Protocol and Preliminary Greenhouse Gases (GHG) Emissions Inventory

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Abstract

This research project is created to build the protocol and the preliminary corporate GHG emissions inventory for Steelcase, Inc., global leader in the office environments industry headquartered in Grand Rapids, Michigan. In October 2005 Steelcase joined the Climate Leaders Program (CL), a voluntary industry-government partnership, created by the US Environmental Protection Agency (EPA). Partner companies develop a corporate-wide GHG inventory of the six major gases – carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride from both direct and indirect emission sources, and design a corporate GHG emissions reduction strategy with reduction goals to be attained over the next 5 to 10 years.

Operational boundaries of the inventory incorporate all business units and subsidiaries that are under full operational control of Steelcase, Inc. Organizational boundaries include all CO_2, CH_4, N_2O and HFC emissions from core direct and core indirect sources. GHG emissions data are collected and analyzed by fuel source using facility-specific approach with 2004 base year. Calculation methodology is based on the emissions factors approach, with final results measured in metric tons of carbon dioxide equivalents (MT CO2e). The preliminary estimate of the total corporate GHG footprint for 2004 is 188,000 MT CO2e with 26% originating from direct and 74% from indirect emissions sources. The inventory identifies manufacturing, corporate, and transportation as the three most carbon intensive operations. They account for 61.6% (115,710 MT CO2e), 20.1% (37,684 MT CO2e) and 7% (10,516 MT CO2e) of emissions, respectively. Most of the GHG footprint comes from electricity use (139,136 MT CO2e or 75% of all emissions) and natural gas combustion (27,811 MT CO2e or 15% of all emissions).

The protocol is designed to institutionalize the process for collecting, calculating, maintaining, and reporting corporate GHG emissions data at Steelcase. Corporate deliverables include the Inventory Management Plan and the GHG Inventory. Finally, the author provides an overview of other voluntary GHG reduction programs in the US and a general discussion of policy and market drivers that influence corporate climate change strategies.

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The author wants to thank Steelcase, Inc. for undertaking this challenging project and committing their resources to building a sustainable enterprise. Especially, he wants to thank David Rinard, Director of Corporate Environmental Performance, and Allan Smith, Director of Corporate Marketing and Communications, for their consistent commitment. Finally, the author wants to express his deep appreciation to Lynn Avery Zimmerman and William Bulkowski for their dedication and unwavering enthusiasm that were instrumental to the overall success of this project.

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Chapter I: Introduction

In October 2005 Steelcase, Inc joined the Climate Leaders (CL), a voluntary industry-government partnership, created by the US Environmental Protection Agency (EPA). This initiative commits the company to develop a corporate-wide Greenhouse Gases (GHG) Emissions Inventory that includes all emission sources of the six major gases (CO_2, CH_4, N_2O, HFCs, PFCs, SF_6) using the Climate Leaders GHG Inventory Protocol. Steelcase will develop a corporate Inventory Management Plan (IMP) to guide the inventory design and the GHG emissions data collection process. Moreover, the company will build the GHG Emissions Reduction Strategy with reduction goals to be achieved over the next 5 to 10 years. Successful implementation of these goals will position Steelcase at the forefront of the office furniture manufacturing industry as it becomes the second company to achieve a comprehensive GHG emissions reduction strategy.[1]

This master's practicum project is dedicated to the first phase of the CL GHG Inventory Protocol. The author created a preliminary corporate wide (limited to Steelcase's North American operations) GHG inventory following guidelines and standards prescribed by the CL Program. Furthermore, the author designed the Inventory Management Plan (IMP) that will provide review of methodological assumptions, data collection and analysis, and project management criteria. Successful implementation of the inventory will enable Steelcase to assess its energy demands at all North American industrial sites and office facilities that are included in the inventory. This assessment will pave the way to a comprehensive, corporate-wide GHG emissions reduction strategy.

[1] Another office furniture manufacturer Haworth has also joined CL with the pledge to reduce its US GHG emissions by 20% per dollar sales from 2004 to 2009.

Chapter II: Steelcase, Inc. – Corporate Profile

Steelcase, Inc. (NYSE: SCS) is the global leader in the office environments industry, with headquarters in Grand Rapids, Michigan.[2] Founded in 1912, Steelcase serves customers through a network of more than 900 independent dealers supported by approximately 14,000 employees worldwide, and manufacturing facilities in over 35 locations around the world. Fiscal 2005 revenue was US$ 2.6 billion.

Since 1912 Steelcase has adopted environmental stewardship as one of their core corporate values and has integrated environmental criteria in all of their business activities:

- Products
- Activities (manufacturing, facilities management)
- Services (packaging, distribution, installation)
- People (employees, customers, community members)

Overall, the company has maintained its environmental ethic by focusing on reducing their ecological footprint through proactive strategies in pollution prevention, energy efficiency, and material intensity and waste reduction. In 2001 Steelcase wood furniture plant in Michigan became the first LEED certified manufacturing facility in the world. In 2003 Steelcase became a nearly VOC-free manufacturer. Currently, two plants in USA and six plants EU are ISO 14001 certified. The company plans to have all of its manufacturing facilities ISO 14001 certified by the end of 2008.

Recognizing its role as a multinational, global corporation, Steelcase participates in a number of strategic environmental and socially responsible programs in addition to maintaining a strong presence in industry-led and government-sponsored partnership programs. Since 1993 the company has partnered with McDonough Braungart Design Chemistry's (MBDC) to expand the environmental assessment of its products. In 2005 Steelcase became the first office furniture company to receive the new MBDC Cradle to Cradle™ Product Certification. The silver level certification recognizes Steelcase's Think chair, which is comprised of 99% recyclable content and is made of up to 41% recycled materials, for its implementation of ecologically intelligent materials and cradle-to-cradle product design. The C2C methodology builds on the successful "Design for the Environment" (DfE) process that examines 19 human and environmental health criteria.

In addition, Steelcase has formed strategic partnerships with the Center for Sustainable Systems (CSS)[3] at the University of Michigan and with the University of Denmark to develop industry-leading life-cycle analysis (LCA) metrics. In 2005 CSS research assistant Bernhard A. Dietz delivered a master's thesis on life cycle assessment of environmental impacts of three office furniture systems. More LCA studies of other Steelcase products will be conducted in the future as Steelcase has begun to incorporate life cycle thinking into its design and manufacturing processes. Finally, many of Steelcase's systems, seating, storage, and architectural products have

[2] More information about Steelcase, its market and environmental profiles can be accessed through the http://www.steelcase.com/na/

[3] Additional information about the CSS and its research activities can be obtained from visiting its website http://www.css.snre.umich.edu/

achieved GREENGUARD certification for indoor air quality. The GREENGUARD Environmental Institute™ (GEI) has established the GREENGUARD Certification Program™, the world's only independent, third-party testing program for low-emitting products and materials. Steelcase supports the International Design Center for the Environment along with 21 voluntary programs with partners from federal, state and local governments, corporations, NGOs and industry associations, including:

- EPA Climate Leaders Program
- EPA Waste Wise Program
- EPA Green Power Partnership (founding member)
- EPA Green Suppliers Network Program
- BIFMA – Business and Institutional Furniture Manufacturers Association (Indoor Air Quality Committee; Government and Environmental Affairs Committee)
- West Michigan Clean Air Coalition
- Air and Waste Management Association
- West Michigan Environmental Action Council
- West Michigan Sustainable Business Forum
- U.S. Green Building Council

Chapter III: EPA Climate Leaders Program – Overview

Climate Leaders (CL) is a voluntary EPA industry-government partnership that works with companies to develop long-term, comprehensive climate change mitigation strategies.[4] The emissions accounting methodologies, first developed by the GHG Protocol Program, were adopted, with minor revisions, by the EPA to fit unique circumstances of the US industries.[5] Partners that come from a wide range of manufacturing and services industries design an inventory of their GHG emissions and set a corporate-wide GHG reduction goal. The inventory allows companies to report data annually in a transparent and consistent way and monitor their reduction progress. The program enables companies to anticipate future emergence of carbon trading markets and strategically position themselves as climate change policy unfolds. Furthermore, partners identify themselves as corporate environmental leaders and put pressure on other companies to develop proactive climate change mitigation strategies.

CL partners develop a corporate-wide GHG inventory of the six major gases – carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6) from both direct and indirect sources. The program offers one main reporting standard through an Inventory Management Plan (IMP) that must be reviewed and approved by the EPA. The IMP defines organizational and operational boundaries of the inventory, and specifies data collection, calculation methodology, data review and quality control procedures. The EPA offers substantial flexibility in reduction goal setting by recognizing that every company has a unique set of GHG emissions sources, market pressures and reduction opportunities. Partner companies must achieve their stated reductions within a 5-10 year period. A reduction goal is set based on an individualized base-year emissions level. The goal can be stated in absolute emissions reduction or it can be normalized per dollar value of product. All partners report their direct emissions from onsite fuel consumption and waste disposal, process-related emissions, and indirect emissions from electricity use. Partners can broaden their management scope to optional activities (e.g., offset investments, employee commuting, international operations), which will also count toward their reduction goal.

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[4] More information can be obtained at http://www.epa.gov/climateleaders/index.html

[5] The GHG Protocol Program is discussed in greater detail in Chapter 4, Section 4.1.

Chapter IV: Other US Voluntary GHG Emissions Reduction Programs

Section 4.1 – The GHG Protocol Initiative[6]

The GHG Protocol Initiative was developed in 1998 by the multi-stakeholder partnership of businesses, NGOs, governments, and academics convened by the World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSD). As the first such effort of its kind, the program's mission was to create a methodology and a process that companies can use to account for their GHG footprint. The GHG Protocol consists of two separate but linked modules:

- The GHG Protocol Corporate Accounting and Reporting Standard ("Corporate Standard")
- The GHG Protocol for Project Accounting ("Project Protocol")

Both modules are designed to provide participating companies the necessary guidance and technical support in reporting their emissions inventories and reductions.

"Corporate Standard" is used by companies as a methodology to track and analyze GHG emissions over time in a consistent and transparent manner. Overall, it provides the following assistance:

- How to establish the organizational and operational boundaries of a reporting entity
- How to distinguish between direct and indirect emissions and what indirect emissions to report
- How to establish and adjust a base year and to determine emissions inventory in accordance with corporate historic emissions recalculation policy
- How to set corporate-wide emissions reduction targets
- How to manage data quality and choose verification options
- What information is included in a public GHG inventory report

"Project Protocol" is a unique offering among other voluntary GHG emissions inventory programs. It provides a tool for determining the overall benefits of climate change mitigation projects undertaken by partner companies. Furthermore, it creates a platform for harmonization among different project-based GHG initiatives and develops common accounting metrics, concepts and principles. It is also designed to offer guidance on how to account for a GHG project's unintended effects on GHG emissions or removals (sometimes called leakage). Finally, it has provisions for project monitoring and reporting of compliance.

