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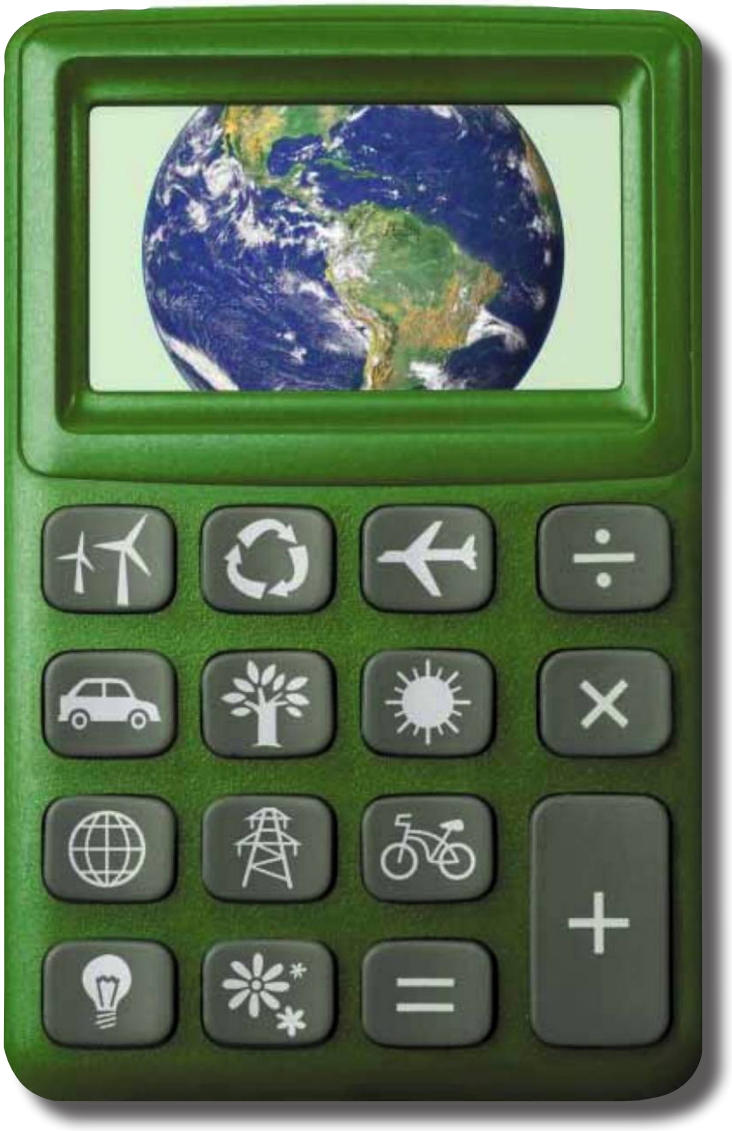

Carbon Footprint

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—Sharon Jaye, D.Ed., CAPM, SFP

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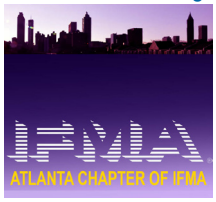

FOREWORD

Buildings currently account for close to 40 percent of energy use in most countries, putting them among the largest end-use sectors globally (2010 Buildings Energy Data Book). It also has been widely reported that about 40 percent of U.S. carbon dioxide emissions are from facilities. Who more than the facility management professional is responsible for a building's carbon footprint and must lead the way toward sustainable practices that lead to lower emissions?

One of the keys to reducing carbon emissions is having the knowledge to do so. Creating a sustainability strategy that positively impacts a facility's carbon footprint is challenging but can be done with the right tools. To assist the worldwide facility management community, the International Facility Management Association and the IFMA Foundation have partnered to create this Sustainability How-to Guide on "Carbon Footprint." This guide is a useful tool for facility managers to increase their knowledge of a carbon footprint, processes that can positively impact a facility's emissions, climate action planning, making the business case to the C-suite and case studies that show FM teams making changes in their facilities carbon emissions.

It's no secret that going green certainly isn't a fad but a course of action for individuals and businesses alike – benefiting the triple bottom line of people, planet and profit. Well-defined sustainability strategy is beneficial to an organization, whether it is a federal, private-sector, military or nonprofit entity. Sustainable practices are not only the right thing to do for the environment, they also benefit the communities in which they are implemented. Sustainability is the business implementation of environmental responsibility.

Every facility professional has the opportunity to truly further sustainable building practices. If you're ready, this how-to guide on "Carbon Footprint" is a good place for you to start.

Tony Keane, CAE
President and CEO
International Facility Management Association

FOREWORD

IFMA Sustainability Committee (ISC)

The IFMA Sustainability Committee (ISC) is charged with developing and implementing strategic and tactical sustainability initiatives. A current initiative involves working with the IFMA Foundation on the development of a series of "How-to Guides" that will help educate facility management professionals and others with similar interests in a wide variety of topics associated with sustainability and the built environment.

The general objectives of these "How-to Guides" are as follows:

1. To provide data associated with a wide range of subjects related to sustainability, energy savings and the built environment

2. To provide practical information associated with how to implement the steps being recommended

3. To present a business case and return-on-investment (ROI) analysis, wherever possible, justifying each green initiative being discussed

4. To provide information on how to sell management on the implementation of the sustainability technology under discussion

5. To provide case studies of successful examples of implementing each green initiative

6. To provide references and additional resources (e.g., websites, articles, glossary) where readers can go for additional information

7. To work with other associations for the purpose of sharing and promoting sustainability content

The guides are reviewed by an editorial board, an advisory board and, in most cases, by invited external reviewers. Once the guides are completed, they are distributed via the IFMA Foundation's website (www.ifmafoundation.org) free of charge.

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The mission of the IFMA Foundation is to promote and support scholarships, educational and research opportunities for the advancement of facility management worldwide.

Established in 1990 as a nonprofit, 501(c)(3) corporation, the IFMA Foundation is supported by the generosity of a community of individuals – IFMA members, chapters, councils, corporate sponsors and private contributors – and is proud to be an instrument of information and opportunities for the profession and its representatives.

A separate entity from IFMA, the IFMA Foundation receives no funding from annual membership dues to carry out its mission. Supported by the generosity of the FM community, the IFMA Foundation provides education, research and scholarships for the benefit of FM professionals and students. Foundation contributors share the belief that education and research improve the FM profession.

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1 EXECUTIVE SUMMARY

'Expand knowledge of the built environment, in a changing world, through scholarships, education and research'

The Vision Statement of the IFMA Foundation

Carbon has become the currency of the sustainability movement. Whether considering energy management, waste handling, environmental impact, purchasing, air quality or a host of other sustainability issues, carbon footprint is the standard measurement of the production of greenhouse gases. In the U.S., about 40 percent of carbon emissions can be attributed to the construction, operation and maintenance of buildings.

This places much of the attention for carbon footprint squarely on the facility manager. Energy consumption alone accounts for a large portion of the facility footprint. Since energy is usually the largest portion of operational cost, the drive to make buildings more energy efficient coincides directly with the intent to reduce the carbon footprint. The facility manager is in a unique position as the steward of the built environment to measure and monitor both building- and workplace-related carbon emissions.

The goal of this guide is to define a carbon footprint and provide facility managers with the tools needed to understand the process, analyze the results and plan for the future. Part 2 of this guide introduces carbon footprinting and why facility managers need to understand the process. Detailed findings, found in Part 3, define the carbon footprint, the role of the facility manager and current industry standards. It also presents the greenhouse gas (GHG) emission inventory process, including basic principles, boundary determination, collecting data and choosing a calculator. Part 3 finishes with a discussion on best practices, benchmarking, and climate action planning and reporting.

Part 4 Making the Business Case presents primary drivers, tangible and intangible benefits, and resources for the creation of a business case. Part 5 presents two real-world applications of greenhouse gas emission inventories and how the organizations individualized the general process. The first case study of Agnes Scott College details the inventory process, choosing boundaries and how to collect the data. The second case study of Wesley College highlights the relationship between the college and ARAMARK for the inventory process and climate action planning.

As the issue of greenhouse gas emission accounting is continuously evolving and can vary broadly by country or climate, this guide is not intended to be an all-inclusive resource. Readers are encouraged to consult the additional resources provided in the appendices.

2 INTRODUCTION

Successful facility management professionals pride themselves on their ability to stay ahead of the curve, to provide the best services and options to their companies and to proactively look ahead at developments and trends that will affect the built environment. Greenhouse gas emission accounting, otherwise known as carbon footprinting, and the reporting and minimizing of these gases is a trend to which attention must be paid. The carbon footprint of an organization or a facility promises to be a major focal point in the near future dictated by common sense, cost savings and legislation. Direct and indirect GHG emissions generated by an organization can be linked to energy consumption and energy costs. Understanding an organization's carbon footprint will lead to developing the ways and means to cut usage and resultant expenses.

2.1 Carbon Footprint Accounting

Accounting leads to improved sustainable development outcomes, as it allows organizations or facilities to measure, track and improve their performance on specific issues. Facility managers are much more likely to effectively manage an issue they can measure. Carbon reporting also promotes transparency and accountability. Performance can be monitored periodically and annually and can be compared to other similar organizations.

In any facility plan, measurement, verification and documentation should be an ongoing practice in operations; a carbon footprint should be part of any reporting protocol. It will show value in facility efforts while helping to identify opportunities for energy and water efficiency. It will also guide in identifying risks while offering the potential to lower facility costs and provide standards for material purchasing, waste minimization and reuse.

Carbon footprint reporting adds rigor to internal data gathering and information systems by ensuring facilities have the baseline information necessary to measure and drive continuous improvement in their operations. It also will facilitate opportunities to benchmark environmental and societal performance against other entities. It leads to improved sustainable development outcomes because it allows organizations to measure, track and improve their performance on specific issues. By taking a proactive role to collect, analyze and report those steps taken by the organization to reduce potential business risk, companies can remain in control of the message they want delivered to shareholders. Public pressure has proven to be a successful method for promoting behavior and disclosure of GHG emissions, as well as for promoting social responsibility.

As well as helping organizations manage their impacts, sustainability reporting promotes transparency and accountability. This is due to organizations disclosing information in the public domain. In doing so, stakeholders (people affected by, or interested in, an organization's operation) may track an organization's performance on broad themes, such as environmental performance, or a particular issue, such as greenhouse gas emissions. It promotes organizational learning by making linkages across typically independent functions within a facility more apparent, such as finance, quality control, procurement, facilities, human resources, environmental health and safety, and senior management.

It also opens value-generating internal conversations that otherwise would not occur while increasing employee awareness of sustainability issues. This has the potential to enhance employee morale and attract new staff. Finally, as the program develops, the tracking efforts and the preparation of reports will lead to a better awareness of the state of the facility. It will provide the ability to enhance operations and afford sharing of this information internally, within the profession, and/or globally.

Sustainability is no longer just a values-based question. It is a core strategic imperative for any company that intends to thrive and grow in the years ahead. Reporting on a carbon footprint performance is one important way for organizations to manage their impact on sustainable development. The challenges of sustainable development are many and it is widely accepted that organizations have not only a responsibility but also a great ability to exert positive change on the state of the world's economy, the environment and social conditions.

2.2 Why Develop a Carbon Footprint?

Increasingly frequent extreme weather events, record annual global average temperatures and disruptive seasonal changes in vulnerable countries point to increasing evidence of anthropogenic climate change. Continued reliance on outdated energy sources, coupled with a growing population and the emergence of a global middle class, is no longer sustainable or economically viable. To achieve economic and development aspirations while also responding to climate change, nations, businesses and citizens need to rethink current energy policies, practices and actions (World Resources Institute 2011).

Organizational GHG inventories quantify the amount of greenhouse gases emitted into the atmosphere and are critical management tools for organizations of all sizes and sectors. These inventories enable companies to identify their emission sources and track changes over time. Information presented in an inventory can help inform corporate strategies and prioritize actions to reduce emissions, as well as provide benchmarks against which the success of these activities can be measured (World Resources Institute 2011). A report from Groom Energy Solutions and Pure Strategies highlights the top five drivers that motivate a business to track and report carbon: improved company/brand image, requests from top customers, investor pressure, GHG regulation and cost savings (Groom Energy Solutions 2010).

3 DETAILED FINDINGS

3.1 What Is a Carbon Footprint?

The term "carbon footprint" is slang for a greenhouse gas emission inventory. According to the U.S. Environmental Protection Agency (EPA), a greenhouse gas inventory is an "accounting of greenhouse gases emitted to or removed from the atmosphere over a period of time" (Environmental Protection Agency 2011). A greenhouse gas is the type of gas that traps heat in the atmosphere. Most inventories account for six types of greenhouse gases that are created through human activity: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) and fluorinated gases (hydrofluorocarbons, perfluorocarbons and sulfur hexafluoride). Because each greenhouse gas has different physical properties, their emissions are converted into an equivalent measurement to make accounting simpler (MacKay 2011). This measurement is called a "carbon dioxide equivalent" (CO2e). Most carbon footprint calculators measure emissions in metric tonnage of CO2e or MTCO2e.

An inventory of emissions also can provide information on activities that cause the emissions and removals. GHG emission inventories can be used in many different ways. Facility managers use them to establish baselines for tracking emission trends, developing mitigation strategies and assessing progress. Policy makers also use them for tracking trends in emissions and creating policies. Scientists use them for creating atmospheric and economic models (Environmental Protection Agency 2011).

3.1.1 The Role of the Facility Manager

The role and prominence of the facility manager in the determination of an organization's carbon footprint will depend on the internal organizational drivers for measurement and reporting. If the organization's primary contributor to carbon footprint is the facility itself, it is likely the FM will be the primary driver of sustainability, carbon measurement and reduction initiatives. If the organization's primary contributor to carbon footprint is its transportation activities, the facility manager may not be the primary driver for measurement and reduction.

Regardless of the FM's position in the organization's hierarchy of drivers, familiarity with measurement, monitoring and reduction can be invaluable. The FM is usually the most familiar with the data collection, communication and reporting of important attributes, such as energy consumption. The facility manager is also usually closest to regulatory requirements, mandatory reporting standards and pending movements toward such disclosures.

