ton = 0.21 metric tons of CO_2

S&P Enterprises' emissions from train travel this year are 0.21 metric tons of CO_2. These are reported as Scope 3 emissions.

CALCULATING EMISSIONS FROM EMPLOYEE COMMUTING

Different emissions factors are used for each mode of transport, so each is calculated separately:

a) For commuting by light rail, train, or bus, separately calculate:

distance traveled × emissions factor for each mode of transport = CO_2 emissions

b) For commuting by car:

quantity of fuel used × emissions factor = CO_2 emissions

If distance-based activity data is used, the calculation is:

distance traveled × emissions factor incorporating default fuel efficiency value = CO_2 emissions

c) Total emissions:

Add the emissions from each mode of transport to obtain the total estimated emissions for all employees that completed the survey. If the survey is a sample of employees, the following additional calculation is made to obtain estimated emissions for all employees:

total emissions from survey group × ratio (number of employees in organization ÷ number of employees in survey) = organization's total estimated emissions

Example:

S&P Enterprises collected the following activity data from its annual commuting survey:

- 976,472 light rail miles
- 150,769 train miles
- 671,498 walk/bicycle miles
- 897 bus miles
- 3,527.6 gallons of gasoline

For each mode of transport, the emissions calculation is made and the result is converted to metric tons.

Light Rail	
Calculate emissions:	$976{,}472\ \cancel{\text{miles}} \times \frac{0.430\ \text{kg of } CO_2}{\cancel{\text{mile}}} = 419{,}882.96\ \text{kg of } CO_2$
Convert to metric tons:	$419{,}882.96\ \cancel{\text{kg of } CO_2} \div 1{,}000\ \cancel{\text{kg}}/\text{metric ton} = 419.88\ \text{metric tons of } CO_2$

Bus	
Calculate emissions:	$897\ \cancel{\text{miles}} \times \frac{0.2997\ \text{kg of } CO_2}{\cancel{\text{mile}}} = 268.83\ \text{kg of } CO_2$
Convert to metric tons:	$268.83\ \cancel{\text{kg of } CO_2} \div 1{,}000\ \cancel{\text{kg}}/\text{metric ton} = 0.27\ \text{metric tons of } CO_2$

Train	
Calculate emissions:	$150{,}769\ \cancel{\text{miles}} \times \frac{0.1719\ \text{kg of } CO_2}{\cancel{\text{mile}}} = 25{,}917.19\ \text{kg of } CO_2$
Convert to metric tons:	$25{,}917.19\ \cancel{\text{kg of } CO_2} \div 1{,}000\ \cancel{\text{kg}}/\text{metric ton} = 25.92\ \text{metric tons of } CO_2$

Car	
Calculate emissions:	3,527.6 ~~gallons of gasoline~~ × $\frac{8.87 \text{ kg of } CO_2}{\text{~~gallon~~}}$ = 31,289.81 kg of CO_2
Convert to metric tons:	31,289.81 ~~kg of CO_2~~ ÷ 1,000 ~~kg~~/metric ton = 31.29 metric tons of CO_2

Walk/Bike

There are no CO_2 emissions associated with walking or biking.

Total CO_2 Emissions from Employee Commuting

419.88 metric tons of CO_2 (light rail)	+	0.27 metric tons of CO_2 (bus)	+	25.92 metric tons of CO_2 (train)	+	31.29 metric tons of CO_2 (car)	=	477.36 metric tons of CO_2

S&P Enterprises has 350 employees, 295 of whom completed the survey. The following calculation estimates total emissions from employee commuting:

477.36 metric tons of CO_2 X (350 ÷ 295) = 566.36 metric tons of CO_2

S&P Enterprises' total annual estimated emissions from employee commuting this year are 566.36 metric tons of CO_2. These are reported as Scope 3 emissions.

STEP FOUR CHECKLIST

✔ **Have you…**

- Calculated emissions making sure units for emissions factors and activity data are the same and performed any necessary conversions?

CALCULATING YOUR ORGANIZATION'S TOTAL CO_2 EMISSIONS

Once you have calculated your organization's emissions from each emissions source, add them together to determine your organization's total emissions.

Example:

S&P Enterprises' total CO_2 emissions for this year are as follows:

Scope 1	24.47 metric tons of CO_2 *(from natural gas)*
	4.3 metric tons of CO_2 *(from air travel in the company-owned plane)*
Subtotal	**28.77 metric tons of CO_2**
Scope 2	195.67 metric tons of CO_2 *(from purchased electricity)*
Subtotal	**195.67 metric tons of CO_2**
Scope 3	0.22 metric tons of CO_2 *(from car travel)*
	643.59 metric tons of CO_2 *(from air travel in commercial planes)*
	0.21 metric tons of CO_2 *(from train travel)*
	566.36 metric tons of CO_2 *(from employee commuting)*
Subtotal	**1,210.38 metric tons of CO_2**
Total CO_2 Emissions *(total of subtotals of Scopes 1, 2, and 3)*	**1,434.82 metric tons of CO_2**

Step 5: ESTABLISH AN EMISSIONS REDUCTION TARGET

Now that you've developed an inventory, you can establish an emissions reduction target. This is the amount of emissions your organization commits to eliminating. To establish an emissions reduction target, first select a base year. This is a reference year against which you can measure emissions performance over time. Select a base year for which reliable and comprehensive data are available. If you do not have reliable historical information, use the current year as your base year.

WRI elected to use 1990 as its base year to mirror what the United States requirements would have been if the United States had ratified the Kyoto Protocol. *(See Box 3.)* A major challenge with this decision was that the information needed to establish WRI's CO_2 inventory for 1990 was largely incomplete. The limited information that was available was used to estimate 1990 emissions. This makes drawing comparisons against the selected base year difficult and less meaningful. WRI's most relevant comparisons are those drawn against recent years for which we obtained more reliable information. We encourage others to select a base year for which reliable information is available. For many, this could be the first year you conduct an inventory.

Once you've selected your base year, establish interim and long-term emissions reduction targets. There are two kinds of reduction targets you might choose: "absolute" targets and "rate-based" targets.