[6] Additional information about the program can be obtained from http://www.ghgprotocol.org/templates/GHG5/layout.asp?MenuID=849

Section 4.2 – The World Wildlife Federation (WWF) Climate Savers[7]

The Climate Savers program was jointly developed by the World Wildlife Fund (WWF) and the Center for Energy and Climate Solutions.[8] The program provides technical guidance and gives companies access to leading experts on the best technologies and most innovative strategies for reducing primarily CO_2 emissions in cost-efficient and profitable ways. Companies join voluntarily and work with the Climate Savers' principles to develop customized strategic climate and energy management plans. These emissions reduction strategies include the following options:

- increase the efficiency of buildings and factories,
- utilize combined heat and power to increase energy efficiency and lower energy costs,
- purchase electricity from renewable energy sources,
- integrate next-generation efficiency measures into the design of new buildings, factories, products, and services
- optimize existing manufacturing processes using advanced environmental assessment techniques
- educate employees, customers, and suppliers
- promote adoption of best practices

Each company enters into a customized agreement with the program. It commits to a CO_2 emissions reduction goal and the Climate Savers program helps companies to develop a customized reduction target, baseline, timeline, and emissions tracking methodology depending on the company's history, track-record of environmental leadership, and their level of sophistication in environmental reporting. Participating companies are obligated to obtain independent verification of current CO_2 emissions to determine a baseline for performance. It is further expected that each company will have an independent verification of its CO_2 emissions every two years, with credible project-related emissions reductions available on a continuous basis. Partner companies measure their progress against other companies internationally. In addition to CO_2 reduction projects companies are obligated to educate other organizations by sharing best practices and participating in annual information exchange workshops.

Section 4.3 – US DOE Voluntary Reporting of GHG (1605(b)) Program[9]

Under the Energy Policy Act (EPAct) of 1992 Section 1605(b) program, companies can voluntarily undertake action to lower their GHG footprint, either by lowering GHG emissions or by sequestering carbon. The program consists of two related, but distinct parts, with companies having the option of reporting one or both requirements:

- Annual GHG inventory
- Specific projects to reduce GHG emissions and increase carbon sequestration.

[7] More information is available at http://www.worldwildlife.org/climate/projects/climateSavers.cfm.
[8] Additional information on the center is available at http://www.energyandclimate.org/
[9] More information is available at http://www.eia.doe.gov/oiaf/1605/frntvrgg.html

The DOE created the general guidelines to help companies align their emissions reporting with the program's requirements that include conversion factors and default emissions factors. These guidelines initially provide for reporting four types of greenhouse gases: carbon dioxide, methane, nitrous oxide, and halogenated substances. Reporting companies decide on the organizational (i.e., company-wide or entity-based reporting) and operational (i.e., direct and/or indirect emissions are reported) scope of the GHG inventory. Historic baseline is based on best available emissions data for 1987 through 1990, and annual emissions for subsequent years. Reporting companies also receive guidance on emissions reduction project analysis and strategies (e.g., industrial cogeneration project, energy efficiency project, and new electricity generating capacity, etc.). Furthermore, companies obtain assistance on reporting strategies, such as joint reporting (i.e., with two or more entities responsible for performance), independent third-party reporting, international projects, confidentiality, certification of results and data collection and management systems. Specific guidelines are available for different economic sectors:

- Electricity Supply Sector
- Residential and Commercial Buildings Sector
- Industrial Sector
- Transportation Sector
- Forestry Sector
- Agricultural Sector

Chapter V: US Corporations Begin to Address Climate Change

Section 5.1 – Market and Policy Drivers

Despite the reluctance of the US Congress and the current Administration to ratify the Kyoto Protocol many forward-looking US-based corporations are developing rigorous climate-related market risk/benefit assessments that serve as the foundation for corporate climate change strategies. To date, over sixty companies, with net revenues of roughly US$ 1.5 trillion, have set GHG emissions reduction targets.[10] Despite the uncertainty regarding future US climate change policy companies want to prepare for long-term policy trends and realize economic benefits of early climate change action. Various political drivers and market incentives induce companies to preempt future climate change regulations. First, marketplace pressures in the form of shareholder and investors' concerns about business risk associated with corporate governance, sustainable development, and "green" supplier standards have become of critical importance to private companies. Furthermore, as part of a corporate management and long-term investment strategy, GHG considerations have started to be incorporated into the company's capital investment decision making, and assessed in the context of prospective acquisitions and mergers. Second, burgeoning carbon cap-and-trade markets in the EU are paving the way to a new corporate worldview that treats carbon as an asset measured in US dollars per ton. These emerging market opportunities provide potential competitive advantages associated with climate change mitigation strategies. Third, international climate change policies and regulations by several state governments in the US have targeted GHG emissions from large industrial and commercial emitting sources. Fourth, wide adoption of corporate social and environmental responsibility has been driven by demand for public disclosure. The "triple bottom line" philosophy of economic, social and environmental responsibility that has been largely viewed as the corporate response to these public pressures is being widely adopted by many leading companies, thus raising the standards across industries and sectors. As a result, corporations are held accountable for their performance based on contributions to economic prosperity, environmental quality and social equity.[11] All of these drivers have created a trend among the US companies towards designing GHG emissions inventories and committing to voluntary emissions disclosure and reduction.

One of the primary market drivers has been stakeholder pressure demanding more detailed disclosure of business risks and opportunities associated with global warming. These actions have resulted in a push for greater accountability facilitated by a disclosure of corporate GHG emissions profiles and estimates of costs to reduce them. Supporters of this view often have argued that reductions in GHG emissions may result in cost savings (via lower energy consumption and material intensity) and provide hedging mechanisms against the risk of future

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[10] Andrew J. Hoffman, Climate Change Strategy: The Business Logic Behind Voluntary GHG Reductions *(California Management review, Spring 2005, 47 (3))*

[11] Lorinda Rowledge, Russell Barton, and Kevin Hardy, *Mapping the Future – Case Studies in Strategy and Action Toward Sustainable Development* (Greenleaf Publishing Limited, 1999)

climate change related events and climate change policies.[12] In fact, in 2003 ten large institutional investors that collectively manage over US$ 1 trillion in assets formed the Investor Network on Climate Risk (INCR)[13]. In 2005 the INCR launched a global Investor Call for Action pressing corporations to provide full disclosure of the risks and opportunities vis-à-vis climate change. In other words, investors have begun to demand from companies to adopt forward-looking investment decisions driven by future climate change polices and markets. Finally, companies no longer desire to purchase only environmentally preferable products and services. They demand from suppliers to demonstrate superior organizational environmental performance that goes beyond compliance and can often be demonstrated with adoption of environmental management systems and other sustainability strategies. Companies want to reduce their exposure to possible supply chain interruptions and to limit extended liability for the environmental performance of their products.[14]

International climate change policymaking has been highlighted by the ratification of the Kyoto Protocol in February 2005 and the inception of the EU GHG Emissions Cap-and-Trade Scheme. Multinational US-based corporations with facilities in the EU are forced to take critical steps to evaluate the impacts of these policies on their future operations and develop new compliance mechanisms.[15] Many corporations respond by applying the same "best practices" standards worldwide, thus minimizing transaction and compliance costs, and gaining economies of scale.[16] Some companies, as they expect future regulations to impose serious financial costs related to GHG emissions, make lower-emissions investments today and, therefore, mobilize to increase their profits in a future climate constrained economy, even if emissions are not regulated today.[17]

At the state and local levels governments are stepping up their regulatory policies in the absence of a national coherent climate change strategy. For example, between 1997 and 2002, Washington, Oregon, Massachusetts and New Hampshire all mandated existing or new power plants reduce or offset their CO2 emissions to levels up to 20%. In New Jersey and Wisconsin, certain large industrial sources have been required to create GHG inventories and disclose GHG emissions. So far, 38 states have completed GHG emissions inventories with estimates of total sources across all sectors within a state; 23 states have created Climate Action Plans detailing steps to reduce their contributions to climate change.[18] In addition, eleven northeastern states have established the Northeastern Emissions Trading Scheme, a market-based cap and trade program for CO_2 emissions from fossil-fuel fired power plants. Finally, the state of California

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[12] Boosting efficiency through environmental strategies is primarily done as part of broad Environmental Management Strategies. Robert Sroufe, Steven Melnyk, and Gyula Vastag, *Environmental Management Systems as a Source of Competitive Advantage* (Broad School of Management, Michigan State University, 1999); http://www.bus.msu.edu/erm/assets/images/EMS-CA.pdf

[13] INCR - http://www.incr.com/

[14] Dayna Simpson, *Greening Beyond the Firm: Improving Environmental Performance Through the Supply Relationship* (University of Melbourne, 2003); http://www.nzsses.org.nz/conference/Session5/54%20Simpson.pdf

[15] David Levy and Sandra Rothenberg, Corporate Strategy and Climate Change: Heterogeneity and Change in the Global Automobile Industry (*Global Environmental Assessment Project, 1999*; Kennedy School of Government, Harvard University); http://www.ksg.harvard.edu/gea/pubs/e-99-13.pdf

[16] Nigel Roome, *Sustainability Strategies for Industry* (Washington DC: Island Press, 1998)

[17] Douglas Cogan, Corporate Governance and Climate Change: Making the Connection (*CERES Sustainable Governance Project Report, 2003*); http://www.ceres.org/pub/docs/Ceres_corp_gov_and_climate_change_0703.pdf

[18] US EPA; http://yosemite.epa.gov/oar/globalwarming.nsf/content/ActionsStateActionPlans.html#CA

created the Climate Action Registry, a voluntary program for businesses to estimate and report their direct and indirect GHG emissions. State governments are important drivers of environmental policy and their influence on policymaking cannot be underestimated. States already implement many federal environmental laws; they currently issues more than 90 percent of all environmental permits and conduct more than 75 percent of all environmental enforcement actions.[19]

Among the most significant evolutions of environmental governance has been an increased reliance on market-based approaches and voluntary agreements.[20] The EU has established a fully-operational CO_2 emissions trading scheme. The US government has a successful SO_2 emissions trading program. The inherent flexibility of choosing GHG emissions reduction options induces business to be creative and active in trading emission allowances in search of lowest mitigation cost options. This reduces the overall social cost of compliance and encourages capital investment and technological innovation.