Throughout this process, the facility manager could be responsible for or be involved in numerous areas, including:

- Developing data collection and reporting processes and standards
- Reporting and communication
- Climate action plan development
- Checking regulations applicable to the company in regards to GHG emissions
- Managing facility department efforts

3.1.2 Industry Standards

Several organizations provide guidance on current industry standards, including:

- World Resources Institute
- World Business Council for Sustainable Development (WBCSD)
- Greenhouse Gas Protocol Initiative
- International Standards Organization

The World Resources Institute is a Washington, D.C.-based environmental think tank founded in 1982. It is an independent, nonpartisan and nonprofit organization with a staff of scientists, economists, policy experts, business analysts, statistical analysts, mapmakers and communicators developing and promoting policies with the intention of protecting the environment and improving quality of life. WRI's mission is to motivate human society to live in ways that protect Earth's environment and its capacity to provide for the needs and aspirations of current and future generations (World Resources Institute 2010). One of the WRI's key goals is climate protection to 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.

The World Business Council for Sustainable Development is an association of more than 200 companies concerned with business and sustainable development. The council aims to be a leading advocate on sustainable development, participate in policy development, and develop and promote the business case for sustainable development (WBCSD 2011). One of its main areas of focus is energy and climate.

The Greenhouse Gas Protocol Initiative is a partnership between the WRI and the WBCSD. It created the most widely used industry standard for greenhouse gas emission accounting. This group is working with countries and businesses around the world to build credible and effective programs for emissions accounting and management. The protocol is used in almost every GHG standard in the world, from the International Standards Organization to The Climate Registry. It also provides developing countries with a management tool to help their businesses compete in global markets and their governments to make informed decisions about emissions (Greenhouse Gas Protocol 2011). The protocol includes all six greenhouse gases as specified under the Kyoto Protocol: carbon dioxide, methane, nitrous oxide, hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulfur hexafluoride (SF_6).

The GHG Protocol Corporate Standard provides standards and guidance for companies and other organizations preparing a GHG emissions inventory. It was designed to:

- Help companies prepare a GHG inventory that represents a true and fair account of their emissions through the use of standardized approaches and principles
- Simplify and reduce the costs of compiling a GHG inventory
- Provide business with information that can be used to build an effective strategy to manage and reduce GHG emissions
- Increase consistency and transparency in GHG accounting and reporting among various companies and GHG programs (Greenhouse Gas Protocol Initiative 2004)

The International Standards Organization (ISO) created an international standard for GHG accounting and reporting. ISO 14064 (2006) specifies principles and requirements at the organizational level for quantification and reporting of GHG emissions and removals. It includes requirements for the design, development, management, reporting and verification of an organization's GHG inventory (International Standards Organization 2011).

ISO 14064 is comprised of three standards. It includes specifications with guidance for use at the organizational level and the project level, as well as the validation and verification of greenhouse gas assertions. They can be used independently, or as an integrated set of tools to meet the varied needs of GHG accounting and verification. Implementing this standard promotes consistency, transparency and credibility in GHG quantification, monitoring, reporting and verification; enables organizations to identify and manage GHG-related liabilities, assets and risks; facilitates the trade of GHG allowances or credits; and supports the design, development and implementation of comparable and consistent GHG schemes or programs (International Standards Organization 2011). The three parts of standard 14064 are:

- 14064-1:2006, Part 1: Provides specification with guidance at the organizational level for the quantification and reporting of greenhouse gas emissions and removals. It details principles and requirements for designing, developing, managing and reporting organizational or company-level GHG inventories. It includes requirements for determining organizational boundaries, GHG emission boundaries, quantifying an organization's GHG emissions and removals, and identifying specific company actions or activities aimed at improving GHG management.
- 14064-2:2006, Part 2: Provides specification with guidance at the project level for the quantification, monitoring and reporting of greenhouse gas emission reductions and removal enhancements. It focuses on GHG projects or project-based activities specifically designed to reduce GHG emissions or increase GHG removals. It includes principles and requirements for determining project baseline scenarios and for monitoring, quantifying and reporting project performance relative to the baseline scenario, and provides the basis for GHG projects to be validated and verified.
- 14064-3:2006, Part 3: Provides specification with guidance for the validation and verification of greenhouse gas assertions. It details principles and requirements for verifying GHG inventories and validating or verifying GHG projects. It describes the process for GHG-related validation or verification and specifies components, such as validation or verification planning, assessment procedures and the evaluation of organization or project GHG assertions (International Standards Organization 2011).

ISO 14064 was designed to work in conjunction with two other standards, ISO 14065:2007 and ISO 14066:2011. ISO 14065 provides requirements for greenhouse gas validation and verification bodies for use in accreditation or other forms of recognition, and ISO 14066 provides competence requirements for greenhouse gas validation teams and verification teams. Figure 1 shows the relationship between the ISO 14064 and ISO 14065.

3.2 Calculating GHG Inventory

3.2.1 Basic Principles and Process

No matter what calculator or tool is chosen, basic principles of GHG accounting should be followed:

- Relevance: The inventory should reflect the emissions of the company and serve the decision-making needs of external and internal users.
- Completeness: Within the chosen boundaries, account for and report on all emission sources and activities. Disclose specific exclusions.
- Consistency: Use consistent methodologies over time. Document changes to data, inventory boundaries or methods.
- Transparency: Address all issues in a coherent manner with a clear audit trail. Disclose assumptions, accounting and calculation methodologies and data sources used.
- Accuracy: Achieve satisfactory accuracy to enable users to make decisions with reasonable assurance as to the integrity of the reported information and minimize uncertainties as much as feasibly possible (Environmental Protection Agency 2011).

There are several components to the greenhouse gas emission inventory process:

- Understanding the aspects of the inventory
- Determining boundaries (organizational, operational and temporal)
- Understanding the metrics
- Collecting the data
- Calculating emission
- Analyzing the results

3.2.2 Understanding the Aspects of the Inventory

The concept of scope is very important to the field of greenhouse gas emission accounting. By delineating direct and indirect sources of emissions, the protocol improves transparency and provides utility for different types of organization poli-

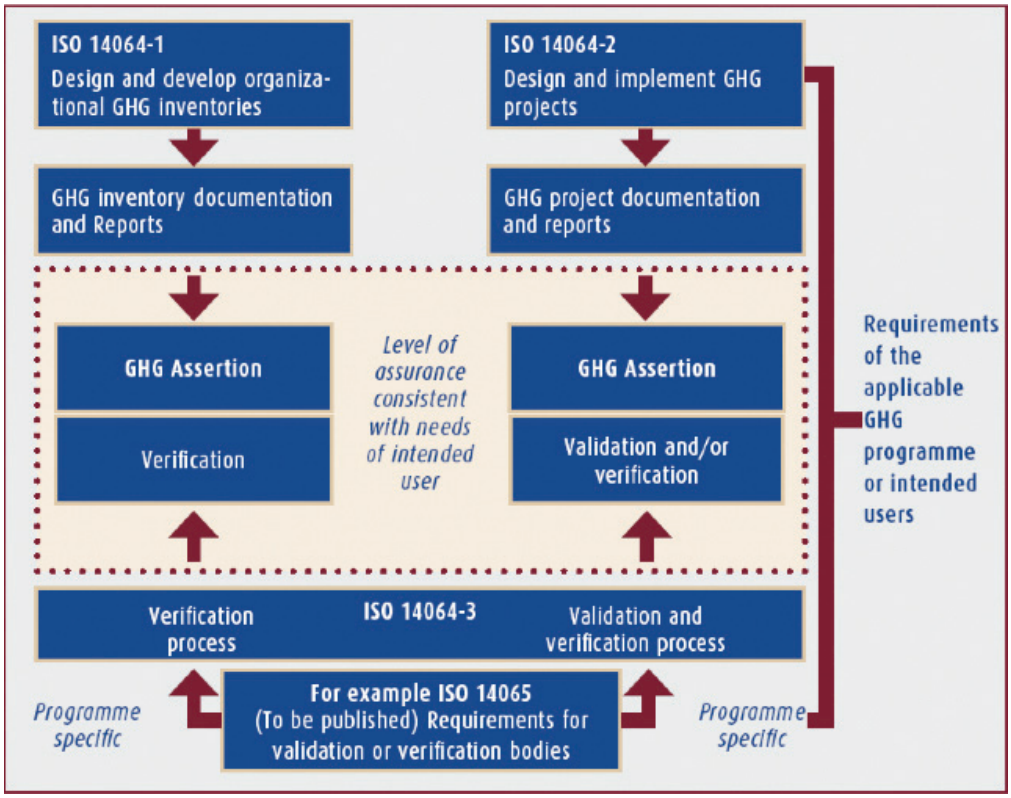

Figure 1: The relationship between the three parts of ISO 14064 and ISO 14065 (Weng and Boehmer 2006)

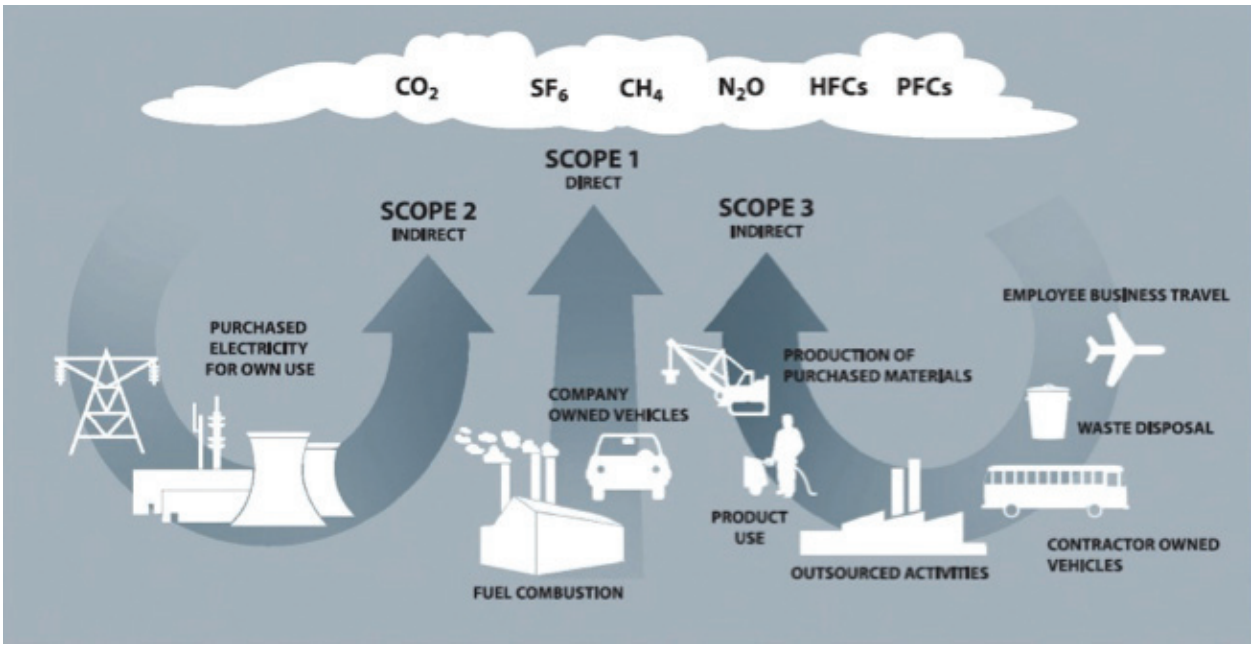

Figure 2: The three scopes of emissions (Greenhouse Gas Protocol Initiative 2004)

cies and goals. Emissions are divided into three scopes, where Scopes 1 and 2 are defined carefully so companies do not account for emissions in multiple places in the inventory (Greenhouse Gas Protocol Initiative 2004). GHG emissions not covered by the Kyoto Protocol are not accounted for in the three scopes, but may be reported separately. Figure 2 represents the three scopes of emissions.

- Scope 1: Direct GHG emissions: Direct GHG emissions occur from sources that are owned or controlled by the company. For example, Scope 1 includes emissions from combustion from boilers, furnaces or vehicles, and emissions from chemical production in process equipment. The GHG Protocol defines Scope 1 as emissions from:
  - Generation of electricity, heat or steam (combustion of fuels in stationary sources, such as boilers, furnaces and turbines)
  - Physical or chemical processing (manufacture or processing of chemicals and materials, such as cement, aluminum, ammonia manufacture and waste processing)
  - Transportation of materials, products, waste and employees (combustion of fuels in company-owned/controlled mobile combustion sources, such as trucks, trains, ships, airplanes, buses and cars)
  - Fugitive emissions (intentional or unintentional releases, such as equipment leaks from joints, seals, packing and gaskets; hydrofluorocarbon emissions during the use of refrigeration and air conditioning equipment) (Greenhouse Gas Protocol Initiative 2004)
- Scope 2: Indirect GHG emissions: Scope 2 accounts for GHG emissions from the generation of purchased electricity consumed by the company. They are emissions that are a consequence of the operations of the company, but occur at sources owned or controlled by another company, most typically electricity, heat or steam. Purchased electricity is defined as electricity that is purchased or otherwise brought into the organizational boundary of the company. Scope 2 emissions physically occur at the facility where electricity is generated but companies must report the emissions from the generation of purchased electricity that is consumed in its owned or controlled equipment (Greenhouse Gas Protocol Initiative 2004). Most emission calculators account for the U.S. region or source of electricity in their calculations in adjusting for how the electricity is produced.
- Scope 3: Other indirect GHG emissions: Scope 3 is an optional reporting category that allows for the treatment of all other indirect emissions. Scope 3 accounts for emissions that are a consequence of the activities of the company, but occur from sources not owned

or controlled by the company. Scope 3 provides an opportunity for a company to be innovative in GHG management. Companies with reliable information may focus on accounting for activities relevant to their business and goals (Greenhouse Gas Protocol Initiative 2004). Examples of Scope 3 activities are:

- Extraction and production of purchased materials and fuels
- Transport-related activities
- Transportation of purchased materials or goods
  - Transportation of purchased fuels
  - Employee business travel
  - Employees commuting to and from work
  - Transportation of sold products
  - Transportation of waste
- Use of sold products and services
- Waste disposal generated in operations or in the production of purchased materials and fuels
- Disposal of sold products at the end of their life

Because Scope 3 emissions are optional, the company must determine which are relevant and should be included in the inventory. Relevancy could be determined for several reasons:

- They are large (or believed to be large) relative to the company's Scope 1 and Scope 2 emissions.
- They contribute to the company's GHG risk exposure.
- They are deemed critical by key stakeholders.
- There are potential emissions reductions that could be undertaken or influenced by the company (Greenhouse Gas Protocol Initiative 2004).