- Absolute targets are a concrete reduction goal that does not take factors such as organizational growth into account. A 10 percent reduction in emissions below those estimated for the base year is an example of an absolute target.
- Rate-based targets are linked to the organizational fluctuations of the business. Reducing per capita emissions by 10 percent is an example of a rate-based target.

TIP! To allow meaningful comparisons, use the same method to calculate your emissions in subsequent years as you do in your base year. If you change your method of calculation, adjust your base year calculations accordingly.

STEP FIVE CHECKLIST

✔ Have you…

- Selected a base year for which reliable and comprehensive information is available?
- Established an emissions reduction target and set interim targets to help benchmark your progress?

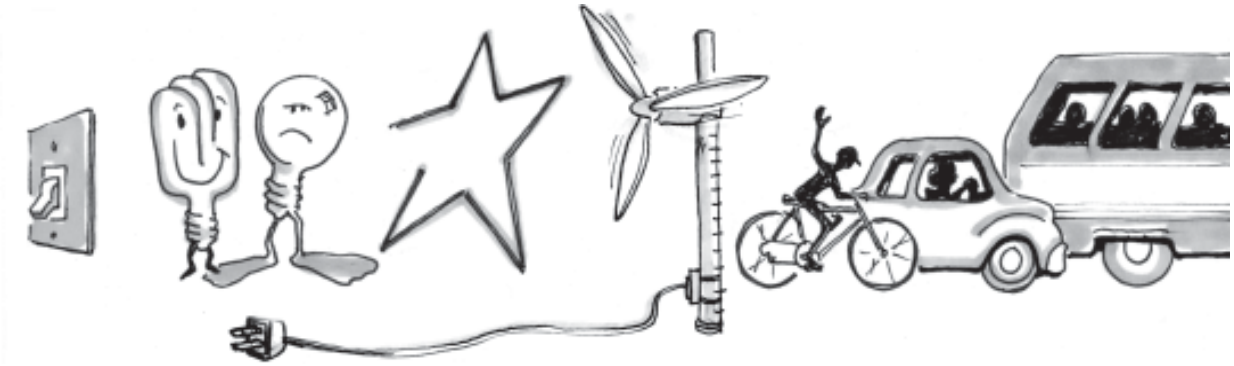
WRI considers absolute targets to be the most meaningful because the problem of climate change is related to the concentrations of GHGs in the atmosphere. Total GHG emissions must be reduced to effect climate change and absolute targets help achieve this. Rate-based targets, even if reached, do not necessarily result in the reduction of an organization's overall emissions. See Box 9 for an example.

BOX 9 ABSOLUTE VERSUS RATE-BASED TARGETS

The CO_2 emissions reduction target set by WRI was "absolute": reduce emissions to net zero through a variety of strategies by 2005, with an interim goal of reducing emissions to 7 percent below 1990 levels by 2000.

In 1990 WRI had 80 employees, and in 2000 it had 125 employees. Estimated emissions in 1990 were 19.4 metric tons of CO_2 per employee. In 2000, estimated emissions were 16 metric tons of CO_2 per employee. The reduction per employee was approximately 16 percent. However, because of the increase in number of employees, the organization's total emissions were still 30 percent greater in 2000 than in 1990.

This example demonstrates why absolute emissions targets, though potentially more challenging, represent a more environmentally meaningful goal because they guarantee a specific reduction amount.



Step 6: REDUCE YOUR CO_2 EMISSIONS

Once you have calculated your organization's CO_2 emissions, you can identify opportunities for emissions reductions to achieve your target. This section describes two categories of emissions reductions: "internal" reductions and "offsets." Internal reductions are those that take place within your organization's operations, like switching to energy-efficient lighting. An offset is the reduction or removal of emissions through a project outside your organization's operations, such as carbon removal from the atmosphere through a tree planting project. WRI recommends that you make internal reductions a priority, but consider offset options as a supplemental effort to help you achieve your goal.

INTERNAL REDUCTIONS

A variety of internal reduction opportunities are possible depending on the type of your organization and which emissions you have included in your inventory. Start by pursuing those actions that will provide the greatest emissions savings for your organization at the lowest cost. Examples follow.

Reducing Energy Consumption

Your office can achieve significant energy savings by promoting the following practices.

(1) Use Less Energy

Equipment

- Ensure equipment is off when not in use. If equipment has an energy-efficient mode, use it! Consider purchasing timers for equipment such as photocopiers and printers so they switch off automatically when not in use during non-office hours. Employ "Switch Me Off!" stickers as reminders. Encourage employees to turn their computers off when they are away from their offices for extended periods. Start competitions among departments to see who has the best record of turning off equipment, or can generate the best ideas for other energy-saving ideas.
- When its time to upgrade your office equipment, purchase equipment that is Energy Star rated by the EPA. Products that bear the Energy Star label are energy efficient (http://www.energystar.gov/default.shtml).

WRI'S ENERGY-EFFICIENT OFFICE

When WRI moved into new offices in 1999, it incorporated energy-efficient appliances, lights, and management into the design of its space. As a result, WRI's electricity use decreased by an estimated 25 percent, even though the new office is 20 percent larger than the old one. If we were still using the same kWh per square foot as we had been in our previous offices, our current annual electricity use would be approximately 60 percent higher.

Visit http://www.wri.org/office/index.html for more information about WRI's green office and links to the suppliers WRI's used for its energy-efficient lighting, office equipment, and appliances.

TIP! The EPA offers on-line tools to help you calculate energy savings. The Financial Value Calculator calculates the impact of improved energy performance on your company's financial value (http://yosemite1.epa.gov/ESTAR/business.nsf/content/fvcalc.htm). The Simple Savings Calculator calculates potential lifetime energy cost savings for specific products (http://www.epa.gov/nrgystar/purchasing/2c_savings_calc.html).