Section 5.2 – Strategic Business Value of Corporate Action on Climate Change

Capturing the business value of climate change mitigation strategies requires a fundamental paradigm shift in corporate decision-making. This new approach necessitates strategic assessment of business operations from the point of corporate-wide and facility-specific GHG emissions, energy efficiency, technology assessments, and carbon trading, among others. Most innovative firms have considered strategic opportunities from voluntary GHG emissions reductions based on the following market and policy considerations:[21]

- operational improvement
- future climate change regulations
- new sources of capital
- improved risk management
- improved corporate reputation and brand image
- market share gains
- enhanced human resource management

Voluntary adoption of GHG inventories and emissions reduction plans provides a valuable pathway for companies to understand their GHG footprint. These tools can help corporations to find the most cost-effective ways of both corporate–wide and facility-specific emissions management and reduction. Moreover, this process feeds on existing and popular lean manufacturing principles and design-for-environment, as it helps to promote innovation and efficiency gains through redesign of business operations. As a result, cost savings (*bottom line* approach) and potential market share gains (*top line* approach) can be achieved through

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[19] Barry G. Rabe, *Statehouse and Greenhouse: The Emerging Politics of American Climate Change Policy* (Washington DC: The Brookings Institution, 2004)
[20] Michael Margolick and Doug Russell, *Corporate GHG Reduction Targets* (2001 Report, Pew Center on Global Climate Change); http://www.pewclimate.org/docUploads/ghg%5Ftargets%2Epdf
[21] Hoffman (2005)

increased energy and material efficiency, enhanced productivity, higher customer satisfaction and loyalty, and revenues from sales of carbon allowances under a cap-and-trade system.[22] Voluntary action allows companies to adopt a "learning-by-doing" approach as they gain valuable knowledge of GHG emissions management and reduction in a flexible regulatory environment.[23]

Public recognition of leading companies for their environmental performance has rewarded corporations with improved corporate reputation. Setting environmental targets, such as GHG emissions reduction commitments, allows corporations to demonstrate leadership and leverage their environmental strategies in their marketing campaigns and attracting employees.[24] Companies can achieve credibility with various stakeholder groups though transparent and proactive GHG reduction strategies. Full disclosure aims to protect shareholder value as investors are given critical information required to assess potential carbon liabilities and to facilitate a better understanding of climate change-related social and business risks. Finally, corporations can participate in policy agenda setting and political negotiations, thus influencing future regulatory regimes by demonstrating the viability of market-based GHG emissions reductions. Dynamic and forward-looking corporate response to climate change will further increase support for market-oriented environmental policies and help establish realistic and cost-effective baselines.

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[22] Bob Willard, *The Next Sustainability Wave* (Gabriola Island, BC, Canada: New Society Publishers, 2005)
[23] Cedric Philibert, *Technology Innovation, Development and Diffusion* (OECD and IEA Information Paper, 2003)
[24] Sroufe, Melnyk, and Vastag (1999)

Chapter VI: Project Objectives

The primary objective of this project is to calculate and document all GHG emissions that fall within the scope of this effort, subject to data availability and facility-specific reporting. This preliminary information will allow Steelcase, Inc. (SCS) and key decision-makers within the company to assess corporate GHG footprint. The design of the inventory is compatible with the reporting requirements and obligations borne by SCS as a full-fledged partner of the Climate Leaders (CL) Program. This project will deliver the GHG emissions assessment in the form of the corporate-wide GHG Emissions Inventory (limited to North-American operations with Canada and Mexico included) and the Inventory Management Plan (IMP). The inventory will track emissions by facility-based activity and fuel source. It will also include an emissions tracking tool that records the company's annual progress over time towards its reduction goal. The IMP will outline a transparent, consistent and verifiable process of emissions data management and reporting.

This project is an ambitious undertaking that reflects Steelcase's commitment to remain an environmental leader in the industry. Prior to joining the CL Program, corporate global energy consumption declined by 46 percent, which resulted in GHG emissions reduction by 41 percent between 2001 and 2005. This progress was achieved through plant consolidation and the implementation of corporate-wide energy efficiency policy. The results measured in metric tons of CO2 equivalents (MT CO2e) are represented in the Appendix 1 and cover corporate global operations. SCS is already a long-standing partner in other EPA programs; partnership with the CL will further develop this valuable relationship. GHG emissions reductions will complement already existing corporate directives on energy technology assessments and energy efficiency goals. Most importantly, this project is the first step in a Corporate Climate Change strategy that is currently under development at SCS.

Chapter VII: Research Process and Scope

The GHG emissions data are collected and analyzed by fuel source using facility-specific approach. The data are obtained based on energy consumption requirements for all SCS operations included in the inventory. Calculation methodology is based on the emissions factors approach, with final results measured in MT CO2e (see Chapter VII, Section 4). As mentioned in Chapter IV the overall scope of the project is aligned with the requirements set forth by the CL Program. The inventory key that describes the process of data collection and assessment methodology is presented in Appendix 2.

Section 7.1 – Organizational Boundaries

For corporate reporting of GHG emissions, the EPA allows companies to use two distinct approaches: *equity share and control*.

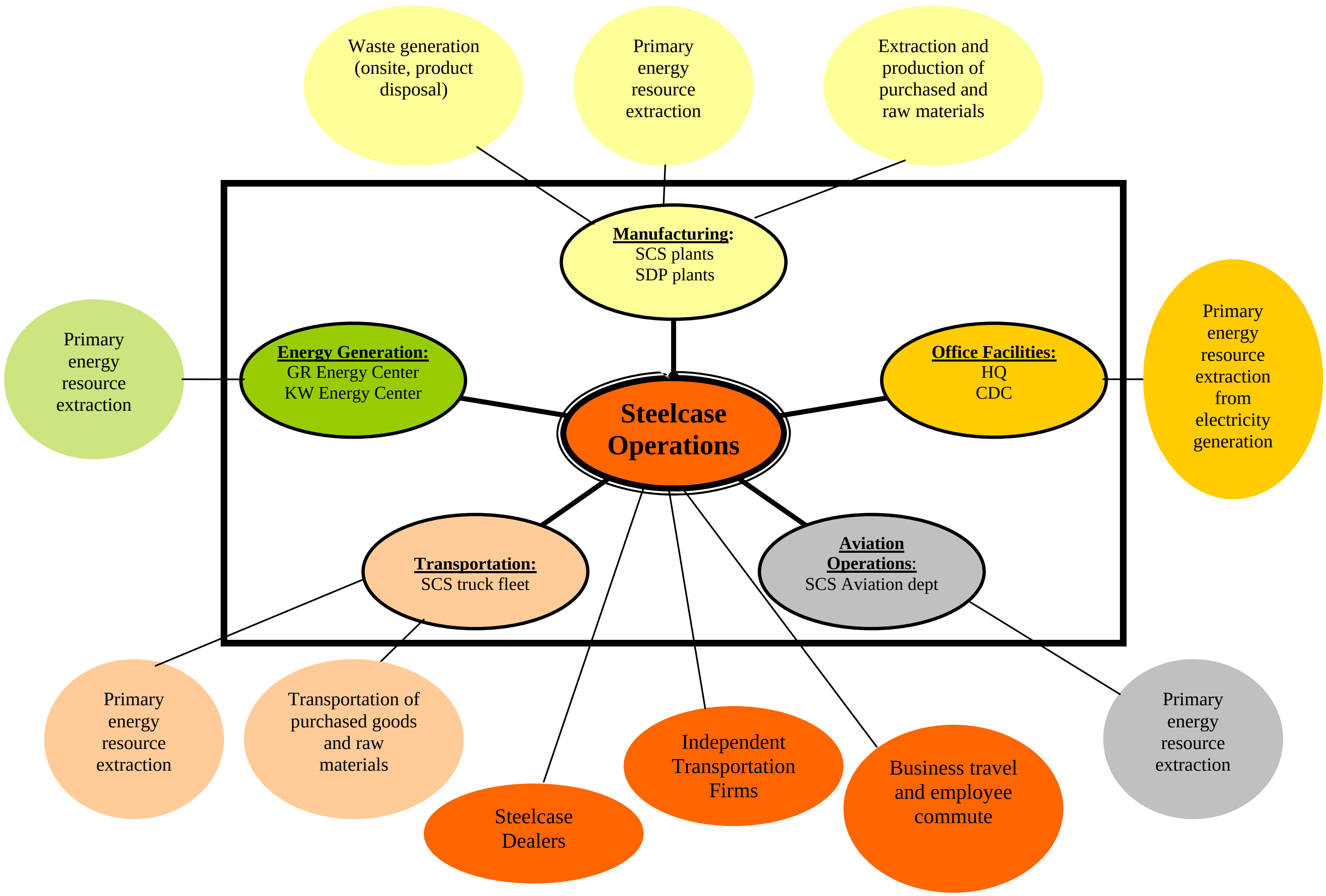
Equity Share Approach: A company shall account for GHG emissions from operations according to its share of equity in an operation. The equity share reflects economic interest, which is the extent of rights a company has to the business risks and rewards accruing from an operation.

Control Approaches: A company shall account for 100 % of GHG emissions from operations over which it has control. It does not account for GHG emissions in which it owns equity but has no control. Control can be defined as a Financial Control or an Operational Control. If *financial control* is exercised a company has the ability to direct financial and operational policies within an operation with the sole purpose of gaining economic benefits from business activities. If *operational control* is exercised, this enables a company to have the full authority to introduce and implement operating policies within a given business entity.

For the purposes of this project, SCS organizational boundaries of GHG emissions reporting will be defined by the *operational control* model. Using this methodology all business entities and facilities over which Steelcase, Inc. has full operational control will be included in the inventory. These include:

- Corporate offices including the Corporate Headquarters (HQ) in Grand Rapids, MI and the Corporate Development Center (CDC) in Kentwood, MI
- Manufacturing facilities the US, Canada and Mexico owned by Steelcase, Inc.
- Manufacturing facilities in the US owned by affiliated companies Steelcase Design Partnerships (SDPs)
- Distribution truck fleet operated by SC Transport, a subsidiary of Steelcase, Inc.
- Onsite energy generation centers in Grand Rapids, MI and Kentwood, MI
- Steelcase Aviation Department owned and operated by Steelcase, Inc.

<u>Figure 1: Operational Boundary (Core and optional emissions sources)</u>



<u>Figure 1 Notes</u>: Emission sources inside the box are core emissions.
Emission sources outside the box are optional emissions that are not included in the inventory.
Primary energy resource extraction includes all upstream processes required to deliver fuels including extraction, processing and delivery.

The operational control model is consistent with the financial and accounting reporting systems currently utilized by SCS. In addition, it provides an accurate portrayal of the economic realities facing Steelcase today. As the company moved away from a vertical integrated business model it has become a nexus of production facilities owned by Steelcase, Inc. and affiliated companies. It must be noted that Steelcase, Inc. owns equity in all of its SDPs. A vast network of dealers is excluded from this inventory. The majority of dealerships are independently owned. In few cases, however, SCS holds majority or minority interest. Regardless of stock ownership status the dealer principals maintain full operational control and have full authority to design and implement new policies. Regional sales offices are also excluded. Steelcase leases office space from dealers but doesn't pay utility bills for these premises. Finally, transportation vendors that currently handle roughly 60% of Steelcase product shipping volume will be excluded from the inventory. These transportation companies are fully independent entities and have full operational control over their operations. For the list of facilities presented by emissions source and fuel type see Appendix 3.