3.2.3 Determining Boundaries

Setting boundaries for the inventory process is an important first step, since nearly every action of the company can be associated with some type of emission. Setting the boundaries for the inventory determines the "where," "which" and "when" of the emissions to be counted. Organizational boundaries are the "where," operational boundaries are the "which" and temporal boundaries are the "when."

- Organizational boundary: An organizational boundary is used to decide which facilities or operations will be included in the GHG emissions inventory. There are three methodologies for determining which greenhouse gases to account for from operations or facilities in which an institution has a partial ownership share or working interest, holds an operating license, leases or otherwise represents joint ventures or partnerships of some kind:
  - Equity share approach: The company would account for emissions from each operation according to its share of economic interest in the operation.
  - Operational control approach: The company would account for emissions from operations under its operational control (the authority to introduce and implement operating policies).
  - Financial control approach: The company would account for emissions from operations under its financial control (the ability to direct the financial and operating policies of an operation with an interest in gaining economic benefits from its activities) (Greenhouse Gas Protocol Initiative 2004).
- Operational boundary: Operational boundaries define which emissions will be accounted for in the inventory. This is where the scopes from the GHG Protocol come into play. Selecting the operational boundaries is a key aspect of carbon management because it dictates how ambitious, and how comprehensive, carbon management efforts will be. At a minimum, Scope 1 and 2 emissions should be included. Scope 3 emissions are optional and are sometimes dictated by whether or not the data can be collected. Figure 3 and Figure 4 below show two types of boundary assignment.
- Temporal boundary: The temporal boundary of the inventory is concerned with the "when." If the data is available, should the company go back in time? If the company implemented energy efficiency or emission reducing projects over several years, the company may choose to calculate previous year's emissions to account for those reductions. Another question to ask is if the inventory time period should be set with the calendar year or the fiscal year. Aligning the inventory with management reporting cycles makes the reporting process simpler.

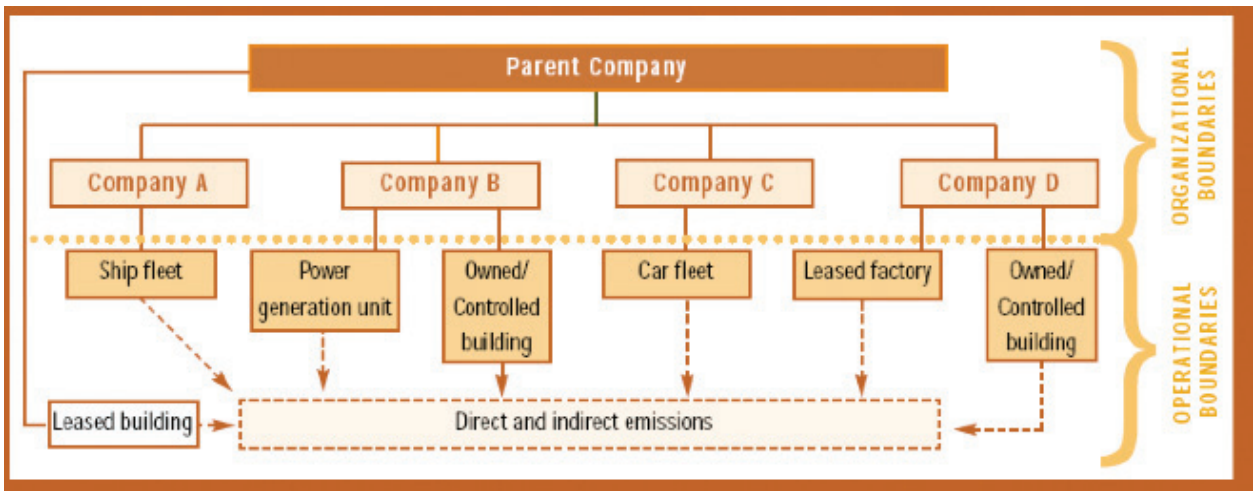

Figure 3: Organizational and operational boundaries of a company. (Greenhouse Gas Protocol Initiative 2004)

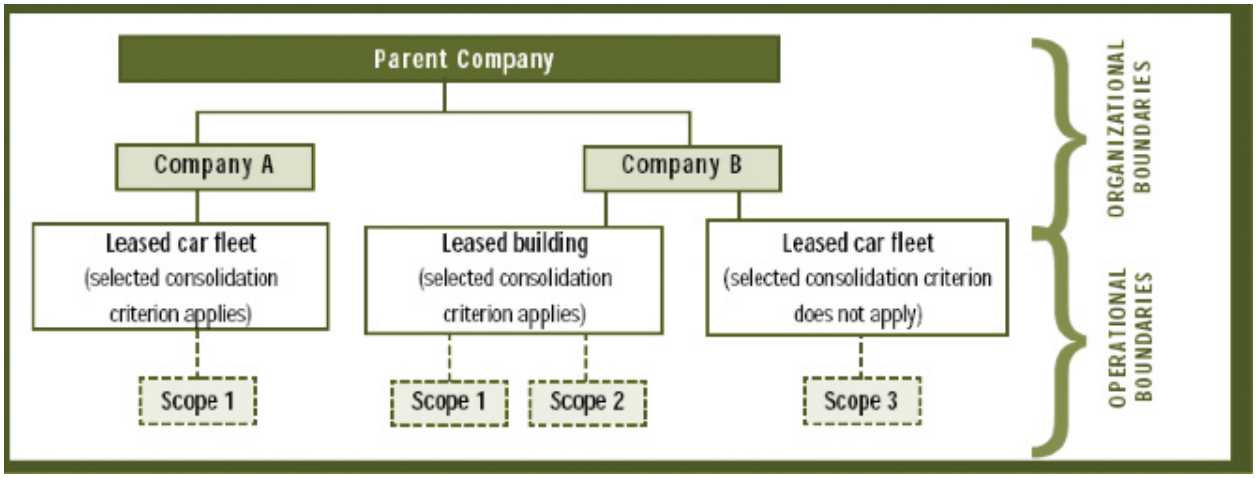

Figure 4: Accounting of emissions from leased assets (Greenhouse Gas Protocol Initiative 2004)

3.2.4 Understanding the Metrics

Understanding the unit of input is important to producing a reliable inventory. The data collected must be input into the calculator in the unit of measure the calculator uses. For example, if the calculator uses MMBtu to account for natural gas use, and the company collected the data in therms, the data must be converted into MMBtu before entering it into the calculator. Making sure the data entered into the calculator is in the correct metric is a very important step. Otherwise, the results of the inventory will be inaccurate. Below is a list of typical metrics used in greenhouse gas emission calculators:

- Gallons, short tons, MMBtu, kWh or percentage generation efficiency
- Pounds, percent nitrogen, MT eCO2
- Percentage generation fuel use and percentage transportation loss
- Percentage commuting, trips per day, days commuting per year, miles per trip

3.2.5 Collecting the Data

The data needed for the inventory is not going to be in one place, easily accessed at the click of a mouse. It will involve employees from all over the company. Bringing key people together to form an inventory project team makes the data collection process easier. Once the group has determined the boundaries, they must determine where to get the needed information for each scope or activity. For example, the list below identifies desirable data and its most likely source within a higher education institution:

- Budget: Controller's office
- Population and physical size: Institutional research/registrar/human resources/director of facilities

- On-campus stationary sources and purchased electricity: Energy manager/director of facilities/fuels purchaser
- Direct transportation sources: Director of transportation/director of facilities
- Refrigerants and other chemicals: Director of facilities/HVAC managers
- Student/faculty/staff commuting: Director of transportation/human resources/registrar
- Directly financed outsourced travel: Director of transportation/university travel office/travel agent
- Study abroad air travel: Study abroad office/international education office
- Solid waste: Waste management supervisor/grounds department/director of facilities

An important part of the data collection process is keeping a detailed journal of every telephone call, inquiry and successful information acquisition throughout the process. Continuity from year to year is important, especially when the people involved in the process may not be the same each time. It also helps when questions arise about emissions and data down the road (Clean Air-Cool Planet 2008).

3.2.6 Choosing a Calculator

There has been a significant shift in both customers and suppliers of carbon software over the last few years. On the customer side, there has been an evolution of buyers of such software going from an environmental health and safety (EH&S) officer, an energy director or a VP of sustainability right up to the C-suite (chief sustainability officer or chief financial officer). This evolution has resulted in a corresponding change in the scope of carbon software functionality from dealing with carbon/energy benchmarks and applications to comprehensive integrated sustainability software systems. In general, management is looking for functionality that not only includes emission monitoring but also the calculation of cost savings, energy bill and rebate validation, risk analysis and financial billing.

Today's integrated sustainability software platforms vary in functionality but tend to calculate more than simple carbon data collection and reporting. Some contain tools for strategic decision-making; others have dashboards for establishing targets for carbon and monitoring progress. Other functionality might include tracking an organization's compliance related to carbon emissions while others model emission data for forecasting purposes. Finally, there are software products with project management and financial functionality related to budgeting.

Each year, additional functionality is added and carbon tracking becomes integrated with more software systems. As the next generation of energy parametric modeling software is designed, retrofit recommendations are generated, and integrated carbon software should become available. Likewise, as more guidelines and local and federal mandates appear related to GHGs, more complex systems with increasing functionality will be developed. New functionality to look for includes more sophisticated compliance tracking and modeling, feedback related to best practices, energy modeling of all building systems to reduce carbon emissions, cap and trade/carbon trading analysis, and system upgrade and fuel switching modeling.

Since this functionality will require increasing amounts of data collection and maintenance, we can likewise expect increased automatic capture of energy meter data using building automation systems and various types of sensor and radio frequency identification (RFID) inputs to these sustainability business software platforms – at least for Scope 1 and 2 data capture and, eventually, Scope 3 data. At this point in time, there has not been a demonstrated demand for the collection of supply chain carbon/energy data because of its complexity and cost.

Verdantix, a sustainability software consulting group based in London, England, has identified six distinct usage scenarios related to carbon calculators (Table 1) along with their associated functionality (Verdantix 2011).

Table 1: Carbon calculator usage scenarios (Verdantix 2011)

Scenario	Functionality required
Data collection, reporting and compliance	Meter integration, compliance workflow, reporting
Strategy and scenario planning	Scenario planning, carbon forecasting and price modeling, regulatory business rules, target setting
Enterprise energy and carbon analytics	Intraday energy data capture, enterprise data aggregation, automated emissions calculation, statistical analysis of data, marginal abatement cost (MAC) calculations
Energy efficiency/cost reduction	Data aggregation to site, business unit or national level, carbon monitoring and targeting, efficiency benchmarking, financial and rebate validation
Energy and carbon program Implementation	Project/portfolio management, constraint-based process optimization, workflow
Carbon trading and allowance management	Risk/allowance management, trade execution, exposure analysis, credit analysis

A 2009 study by Groom Energy Research estimated that more than 60 companies offer GHG accounting software and more than 200 GHG calculators are available (Groom Energy Solutions 2010). More than US$46 million was invested in GHG accounting software startups in 2009 (Fargo 2010). Pike Research completed a study in 2010 showing that the global market for GHG accounting software and support services grew nearly 84 percent from 2008 to 2009, representing a total market of US$384 million. Pike predicts that market will achieve 40 percent compounded annual growth through 2017 (Fargo 2010). Because there are so many calculator and software choices, many of them specific to certain industries, this section explores the types of calculators available and how to choose the right calculator for a business type.

GHG accounting tools range from those that focus solely on emission measurement, to ones that allow project planning for future emission reductions, to those that enable companies to trade carbon credits. Before choosing a tool, it is important to understand the options and select a tool that best meets the objectives (Fargo 2010). GHG tools can be categorized in six ways (Fargo 2010):

1. Historical analysis: These tools are usually very easy to use and good for companies that do not actively manage business risks associated with climate change and energy consumption. They are usually used for participating in GHG reporting initiatives. Examples of this type are the calculators available on the Greenhouse Gas Protocol website at www.ghgprotocol.org.
2. Historical analysis plus forward projections: Many tools are not only a historical tool, but also have a module for projecting future emissions based on different scenarios. Projections can include business-as-usual emissions trajectories or project-specific emissions forecasts.
3. Life-cycle analysis-based: Some tools are focused on analyzing a products footprint through life-cycle analysis (LCA). This is a way of estimating GHG emissions based on assumptions about process emissions. A listing of LCA-based resources can be found at www.life-cycle.org.
4. Supply chain-based: A number of tools focus on gathering data from a company's supply chain partners. If a company decides this approach to GHG calculation is important, they should prioritize key suppliers, such as major manufacturers or transportation providers.
5. Operational integration: This newest category of tools integrates GHG accounting into existing corporate operating systems (such as financial accounting systems), enabling reporting on environmental and operational performance.
6. Ecosystem-based: Some software providers are looking at the need for tools that go beyond GHG emissions to include other environmental issues, such as water and waste. These tools look at emissions as one element in a company's impact.