WRI'S GREEN POWER MARKET DEVELOPMENT GROUP

Convened by the World Resources Institute and Business for Social Responsibility in 2000, the Green Power Market Development Group is a unique commercial and industrial partnership dedicated to building corporate markets for green power. The Group is working to transform energy markets to enable corporate buyers to diversify their energy portfolios with green power and to reduce their impact on climate change. The Group seeks to develop 1,000 megawatts of new, cost-competitive green power by 2010. For more information about the Group and about green power markets for corporate users, visit the Group's website and on-line marketplace at http://www.thegreenpowergroup.org.

Computers

- If your organization's computers include power management features, encourage employees to activate them, or have your information technology (IT) department do it. Power management features are now common on most computers. When activated, they enable the computer's monitor to automatically power down after a specified period of inactivity, saving significant energy. The EPA provides an on-line calculator to estimate your energy savings from the "power management" feature (http://yosemite1.epa.gov/estar/consumers.nsf/content/power.htm). The EPA estimates that if all computers in the U.S. utilized this feature, the reductions in CO_2 emissions would be equivalent to removing 1.5 million cars from the road.[8]

Lighting

- Turn lights off when offices and meeting rooms are empty. Consider installing motion sensors so that lights turn off when offices are unoccupied for more than a few minutes.
- Purchase compact fluorescent lamps (CFLs) for the office. CFLs typically save a consumer 50 to 80 percent of the energy costs associated with incandescent bulbs and the average CFL lasts more than 10 times longer. A variety of CFLs and other energy-efficient products are available at many hardware stores and on-line at WRI's SafeClimate store (http://www.safeclimate.net/store/).
- If you have access to sufficient natural light, consider dimming or turning off the lights during brighter parts of the day. If you are building new office space, encourage architects and designers to incorporate as much natural light and reflective ceiling tiles as possible into the design phase.

Other

- Replace old air conditioning equipment with energy-efficient systems. This measure can save up to 25 to 35 percent of electricity use in your office building. The financial payback period ranges from 3 to 5 years.[9]
- If you have an old boiler, consider upgrading it to a more energy-efficient one.
- Incorporate green building practices into new buildings.

(2) Use Greener Energy

Consider purchasing green power for your business. Green power is electricity that is generated from clean, non-fossil fuel based sources such as solar, wind, and some forms of biomass. You may be able to partner with another business and use your joint purchasing power to obtain more cost-competitive green power.

Reducing Travel-Related Emissions

Business Travel

- Recognizing that air travel is the most carbon-intensive travel method, explore alternatives to plane trips. For example, depending on where your business is located and the trip you are planning, sometimes it's as easy to travel by train

as by plane. As it developed its annual CO_2 inventory, WRI learned that staff took 10 trips by plane in one year from Washington, D.C., to New York, a distance of approximately 230 miles. These two cities are connected by fast train service located close to WRI's office. If the employees had traveled by trains instead of planes, WRI would have reduced its emissions responsibility from those trips by about 40 percent.

- When possible, organize your trips so they are multipurpose, enabling you to maximize your trip productivity. Also consider consolidating trips. For example, if you are traveling to the same area at two different times, consider combining the trips into one. Besides reducing emissions, reducing travel will save your company money.
- Reduce your organization's need for travel, or reduce the number of employees who go on each trip. Alternatives to travel include telephone, video, and web conferencing. The cost and reliability of video conferencing technologies have greatly improved over the past few years. In January 2001 alone, WRI avoided two international air trips by using video and audio conferencing technology. We saved an estimated 24,780 miles, 4.4 metric tons of CO_2, and approximately nine staff days. In addition to the environmental benefits, the reduced staff time also saved WRI money. In some areas, video conferencing equipment, or public facilities with video conferencing, can be rented. You may also be able to rent video conferencing equipment and space to meet from other organizations. (See Appendix III for a list of resources.)

Employee Commuting

- Consider teleworking—that is, using communications technology to work at a distance rather than commuting—as an alternative to traditional commuting for some employees. AT&T estimates that in 1999, its teleworkers avoided 87 million miles of driving, preventing emissions of 41,000 tons of CO_2, 93,000 tons of nitrogen oxides, 1.4 million tons of carbon monoxide, and 180,000 tons of hydrocarbons.[10] Telework can also help with employee retention. When AT&T surveyed its teleworking employees, 67 percent who reported receiving a competing job offer said that giving up their current telework arrangement was a factor in their decision to turn the competing offer down. Additionally, 66 percent of AT&T managers said that telework helped them keep and attract good employees. See AT&T's website for useful information on setting up teleworking programs, and some of the benefits for employees and managers (http://www.att.com/telework).
- Create incentives for employees to use car pool or other alternative methods for their work commute, such as walking, cycling, and mass transit. For example, you could offer discounts on mass transit to employees or allow employees to use pre-tax dollars to pay for commuting. Some government incentive programs offer pre-tax benefits. Provide a place where employees can secure their bicycles.
- When relocating offices, consider proximity to public transportation as a factor in selecting a site.

A GUIDE TO GAINING THE AIR QUALITY AND CLIMATE PROTECTION BENEFIT OF TELEWORK

Working with the Electronic Industries Alliance, WRI has completed a guide to help companies factor the benefits of telework into their climate strategies. The guide provides an introduction to using telework (substituting electronic communication for commuting or business travel) as a measure to reduce greenhouse gases and air pollution. The guide:

- outlines the opportunity to use telework to avoid emissions of greenhouse gases and air pollutants from transport and buildings;
- describes the business case for telework at computer, telecommunications, and electronics companies; and
- suggests how a company can get started or expand its approach to factoring climate and air quality protection into telework.

The guide will be available at http://www.safeclimate.net in early 2003.

TIP! A key to reducing emissions is to engage staff at all levels of your organization in identifying reduction opportunities and taking action. WRI staff are organized into 11 Programs. At an Institute-wide staff meeting, a volunteer was requested from each program to serve as a "Climate Cop." WRI's Climate Cops help identify emissions reduction opportunities in their programs, raise awareness for the initiative, disseminate information to their colleagues, and serve as enthusiastic advocates. The Climate Cops meet every two or three months to brainstorm ideas, report on successes, and discuss challenges that arise. They keep awareness of the organization's CO_2 reduction commitment high among staff and invent creative ways to remind colleagues about daily actions they can take such as turning their computers off at night.