Section 7.2 – Operational Boundaries

The EPA requires SCS to report all *core direct and indirect GHG emissions* from all facilities that fall within the chosen organizational boundary. *Core direct* emissions are GHG emissions that result from stationary, mobile and process-related combustion of fuels. *Core indirect* emissions are GHG emissions that are associated with the import/purchase of electricity and/or steam. The company may opt to include optional direct and indirect emissions in the inventory. The inventory tracks emissions from the following sources:

Core Direct Emissions:
- Fossil fuel combustion onsite from manufacturing processes
- Generation of steam onsite for internal use
- Transportation of products via SCS distribution truck fleet
- Fugitive HFC emissions from mobile and stationary air-conditioning equipment

Core Indirect Emissions:
- Imported/purchased electricity for plants in US, Canada and Mexico

Additional optional GHG emissions reporting, such as total fuel cycle of fossil fuels and electricity generation, employee commute and travel, shipment of purchased materials and goods, and waste disposal, among others, are not included in the inventory.

Section 7.3 – Base Year Calculation and Historic Emissions Recalculation Policy

SCS has chosen 2004 as the baseline for reporting GHG emissions. This year was selected on the basis of data availability for facilities included in the organizational boundaries. The EPA requires partner companies to have a historic emissions recalculation policy that will be consistently applied throughout. According to this policy, the base year 2004 for the 2012 reduction goal will be adjusted for mergers, acquisitions and divestitures according to the CL historic emissions recalculation procedures.[25] Actual annual emissions from an acquisition will be added to the base year and each subsequent year, provided the facility existed in 2004. Actual annual emissions from divestitures will be subtracted from the base year and each subsequent year, provided the facility was included in the organizational boundaries of the inventory. Any merger will be treated as an acquisition with emissions added to the base year and each subsequent year, provided newly added facilities existed in 2004. In an event of organic growth

[25] CL Design Principles, Chapter 5, *Basic Rules for Base Year Emissions Recalculation* (http://www.epa.gov/climateleaders/docs/design_princ_ch5.pdf)

or organic decline no base year adjustments will be made. The ultimate goal is to maintain the environmental integrity of the GHG emissions inventory and to provide credible and relevant information to the CL Program. It is the responsibility of Steelcase to provide the following:

(1.) Clearly state and comply with a "*significant threshold*" that triggers recalculation of historic emissions.
(2.) Find either qualitative or quantitative, or both, criterion to identify a "*significant change*" to the data, inventory boundary, collection methods, or scientific factors.

Significance threshold creates a transparent and consistent emissions tracking process that reflects future market realities, advancement of science and improvements in data collection and availability, and corporate structural changes (e.g., acquisitions, divestments, mergers, restructuring, etc.). *The significance threshold is set at 1% of base year corporate GHG emissions.* The EPA provides specific rules for base year and historical emissions recalculations (also see Table 1).[26]

Table 1: Historical Emissions Recalculation Guidance (EPA CL)

Condition	Base Year Recalculation Action
Mergers, Acquisitions, Divestitures	
(1.) Acquisition of (or insourcing) a facility that existed during the base year	Add the new facility's emissions generated during the base year to overall entity base year emissions, unless the now insourced operation was already included in the inventory as an optional emission
(2.) Acquisition of (or insourcing) a facility that did not exist during the base year	No base year recalculation is needed
(3.) Divestiture of (or insourcing) a facility that existed during the base year	Subtract the divested facility's emissions generated during the base year from overall entity base year emissions, unless the now outsourced operation is still included in the inventory as an optional emission
(4.) Divestiture of (or insourcing) a facility that did not exist during the base year	No base year recalculation is needed
(5.) Transfer of control of emissions sources. This includes changes in lease status.	Increased ownership shall be treated the same as a new acquisition; decreased ownership shall be treated the same as a divestiture
Organic Growth and Decline	
(6.) Organic Growth: - Increase in production output - Changes in product mix resulting in increased emissions	No base year recalculation is needed

[26] This table is taken from the EPA Climate Leaders Design Principles; http://www.epa.gov/climateleaders/docs/climateleadersdesignprinciples.pdf

- Opening of new plants or operating units	
(7.) Organic Decline:	No base year recalculation is needed
- Decrease in production output - Changes in product mix resulting in decreased emissions - Closing of new plants or operating units	
Changes in Quantification Methodologies/Errors	
(8.) Changes in emission factors or methodologies that reflect real changes in emissions (i.e., changes in fuel type or technology)	No base year recalculation is needed
(9.) Changes in measurement or quantification methodologies, improvements in the accuracy of emission factors/activity data, or discovery of previous errors/number of cumulative errors	Recalculate base year emissions to be consistent with new approach or to correct errors

Based on consultations with the EPA and the consulting firm E-Source (EPA's subcontractor that provides technical assistance to CL partners and conducts onsite reviews) SCS has adopted the following modifications to base year GHG emissions recalculation criteria specific to its own business model:

- SCS has adopted lean manufacturing principles throughout the North American operations. This allows for consolidation of production facilities that is accomplished by plant closure. Despite a reduced number of facilities production output can stay the same or may even increase. In an event of such closure, total GHG emissions from a plant are divided into emissions from a building itself and emissions from equipment based on the *70/30 rule* (70% emissions come from plant equipment; 30% of emissions come from a facility).[27] If the old equipment (from a now closed plant) is moved to a new facility the increase in emissions will trigger recalculation if the associated impact exceeds the 1% significance threshold.
- If SCS reduces its distribution truck fleet, which results in outsourcing of shipment needs to independent transportation vendors, this will trigger emissions recalculation if the reduction in GHG emissions exceeds the 1% significance threshold.
- If fuel compositions change over time (i.e., changes in heating values and/or oxidation factors affect changes in emissions factors) this will not trigger emissions recalculation unless required otherwise by the EPA CL.
- In an event of fuel switching to less carbon-intensive fuel sources (i.e., use of biodiesel, biomass, hydrogen, and other fuel types) no emissions recalculation is necessary.

[27] The 70/30 rule was established by the EPA CL and Haworth (office furniture manufacturing firm in Holland, MI) to develop a general emissions recalculation guideline to deal with plant closure driven by consolidation of manufacturing capacity. This guidance was relayed to Steelcase by E-Source as the same issue of plant closure and lean manufacturing came up in the design of corporate GHG emissions recalculation policy.

Section 7.4 – Identification and Calculation of Emissions

The inventory tracks the following GHGs:

- CO_2, CH_4, N_2O, HFC 134a – *core direct emissions sources*, both stationary and mobile (as specified in the operational boundaries)
- CO_2, CH_4, N_2O – *core domestic indirect emissions sources* (as specified in the operational boundaries), except for purchased electricity for US-based plants
- CO_2 – *core international indirect emissions sources* for plants in Canada and Mexico

Other GHGs (e.g., SF_6 and PFCs) are not tracked since there are no significant emissions within the Steelcase operations.

Table 2: Direct Emissions Sources

Fuel Type	Activity
Natural Gas	➢ Ovens and dryers are used for treating parts and pieces before they are powdercoated with paint ➢ Ovens for the curing of powder paint ➢ Make-up air units that warm up air before it enters the plant ➢ Large boilers for steam generation ➢ Small boilers for bathroom facilities onsite ➢ HVAC systems ➢ Hook burn-off ovens used to remove accumulated paint on part hooks
Propane	➢ Large lift trucks used onsite
Diesel	➢ Delivery OTR trucks ➢ Backup generators at the computing centers in HQ and CDC, the Safety Services (Grand Rapids complex), Athens Plant, Fletcher Plant, Steelcase Wood Plant , Vecta Plant, Steeclase Canada Plant (test-fired for 30 min per month) ➢ Diesel powered fire suppression pumps at the Desk and Systems Plants (GR Complex), CDC, Steelcase Wood, Steelcase Canada, Athens Plant, AMEX and Fletcher Plant (test-fired for 30 min per week)
Gasoline	➢ Delivery trucks
Coal	➢ Energy generation centers in Grand Rapids and Kentwood generate steam for process and building heat in the plants
Jet Fuel	➢ Used by the SCS Aviation Department for operation of corporate jets
Distillate Oil #2	➢ Kentwood Energy Center has the capacity to burn #2 oil as a backup fuel in several boilers to produce steam for

	process and building heat in the plants
Residual Oil #6	➢ Kentwood Energy Center has the capacity to burn #6 oil as a backup fuel in several boilers to produce steam for process and building heat in the plants
HFCs - Fugitive Emissions	➢ Refrigerants and air conditioning units

Table 3: Indirect Emissions Sources

Sources	**Activity**
Electrical Grid	➢ Electricity consumption for on site use at all manufacturing plants, energy generation centers, and office facilities

Calculation Methods:

The chosen approach for emissions calculations is based on the application of the EPA default emissions factors. Other methods such as a continuous emissions monitoring system (CEMS) or the fuel analysis approach to determine carbon content of the fuel are not available at this time. However, a CEMS will be installed at the energy centers in Grand Rapids and Kentwood, MI by the end of 2006. As a result, a monitor measuring CO_2 concentration percent by volume of flue gas and a flow monitoring system measuring the volumetric flow rate of flue gas will be used to determine CO_2 mass emissions. Annual CO_2 emissions are then determined based on the operating time of the unit. The emissions factors for direct combustion from stationary and mobile sources are provided by the EPA CL.[28] The emissions factors for indirect combustion from electricity purchases are based on the 2000 eGrid Subregion Emission Rates that divide US electricity grid in 27 subregions.[29] All emissions factors for direct and indirect sources are presented in the excel-based inventory that accompanies this document. For more information consult the following worksheets:

Worksheet 8 -	Direct Mobile Emissions Factors (including fugitive HFC emissions)
Worksheet 9 -	Direct Stationary Emissions Factors (including fugitive HFC emissions)
Worksheet 10 -	US Indirect Emissions Factors (EPA, eGrid 2000)
Worksheet 11 -	International Indirect Emissions (IEA, 2004)
Worksheet 12 -	E-Source Emissions Factors (provided by E-Source)

The CL protocol requires data to be reported in MT CO2e, which are calculated by multiplying the mass of emissions by the global warming potential (GWP) of the specific GHG. Carbon dioxide equivalents are determined by GWPs estimated in the IPCC 1996 Second Assessment Report (SAR). In short, GWPs measure the relative effectiveness of GHGs in

[28] They can accessed through the CL website via Cross Sector Core Modules Guidance;
- Stationary combustion - http://www.epa.gov/climateleaders/docs/stationarycombustionguidance.pdf
- Mobile combustion - http://www.epa.gov/climateleaders/docs/mobilesourceguidance.pdf
- HFCs fugitive emissions - http://www.epa.gov/climateleaders/docs/refrige_acequipuseguidance.pdf

[29] The emission rates for 27 subregions and off-grid generation were obtained from the EPA Climate Leaders (contact person: Vincent Camobreco through a personal communication by Greg Keoleian)

trapping the Earth's heat. For the list of 100-year GWPs of various GHGs see Appendix 4. GWPs for gases tracked by the inventory are: CO_2 (1), CH_4 (21), N_2O (310), and HFC 134a (1300).