Choosing the right tool is not about benchmarking or marketing. It is about realizing what works for an organization. Each tool has benefits and limitations. There is no "one-size-fits-all" solution. Calculators should be chosen based on the level of detail needed, the expected level of scrutiny, community or stakeholder interest, and the resources available in terms of labor and funding. The following outlines the process for determining selection criteria (Fargo 2010):

1. Clarify the primary objective: Establish clear objectives for GHG accounting activities and look at the category of tools that best meets those needs (for example, performance management, risk mitigation, emissions reduction planning or public reporting).
2. Determine functionality (needs versus wants): Functionality is most important when choosing the right tool. Depending on the company's requirements, functionality decisions should be based on the following areas:
    a. User interface: Spreadsheets, software or Web-based platforms? Is there a need for multiple people in different locations to access the data?
    b. Data demands: Be realistic about the data available in the company and the time required to enter data.
    c. Use of standards: The tool should be based on a recognized global standard for GHG accounting, such as the GHG Protocol and ISO 14064 series.
    d. Output: The quality and quantity of canned reports from the software should align with the company's primary purpose and key objectives.
    e. Timeliness: The tool should allow data input on a regular, sustainable schedule that enables at least quarterly review, comparison between reporting periods and external reporting.

   f. Verifiability: The ability to document and trace data sources within the tool is an important feature for companies that perform external reporting.
3. Assess flexibility and ease of integration: The tool should be easy to integrate into the day-to-day business of the company. The flexibility of the tool should allow the company to expand and integrate it into existing, core business processes.
4. Match cost to expected benefits: Tools vary in cost depending on the vendor, company size and the emissions intensity of the industry. Prices can range from free to upward of US$200,000 per site (Fargo 2010).

Following are examples of calculators:

- Campus Carbon Calculator by Clean Air-Cool Planet: Higher education is at the forefront of climate change activity and greenhouse gas emission inventory calculation. Clean Air-Cool Planet developed a Campus Carbon Calculator specifically for college and university campuses. It is used at more than 1,200 campuses across the United States, and for the signatories to the American College & University Presidents Climate Commitment (ACUPCC), it is the calculator of choice (Clean Air-Cool Planet 2008). In addition to providing a wide range of tools for Scope 3 emission calculation, the latest version provides a solutions module to analyze planned reduction projects.
- GHG Tool for Buildings in California by E3: To assist designers, architects and engineers in better understanding emissions in California buildings, the California Public Interest Energy Research commissioned Energy and Environmental Economics Inc. (E3) to develop a simple calculation tool. The tool provides a forecast of greenhouse gas emissions associated with the operation of a specific building design located in California. It is also able to compare the GHG emissions associated with two design options of the same building on an annual basis (Mahone, Price and Morrow 2010).
- Office Carbon Footprint Tool by the EPA: The EPA developed this tool for office-based organizations to assist companies in making decisions to reduce their activity-based emissions. This tool estimates emissions from a variety of sources, including company-owned vehicle transportation; purchased electricity; waste disposal; and leased assets, franchises and outsourced activities (Environmental Protection Agency 2010).
- Climate Leaders Simplified GHG Emissions Calculator by the EPA: This simplified calculation tool helps organizations in estimating their greenhouse gas emissions for reporting to the EPA's Climate Leaders program. The calculator will determine the direct and indirect emissions from all company sources (Environmental Protection Agency 2011).
- ENERGY STAR Portfolio Manager by the EPA: The Portfolio Manager online tool calculates a building's GHG emissions from direct and indirect fuel consumption through energy use within the building. It also has the ability to track avoided emissions from renewable energy certificates (RECs). The methodology for calculating GHG emissions in Portfolio Manager was designed to be consistent with the GHG Protocol and is compatible with the accounting, inventory and reporting requirements of the EPA's Climate Leaders program (ENERGY STAR 2011).

The Portfolio Manager tool can be used to feed energy consumption data into the Climate Leaders Simplified GHG Emissions Calculator. When logged into Portfolio Manager, the company should request an "Energy Performance Report." The report is generated automatically and sent to the email address specified in Portfolio Manager. Companies may add data from emission sources not included in Portfolio Manager, such as vehicle fleets, to the calculator and complete their GHG inventory (Environmental Protection Agency 2011).

3.2.7 Analyzing the Results

Analyzing the results and creating a final report provides an important opportunity to move forward in the larger process of emissions reduction and climate action. Many calculators or software programs aid in the creation of the report by providing charts, tables and graphs.

The Campus Carbon Calculator's User's Guide shows an example of the types of graphs that can be produced with the program (Clean Air-Cool Planet 2008). Figure 5 is a graph of Middlebury College's metric ton carbon dioxide equivalents emitted from 1990-2000.

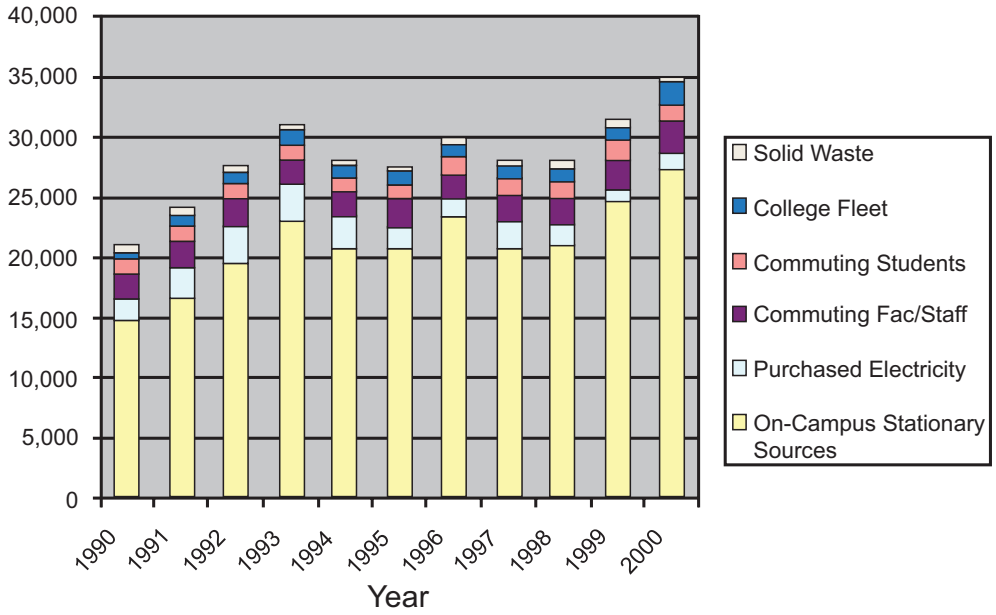

Figure 5: Middlebury College's metric ton carbon dioxide equivalents emitted from 1990-2000

The analysis and summary of the inventory is usually integrated into a formal report to create a platform for education and action necessary for all further climate efforts.

3.3 Best Practices

Because there are so many calculators available and each organization can follow a different set of procedures or set different boundaries, best practices have to focus on documentation of the inventory procedures and the quality of the inventory process. Documentation and quality of the inventory process are important to the basic principles of GHG accounting (relevance, completeness, consistency, transparency and accuracy).

The EPA suggests creating an inventory management plan (IMP) to accurately document the processes used to collect the inventory data, so a high-quality inventory can be completed year after year. An IMP documents the answers to questions such as: What facilities did we include in the inventory? Which sources are included? Who in the company collects the utility bill information? How do we account for new facilities or acquisitions (Environmental Protection Agency 2011)? The IMP is a protocol developed by each company that addresses its unique procedures for creating a credible corporatewide GHG emissions inventory on an annual basis. The seven major components of an IMP are:

- Partner information: Company name, address and inventory contact information
- Boundary conditions: Organizational, operational and temporal descriptions
- Emissions quantification: Quantification methodologies and emissions factors
- Data management: Data sources, collection process and quality assurance
- Base year: Base year adjustments for structural and methodology changes
- Management tools: Roles and responsibilities, training and file maintenance
- Auditing and verification: Auditing, management review and corrective action (Environmental Protection Agency 2011)

To ensure a quality product, the company should use a framework to design an inventory quality management system (IQMS), as shown in Figure 6, to help plan future improvements to the process. The framework focuses on inventory methods, data, processes and systems, and documentation. The GHG Protocol Initiative outlines the following framework for creating an IQMS:

1. Establish an inventory quality team: Responsible for implementing a quality management system and continually improving inventory quality.
2. Develop a quality management plan: Describes the steps the company is taking to implement its quality management system, which should be incorporated into the design of its inventory program from the beginning.

This should include procedures for all organizational levels and inventory development processes.

3. Perform generic quality checks: Apply to data and processes across the entire inventory, focusing on data handling, documentation and emission calculation activities.
4. Perform source-category-specific quality checks: More rigorous investigations into the appropriate application of boundaries, recalculation procedures, and adherence to accounting and reporting principles for specific source categories, as well as the quality of the data input used.
5. Review final inventory estimates and reports: An internal technical review should focus on its engineering, scientific and other technical aspects. Subsequently, an internal managerial review should focus on securing official corporate approval of and support for the inventory.
6. Institutionalize formal feedback loops: Results of the reviews in step 5, as well as the results of every other component of a company's quality management system, should be fed back via formal feedback procedures.
7. Establish reporting, documentation and archiving procedures: Should contain record-keeping procedures that specify what information will be documented for internal purposes, how that information should be archived and what information is to be reported for external stakeholders.

3.4 Next Steps

Now that the inventory process is complete, what should be done next? In conjunction with the C-suite's input, the facility manager could look at benchmarking the organization's inventory to determine what types of internal and external reporting should take place, set goals for GHG reduction or begin a process of climate action planning.

3.4.1 Metrics

Choosing the right metrics for reporting are just as important as setting the boundaries of the inventory. These metrics are the public voice for the company's environmental indicators and help an organization define and measure progress toward goals. A key performance metric must reflect the organization's goals, be important to its success, be quantifiable (measurable) and be long term with a consistent definition (Sullivan 2005). Examples of key performance metrics are:

- Scope 1 emissions
- Scope 2 emissions
- Scope 3 emissions
- Carbon offsets
- Renewable energy certificates
- Sequestration and carbon storage

Another important set of metrics to consider is how to represent the data so it may be compared to other similar organizations. This is called "normalization" or "contextual data." In most inventories, the results are provided as a total figure of MTCO2e (metric tons of carbon equivalent).

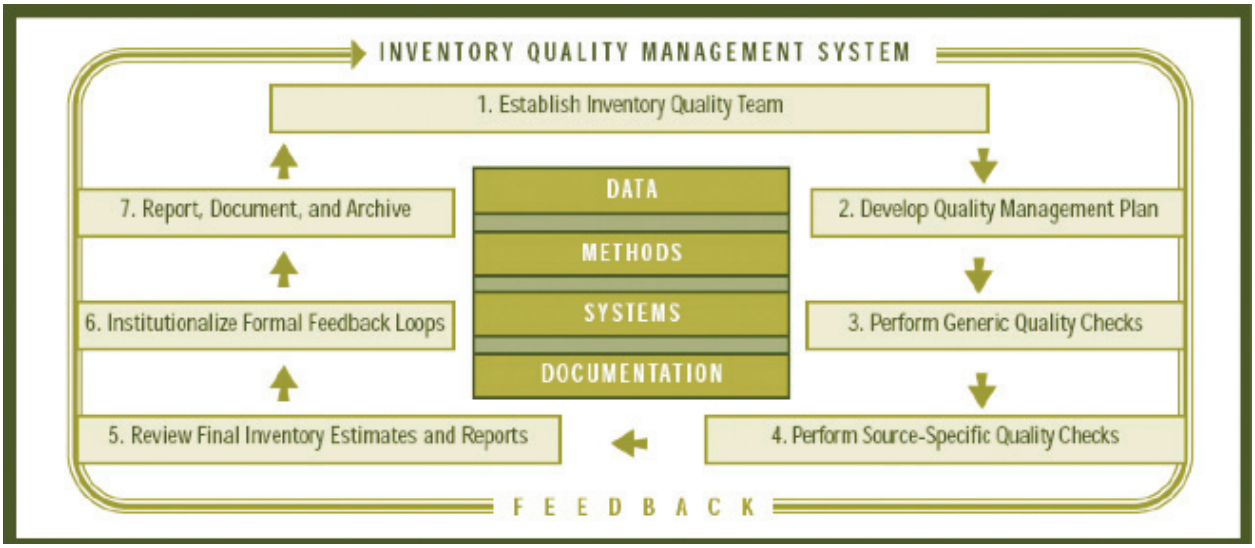

Figure 6: Inventory quality management system (Greenhouse Gas Protocol Initiative 2004)

Examples of these types of data are:

- Square feet of building
- Population (number of employees, students, etc.)
- Annual budget
- Annual research budget
- Production costs
- Revenue

Another tool for creating metrics for reporting is the Greenhouse Gas Equivalencies Calculator provided by the EPA. The calculator can translate abstract measurements into concrete terms that an average person can understand, such as "equivalent to avoiding the carbon dioxide emissions of 183,000 cars annually." This calculator may be useful in communicating the GHG reduction strategy, reduction targets or other initiatives aimed at reducing greenhouse gas emissions. It is available at www.epa.gov/cleanenergy/energy-resources/calculator.html.

3.4.2 Benchmarking

Awareness of greenhouse gases and their affect on the planet is on the rise, but depending on the industry, there may be a lack of tools and references for benchmarking purposes. In 2009, Bryan and Grimm presented a carbon emissions performance standard for basic building types using budgets for specific climate zones (Bryan and Grimm 2009). The standard was based on climate zone and building type. The intent for the new performance measure was if a company had a standard type of building (similar to the Department of Energy's ENERGY STAR building types), the company could look at this carbon performance standard and estimate GHG emissions without having to perform an actual GHG inventory.

The benchmarking of GHG inventories is still in its infancy. There is a need for more comprehensive benchmarking within different sectors of the economy and an exploration of how to account for diversity. In 2009, the EPA, U.S. Energy Information Administration and the U.S. Treasury formally recognized the need for more comprehensive production, energy and emissions data to develop greenhouse gas benchmarks.