Other Suggestions

- Encourage and help another company conduct a CO_2 inventory and set a reduction target. This might be a business partner or neighboring organization.
- Tell your suppliers and other business partners about your actions.
- Organize an education program on climate change for your employees using SafeClimate (http://www.safeclimate.net). E-mail sepinfo@wri.org for more information.
- Encourage and support employees' efforts to reduce CO_2 emissions at home. Resources to help individuals take action at home are available at http://www.safeclimate.net.
- Share your emissions reduction ideas with WRI so we can improve the next edition of this Guide, e-mail sepinfo@wri.org.

For a list of more resources to help you reduce your organization's emissions, see the references in Appendix III.

OFFSETS

Reducing your organization's CO_2 emissions is challenging. Even after your best reduction efforts, you may find you still have not reached your goal. If this is the case, you may wish to consider purchasing carbon offsets. An offset is an emissions reduction or removal project outside the boundaries you have defined that helps another organization reduce their emissions. Offsets are necessary if your goal is net zero and your inventory includes employee commuting and business travel.

The purchase of offsets is controversial, partly because it could be implied that companies are "buying their way out" of their climate responsibilities, and partly because there is still uncertainty about how to calculate the CO_2 benefits of certain offset projects like tree planting. Nevertheless, carbon offsets can be an effective and often necessary tool to reduce CO_2 emissions. It is important, however, to first vigorously pursue actual emissions reductions within your organization. Maximizing in-house emissions reduction opportunities so that the need for offsets can be gradually reduced is WRI's long-term strategy.

WRI's values are reflected in its choices of offset projects; you might want to do the same. We chose our first offset purchase (See Box 10) because staff felt strongly that the project should be based in the United States, given the need to reduce total U.S. CO_2 emissions. Staff also favored an energy-based project. For our second offset purchase, we chose to invest in a project that captures methane from abandoned coal mines in Ohio and converts it to electricity, for similar reasons as the prior year. The cost per metric ton is also less, a compelling factor given WRI is a nonprofit organization. However, WRI is also an organization that works worldwide. Some staff hail from developing countries, and staff travel widely and contribute to emissions outside the United States as a result of our activities. For these reasons, WRI's next offset purchase will be an investment in a developing country project. As an additional advantage, offset projects in developing countries can help drive CO_2 reduction efforts and encourage investment in CO_2 emissions reduction technologies.

Once you have investigated all your emissions reduction options, you will have a better understanding of the opportunities available. Remember to refer to the decision your organization made about an emissions reduction target in Step 5. Ensure your target is realistic and achievable.

BOX 10 WRI'S OFFSET PROJECT

In 2000, WRI purchased offsets for 100 percent (2,011 metric tons) of CO_2 emissions that it estimated it had emitted the previous year.

Through Trexler and Associates, WRI invested in a project in the Portland, Oregon, public school system that will replace oil-burning boilers with a cleaner, natural gas-fired heating system and will also incorporate computerized energy management tools.

To determine the offsets available for this project, Trexler and Associates calculated the base emissions from the school's oil-burning boilers, then the emissions from the new improved system. The offsets available for the project are the difference between these two calculations.

The school system provides an annual emissions report to Trexler and Associates through a customized software program. They then verify the emissions and monitor the school's progress.

In order to purchase the offsets, WRI entered into a contractual agreement with Trexler and Associates. The offsets now belong to WRI and cannot be claimed by any other party (for example, the school). In this case, the contract was "front-loaded," meaning that Trexler and Associates estimated emissions from the schools new heating system over 15 years, then brought them forward to the year of purchase. They then retired the credits, giving WRI rights to all the emissions reductions from the project it had purchased.

The total cost of WRI's offset project was just over $20,000. WRI spread the cost of the offsets across all its programs according to the size of their budget in the year the emissions occurred so they would realize the financial impact of their emissions.

SafeClimate for Business

***SafeClimate for Business*, a sister site to the existing SafeClimate site (http://www.safeclimate.net) will debut in early 2003. It will contain practical information to help businesses and organizations understand and take action on climate change. The site will also feature content from WRI's partners at the Center for Environmental Leadership in Business at Conservation International on how carefully designed forestry-based carbon offset projects can provide multiple benefits such as biodiversity protection.**

TIP! If your organization is undergoing structural changes such as acquisitions or mergers, you need to adjust your base year emissions to ensure meaningful comparisons. For guidance, refer to the GHG Protocol website.

STEP SIX CHECKLIST

✔ **Have you…**

- Identified and implemented emissions reduction opportunities within your organization?
- Secured the support of other employees to help you identify opportunities you may have missed?
- Investigated offset options, if necessary?
- Revisited your emissions reduction target?

Example:

S&P Enterprises' current emissions and reduction target follow. All emissions are in metric tons of CO_2:

Base Year (2001)	Current Year (2002)	Percent Change	Reduction Target	Gap
1,560	1,434.82	–8.02%	1,326	108.82

S&P Enterprises has reduced emissions through internal reductions by 8.02 percent but has still not reached its target. The organization must now answer the following questions:

- ***To reach its target, is a purchase of offsets appropriate and financially possible?***
- ***How will further internal reductions be achieved in the coming year?***
- ***Is the organization's emissions reduction target realistic? If it will be easily achieved, should the target be revised to be more aggressive?***

ACCOUNTING FOR GHG REDUCTION PROJECTS

The development of standards and guidelines to help companies and project developers account for GHG reduction projects or offsets becomes important as national emissions trading schemes evolve and the trading volume of emissions credit grows. GHG reduction projects include activities to store carbon (such as growing trees) and activities that reduce greenhouse gas emissions (such as improving energy use efficiency). As part of the GHG Protocol, WRI and WBCSD have convened a multi-stakeholder process to develop guidance on accounting for GHG reductions from projects. The aims are to:

- develop straightforward and credible accounting and reporting standards and guidance for project-based reductions that keep transaction costs at a minimum, and
- identify credible methodologies and data sources for the measurement of GHG emissions and removals.