Table 4: Calculation examples

a) Direct emissions from stationary sources in metric MT CO2e:

- Quantity of fuel (MMcf/year) x Heat content of fuel (MMBtu/MMcf) = Quantity of fuel (MMBtu/year)
- [Quantity of fuel (MMBtu) x Emission factor (lbs CO_2/MMBtu)] / 2205 = CO_2 Emissions (metric tons)
- [Quantity of fuel (MMBtu) x Emission factor (lbs CH_4/MMBtu)] / 2205 = CH_4 Emissions (metric tons)
- [Quantity of fuel (MMBtu) x Emission factor (lbs N_2O/MMBtu)] / 2205 = N_2O Emissions (metric tons)
- CO_2 Emissions (MT) + [CH_4 Emissions (MT) x 21] + [N_2O Emissions (MT) x 310] = Total emissions $CO_{2\ equivalents}$ (metric tons)

b) Direct emissions from mobile sources in MT CO2e:

- [Miles traveled (mi/year) x Emission factor (grams CO_2/mi)] / 1000 = CO_2 Emissions (kg)
- CO_2 Emissions (kg) / 1000 = CO_2 Emissions (metric tons)
- [Miles traveled (mi/year) x Emission factor (grams CH_4/mi)] / 1000 = CH_4 Emissions (kg)
- CH_4Emissions (kg) / 1000 = CH_4 Emissions (metric tons)
- [Miles traveled (mi/year) x Emission factor (grams N_2O /mi)] / 1000 = N_2O Emissions (kg)
- N_2O Emissions (kg) / 1000 = N_2O Emissions (metric tons)
- CO_2 Emissions (MT) + [CH_4 Emissions (MT) x 21] + [N_2O Emissions (MT) x 310] = Total emissions $CO_{2\ equivalents}$ (metric tons)

c) Direct fugitive HFC emissions from stationary and mobile AC units in MT CO2e:

- [HFCs in chiller (kg HFC/tons of cooling) x Annual HFC leakage factor (%)] / Average cooling capacity of chiller (ft2/tons of cooling) = Total annual HFC losses (MT HFC/1000 ft2)
- Total annual HFC losses (MT HFC/1000ft2) x 1300 = Total annual HFC losses (MT $CO_{2\ equivalents}$/ 1000 ft2)
- Total annual HFC losses (MT $CO_{2\ equivalents}$/ 1000 ft2) / 1000 = Total annual HFC losses (MT $CO_{2\ equivalents}$/ ft2) = Emissions factor per ft2
- Facility air-conditioned area (ft2) x Emissions factor (MT $CO_{2\ equivalents}$/ ft2) = Facility fugitive HFC emissions (MT $CO_{2\ equivalents}$)

- [HFC capacity (kg HFC) x Annual leakage factor (%)] x 1300 (GWP) = Emissions ($CO_{2\ equivalents}$/yr)
- Total annual miles (VMT/year) / [fuel economy (mi/gal) x CO_2 Emission factor (kg CO_2/gal) = CO_2 Emissions (kg CO_2/yr)
- Emissions ($CO_{2\ equivalents}$/yr) / CO_2 Emissions (kg CO_2/yr) = HFC Emission factor (HFC emissions ($CO_{2\ equivalents}$) to CO_2 (as %)
- Annual facility CO_2 Emissions (MT) x HFC Emission factor (HFC emissions ($CO_{2\ equivalents}$) to CO_2 (as %)) = Facility fugitive HFC emissions (MT $CO_{2\ equivalents}$)

Note 1: Floor space for stationary combustions in measured in ft2.
Note 2: Each plant (including truck garages) has an air-conditioned office space that amounts to 25% of the total facility square footage. This 25/75 benchmark will be used to estimate stationary HFC emissions from all plants and truck garages.

d) Indirect emissions from electricity purchase in MT CO2e:

- [Electricity used (kWh/year) x Regional Emission factor (lbs CO_2/kWh)] / 2205 = CO_2 Emissions (metric tons)
- [Electricity used (kWh/year) x Regional Emission factor (lbs CH_4/kWh)] / 2205 = CH_4 Emissions (metric tons)
- [Electricity used (kWh/year) x Regional Emission factor (lbs N_2O/kWh)] / 2205 = N_2O Emissions (metric tons)
- CO_2 Emissions (MT) + [CH_4 Emissions (MT) x 21] + [N_2O Emissions (MT) x 310] = Total emissions $CO_{2\ equivalents}$ (metric tons)

Note: Regional emission factors are obtained from the 2000 eGrid Subregion Emission Rates database

All of the above calculations are used in the emissions calculations that are included in the corporate GHG Inventory. The data is tracked by a fuel type and facility. All results are reported in MT CO2e and are linked to the GHG Emissions Tracking Tool which analyses annual emissions and progress toward the reduction goal.

Section 7.5 – Uncertainty Analysis

GHG emissions can be estimated only with large ranges of uncertainty. In general, uncertainties associated with GHG inventories can be broadly categorized into a *scientific uncertainty and an estimation uncertainty*. *Scientific uncertainty* becomes an issue when the science of the actual emission process is not completely understood. For instance, GWP values that are used to calculate GHG emissions in MT CO2e involve significant scientific uncertainty. *Estimation uncertainty* arises any time GHG emissions are quantified. Estimation uncertainty can be further classified into two types: *a model uncertainty and a parameter uncertainty*.

Model uncertainty is associated with the mathematical equations (i.e., modeling) used to characterize the relationships between various parameters and emission processes. For example, model uncertainty can take place either due to the use of an incorrect mathematical model or erroneous input into the model. *Parameter uncertainty* is associated with quantifying the parameters used as inputs (e.g., emissions factors and activity data) into estimation models.

Parameter uncertainties can be evaluated through statistical analysis and measurement equipment precision determinations. CL program recognizes that only parameter uncertainties are within the feasible scope of most companies. In order to manage inventory's completeness and accuracy it is desirable to produce ranges of estimates rather than point estimates for highly uncertain categories. However, for most parameters only a single data point may be available. As a result, almost all comprehensive estimates of uncertainty for GHG inventories will be not only be imperfect but also have a subjective component and, despite the most thorough efforts, are themselves considered highly uncertain. In most cases, uncertainty estimates cannot be interpreted as objective measures of quality, nor can they be used to compare the quality of emission estimates between source categories or companies.

CL does not require partner companies to quantify uncertainty as +/- % of emissions estimates or in terms of data quality indicators. Instead, companies can provide a single point estimate for each gas. This was done to make the task of data collection, comparison and calculation manageable. It is recommended that Steeclase attempts to identify areas of uncertainty in their emissions estimates in the future. At this preliminary stage it is critical to use the most accurate data possible utilizing stringent QA/QC (Quality assurance and quality control) methods available at the company. These methods are described in Chapter VI, Section 7.8.

Section 7.6 – Emissions Reduction Targets

SCS global environmental strategy includes an aggressive target of reducing its worldwide environmental footprint by 25% by the year 2012 – the centennial anniversary of the company. The GHG emissions intensity-based reduction goal will be set as the normalized value of MT CO2e per million US$ of sales compared to the 2004 base year. This intensity target will be used to report reduction progress to the EPA CL. The overall reduction target that will be achieved by 2012 has not been set at the time of the project's completion. As part of this project, the author conducted an intensity target analysis that is compatible with the normalization factor used in all of environmental reporting and productivity analyses at SCS. Normalization factor is a Net-Dealer-Net (NDN) value, measured in US$ 1,000s, is used as a manufacturing definition of production volume. Functionally, it equals half the cost of the list price of a piece of furniture. From a manufacturing point of view, it is difficult to measure the volume of production at Steelcase as there is a wide range of products with vastly different time, labor, and material intensity requirements. Consequently, to get around this variability, the company uses NDN value that is dependent on the list retail price, which is, more-or-less, dependent on the time and materials needed to manufacture a piece of furniture. This preliminary analysis will allow corporate operations management and key decision makers within the company to quantify the GHG footprint within the North American operations per NDN. The results are presented in the GHG Inventory in the Normalization Factors worksheet.

Section 7.7 – Tracking Progress towards the Reduction Goal

Given the preliminary status of the protocol and the inventory the emissions reduction goal has not been set by Steelcase. The tentative goal is to adopt an aggressive GHG emissions management and reduction strategy to reduce GHG emissions by 2012. Emissions tracking is a part of the GHG Inventory and is presented in the SCS Emissions Tracking Tool, which is designed to track both absolute and intensity reduction targets. The latter value will be used to track and report reduction progress to the EPA. Absolute reduction progress is reported in MT CO2e. Intensity reduction progress is reported in MT CO2e per million US$ of annual sales.

Section 7.8 – Data Reporting and Data Quality Management

This is a critical part of the SCS corporate commitment as a CL partner. The GHG inventory data reporting is designed to be compatible with other environmental reporting systems currently practiced in the company. This is a logical fit for the current system of environmental reporting that is based on a facility-specific data collection method. As part of its CL commitment SCS will adopt the GHG Inventory Quality Assurance Procedure that will ensure reporting consistency and completeness through the entire emissions data collection, analysis and reporting process. GHG emissions data are monitored on a quarterly basis by the facility environmental coordinator and reviewed for inconsistencies and unexpected fluctuations prior to being reported to the corporate GHG Inventory manager. As part of the data quality management each site's environmental coordinator will analyze and document any areas of possible error and appropriate QA/QC measures undertaken at each site

At the corporate level the corporate GHG Inventory manager is responsible for all QA/QC controls. Emissions data from individual facilities are collected on quarterly basis and the aggregate data analysis is performed on an annual basis. Before that data from each site are accepted and entered into the SCS GHG Inventory the corporate GHG Inventory manager reviews all data for consistency. Any significant variations from the established benchmark or large quarterly fluctuations are identified and investigated for accuracy. As a result, aggregate emissions data are evaluated based on the appropriate magnitude of each site's emissions for the production output and emissions scale. Throughout the process any areas of possible error are documented and investigated. Periodic audits of site records will be conducted to evaluate the integrity of individual site's data collection and monitoring processes.

Each manufacturing and non-manufacturing site is responsible for maintaining its on-site records. As a general practice, each facility retains hard (original or printed) copies of emissions data, fuel purchase and fuel delivery records supported by scheduled computer system backup. A site's environmental coordinator can only provide data for his/her specific site. The corporate GHG Inventory manager controls access to SCS GHG Inventory and can also change data for any site and for corporate-wide categories given the GHG Inventory Quality Assurance procedures. All data is reported using the facility-specific approach:

- *Manufacturing facilities* – fuel consumption records (internal data provided by facilities' management and energy coordinators through fuel purchase and delivery receipts, and data aggregation)
- *Corporate office facilities* – energy consumption (utility bills, fuel purchase receipts and metering)

- *Energy generation facilities* – fuel consumption, fuel used as feedstock (fuel purchase and delivery records)
- *Distribution truck fleet* – Fleet Fuel Management System tracks diesel and gasoline consumption on quarterly and annual basis for all trucks (fuel purchase receipts)
- *SCS Aviation Department* – fuel purchase receipts at the point of origin (Grand Rapids, MI) and at the national refueling outlets; metering, fuel purchase and delivery receipts for the energy consumption at the jet hangar

Based on the author's recommendation, Corporate Environmental Performance department (CEP) is committed to integrate GHG emissions reporting with all existing energy and environmental reporting systems, including VOCs, solid waste and material intensity reporting. Emissions data are reported to CEP on a quarterly schedule. The corporate GHG Inventory manager compiles quarterly emissions reports and analyzes corporate-wide emissions on an annual basis. Data are reported to the SCS GHG Inventory annually. Annual emissions data are reported to CL via the Annual GHG Inventory Summary and Goal Tracking Form. The analysis of corporate GHG footprint and its emissions reduction goal will be made part of quarterly reporting of both GHG emissions facility-specific and corporate-wide GHG emissions. The author emphasizes the need to fully integrate GHG emissions reports with the current quarterly environmental reporting procedure to Senior VP of Global Manufacturing, VP of North American Manufacturing, and President of Steelcase Design Partnerships. Moreover, the Annual Corporate Environmental Report should contain a status report on corporate-wide GHG emissions. Finally, once all manufacturing facilities become ISO 14001 registered the GHG emissions reporting will be integrated into the Environmental Management System within those facilities.