Several industries have led the charge to create standards in their fields to assess GHG emissions. For example, in the global cement industry, companies share data on emissions per ton of cement so they can compare the efficiency of their manufacturing plants. The steel, aluminum and petroleum refining industries have created similar benchmarks. APPA has recently added energy benchmarking to its annual "Facilities Core Data Survey," resulting in annual "Facilities Performance Indicators," but it has not gone as far as to add greenhouse gases (Medlin 2007). Table 2 summarizes several of the industries in the process of developing GHG benchmarks and how they may use them.

Table 2: Industry GHG energy benchmark programs (SEI et al 2010)

Scenario	Program	Use of benchmark	Basis for benchmark
Cement	Cement Sustainability Initiative	Voluntary industry comparison	Average of existing facilities
Steel	International Iron and Steel Institute EcoTech program	Voluntary industry comparison	Hypothetical plant employing commercially available, cost-effective energy-saving technologies
Aluminum	Proposed European Union Benchmark for primary aluminum	Basis for allocating emissions allowances	Top 10 percent most carbon-efficient installations in Europe
Electricity	Clean Development Mechanism	Baseline against which emission reductions are estimated	Standardized baseline methodology based on local power plant data and plans
Various	US EPA ENERGY STAR	Basis for awarding ENERGY STAR label/designation	Top 25th percentile of energy performance

Benchmarking GHG emissions is becoming a political hot topic that may result in regulations to restrict emissions. The U.S. EPA issued a report in December 2009 that stated greenhouse gases "endanger both the public health and the public welfare of current and future generations" (SEI et al 2010). To approach the possible regulation of GHG emissions, discussion has begun within the government on how to standardize the approach. The EPA has developed a "sector-based" benchmark methodology to project "business-as-usual" GHG improvements and reduction goals as part of its Climate Leaders Partnership (Tonkonogy et al 2007). In this program, a "Climate Leader" would differentiate itself by setting GHG reduction goals as compared to the sector performance benchmark.

From a policy or regulatory perspective, the European Union (EU) is the most advanced in industry GHG benchmarking. The EU uses benchmark standards to create voluntary agreements between the national governments and industry sectors or companies, resulting in allowance distributions in the EU's Emission Trading System. The third phase of the trading system, beginning in 2013, will implement a cap-and-trade system for GHG emissions based on the "average performance of the 10 percent most efficient installations in a sector or sub-sector" from 2007 and 2008 (SEI et al 2010).

The World Resources Institute provides high-level benchmarking on a country or state level through its Climate Analysis Indicators Tool (CAIT). CAIT provides a comprehensive and comparable database of greenhouse gas emissions data and other climate-relevant indicators that can be used to analyze a wide range of climate-related data questions (World Resources Institute 2010).

Benchmarking in the GHG emissions field is growing and will continue to have challenges as the process is defined in each industry and data is collected and studied (Medlin 2007). The outcomes allow facility managers and administrators to set realistic energy conservation goals, allow comparisons for developing emissions reduction planning, improve facilities planning and establish quantifiable goals for continuous improvement (Briselden 1998).

3.4.3 Setting Goals for Reduction (Climate Action Planning)

Once a GHG emissions inventory is completed, a clear picture of the carbon footprint emerges. Setting a target and timeline for emissions reductions accomplishes several important functions. It formalizes a commitment to ongoing, comprehensive climate action; provides a tangible goal and mechanism for engagement and motivation; and introduces a level of accountability to the process.

Setting a GHG reduction goal is a tangible action that communicates a company's climate strategy and commitment. A credible goal should meet the following criteria:

- Corporatewide: Including all operations
- Forward-looking: Based on the most recent base year for which data are available
- Long-term: Achieved over 5 to 10 years
- Reduction from baseline emissions: Expressed as an absolute GHG reduction, a decrease in GHG intensity or as a goal to be "carbon neutral"
- Aggressive: In comparison to the projected GHG performance for the company's sector (Environmental Protection Agency 2011)

Why should a company set a GHG reduction target?

- Minimizing and managing GHG risks: While developing a GHG inventory is an important step toward identifying GHG risks and opportunities, a GHG target is a planning tool that actually can drive GHG reductions. A GHG target will help raise internal awareness about the risks and opportunities presented by climate change and ensure the issue is on the business agenda. This can serve to minimize and more effectively manage the business risks associated with climate change.
- Achieving cost savings and stimulating innovation: Implementing a GHG target can result in cost savings by driving improvements in process innovation and resource efficiency. Targets that apply to products can drive research and development which, in turn, creates products and services that can increase market share and reduce emissions associated with the use of products.
- Preparing for future regulations: Internal accountability and incentive mechanisms established to support a target's implementation can equip companies to respond more effectively to future GHG regulations. For example, some companies have found that experimenting with internal GHG trading programs has allowed them to better understand the possible impacts of future trading programs on the company.
- Demonstrating leadership and corporate responsibility: With the emergence of GHG regulations in many parts of the world, as well as growing concern about the effects of climate change, a commitment such as setting a public corporate GHG target demonstrates leadership and corporate responsibility. This can improve a company's standing with customers, employees, investors, business partners and the public, and enhance brand reputation.
- Participating in voluntary programs: A growing number of voluntary GHG programs are emerging to encourage and assist companies in setting, implementing and tracking

progress toward GHG targets. Participation in voluntary programs can result in public recognition, may facilitate recognition of early action by future regulations, and enhance a company's GHG accounting and reporting capacity and understanding (Greenhouse Gas Protocol Initiative 2004).

The GHG Protocol Initiative has outlined a 10-step process for setting GHG targets. The steps for setting reduction targets are very similar to the inventory process:

- Obtain senior management commitment
- Decide on the target type (absolute or intensity)
- Decide on the target boundary
- Choose the target base year
- Define the target completion date
- Define the length of the target commitment period
- Decide on the use of offsets or credits
- Establish a target double counting policy
- Decide on the target level
- Track and report progress

In addition to basic GHG reduction goals, some companies and higher education institutions have set a carbon neutral or climate neutral goal, which is a commitment to achieve and maintain net-zero GHG emissions in a company's operations. A carbon neutral goal should include the following:

- Have a robust, transparent GHG inventory and inventory management plan in place.
- Look for opportunities to reduce the company's internal emissions, such as through energy efficiency, installing on-site renewable energy or setting up employee commuting programs.
- Purchase green power, renewable energy certificates and/or offsets for the part of the inventory not reduced through internal projects (Environmental Protection Agency 2008).

3.4.4 Reporting Basics

As a profession, facility management has the most profound influence as to how buildings affect the environment. The importance of that role and the resulting outcomes of these activities have a far-reaching impact. Reporting an organization's sustainability actions is critical in establishing and maintaining an effective environmental stance and sharing it so others can follow the lead.

Sustainable actions satisfy corporate responsibility and governing bodies and provide common ground that benefits them both. Stakeholders receive the societal benefits of clean healthy workplaces, indoctrination into sound environmental practices, and new parameters by which to work and live. Sustainability also strengthens the company's economic situation, leading to continued employment and business relationships. Shareholders benefit from the economic savings that sustainability drives, the increasing valuation of the company and the reputation the company will earn as a good corporate citizen.

A sustainability reporting structure will allow all vested parties the ability to know and understand progress the organization has made environmentally and will publicize those accomplishments globally.

GHG reports should be based on the best data available at the time of publication. At the outset, it is better to be open about any limitation and, over time, correct and communicate any discrepancies identified in subsequent years. At a minimum, reporting should include a description of the company and its boundaries, information on emissions and performance, and supporting information. The New Zealand Business Council for Sustainable Development proposed a GHG report framework as shown in Figure 7.

3.4.5 External Reporting

As the practice of greenhouse gas emission inventories becomes a more accepted business practice, there are many opportunities to share this data with the outside world. There are organized efforts on a national and international scale that may work for some facilities or corporations. There is the Global Reporting Initiative, The Climate Registry by the WRI, the American Carbon Registry, the California Climate Action Registry and the EPA's ENERGY STAR program, to name a few.

- Global Reporting Initiative: The Global Reporting Initiative (GRI) is a voluntary, multistakeholder approach to develop a corporate reporting system based on sustainability for organizations around the world. The GRI provides a working structure that assists in combining a variety of efforts using a consistent measurement. The organization utilizes a set of core metrics

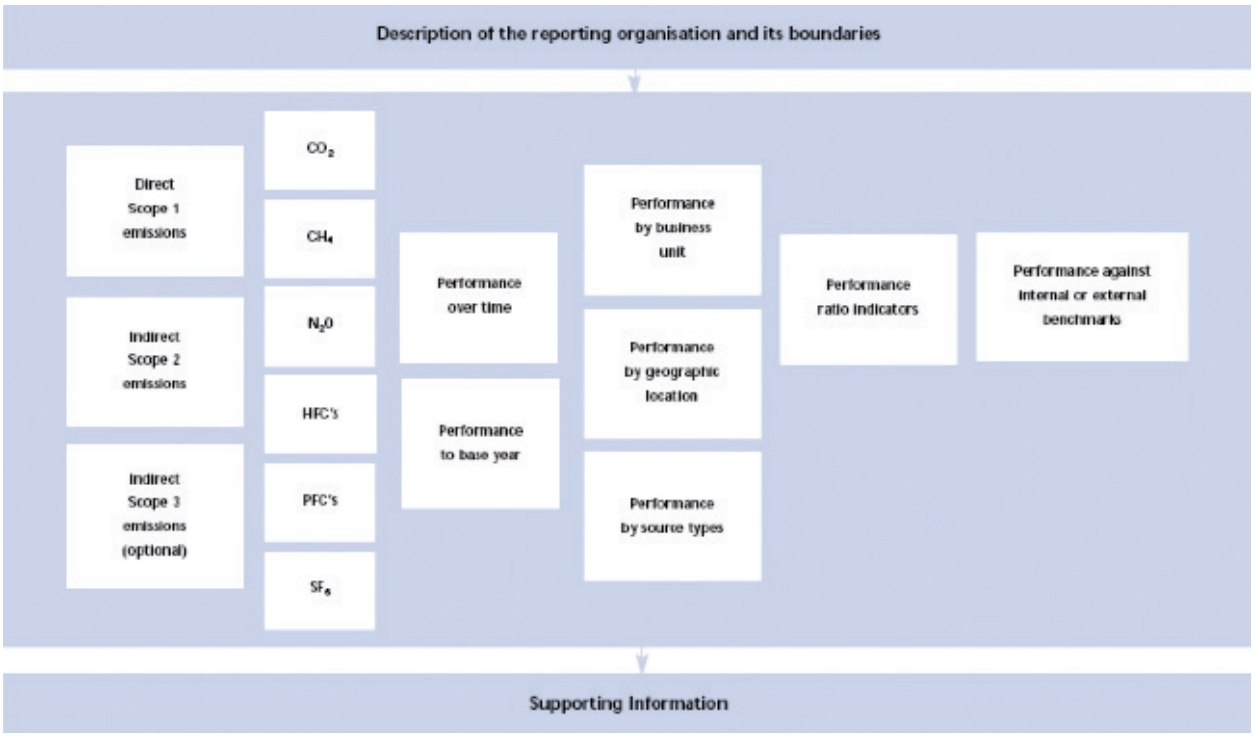

Figure 7: GHG reporting framework (New Zealand Business Council for Sustainable Development 2002)

that is intended to apply to all business enterprises. It has set sector-specific metrics for specific types of enterprises, presenting a uniform format for reporting information that is integral to a company's performance in regard to sustainability and environmental concerns.

The measures covered equate to triple bottom line objectives. They should reflect economic performance indicators, such as profit, assets, investments, productivity and community involvement. Environmental indicators would include energy efficiency, water conservation, material consumption and disposal/diversion, and the organization's impact on land, air and water as affected by its operations. Social performance indicators would entail employee attraction/retention, health and safety in the workplace, human rights within the community and relationships between suppliers, and the environmental impact of their products and services.

- G3 Reporting Framework: The G3 Sustainability Reporting Guidelines provide updated universal guidance for reporting on sustainability performance. This means they are applicable to small companies, large multinationals, public sector, nongovernmental organization (NGO) and other types of organizations on a global basis. It is the way that the guidelines are created (through the multistakeholder, consensus-seeking approach) that enables them to be so broadly applicable. Figure 8 is a representation of the reporting framework.