The guidance and standards will be available in 2003. For more information, visit http://www.ghgprotocol.org.

Step 7: REPORT YOUR CO_2 INVENTORY

You've developed your inventory, set your emissions reduction target, and implemented strategies to reach your goal. Now, you may want to share your progress with your shareholders, other businesses in your sector, the environmental community, or the general public. You can alert others to your good work on your company's website or in your annual report. Another easy place to report is at http://www.safeclimate.net.

You'll also want to be sure you keep all your employees and colleagues apprised of the inventory and your progress as a leader on climate change. You might include regular updates in a staff newsletter or e-mail, or at staff meetings. If various locations are undertaking inventories separately, you could create a competition, rewarding those who achieve or most exceed their targets.

Use the guiding principles of GHG emissions accounting and reporting (See Box 5) when you develop your CO_2 report: make sure your reporting is "relevant, complete, consistent, transparent, and accurate." Your report should be based on the best data available at the time of publication.

REPORTING INFORMATION ON EMISSIONS AND PERFORMANCE

- Report your emissions in metric tons.
- Report each scope separately AND total emissions from each scope to show the total amount of your organization's emissions.
- Illustrate performance over time and, if appropriate, relative to a base year and reduction target.

SUPPORTING INFORMATION

- Describe the methodologies used to calculate emissions, or provide a reference or link to the calculation tools used.
- Provide appropriate context for any significant emissions changes such as acquisitions/divestitures, outsourcing/insourcing, changes in reporting boundaries, etc.
- Outline information on any emissions reduction projects (offsets) undertaken.

STEP SEVEN CHECKLIST

✔ Have you…

- Reported your organization's emissions publicly following the guidelines described?
- Considered developing your inventory for next year, including revisiting your boundaries if necessary and improving your methods of collecting activity data?
- Shared your experiences with WRI by e-mailing questions, comments, innovative approaches for reductions, and other feedback on this Guide to sepinfo@wri.org?

You may also wish to consider having an external third party certify your emissions inventory. External certification lends credibility to your inventory and may be required if you intend to submit your inventory to a regulatory body or emissions registry. Registering emissions could provide benefits if emissions trading schemes become operational in your country. There are various voluntary initiatives where businesses can register their emissions such as EPA's Climate Leaders program, the California Climate Action Registry, the 1605(b) registry (a section of the Energy Policy Act), and the Wisconsin Voluntary Emission Reduction Registry.

For more in-depth information on GHG reporting, refer to the GHG Protocol website.

NOTES

1. 1999 Commercial Buildings Energy Consumption Survey (CBECS) Detailed Tables, Energy Information Administration, U.S. Department of Energy, http://www.eia.doe.gov/emeu/cbecs/detailed_tables_1999.html.
2. *Aviation and the Global Atmosphere*, Intergovernmental Panel on Climate Change, 1999, http://www.ipcc.ch/pub/reports.htm.
3. Economics FAQs, Air Transport Association of America, 1998, http://www.airlines.org.
4. Energy Star Program, EPA, http://www.energystar.gov/default.shtml.
5. Center for Energy and Climate Solutions, http://www.energyandclimate.org/.
6. Cool Companies, Center for Energy and Climate Solutions, http://www.coolcompanies.org/.
7. Americans and the World, Program on International Policy Attitudes, http://www.americans-world.org/digest/global_issues/global_warming/gw1.cfm; Zogby International Omnibus Polling Results, *American Attitudes on Climate Change,* http://www.ucsusa.org/global_environment/global_warming/index.
8. Energy Star Program, EPA, http://www.energystar.gov/powermanagement/index.asp.
9. "Groups Issue Chiller Statement," editorial reprint of position statement issued by Alliance to Save Energy, American Council for an Energy-Efficient Economy, and Natural Resources Defense Council, http://www.hvacrnews.com/editorials/2001chiller.htm.
10. Telework Webguide, AT&T, http://www.att.com/telework.

Appendix I

UNIT CONVERSION FACTORS				
Type	**Unit**	**Equals**	**Equals**	**Equals**
Mass	1 pound (lb)	453.6 grams (g)	0.4536 kilograms (kg)	0.0004536 metric tons (tonnes)
	1 kilogram (kg)	2.205 pounds (lb)		
	1 short ton (ton)	2,000 pounds (lb)	907.2 kilograms (kg)	
	1 metric ton (tonne)	2,205 pounds (lb)	1,000 kilograms (kg)	1.102 short tons (tons)
Volume	1 cubic foot (ft^3)	7.4805 gallons (gal)	0.1781 barrel (bbl)	
	1 cubic foot (ft^3)	28.32 liters (l)	0.02832 cubic meters (m^3)	
	1 gallon (gal)	0.0238 barrel (bbl)	3.785 liters (l)	0.003785 cubic meters (m^3)
	1 barrel (bbl)	42 gallons (gal)	158.99 liters (l)	0.1589 cubic meters (m^3)
	1 liter (l)	0.001 cubic meters (m^3)	0.2642 gallons (gal)	
	1 cubic meter (m^3)	6.2897 barrels (bbl)	264.2 gallons (gal)	1,000 liters (l)
Energy	1 kilowatt hour (kWh)	3,412 Btu (Btu)	3,600 kilojoules (KJ)	
	1 megajoule (MJ)	0.001 gigajoules (GJ)		
	1 gigajoule (GJ)	0.9478 million Btu	277.8 kilowatt hours (kWh)	
	1 Btu (Btu)	1,055 joules (J)		
	1 million Btu (million Btu)	1.055 gigajoules (GJ)	293 kilowatt hours (kWh)	
	1 therm (therm)	100,000 Btu	0.1055 gigajoules (GJ)	29.3 kilowatt hours (kWh)
Other	Kilo	1,000		
	Mega	1,000,000		
	Giga	1,000,000,000		
	Tera	1,000,000,000,000		
	1 land mile	1.609 land kilometers		
	1 nautical mile	1.15 land miles		
	1 metric ton carbon	3.664 metric tons CO_2		

APPENDIX II
EMISSIONS FACTORS

Emissions factors are published by various entities. It is important to select the most **current and relevant** emissions factor available. A continuously updated list of emissions factors can be found in the GHG Protocol calculations tools (http://www.ghgprotocol.org) and in the spreadsheets that accompany this Guide, which can be downloaded from the GHG Protocol or SafeClimate websites.