Given the fact that SCS is just developing data management and quality control requirements for the GHG Inventory, definition and scope of data collection, analysis, reporting and system security will be further defined and, if necessary, broadened.

Chapter VIII: Research Methodology and Data Sources

This project was developed in close collaboration with Steelcase through an aggressive schedule of interviews and meetings. The research team consisted of the author, Lynn Zimmerman and William Bulkowski. Lynn Zimmerman and William Bulkowski are environmental engineers at the Corporate Environmental Performance department who were responsible for data collection and monitoring data flows. Organizational boundaries were developed in consultation with the corporate legal department. Operational boundaries were constructed through organizational analysis conducted by the author and Lynn Zimmerman. Throughout this process the entire team held multiple meeting and conference calls with facility managers, environmental coordinators and plant engineers. All issues pertaining to the EPA requirements and process related criteria were discussed with Robert Hall from E-Source. The author was responsible for designing the inventory, the inventory management plan, and calculation methodology for the entire project. Facility-specific approach was chosen to ensure data quality and consistency as GHG emissions data were analyzed for each industrial site and office location vis-à-vis a specific fuel type. Emissions were calculated using emissions factors methodology that is scientifically and technically valid. All emissions factors for direct and indirect source were provided by the EPA. Corporate-wide GHG emissions are reported in MT CO2e.

All guidance material and technical assistance for the project was provided courtesy of the EPA Climate Leaders. These included tools for setting up the boundaries of the project, data collection and data analysis methods, data quality and process management requirements. Also, the EPA supplied all scientific information for the project (i.e., emissions factors for direct and indirect combustion sources, and global warming potentials). GWP values used were developed by the IPCC in the 1996 SAR (see Chapter VII, Section 7.4). Finally, the author researched other voluntary GHG emissions reduction programs in the US (see Chapter IV) and provided an overview of corporate climate change strategies adopted by the US corporations (see Chapter V).

Chapter IX: Results and Deliverables

Section 9.1 – Data Limitations

Given the preliminary status of the inventory the results produced in this project have not been reviewed by Steelcase and E-Source for accuracy and completeness at the time of publication. A thorough onsite audit of all emissions data reporting is needed before the corporate-wide inventory and the Inventory Management Plan (IMP) are submitted to the EPA. Given the aggressive timeline and the corporate-wide scope of the inventory not all facilities included in the operational boundaries have reported complete onsite energy consumption data. The data collection cut-off was set for March 31st, 2006. As a result, the data not reported by the aforementioned date were excluded from this preliminary emissions assessment. The inventory currently contains the emissions data for the 2004 base year only. Where available, the author began to enter data for the year 2005. *At the facility level*, only corporate offices, SCS manufacturing facilities (except for AMEX, Athens plant, Atlanta plant and KW/GR Distribution Center), energy generation centers, aviation operations and two out of three manufacturing SDPs Metro Furniture and Vecta (except for Brayton International) provided the emissions data. As a result, the majority of SDPs are not included in this preliminary emissions analysis. *At the emissions level*, many facilities reported data for indirect electricity purchases only, which, however, represents the bulk of the corporate GHG footprint. Specific breakdown of data by emissions source is presented below in the Table 5 in Section 9.2. The final corporate-wide GHG emissions inventory will have to account for all emissions and all facilities included in the operational and organizational boundaries of the project.

Section 9.2 – GHG Emissions Profile of Steelcase

The preliminary estimate of the total GHG emissions for 2004 is in 187,679 MT CO2e with 25.9% coming from direct and 74.1% from indirect emissions sources. As expected, most of the GHG footprint comes from *SCS manufacturing* (61.6% of GHG emissions or 115,682 MT CO2e). It is primarily driven by electricity use with GHG emissions defined by the physical location of plants. Most of the manufacturing base is in the eGrid Subregion ECAR Michigan where the bulk of the grid mix is generated by coal combustion (~68%).[30] *Corporate offices* represent the second largest source of emissions (20.1% of GHG emissions or 37,684 MT CO2e). Once again, the regional electrical grid mix is the main driver. *Transportation* represents the third largest source of emissions (5.8% or 10,896 MT CO2e). Diesel consumption accounts for 96% of total mobile fuel usage. The fourth largest emissions source is the *onsite energy centers* that generate steam for plants in Grand Rapids and Kentwood, MI. Both centers use coal, natural gas, diesel, distillate and residual oil, and electricity and account for 4.7% of GHG emissions or 8,891 MT CO2e. *Corporate aviation operations* represent the fifth largest source of GHG emissions (3.4% or 6,470 MT CO2e) driven mostly by the jet fuel combustion, followed by natural gas and electricity usage at the hangar. Finally, *two SDP manufacturing plants* Metro

[30] EPA eGRid http://oaspub.epa.gov/powpro/ept_pack.charts

Furniture (Oakland, CA) and Vecta (Grand Prairie, TX) collectively make up 4.3% of GHG emissions or 8,056 MT CO2e.

The author wishes to stress that the inventory will present an accurate picture of the corporate-wide GHG footprint *only* when all facilities report complete data for all fuel sources. Below, Figure 2 provides the summary of emissions in MT CO2e from all corporate operations: manufacturing (SCS and SDPs), corporate and sales offices, transportation fleet, energy generation centers, and aviation operations. Figure 3 gives the contribution of various GHGs to the inventory. Clearly, CO_2 emissions certainly dominate the corporate-wide GHG emissions profile. Please refer to the Section 9.1 (above) and Table 5 (below) for the description of all included facilities and emissions sources that satisfied data reporting requirements for this preliminary inventory.

Figure 2: Corporate-wide GHG Emissions Profile by Operations Type (MT CO2e)

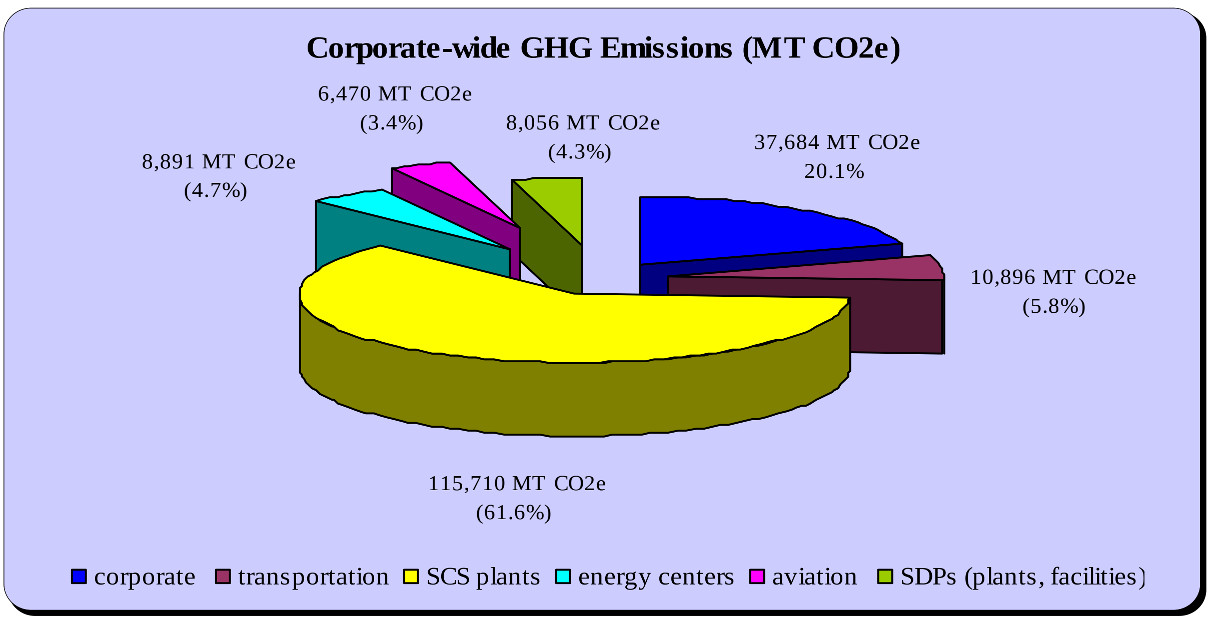
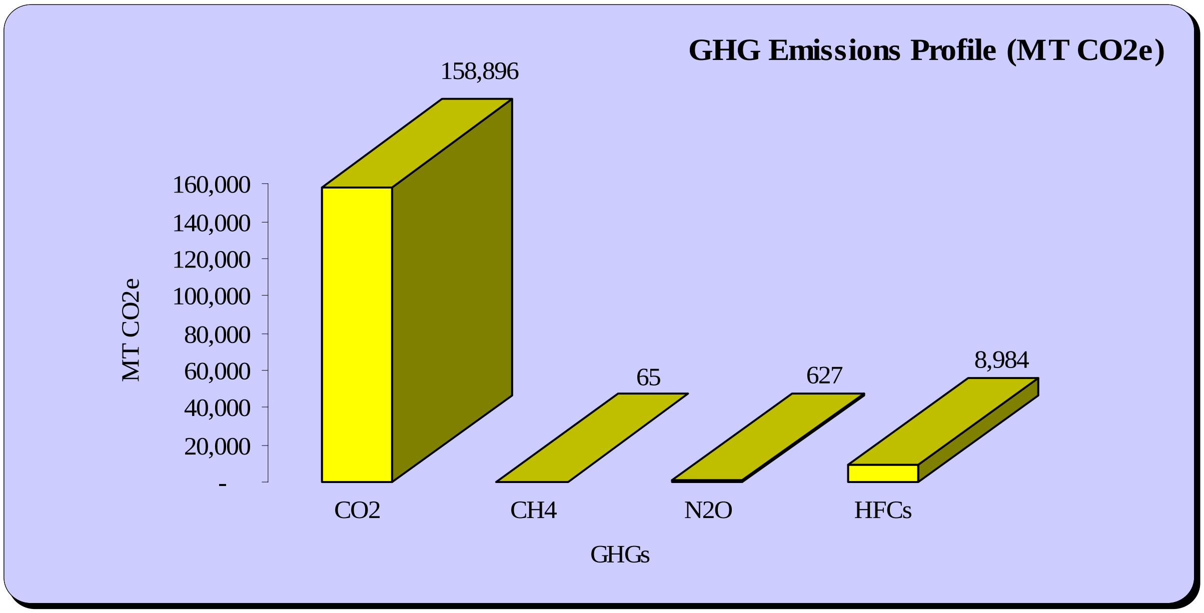


Figure 3: Contribution of Various GHGs to the Inventory (MT CO2e)



Note: Mobile HFC emissions were reported for truck fleets and stationary HFC emissions only for truck garages.