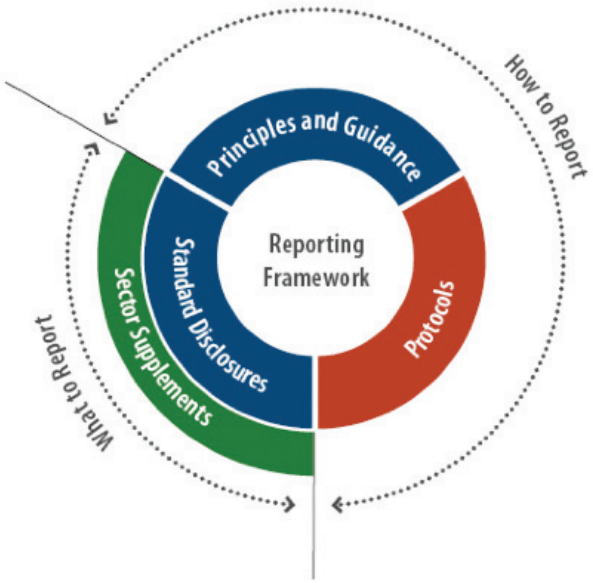

Figure 8: The GRI reporting framework (Global Reporting Initiative 2011)

While the GRI provides guidelines for reporting all aspects of sustainability, the section titled "Environmental Performance Indicators" is focused on greenhouse gas emissions. The section provides five guidelines (Global Reporting Initiative 2011):
  - (EN16) total direct and indirect greenhouse gas emissions, by weight
  - (EN17) other relevant indirect greenhouse gas emissions by weight
  - (EN18) initiatives to reduce greenhouse gas emissions and reductions achieved
  - (EN19) emissions of ozone-depleting substances by weight
  - (EN20) NO, SO and other significant air emissions by type and weight
- The Climate Registry by the World Resources Institute (WRI): The Climate Registry is a collaboration among 40 states, provinces and tribes in the United States, Canada and Mexico to develop and manage a common and unified greenhouse gas emissions reporting system (The Climate Registry 2009). It is designed to support GHG reporting and reduction policies for its members based on data that is accurate, complete, consistent, transparent and verified. The registry is founded on the GHG Protocol Corporate Accounting and Reporting Standard, and the WRI provided technical support and facilitation throughout the development process. It supports both voluntary and mandatory reporting programs and provides comprehensive, accurate data to reduce GHG emissions (The Climate Registry 2009). The Climate Registry states many benefits for joining:
  - Technical resources for GHG accounting: Exclusive access to Web-based accounting software and extensive technical support simplifies and reduces costs of GHG tracking.
  - Recognition as an environmental leader: Participants receive wide recognition as environmental leaders.
  - Readiness for emissions trading: Many states are now developing GHG emissions trading programs that will be based on The Climate Registry standards and data.
  - Risk management: Learning to identify emissions sources, understanding the GHG profile and developing management strategies to prepare organizations for assessing and responding to the potential impact of new regulations.
  - Gain competitive advantage: Measuring and managing emissions can lead to streamlining business processes and improving efficiency.
  - Baseline protection: Establishing a GHG emissions baseline means organizations can document reductions for consideration under any regulatory programs.
- American Carbon Registry (ACR): The ACR is a voluntary, online greenhouse gas registration and emissions tracking system. It is used by members for several reasons:
  - To transparently register verified, project-based emissions reductions and removals as serialized offsets
  - Record the purchase, sale, banking and retirement of tradable offsets, branded as "Emission Reduction Tons" (ERTs)
  - Optionally report, in a separate account, verified GHG inventories (American Carbon Registry 2011)
- California Climate Action Registry (CCAR): The CCAR was established by a California statute as a nonprofit voluntary registry for greenhouse gas emissions. The purpose of the registry is to help companies and organizations with operations in California to establish GHG emissions baselines against which any future GHG emission reduction requirements may be applied. The CCAR provides leadership on climate change by developing and promoting credible, accurate and consistent GHG reporting standards and tools for organizations to measure, monitor, third-party verify and reduce their GHG emissions consistently across industry sectors and geographical borders. In turn, California offers its best efforts to ensure that CCAR members receive appropriate consideration for early action in light of future state, federal or international GHG regulatory programs.

  The CCAR is a program of the Climate Action Reserve and serves as a voluntary GHG registry to protect and promote early actions to reduce GHG emissions by organizations. Members voluntarily measure, verify and publicly report their GHG emissions, are leaders in their respective industry sectors and are actively participating in solving the challenge of climate change. Registry

members are well-prepared to participate in market-based solutions and regulatory requirements. The registry is regarded as a leading international thought center on climate change issues and an intersection where business, government and environmental organizations meet to work together to implement practical and effective solutions.

- Facility Reporting Project (FRP): The Ceres coalition has received support from the EPA to conduct additional pilot projects under its facility reporting project, aiming to improve sustainability reporting and performance at individual facilities across the country. Under a contract between EPA's National Center for Environmental Innovation (NCEI) and the consultancy Industrial Economics, Ceres is working with up to seven member facilities of the EPA's National Environmental Performance Track program. Volunteer facilities have an opportunity to gain no-cost technical assistance from Ceres to create facility-level environmental reports. Through these pilots, NCEI aims to further explore the relationship between environmental data collection, reporting and performance.

  Ceres and the Tellus Institute launched the FRP in 2002 as a multistakeholder effort to help companies improve their reporting and performance on sustainability challenges, such as global climate change. The project builds on Ceres' experience in launching the GRI in the late 1990s. The GRI's Sustainability Reporting Guidelines have since become the de facto international standard for corporate reporting on economic, social and environmental performance. Today, more than 700 companies worldwide follow the GRI Guidelines in their public reporting on sustainability issues.

  The use of FRP Sustainability Reporting Guidelines can help strengthen facility accountability to facility stakeholders and civil society by enabling them to report economic, environmental and social performance in a credible and consistent manner. The FRP framework provides a viable checklist for facility professionals with which to work, whether it is part of the FRP network or just for internal use. The indicators outlined in the FRP would include a facility policy statement and an overview of the facility (size, location, population and use). It outlines economic, environmental and social indicators that reflect those in the GRI, but are more specific to individual buildings, campuses or portfolios. This type of data collection, documentation and reporting facilitates the ability to engage in benchmarking and comparison both internally and externally.

4 MAKING THE BUSINESS CASE

4.1 Drivers

The primary drivers for making the business case include the following:

- GHG risk management: The regulatory risk alone is a strong driver for businesses with potential high cost exposure. An inventory of emissions, including those emissions that occur both upstream and downstream of operations, will help assess the business risks and opportunities. It will also help businesses respond to shifts in consumer preferences based on corporate GHG performance and reputation. Once an emission position is known, reduction opportunities may be evaluated and targets set.
- Competitiveness considerations: What gets measured gets managed. Many leading businesses have already concluded they can benefit financially by addressing emissions management. By using energy and other resources more efficiently, production costs can be reduced and competitiveness improved. In addition, creating new products or services that use less energy and produce lower GHG emissions can differentiate the business in an increasingly environmentally conscious marketplace.
- GHG markets: Emissions trading markets are maturing. Over time, the importance of emissions trading will grow. Already several markets are operating internationally, and although each market has specific requirements, a common requirement is an accurate emissions inventory. Participation in GHG markets provides a clear business opportunity for many organizations to generate new revenue.
- Participation in government initiatives: The U.S. government's proposed climate change policy package signals a reliance on market-based approaches and voluntary initiatives (for example, by way of "Negotiated Greenhouse Agreements"). Measurement of emissions will be required for participants in such schemes (New Zealand Business Council for Sustainable Development 2002).

4.2 Tangible Benefits

4.2.1 Cost Savings From Improved Energy Management

Reducing energy consumption by implementing energy efficiency and conservation measures is often a key component in a company's strategy to reduce GHG emissions. From a financial perspective, this is simply good business, as better energy management can result in significant gains for many companies. This is particularly true when energy prices are high. Service-sector companies can save money by cutting fuel consumption in company vehicles and on-site building equipment, such as boilers and furnaces, as well as by using less electricity in company facilities. Beginning in 2002, Staples, a U.S.-based office products supply company, used a range of energy efficiency measures in its stores and warehouses that saved the company US$6.5 million (SustainableBusiness.com 2008).

4.2.2 Cost Savings From Operational Efficiencies

One of the most important outcomes of measuring GHG emissions is finding ways of reducing them. In addition to energy-related savings, these opportunities for emission reductions can stem from correcting operational inefficiencies. Such inefficiencies may be related to the distribution of products or the use of resources like paper. By focusing on them, companies can capitalize on opportunities to reduce emissions and costs. For example, UPS, the world's largest package delivery company, uses "Package Flow Technology" to minimize the number of miles on its drivers' routes. With the full deployment of the technology in 2007, the company expected to cut more than 100 million miles (161 million kilometers), saving the company almost 14 million gallons (53 million liters) of fuel and reducing CO_2 emissions by 130,000 metric tons, while improving on shipment delivery time. (Greenemeier 2006)

4.2.3 Increased Revenues and New Markets

As climate change becomes more pressing, new markets for low-carbon products and services will continue to expand, providing business opportunities for service-sector companies to bring these products and services to market. For example:

- Companies can sell energy-efficient products or services that promote sound energy management. For example, Fannie Mae offers a mortgage product — called an energy-efficient mortgage — that enables borrowers who buy a new energy-efficient home or make energy-efficient improvements to an existing home to qualify for a larger mortgage. These mortgages can also finance 100 percent of the energy improvements made to a home, up to 15 percent of an existing home's value and up to 5 percent of a new home's value.
- Insurance companies can offer preferential rates to drivers of highly fuel-efficient vehicles. For example, Sumpo Japan offers an "Eco-Car Discount" of 1.5 percent to drivers of hybrid or low-emission vehicles. In 2004, the discount was applied to drivers of approximately 3.25 million cars. Travelers, a U.S.-based insurance provider, has a similar service called Hybrid Travelers, which offers an auto insurance discount of up to 10 percent to owners of hybrid cars.
- Some of the most expansive greenhouse gas regulations treat carbon as a tradable commodity with a financial value. This represents a business opportunity for banks and investment companies entering these new markets. Companies can also invest in clean-energy technologies. These opportunities could each be nearly US$2 trillion-a-year markets within 15 years. In addition, a better understanding of, and more experience with, climate change-related issues will help these companies advise clients on carbon-specific financial issues.
- Companies can brand products or services as carbon neutral by investing in GHG reduction projects — also known as GHG offsets — to counteract the GHGs generated from those products or services. For example, British Airways has a program that gives its customers an opportunity to offset their share of the CO_2 emissions created from the flights they take. Customers pay a small premium on their airfare, and, in return, British Airways invests in GHG reduction projects through a professional third-party offset provider. Companies can also offer low-carbon services and brand them as climate friendly. DHL Scandinavia offers a Green Tonnage shipping product that allows customers to choose, for an extra fee, to have their shipments transported using low-carbon biofuels instead of conventional fuels, such as diesel (Putt Del Pino, Levinson and Larsen 2006).

4.3 Intangible Benefits

4.3.1 Competitive Positioning

Enacting a strong corporate GHG management program can enhance a company's image with customers and other stakeholders. Being the first company among its competitors to offer new low-carbon products or services can give the company a competitive advantage as the markets for these products and services expand and become more profitable.

4.3.2 Improved Shareholder Relations

In recent years, investors have become concerned with environmental performance and particularly the actions that companies are taking to address climate change. Investors increasingly view a successful corporate climate change strategy as an indication of superior business management. It is even possible that a corporate GHG management strategy that mitigates risks to the company or encourages profit opportunities or significant cost savings could result in a lower cost for capital or higher profit margins, which can in turn improve shareholder value.

4.3.3 Employee-Related Benefits

Most companies strive to recruit and retain the best possible employees and provide a productive work environment for them. Some aspects of a GHG program, such as incorporating green building design into new or existing space, offering employee incentive programs to promote emission-reducing activities or discussing GHG management activities internally, may enhance employee recruitment and retention efforts. This has the potential to lead to other human resource management advantages as well. For example, research shows that high-performance green buildings can lead to increased productivity, more satisfying work environments, and improved occupant health and well-being (Putt Del Pino, Levinson and Larsen 2006).

4.4 Business Case Resources

Facility managers often are required to cost-justify the case for sustainability investments in light of alternative demands on limited capital funds. This section of the guide identifies government-developed financial tools facility managers can use to justify financial requests.

4.4.1 Federal Business Case Resources

- DOE – Federal Energy Management Program (FEMP):
  evanmills.lbl.gov/pubs/pdf/bcsddoc.pdf
  An earlier paper by FEMP – "The Business Case for Sustainable Design in Federal Buildings" provides an outline of business benefits and case study discussions.
- National Institute of Building Sciences – Whole Building Design Guide (WBDG):
  www.wbdg.org/design/cost_effective.php
  This site is focused on being the "one stop access to up-to-date information on a wide range of building-related guidance, criteria and technology from a 'whole-buildings perspective.'" From the perspective of "presenting the sustainability business case," the site discusses how best to take a life-cycle approach to building cost-effectiveness. It provides advice on how best to utilize cost planning throughout the planning, design and development phases, using economic analysis to evaluate design alternatives and how to consider nonmonetary benefits, such as aesthetics, historic preservation, security and safety.
- US Green Building Council (USGBC):
  www.usgbc.org/Docs/Member_Resource_Docs/makingthebusinesscase.pdf
  The USGBC has issued a paper, "Making The Business Case For High Performance Green Buildings," that documents 10 reasons for pursuing a green building strategy. There are also a number of papers documenting the business case for green buildings in the "Real Estate Management and Value" part of the research publications section (www.usgbc.org/DisplayPage.aspx?CMSPageID=77#real_estate).
- WBDG: Measuring Performance of Sustainable Buildings (cost benefit tools):
  www.wbdg.org/resources/measperfsustbldgs.php
  The WBDG examines various perspectives and challenges associated with measuring performance of sustainable buildings. There is also an extensive list of resources that support measurement including the triple bottom line, new and existing buildings, specific measurement parameters, measurement approaches and benchmarking.
- EPA ENERGY STAR (financial tools):
  www.energystar.gov/index.cfm?c=assess_value.financial_tools
  Two tools that are particularly worthwhile are the financial value calculator and the building upgrade value calculator. The financial value calculator presents energy investment opportunities in terms of key financial metrics to convey the value of improved energy performance to senior financial decision-makers and other stakeholders. The building upgrade value calculator is a product of the partnership between ENERGY STAR, BOMA International and the BOMA Foundation. The calculator estimates the financial impact of proposed investments in energy efficiency for office properties.
- High-Performance Buildings (case studies):
  The DOE's High Performance Database includes 126 projects and is a shared resource for industry. It is a repository of in-depth information and data on high-performance, green projects across the United States. The database includes information on federal projects, USGBC LEED certified projects, buildings that have featured in the American Institute of Architects Committee on the Environment's annual "Top 10 Green Projects" competition and best practice buildings as determined by BuildingGreen, LLC. The case studies outline the attributes that each building exemplifies.

4.4.2 Benefits Resources

There are a number of studies documenting expected returns from pursuing a green building strategy. Two such studies are:

- "High Performance Green Building: What's it Worth? Investigating the Market Value of High Performance Green Buildings" (2009) by Theddi Wright Chappell (Cushman and Wakefield), Chris Corps (Vancouver Valuation Group) and Project Managed by Brandon Smith (Cascadia Region Green Building Council) (cascadiagbc.org/news/GBValueStudy.pdf)

- “Assessing Green Building Performance: A Post Occupancy Analysis of 12 GSA Buildings” (July 2008) by Kim M. Fowler and Emily M. Rauch from the Pacific Northwest National Laboratory (www.wbdg.org/research/sustainablehpbs.php?a=8).