Always remember that the emissions factor you use must be expressed in the same measurement unit as your activity data, which may require that you perform appropriate unit conversions before completing your calculations.

Fuel Combustion

Table 1 *(all emissions factors are based on net calorific value)*

Fuel	Carbon emissions factor in tC/TJ	Carbon Dioxide emissions factor[3] in tCO_2/TJ
Liquid Fossil Fuels[1]		
Gasoline	18.9	69.2
Kerosene	19.6	71.7
Shale Oil	20.0	73.2
Diesel Oil	20.2	73.9
Residual Fuel Oil	21.1	77.2
Liquid Petroleum Gas (LPG)	17.2	63.0
Petroleum Coke	27.5	1000.7
Solid Fossil Fuels[1]		
Anthracite	26.8	98.1
Other Bituminous Coal	25.8	94.4
Lignite	27.6	101.0
Peat	28.9	105.8
Gaseous Fossil Fuels[1]		
Natural Gas	15.3	56.0
Other Fossil Fuels[2]		
Propane	17.02	62.3
Heating Oil	19.88	72.83

Key: tC/TJ = metric tons of carbon/terajoule; tCO_2/TJ = metric tons of carbon dioxide/terajoule

Notes:
1. Revised 1996 IPCC Guideline Table 1-2, Volume II, http://www.ipcc-nggip.iges.or.jp/public/gl/guidelin/ch1wb1.pdf
2. Derived from U.S. Department of Energy/Energy Information Administration (DOE/EIA), Form EIA-1605 Instructions, 1996, http://www.eia.doe.gov/oiaf/1605/factors.html
3. CO_2 emissions factors are derived from carbon emissions factors

If the quantity of fuel used in energy units is unknown, energy units can be determined from the mass of fuel used using *Table 2*.

Fuel Energy Content

Table 2

Fuel	Mass of Fuel	Net calorific value in GJ
Gasoline	One tonne equals	44.8
Kerosene	One tonne equals	44.75
Shale Oil	One tonne equals	36.00
Gas/Diesel Oil	One tonne equals	43.33
Residual Oil	One tonne equals	40.19
Liquid Petroleum Gas (LPG)	One tonne equals	47.31
Bitumen	One tonne equals	40.19
Petroleum Coke	One tonne equals	31.00

Source: Revised 1996 IPCC Guideline Table1-3, Volume II, http://www.ipcc-nggip.iges.or.jp/public/gl/guidelin/ch1wb1.pdf

Car Travel

Table 3

Liquid Fuel	kg of CO_2/gallon	kg of CO_2/litre
Gasoline/Petrol	8.87	2.34
Diesel	10.15	2.68

Source: Derived from Energy Information Administration, *Emissions of Greenhouse Gases in the United States 2000,* Appendix B, Table B1, http://www.eia.doe.gov/oiaf/1605/ggrpt/tblb1.html

Air Travel

Table 4

Liquid Fuel	kg of CO_2/gallon	kg of CO_2/litre
Jet Fuel	9.57	2.53
Aviation Gasoline	8.32	2.20

Source: Derived from Energy Information Administration, *Emissions of Greenhouse Gases in the United States 2000,* Appendix B, Table B1, http://www.eia.doe.gov/oiaf/1605/ggrpt/tblb1.html

Emissions Factor Sources

The following are common emissions factor sources.

Electricity

- Emissions factors from U.S. power plants, generating companies, states, and regions of the power grid are available from the U.S. Environmental Protection Agency's E-Grid database, http://www.epa.gov/airmarkets/egrid/
- U.S. Average Electricity Emissions Factors by State, U.S. Department of Energy, ftp://ftp.eia.doe.gov/pub/oiaf/1605/cdrom/pdf/e-supdoc.pdf
- Country-level electricity emissions factors are available from the International Energy Agency, http://www.iea.org, and the United National Environment Programme (UNEP), http://www.unep.org/

Air Travel

- Emissions factors for short and long flights in commercial planes are available from the UK Department of Environment, Food, and Rural Affairs (UK DEFRA) http://www.defra.gov.uk/environment/envrp/gas/10.htm. The GHG Protocol uses an additional emissions factor for medium flights that is derived from UK DEFRA, http://www.ghgprotocol.org

Rail

- Emissions factors for UK rail are available from UK DEFRA, http://www.defra.gov.uk/environment/envrp/gas/10.htm
- Emissions factors for U.S. diesel trains are available from the Bureau of Transportation Statistics, http://www.bts.gov
- In the GHG Protocol, emissions factors for U.S. electric trains, coal trains, and light rail are derived from U.S. diesel trains emissions factors, http://www.ghgprotocol.org

Bus

- Emissions factors for bus travel are available from the U.S. Bureau of Transportation Statistics, http://www.bts.gov

Car

- Fuel efficiency ratings for cars are available in the United States from the EPA, http://www.epa.gov/autoemissions
- Emissions factors for cars that assume a default fuel efficiency value are available from UK DEFRA, http://www.defra.gov.uk/environment/envrp/gas/10.htm

APPENDIX III
REFERENCES AND RESOURCES

INTRODUCTION

For more information on WRI's CO_2 commitment, visit http://www.wri.org/office/co2comm.html

WHAT IS CLIMATE CHANGE AND WHAT ARE THE IMPACTS?