Figure 4 presents emissions profile by fuel source, which includes direct and indirect emissions measured in MT CO2e. It must be noted that due to incomplete data reporting for several fuel sources are excluded from this analysis: propane, diesel (stationary combustion), residual oil # 6, and distillate oil # 2. Even at this preliminary stage of emissions assessment it appears that electricity-related GHG emissions dominate all other fuel sources accounting for 139,136 MT CO2e or 75% of all emissions. GHG emissions from natural gas combustion represent the second largest source measured at 27,811 MT CO2e or 15%.

Figure 4: Emissions Profile by Fuel Source (MT CO2e)

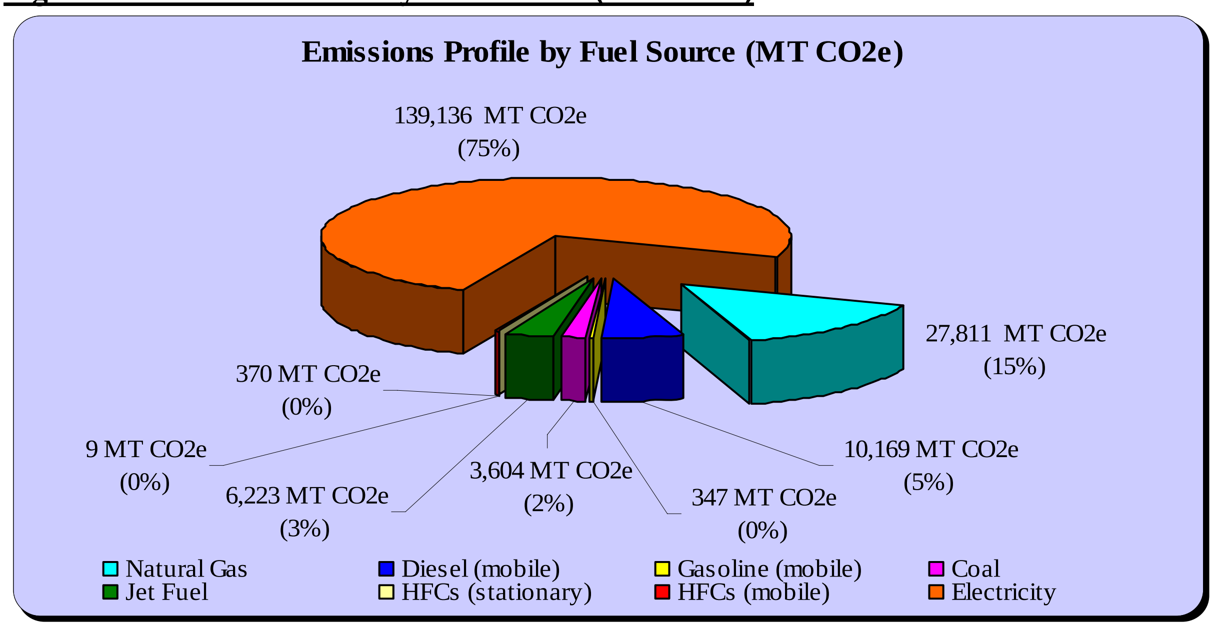


Table 5 represents the GHG emissions profile tracking the emissions footprint of the company by operations, by facility and emissions source (i.e., direct and indirect) Moreover, it provides a detailed account of the emissions data analyzed at the time of the project's completion and documents missing data gaps.

Table 5: Corporate-wide GHG Emissions Profile

Steelcase GHG Emissions Tracking Tool						
Facilities			GHG Emissions (MT CO2e)			
			2004			
Facility Type	**Name**	**City/State/Country**	**Direct (MT CO2e)**	**Indirect (MT CO2e)**	**Aggregate (MT CO2e)**	
Corporate Offices	Corporate HQ	Grand Rapids, MI	0	20,509	20,509	
	CDC	Kentwood, MI	0	17,176	17,176	
	Total Corporate Emissions				37,684	20.1%
Transportation	GR Truck Fleet	Grand Rapids, MI	816	0	816	
	KW Truck Fleet	Kentwood, MI	10,080	0	10,080	
	Total Transportation Emissions				10,896	5.8%
Manufacturing Facilities	AMEX	Tijuana, Mexico	3	0	3	
	Athens Plant	Athens, AL	6	0	6	
	Atlanta Plant	Lithia Springs, GA	0	0	0	
	Chair Plant	Grand Rapids, MI	2,378	12,505	14,883	
	Chair Fabric Plant	Grand Rapids, MI	0	2,281	2,281	
	Computer Furniture Plant	Kentwood, MI	35	12,812	12,846	
	Desk	Grand Rapids, MI	435	4,621	5,056	
	KW/GR Distribution Center	Kentwood, MI	0	0	0	
	Kentwood West	Kentwood, MI	4,734	14,738	19,472	
	Panel Plant	Kentwood, MI	59	6,099	6,157	
	SCS Wood	Gaines Township, MI	7,673	19,514	27,187	
	Systems I & II	Grand Rapids, MI	1,830	12,164	13,994	
	SCS Canada	Markham, Ontario	4,130	2,806	6,936	
	SCS California	City of Industry, CA	3,967	2,894	6,861	
	Total Manufacturing Emissions				115,682	61.6%
Energy Generation Centers	GR Energy Center	Grand Rapids, MI	2,010	89	2,099	
	KW Energy Center	Kentwood, MI	1,785	5,006	6,792	
	Total Energy Generation Emissions				8,891	4.7%
Aviation Operations	SCS Aviation Dept	Grand Rapids, MI	6,306	165	6,470	
	Total Aviation Operations Emissions				6,470	3.4%
Steelcase Design Partnerships (SDPs)	Brayton International	High Point, NC	0	0	0	
	Custom Cable	Ft. Lauderdale, FL	0	0	0	
	Custom Cable	Lake Mary, FL	0	0	0	
	Custom Cable	Tampa, FL	0	0	0	

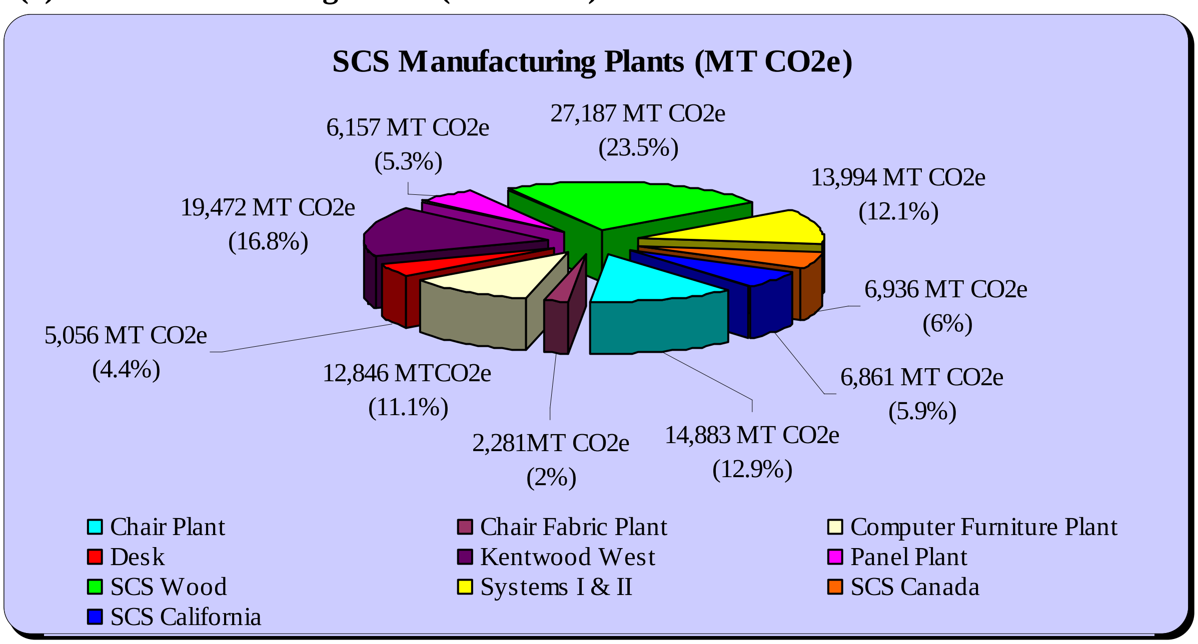
	DesignTex	New York, NY	0	0	0	
	Details	Athens, AL	0	0	0	
	J.M. Lynne	Hauppage, NY	0	0	0	
	Metro Furniture	Oakland, CA	559	1,172	1,730	
	Polyvision HQ	Atlanta, GA	0	0	0	
	Polyvision	Beaverton, OR	0	0	0	
	Polyvision	Corona, CA	0	0	0	
	Polyvision	Dixonville, PA	0	0	0	
	Polyvision	New York, NY	0	0	0	
	Polyvision	Okmulgee, OK	0	0	0	
	Polyvision	Riverside, CA	0	0	0	
	Polyvision	Wheeling, IL	0	0	0	
	Vecta	Grand Prairie, TX	1,739	4,587	6,326	
	Total SDP Emissions				8,056	4.3%
	TOTAL GHG Emissions:		**25.9 %** **48,544**	**74.1 %** **139,136**	**100 %** **187,679**	**100%**

Note: Zero value (0) identifies facilities that did not report data by March 31st, 2006

Below is the analysis performed on a facility basis to show the emissions profile of specific plants and facilities within a specific operations type. Figure 5 includes (a) SCS Manufacturing (% by plants), (b) corporate operations (MT CO2e), (c) transportation (MT CO2e), and (d) energy generation (MT CO2e). Aviation operations are concentrated in one department only, with no comparison necessary. Given the lack of data for regional sales offices and a fraction of data collected for SDPs their emissions profiles for these are not represented.