5 CASE STUDIES

5.1 Agnes Scott College, Decatur, Ga., USA

Completion of Agnes Scott College's GHG inventory was a team effort, led by the emission inventory subcommittee of the sustainability steering committee (SSC). The inventory was conducted by a student research assistant, assisted by an academic advisor for internship credit, the director of sustainability and other college staff (especially in the Office of Facilities).

5.1.1 Determining Inventory Boundaries

In fall 2007, Agnes Scott's president signed the American College and University Presidents Climate Commitment (ACUPCC) and appointed the 19-member SSC. The SSC includes all the college's vice presidents, two trustees and two alumnae, as well as students, faculty and staff in leadership roles on campus that relate to sustainability. The emissions inventory subcommittee met several times with staff in early 2008 to discuss the parameters of the inventory. Subcommittee members reviewed guidance documents for GHG inventories, as well as inventories from other colleges. The team established the following boundaries for the inventory:

- The college used Clean Air-Cool Planet's "Campus Carbon Calculator."
- The operational boundaries were defined to include all the buildings that are included in the college's primary utility bills, described as the "main campus." Agnes Scott owns off-campus properties, but these are rented and the utilities are billed directly to the tenants, so they were not included in the inventory.
- The organizational boundaries included all departments and services of the college.
- While utility data was available for multiple years, other inventory data was only available for 2008. Therefore, 2008 was the baseline year for the inventory.
- In the interest of time, and because there was no standard travel data collection process on campus, the college decided to collect air travel data only from the departments that travel most frequently (i.e., admissions, development, student abroad trips).
- The temporal boundary was defined as the college's fiscal year, July 1 to June 30.

5.1.2 Data Collection

Complete data was acquired from various college departments and offices for the following categories: operating budget, research budget, energy budget, full-time students, part-time students, summer school students, faculty, staff and total building space.

The Office of Facilities was able to provide spreadsheets with total electricity usage per fiscal year from 2003 to 2008. Agnes Scott's EPA eGRID subregion is SERC South (abbreviated SRSO), which also includes parts of Alabama, Florida and Mississippi. Selecting this region allowed the calculator to use historical emissions factors for electricity produced in the region for the calculations. The current EPA eGRID subregion map is shown in Figure 9.

Agnes Scott does not purchase any steamed or chilled water. Campus boiler emissions were included in the stationary sources section as natural gas. Agnes Scott uses natural gas for a variety of heating purposes, and this was accounted for as on-campus stationary sources. The Office of Facilities provided spreadsheets with usage totals from fiscal year 2003 to 2008. No other stationary sources, such as propane, coal or incinerated waste, are used on campus.

Transportation emissions were divided into two categories: commuting and air travel. Although no commuting data could be tracked for previous years, a survey created in conjunction with Agnes

Figure 9: eGRID2010 version 1.1 (Environmental Protection Agency 2011)

Scott's information technology services office was sent to all staff and faculty, as well as commuting students, in April 2008. The survey requested information on whether or not an individual drove alone, carpooled, took the bus, took a commuter train or some other form of alternative transportation, and how far they traveled per trip. Out of 149 emailed surveys sent to students, 40 percent responded. Forty-seven percent of staff and 45 percent of faculty participated in the survey. Agnes Scott did not include residential student transportation to and from campus each year, as this was determined to be the individual student's "footprint" rather than that of the college. Data for the small campus vehicle fleet was largely unavailable, as only a few drivers regularly recorded mileage, so this was not included in emissions calculations.

Air travel data for staff was researched with assistance of administrative staff in the offices expected to have the greatest amount of off-campus travel: development, admissions and the president. No centralized method of recording air travel for faculty existed on campus, but efforts were made to change logging techniques for travel to make future inventories more complete. Student flight data took into account travel by students studying abroad, as well as the Global Connections program, and other programs directly affiliated with Agnes Scott.

Agnes Scott's solid waste is sent to a landfill where methane recovery and flaring is currently under way. Dollar amounts charged to the campus for waste handling were obtained from purchase orders filed in the facilities from fiscal year 2005 to 2008. After contacting the waste hauler, an estimate was given of US$40 per ton of waste. This allowed for calculation of tonnage using the purchase orders. Only the 34 cubic yard (26 cubic meter) container was included in calculations because all other containers are not weighed at the time of pickup. The data are still considered accurate as the 34 cubic yard (26 cubic meter) container makes up roughly 90 percent of waste collected from the campus.

The refrigerants HFC-134a, HFC-404a and HFC-22 are used in varying amounts at Agnes Scott. Total pounds for fiscal years 2005 to 2008 were obtained from purchase orders in facilities. It should be noted that the accuracy of the data is not known, as Agnes Scott relies on the mechanics to write down the type and amount of

refrigerant used per work order; thus it is possible that some data is missing from the calculations. Figure 10 shows the breakdown of GHG emission sources for 2009.

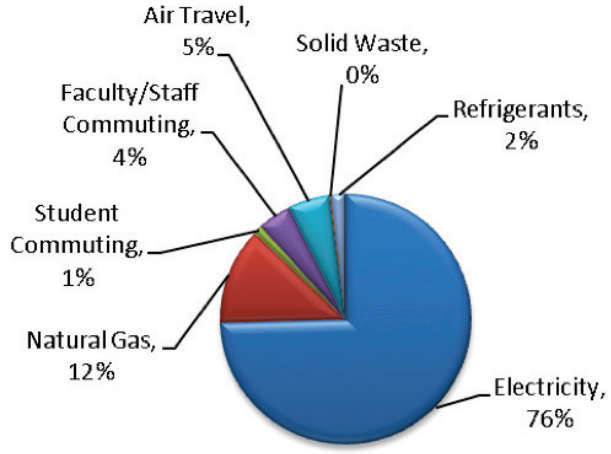

Figure 10: GHG emission sources 2009 – 12,616 MT eCO_2

5.2 Wesley College, Dover, Del., USA

Wesley College's president signed the American College and University Presidents Climate Commitment carbon neutrality pledge in May 2007. In support of this commitment, Wesley College enlisted the services of ARAMARK to conduct a greenhouse gas inventory to determine the college's carbon footprint, followed by the development of a climate action plan to guide the college as it progresses toward its goal of achieving carbon neutrality.

5.2.1 Greenhouse Gas Inventory

The first step in determining the college's carbon footprint was to collect the emissions data from a variety of sources that were categorized in a series of boundaries (operational, organizational and temporal). The first boundary included operational boundaries selected by Wesley College to include all campus-owned facilities where the college pays the utility bills. The second boundary, organizational boundaries, were all college approved programs and services. The temporal boundary was calendar year 2007.

With the boundaries identified, ARAMARK began the process of collecting the necessary information to complete the Clean Air-Cool Planet (CA-CP) campus carbon calculator. This included working with the facility manager to collect historical electricity and fossil fuel utility data, solid waste and recycling information, refrigerant information and historical purchasing information. Interviews were also conducted with each of the departments on campus to collect transportation-related emissions data identified within transportation and departmental purchasing records.

Using input tables within the CA-CP calculator, ARAMARK developed a comprehensive checklist and exclusive emissions calculator tool for use during the data collection process to ensure all necessary information was collected and calculated correctly. The data collection process also incorporated the use of a comprehensive detailed journal as recommended for this process within the ACUPCC implementation guide. All data was actual, comprising documenting the source of data as recommended in the guidelines provided by CA-CP and the Environmental Protection Agency.

Once initial carbon footprint calculation emissions were equated, ARAMARK completed a final quality assurance check utilizing its exclusive carbon emissions calculator tool. This step included assessing all data outputs from the CA-CP calculator and benchmarking them against data from institutions with similar campus size. Outliers were identified and re-addressed to ensure all data had been collected and accurately entered. Identified and approved anomalies were clearly noted in the final report. This final step is critical as the initial greenhouse gas inventory will be the foundation in supporting key financial and programmatic decisions required in attaining Wesley College's goal of achieving carbon neutrality.

The result of the greenhouse gas inventory was the identification of more than 8,000 metric tons of eCO_2 for the established baseline year of 2007 (Figure 11).

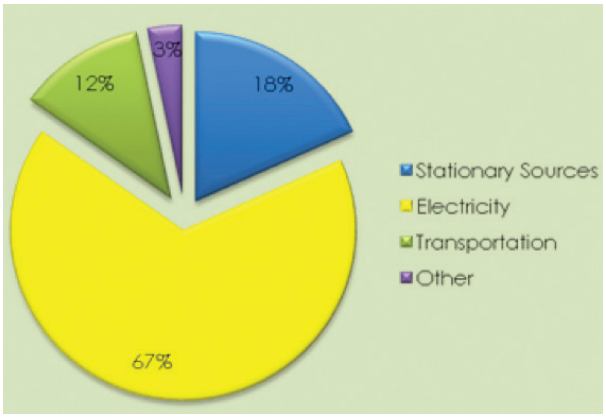

Figure 11: Total carbon footprint – 8,308 MT eCO_2

5.2.2 Climate Action Plan

With the greenhouse gas inventory completed, a climate action plan was developed to provide guidance for carbon neutrality efforts. Development of the climate action plan included the following activities:

- Review of campus future growth plans
- Forecast future emissions
- Complete campus energy assessment
- Analyze fleet and commuter transportation
- Develop emission mitigation strategies and climate neutrality planner
- Develop action plan to achieve carbon neutrality.

Wesley College's climate action plan has proposed implementing a variety of mitigation strategies (Figure 12) through the five-phase program (Figure 13). Significant reductions have been identified in the first phase based on a strategic performance contracting (PC) program created through a consulting agreement with ARAMARK. Phase I runs from 2010 through 2015, Phase II from 2015-2020 and Phases III through V from 2020 through 2050, with each phase lasting 10 years. Wesley College's goal is to achieve carbon neutrality by 2050. The college will review and update the climate action plan on a regular basis to ensure progress toward both its short- and long-term goals. Phase I initiatives are under way with the energy performance contract expected to be completed by spring 2012.

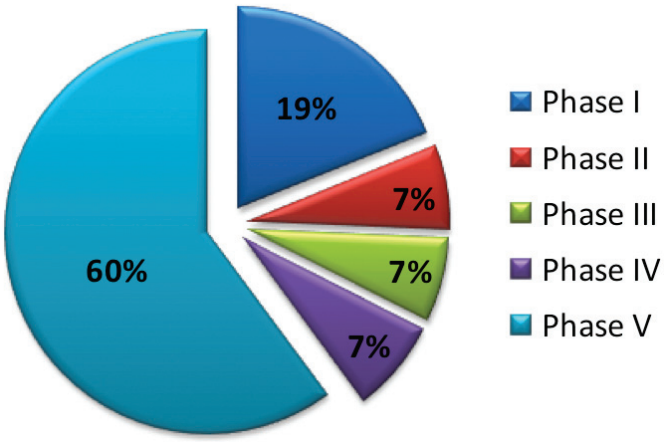

Figure 13: Climate action plan phasing — percent of 2007 carbon emissions

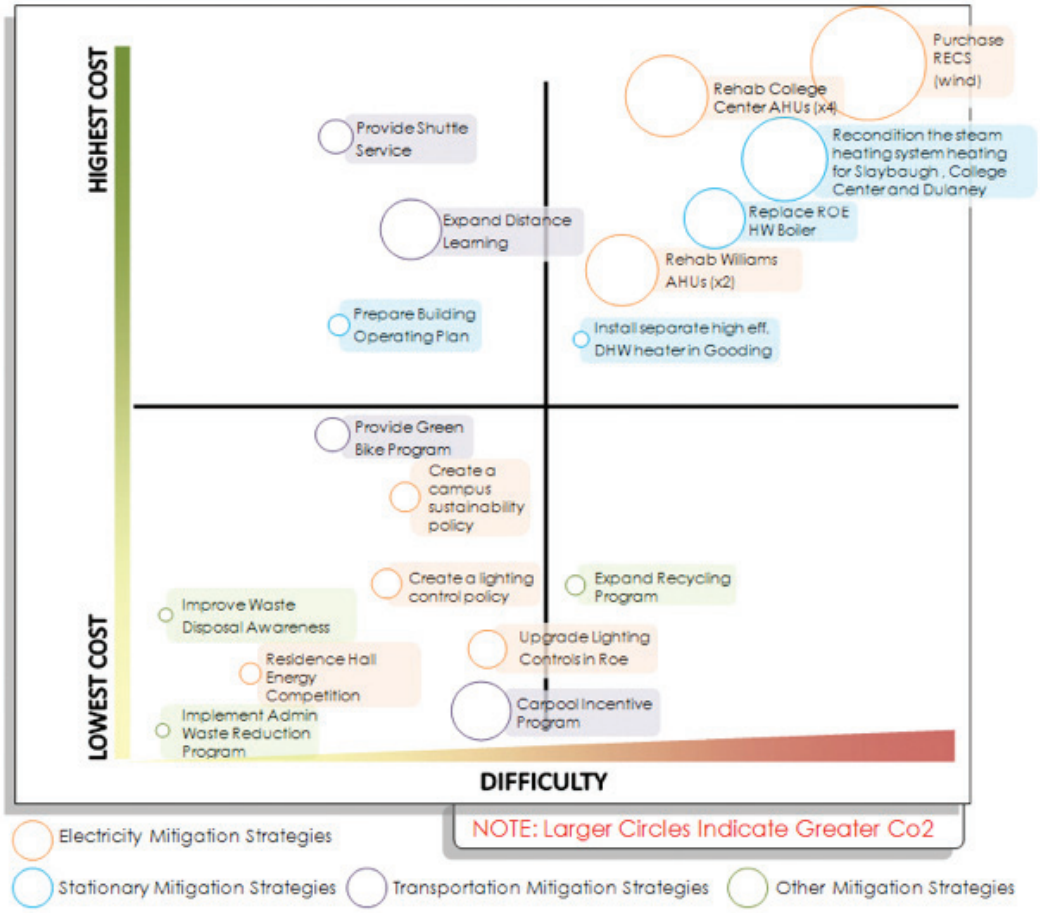

Figure 12: Highlighted mitigation strategy measures

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6.1 Appendix A: References

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6.2 Appendix B: Additional Resources

6.2.1 Environmental Tools and Calculators

Exhibit 1 was retrieved from the Pacific Northwest Pollution Prevention Resource Center's website at www.pprc.org/hubs/index.cfm?page=subsection&hub_id=1000&subsec_id=15.