More information about climate change can be found at the following websites:

- Center for Energy and Climate Solutions, Cool Companies, http://www.coolcompanies.org/
- Clean Air-Cool Planet, Solutions, http://www.cleanair-coolplanet.org/for_business.php
- *Emissions of Greenhouse Gases in the United States 2000,* Energy Information Administration, U.S. Department of Energy: The latest estimates of GHG emissions in the United States, http://www.eia.doe.gov/oiaf/1605/ggrpt/index.html#carbon
- *Greenhouse Gases, Global Climate Change and Energy.* Energy Information Administration, U.S. Department of Energy: Information about the connection between climate change and energy, http://www.eia.doe.gov/oiaf/1605/ggccebro/chapter1.html
- Intergovernmental Panel on Climate Change (IPCC): IPCC publications for download and/or purchase as well as IPCC speeches and presentations, http://www.ipcc.ch
- National Assessment of the Potential Consequences of Climate Variability and Change, http://www.gcrio.org/NationalAssessment/
- EPA, Global Warming: Information on climate change science, potential impacts in the United States and mitigation opportunities, http://yosemite.epa.gov/oar/globalwarming.nsf/content/index.html
- U.S. Global Research Program: Detailed information on climate change science including links to the U.S. National Assessment of the Potential Consequences of Climate Variability and Change, http://www.usgcrp.gov/
- WRI, Contributions to Global Warming Map: A map and table illustrate historical CO_2 emissions from fossil fuel consumption for countries and regions of the world, http://www.wri.org/climate/contributions_map.html
- WRI, *EarthTrends*, The Environmental Portal: Searchable time series data of CO_2 emissions for countries and regions of the world, maps of per capita emissions, and articles on climate change politics, http://earthtrends.wri.org/
- WRI, SafeClimate: A website that provides clear, simple information about climate change and suggests ways that businesses and individuals can reduce their impact, http://www.safeclimate.net

STEP THREE—Gather Data

- Distance calculator: http://www.indo.com/cgi-bin/dist

STEP SIX—Take Action to Reduce Your CO_2 Emissions

Greening Your Office

- Virtual tour of the Chesapeake Bay Foundation's green building, http://www.cbf.org/merrillcenter/index.htm
- Co-op America: Includes a green office guide and the *Green Pages* with over 10,000 environmentally friendly products and businesses, http://www.coopamerica.org/
- Energy Star: Includes information and links to Energy Star-compliant suppliers, http://www.energystar.gov/products/
- U.S. Green Building Council: A coalition of building-industry leaders working to promote buildings that are environmentally responsible, profitable, and healthy places to live and work, http://www.usgbc.org
- Information about WRI's green office and links to energy-efficient lighting and equipment vendors, http://www.wri.org/office/index.html

Energy

- SafeClimate store: purchase CFLs and find links to climate friendly appliance and office supply vendors, http://www.safeclimate.net/store
- DOE, http://www.eren.doe.gov/erec/factsheets/eelight.html
- EPA's on-line calculator to estimate savings from using power management features on computers, http://yosemite1.epa.gov/estar/consumers.nsf/content/power.htm
- EPA's Energy Star Program, http://www.energystar.gov/

Use Green Energy

- The Green Power Market Development Group: This site includes comprehensive information about green power including wind, solar, landfill gas, and fuel cell sources; green tags, the business case for green power, a guide to buying green power, and links to other resources, http://www.thegreenpowergroup.org
- SafeClimate: Includes information about green power, green tags, green labeling programs, and more, http://www.safeclimate.net/store/greenpower.php

Business Travel

- Kinko's has video conferencing facilities available at many locations in the United States, http://www.kinkos.com
- WebEx provides the technology to hold real-time, internet-based, interactive meetings, http://www.webex.com

Employee Travel

- AT&T's on-line Telework Webguide, http://www.att.com/telework
- Commuter Check works with employers to provide tax-free commuting benefits to employees, http://www.commutercheck.com
- Travel agency that invests in environmental projects and technologies that reduce carbon emissions to offset the impacts of your travel, http://www.betterworldclub.com

For more information on investing in offsets, visit:

- 500PPM, http://www.500ppm.com
- Climate Neutral Network, http://www.climateneutral.com
- Future Forests, http://www.futureforests.com
- Trexler and Associates, http://www.climateservices.com
- Natsource, http://www.natsource.com/

We want to hear from you!

Provide feedback, ask questions, and share experiences:

e-mail: sepinfo@wri.org

APPENDIX IV
ACCOUNTING FOR OTHER GREENHOUSE GAS EMISSIONS

This Guide is focused on developing a CO_2 inventory. But perhaps your office wants to expand its inventory and its efforts to reduce some of the other greenhouse gases that it produces—some of which are more harmful to the climate than CO_2 (though there are less of them in the atmosphere). Examples include:

- CH_4: Methane is approximately 21 times more damaging to the climate than CO_2. One cause of methane emissions is the degradation of organic waste in landfills. Landfills produce 12 percent of the global methane that flows into the atmosphere.[1]
- HFC134a[2]: Air conditioners emit hydrofluorocarbons (HFCs) during servicing and recharging. HFCs are approximately 1,300 times more damaging to the climate than CO_2.
- N_2O: Automobiles that include catalytic control technologies release nitrous oxide (N_2O), in addition to CO_2. Only 5 to 8 percent of the GHG emissions of such vehicles are N_2O, but N_2O emissions are approximately 310 times more damaging to the climate than CO_2. These emissions are not currently included in the GHG Protocol Initiative's mobile combustion tools (first edition), but they will be in a future edition.

One source of greenhouse gas emissions that office-based organizations may want to measure is emissions from the manufacture and disposal of paper. The manufacture and disposal of paper generates both CO_2 and CH_4. WRI includes these emissions in its inventory as Scope 3, indirect emissions. The study of GHG emissions related to paper production and disposal is continually evolving, making it difficult to accurately account for these emissions at present. A general methodology for calculating emissions from paper is included in this appendix. For extensive information on methodologies and emissions factors, refer to Environmental Defense's Paper Task Force.[3]

PRODUCTION AND DISPOSAL OF PURCHASED MATERIALS

Office-based organizations rely on a variety of purchased materials to conduct business. These range from furniture to carpeting and from kitchen supplies to packaging materials. Many of these materials will not necessarily produce emissions when used, but emissions are likely to occur during the production of raw materials and the manufacture and disposal phases. Relevant and comprehensive data for many materials are not yet available and therefore are not included in this Guide. Paper is a common material used by almost all organizations and some data are available. Paper may be a significant source of GHG emissions for your business. For example, WRI publishes hundreds of papers and reports each year. Emissions from the production and disposal of paper constitute approximately 8 percent of the organization's total emissions.

Activity Data

GHG emissions occur as a result of fossil fuel combustion during the harvesting, transportation, and production phases. Emissions also occur during disposal, most notably when paper decomposes in a landfill and produces CH_4 emissions or CO_2 is produced through incineration.

There are two kinds of paper used by most organizations—office paper and publications paper—and you need to collect activity data for both. The activity data for paper is weight in pounds.

Office Paper: Used for internal memos, letters, faxes, photocopies. It is usually purchased by the organization and measured in reams. Your office supplies vendor can tell you how many reams of paper your organization has purchased over a given time period. This information may also be contained on invoices. To convert reams of paper to pounds of paper, calculate:

number of reams
×
average weight of ream in ounces
÷ 16
= weight of paper in pounds

1. *World Energy Assessment*, World Energy Council, www.worldenergy.org/.
2. There are several different refrigerants in the HFC group. HFC134a is used in air conditioning equipment.
3. *Lifecycle Environmental Comparison: Virgin Paper and Recycled Paper-Based Systems,* 1995, Environmental Defense, Paper Task Force, http://www.environmentaldefense.org/documents/1618_WP3.pdf.

Publications Paper: Used primarily for external purposes such as brochures, newsletters, and annual reports. It is often purchased and used by an external printer on behalf of the organization. To determine the amount of paper used by your organization for its publications, contact your printing companies or in-house print shop staff. They will be able to tell you the weight of paper used for each printing job.

Calculating Emissions

For each type of paper (office paper and publications paper), use the following three-part calculation:

[1] weight of paper × emissions factor for manufacture of paper* = CO_2 equivalent** emissions

[2] weight of paper × emissions factor for disposal of paper* = CO_2 equivalent** emissions

[3] total emissions = sum of 1 & 2

Paper Reduction Opportunities

Reduce

- Consider purchasing duplex printers for the office. Duplex printers enable you to automatically print on both sides of a sheet of paper.
- Be creative: Encourage office competitions to find the best ways to reduce paper use. Maximize use of e-mail for memos and shared documents. Consider what other office administrative tasks could "go paperless." For example, WRI recently began using an electronic time sheet system, saving us paper and making our accounting department's life easier.

Reuse

- Save envelopes from incoming mail that are still presentable and use them again for outgoing mail. You might even want to add a sticker to the envelope letting the next recipient know that the envelope is being reused.
- Use paper twice before recycling. If you do not have duplex printers, set up boxes by each printer and fax machine for paper that is used on only one side. Print on the blank side before sending it to the recycling bin.

Recycle

- Implement a paper recycling program.
- Increase the recycled content of your office paper. Specify recycled content paper for your outsourced printing jobs.

TIP! Request that your printer or in-house print shop staff include quantity of paper used for each job on their invoices, saving them the work of revisiting their records.

* The emissions factor you use depends on the content of the paper—virgin or recycled. If the paper has mixed content, you will need to adjust your calculation accordingly. The emissions factor also varies depending on the waste disposal method used (recycling, incineration, or landfilling).

** CO_2 equivalent is the standard unit for comparing the degree of harm which can be caused by emissions of different GHGs.

World Resources Institute

The World Resources Institute is an environmental think tank that goes beyond research to create practical ways to protect the planet and improve people's lives. Our mission is to move human society to live in ways that protect Earth's environment for current and future generations.

Our program meets global challenges by using knowledge to catalyze public and private action:

- *To reverse damage to ecosystems.* We protect the capacity of ecosystems to sustain life and prosperity.
- *To expand participation in environmental decisions.* We collaborate with partners worldwide to increase people's access to information and influence over decisions about natural resources.
- *To avert dangerous climate change.* We promote public and private action to ensure a safe climate and sound world economy.
- *To increase prosperity while improving the environment.* We challenge the private sector to grow by improving environmental and community well-being.

In all of our policy research and institutions, WRI builds bridges between ideas and action, meshing the insights of scientific research, economic analysis, and practical experience with the need for open and participatory decision making.

Sustainable Enterprise Program

For more than a decade, WRI's Sustainable Enterprise Program has harnessed the power of business to create profitable solutions to environment and development challenges. WRI is the only organization that brings together corporations, entrepreneurs, investors, and business schools to accelerate change in business practice. The program improves people's lives and the environment by helping business leaders and new markets thrive.
http://www.wri.org/sep

[SafeClimate]

World Resources Institute

Business and climate initiatives at WRI include:

GHG Protocol Initiative—The Greenhouse Gas Protocol Initiative develops and promotes internationally accepted greenhouse gas (GHG) accounting and reporting standards through an open and inclusive process. In partnership with the World Business Council for Sustainable Development (WBCSD), WRI brings together representatives from business, government and nongovernmental organizations (NGOs).
http://www.ghgprotocol.org/

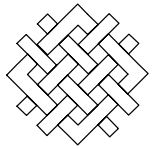
SafeClimate.net—This website provides practical, simple guidance for businesses and individuals who want to understand and reduce their impact on the world's climate. SafeClimate resources can be customized for corporate and nonprofit employee education programs.
http://www.safeclimate.net/

Green Power Market Development Group—Convened by WRI and Business for Social Responsibility, the Group is working to transform energy markets to enable corporate buyers to diversify their energy portfolios with green power and to reduce their impact on climate change.
http://www.thegreenpowergroup.org

CO_2 Reduction Commitment—Through its institutional commitment to reduce carbon dioxide emissions, WRI learns first-hand about the challenges and opportunities faced by businesses that wish to reduce their impact on the climate, and shares what it learns with others.
http://www.wri.org/office/co2comm.html

Notes

Notes



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For more information, visit
www.safeclimate.net

ISBN 1-56973-530-1