Table 1 - Environmental Tools and Calculators

Name of Calculator or Tool(s)	Author or Producer	Scope and Purpose	Intended Audience	Use and Training
U.S. EPA **P2 Cost Calculator**	U.S. EPA Office of Chemical Safety and Pollution Prevention	This tool calculates GHG emission reductions from electricity conservation, green energy, fuel and chemical substitutions with lower GHG-intensities, water conservation, and improved materials and process management for various industries.	Organizations seeking to calculate savings associated with various P2 activities	Webinar tutorial, tools, and contact information available for downloading from **National Pollution Pevention Roundtable** *(scroll down)*
U.S. EPA **Gallons to Pounds Converter**	U.S. EPA Office of Chemical Safety and Pollution Prevention	This tool provides conversions from units commonly encountered in business, to units needed for P2 Program measures. It is not uncommon for hazardous materials to be measured in gallons for business purposes (for example, gallons of solvent, paint, or wastewater).	Organizations seeking to calculate savings associated with various P2 activities	Webinar tutorial, tools, and contact information available for downloading from **National Pollution Pevention Roundtable** *(scroll down)*
Energy and Materials Flow and Costs Tracker (EMFACT)	Northeast Waste Management Official's Association (NEWMOA)	The Energy and Materials Flow and Costs Tracker (EMFACT) helps end users understand and analyze their materials (water/fuel), energy, chemical use, and releases and associated costs, along with potential financial return on investment from prevention and sustainability efforts within one or more facilities.	Small and medium size businesses, EHS staff, and agencies	Downloadable, extensive training and user guides available
Energy Efficiency Opportunity Calculator for Small and Medium Sized Manufacturers	Texas Industries of the Future	The purpose of this tool is to provide small or medium-sized manufacturing plants with a list of questions and a calculator to quickly assess opportunities for energy and cost savings It assists managers in identifying where their "easy" 15% of energy cost savings might be found. The calculator will estimate the potential savings based on inputs, for 16 energy cost reduction projects commonly identified at manufacturing plants, from reducing compressed air leaks to improving controls.	Manufacturing or other facilities	Downloadable tool (MS Excel) and manual
VOC Calculators	Paints & Coatings Resource Center	Provides calculators that determine the volatile organic comopound (VOC) and hazardous air pollutant (HAP) emissions from four different scenarios: (1) VOC, HAP emissions per gallon of coating, less water, where the weight of water per gallon is known; (2) VOC, HAP emissions per gallon of coating, less water, where the percent water by weight is known; (3) VOC, HAP emissions per gallon of solids; and (4) VOC, HAP emissions per weight of solids.	Painters (professional, commercial, industrial, consumer)	On-line tools
National Mobile Inventory Model (NMIM)	U.S. EPA Office of Transportation and Air Quality	The National Mobile Inventory Model (NMIM) helps develop estimates of current and future emission inventories for on-road motor vehicles and nonroad equipment.	Trucking and distribution fteet managers	Downloadable tool and user guide

SmartWay Technology Package Savings Calculator for Fleets	U.S. EPA Office of Transportation and Air Quality	Provides calculators that determine the VOC and HAP emissions from four different scenarios: (1) VOC, HAP emissions per gallon of coating, less water, where the weight of water per gallon is known; (2) VOC, HAP emissions per gallon of coating, less water, where the percent water by weight is known; (3) VOC, HAP emissions per gallon of solids; and (4) VOC, HAP emissions per weight of solids.	Trucking and distribution fleet managers	On-line tools
Clean School Bus USA	U.S. EPA Office of Transportation and Air Quality	This is a simple calculator to determine the fuel savings and fuel cost reduction by reducing school bus idling times.	Bus fleets, schools	On-line tool

6.2.2 GHG Tools and Calculators

Exhibit 2 was retrieved from Pacific Northwest Pollution Prevention Resource Center at www.pprc.org/hubs/index.cfm?page=subsection&hub_id=1000&subsec_id=15.

Table 2 - GHG Tools and Calculators

Name of Calculator or Tool(s)	Author or Producer	Scope and Purpose	Intended Audience	Use and Training
The Greenhouse Gas Protocol - Calculation Tools	Greenhouse Gas Protocol Initiative	Sector-specific and cross-sector calculators to determine GHG emissions from energy consumption, combustion of fuels and other GHG-emitting processes	Organizations and companies seeking to report emissions to the GHG Protocol or calculate for internal use or voluntary reporting.	Requires registration to access and download MS Excel-based tools
Climate Leaders' **Simplified GHG Emissions Calculator (and Guidance)**	U.S. EPA Climate Protection Partnership Division, Office of Atmospheric Programs	In the Climate Leaders archives, many partner companies completed a corporate-wide inventory of GHG emissions using these tools. The resources available on this website help corporations inventory their GHG emissions, set aggressive reduction goals and plan mitigation actions	Organizations and companies seeking to calculate emissions for internal use or voluntarily reporting	Online webinar, tutorial, and guidance document
U.S. EPA **P2 Greenhouse Gas Calculator**	U.S. EPA Office of Chemical Safety and Pollution Prevention	This tool calculates the GHG emission reductions from electricity conservation, green energy, fuel and chemical substitutions with lower GHG-intensities, water conservation, and improved materials and process management, applicable to many manufacturing sectors.	Organizations seeking to calculate emission reductions associated with specific activities	Webinar tutorial, tools, and contact information available for downloading from **National Pollution Pevention Roundtable** *(scroll down)*
Seattle Climate Partnership's Business Carbon Footprint Tool	City of Seattle, Washington	Excel-based tool which calculates an annual GHG inventory covering purchased energy, fuel for transportation, employee commute, air travel, certain material purchases, and wastes. It is not intended to include direct manufacturing emissions, material use, or refrigerants.	Organizations looking to calculate a basic carbon footprint	On-line web tool or downloadable spreadsheet with instructions
Greenhouse Gas Equivalencies Calculator	U.S. EPA, Green Power Partnership, Climate Protection Partnership Division	Calculator tool to show the environmental equivalency of a green power purchase in order to better communicate a green power purchase to interested stakeholders. It translates from kilowatt-hours (kWh) purchased into more understandable terms, such as an equivalent number of passenger vehicles, homes, or coal plants	Organizations looking to purchase green power	On-line web tool with instructions
Waste Reduction Model (WARM) Calculator	U.S. EPA Office of Resource Conservation and Recovery	WARM calculates marginal emissions reductions and increases from waste management alternatives for common materials in the municipal waste stream	Individuals or organizations seeking to tie GHG emission reductions to reduced wastes	On-line tool and training
Recycled Content (ReCon) Calculator	EPA, Office of Resource Conservation and Recovery	The ReCon tool calculates the GHG and energy benefits of increasing the recycled content of specific materials	Individuals or organizations seeking to tie GHG emission reductions to green purchasing	On-line tool and training
Economic Input-Output Life Cycle Assessment (EIO-LCA) Model	Carnegie Mellon	EIO-LCA estimates materials and energy resources required for, and environmental emissions resulting from economic activities related to those materials	Individuals or organizations seeking to tie GHG emission reductions to materials	On-line tool (1997 and 2002 versions)
Office Carbon Footprint Tool Calculator (WasteWise)	U.S. EPA Waste Wise	This tool assists offices in making decisions to reduce their greenhouse gas (GHG) emissions associated with their activities, and includes examples of carbon-cutting actions such as recycling, waste prevention, and green power purchasing	Offices seeking to understand their inventory and GHG emissions	Downloadable tool
Energy Star Portfolio Manager	EPA, Energy Star, Climate Protection Partnership Division,	Portfolio Manager calculates energy and water consumption within individual buildings as well as across an entire building portfolio and provides a score on how a business is doing with respect to energy consumption	Those who own, manage, or hold properties for investment	On-line services; webinars, presentations, and pre-recorded trainings
Clean Air Cool Planet Campus Calculator	Clean Air Cool Planet	This tool contains projection and solutions modules, designed to aid schools that have completed GHG inventories, in developing long term, comprehensive climate action plans based on those inventories; it facilitate analysis of carbon reduction options, determining project payback times, net present value, cost per ton reduced, and other relevant markers	Campuses	Downloadable spreadsheet file and guidance document
State Inventory and Projection Tool	U.S. EPA State and Local Climate and Energy Program	This interactive spreadsheet model designed to help states develop GHG emissions inventories via a state inventory tool and a projection tool. The State Inventory Tool (SIT) gives users the option of applying their own state-specific data or using default data pre-loaded for each state. The Projection Tool allows users to create a simple forecast of emissions through 2020 based on historical emissions and projections of future energy consumption, population, and economic factors.	State government	Request a copy online
Landfill Methane Outreach Program (LMOP) Benefits Calculator	U.S. EPA, Climate Change Division, Office of Atmospheric Programs	The Landfill Methane Outreach Program Benefits Calculator calculates the direct emissions reductions and the avoided emissions (from electricity generation) of landfill methane projects	LMOP partners and managers of LFGTE projects	On-line tool and services
Electronics Environmental Benefits Calculator	Federal Electronics Challenge (under U.S. EPA)	The EEBC estimates the environmental and economic benefits of purchasing Electronic Product Environmental Assessment Tool (EPEAT)-registered products, in addition to improvements in equipment operation and end-of-life management practices. The calculator estimates numerous environmental improvements including CO2/Greenhouse gas emission reductions.	Organizations interested in estimating the environmental benefits of greening their purchase, use and disposal of electronics	On-line tool and instructions

6.3 Appendix C: Glossary

The glossary in this appendix was provided courtesy of Greenhouse Gas Protocol Initiative.

Audit trail: Well-organized and transparent historical records documenting how an inventory was compiled.

Baseline: A hypothetical scenario for what GHG emissions, removals or storage would have been in the absence of the GHG project or project activity.

Base year: A historic datum (a specific year or an average over multiple years) against which a company's emissions are tracked over time.

Boundaries: GHG accounting and reporting boundaries can have several dimensions (i.e., organizational, operational, geographic, business unit and target boundaries). The inventory boundary determines which emissions are accounted and reported by the company.

Carbon footprint: The total set of greenhouse gas emissions caused by an organization, event, product or person.

Control: The ability of a company to direct the policies of another operation. More specifically, it is defined as either operational control (the organization or one of its subsidiaries has the full authority to introduce and implement its operating policies at the operation) or financial control (the organization has the ability to direct the financial and operating policies of the operation with a view to gaining economic benefits from its activities).

CO_2 equivalent (CO2e): The universal unit of measurement to indicate the global warming potential (GWP) of each of the six greenhouse gases, expressed in terms of the GWP of one unit of carbon dioxide. It is used to evaluate releasing (or avoiding releasing) different greenhouse gases against a common basis.

Direct GHG emissions: Emissions from sources that are owned or controlled by the reporting company.

Emissions: The release of GHG into the atmosphere.

Fugitive emissions: Emissions that are not physically controlled but result from the intentional or unintentional releases of GHGs. They commonly arise from the production, processing transmission storage and use of fuels and other chemicals, often through joints, seals, packing, gaskets, etc.

Green power: A generic term for renewable energy sources and specific clean energy technologies that emit fewer GHG emissions relative to other sources of energy that supply the electric grid. Includes solar photovoltaic panels, solar thermal energy, geothermal energy, landfill gas, low-impact hydropower and wind turbines.

Greenhouse gases (GHG): For the purpose of this guide, the six gases listed in the Kyoto Protocol: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulfur hexafluoride (SF_6).

GHG program: A generic term used to refer to any voluntary or mandatory international, national, subnational, government or nongovernmental authority that registers, certifies or regulates GHG emissions or removals outside the company.

GHG project: A specific project or activity designed to achieve GHG emission reductions, storage of carbon or enhancement of GHG removals from the atmosphere. GHG projects may be standalone projects, or specific activities or elements within a larger non-GHG-related project.

Indirect GHG emissions: Emissions that are a consequence of the operations of the reporting company, but occur at sources owned or controlled by another company.

Inventory: A quantified list of an organization's GHG emissions and sources.

Inventory boundary: An imaginary line that encompasses the direct and indirect emissions that are included in the inventory. It results from the chosen organizational and operational boundaries.

Inventory quality: The extent to which an inventory provides a faithful, true and fair account of an organization's GHG emissions.

Mobile combustion: Burning of fuels by transportation devices, such as cars, trucks, trains, airplanes, ships, etc.

Operational boundaries: The boundaries that determine the direct and indirect emissions associated with operations owned or controlled by the reporting company. This assessment allows a company to establish which operations and sources cause direct and indirect emissions, and to decide which indirect emissions to include that are consequences of its operations.

Organizational boundaries: The boundaries that determine the operations owned or controlled by the reporting company, depending on the consolidation approach taken (equity or control approach).

Process emissions: Emissions generated from manufacturing processes, such as the CO_2 that arises from the breakdown of calcium carbonate ($CaCO_3$) during cement manufacture.

Renewable energy: Energy taken from sources that are inexhaustible (e.g., wind, water, solar, geothermal energy and biofuels).

Reporting: Presenting data to internal management and external users, such as regulators, shareholders, the general public or specific stakeholder groups.

Scope: Defines the operational boundaries in relation to indirect and direct GHG emissions.

Scope 1 inventory: A reporting organization's direct GHG emissions.

Scope 2 inventory: A reporting organization's emissions associated with the generation of electricity, heating/cooling or steam purchased for its own consumption.

Scope 3 inventory: A reporting organization's indirect emissions other than those covered in Scope 2.

Stationary combustion: Burning of fuels to generate electricity, steam, heat or power in stationary equipment, such as boilers, furnaces, etc.

Target boundary: The boundary that defines which GHGs, geographic operations, sources and activities are covered by the target.

Verification: An independent assessment of the reliability (considering completeness and accuracy) of a GHG inventory.

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