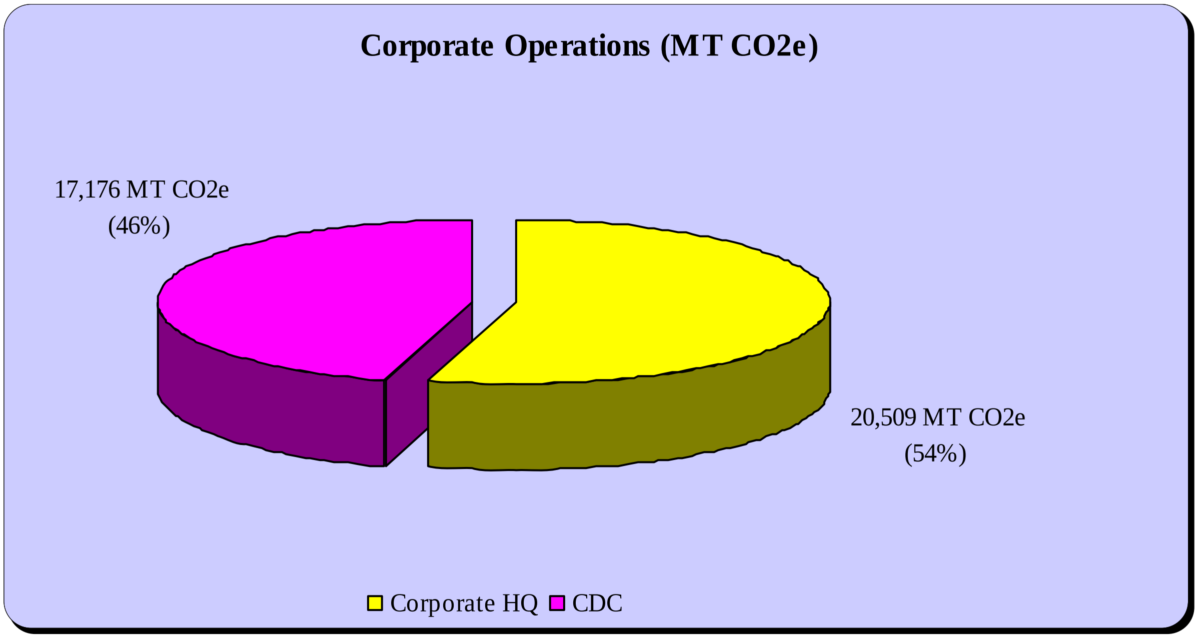
Figure 5: Emissions by Facility (MT CO2e)

(a) SCS Manufacturing Plants (MT CO2e)

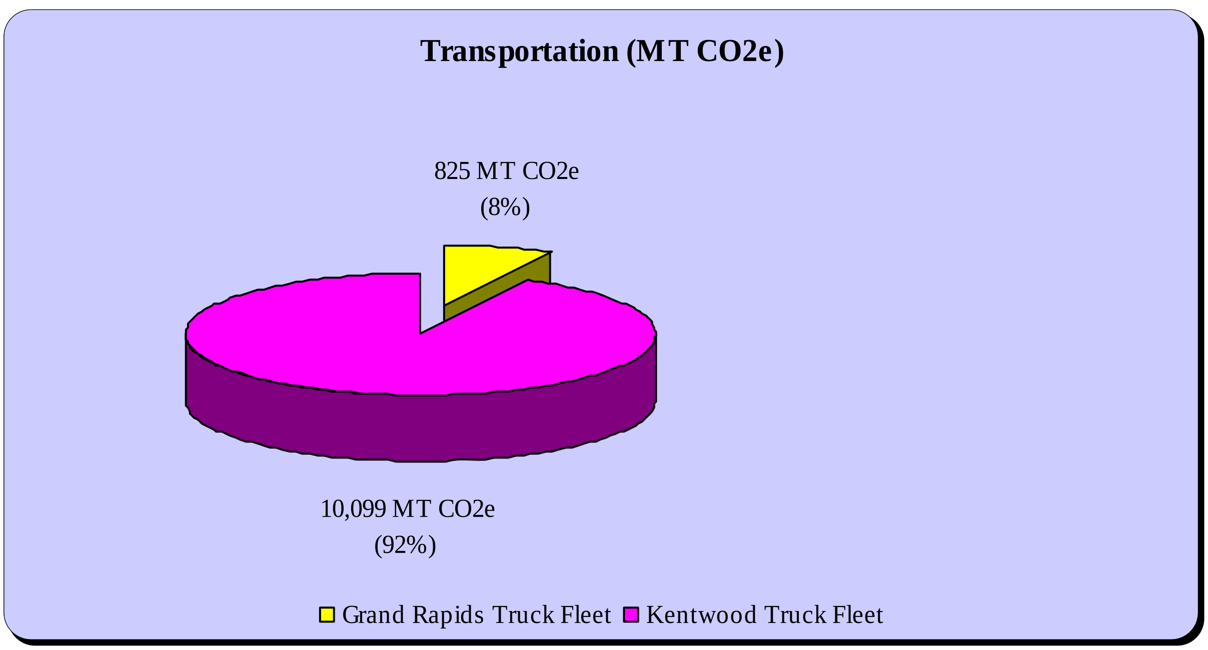


Note: AMEX (3 MT CO2e), Athens Plant (6 MT CO2e), Atlanta Plants (0 MT CO2e) and KW/GR Distribution Center (0 MT CO2e) were excluded due to incomplete data reporting.

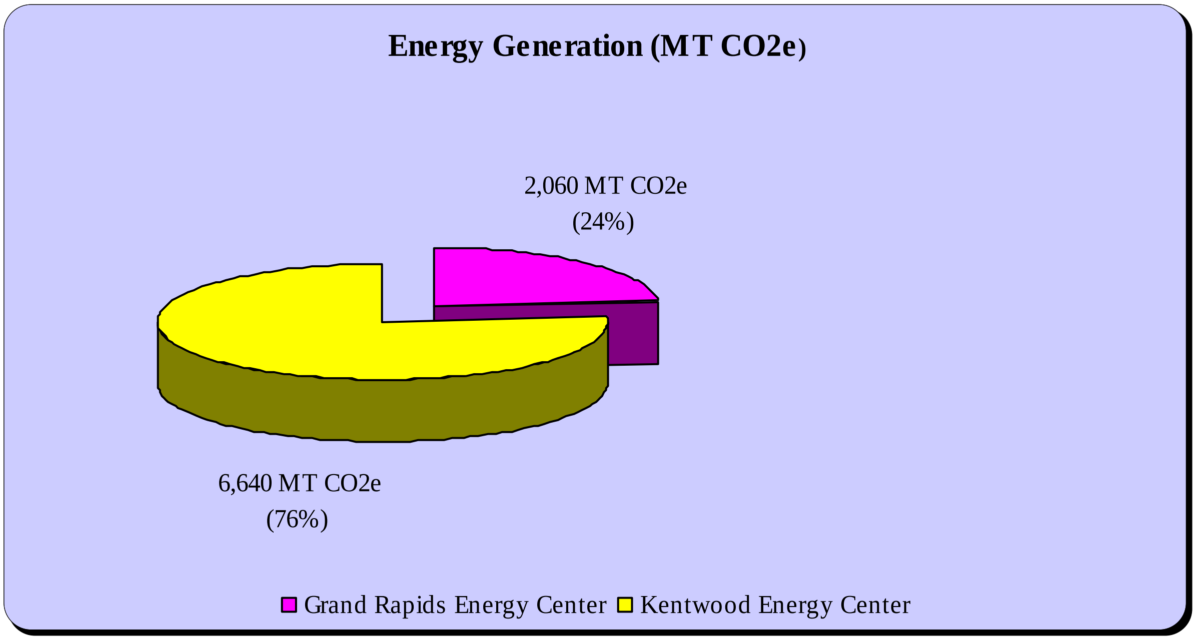
(b) Corporate Operations (MT CO2e)



(c) Transportation (MT CO2e)



(d) Energy Generation (MT CO2e)



Section 9.3 – Corporate Deliverables: GHG Inventory Management Plan (IMP) and Steelcase GHG Emissions Inventory

Corporate deliverables are the Inventory Management Plan (in PDF format) and the corporate–wide GHG Inventory (in Excel format). Both documents constitute the full set of Steelcase's corporate obligations under the Climate Leaders Program. The IMP is designed to describe the process used by Steelcase to institutionalize the process for collecting, calculating, maintaining, and reporting corporate GHG emissions data. The GHG Inventory tracks GHG emissions in MT CO2e at a corporate level, broken down by facilities and emissions source type – core direct (e.g., stationary combustion, process, mobile sources) and core indirect (e.g., electricity imports/purchases, both domestic and international). Finally, the inventory accounts for historical emissions and includes a performance indicator that is used to track progress toward a reduction goal. Both documents will be presented at the onsite review to be conducted by E-Source on April 11th, 2006. Below is the brief overview of the contents of both documents.

<u>The Inventory Management Plan (IMP):</u>

- Partner Information
- Boundary Conditions
- Emissions Quantification
- Data Management
- Base Year
- Management Tools

Note: The IMP is available in <u>Appendix 4</u>.

The GHG Inventory:

Worksheet 1	Inventory Key
Worksheet 2	Facilities List
Worksheet 3	EPA CL Emissions Tracking Tool
Worksheet 4	SCS Emissions Tracking Tool
Worksheet 5	Normalization Factors
Worksheet 6	Conversion Factors
Worksheet 7	GWP Values
Worksheet 8	Direct Mobile Emissions Factors (including fugitive HFC emissions)
Worksheet 9	Direct Stationary Emissions Factors (including fugitive HFC emissions)
Worksheet 10	US Indirect Emissions Factors (EPA, eGrid 2000)
Worksheet 11	International Indirect Emissions (IEA, 2004)
Worksheet 12	E-Source Emissions Factors (provided by E-Source)
Worksheet 13	Natural Gas
Worksheet 14	Propane
Worksheet 15	Diesel (stationary)
Worksheet 16	Diesel (mobile)
Worksheet 17	Gasoline (mobile)
Worksheet 18	Coal
Worksheet 19	Jet Fuel
Worksheet 20	Residual Oil #6
Worksheet 21	Distillate Oil #2
Worksheet 22	HFC Emissions (stationary)
Worksheet 23	HFC Emissions (mobile)
Worksheet 24	Electricity

Note: The GHG Inventory is available on the disc attached to this report

Chapter X: Conclusions

The main goal of this project is to provide the GHG emissions assessment and reporting protocol for Steelcase, Inc. that will contribute to their long-term corporate strategy to improve their environmental performance by incorporating climate change-related impacts in investment decisions and operations management.

Section 10.1 – Preliminary Inventory Findings and Emissions Reduction Opportunities

The preliminary estimate of the corporate-wide GHG footprint for 2004 is 187,679 MT CO2e with 25.9% originating from direct and 74.1% from indirect emissions sources. The inventory findings have shown that GHG emissions are closely linked with the energy consumption. Most of Steelcase's GHG emissions come from electricity use (139,136 MT CO2e or 75% of all emissions); natural gas combustion-related GHG emissions represent the second largest source (27,811 MT CO2e or 15% of all emissions). The three most energy intensive operations are *manufacturing*, *corporate* and *transportation*.

- *Manufacturing* accounts for 61.6% (115,710 MT CO2e) of the corporate-wide emissions. Steelcase has an internal energy auditing system in place in all of its plants that can also contribute to GHG emissions reductions. The company will greatly benefit from energy saving guidelines for all manufacturing facilities. Measures such as turning off machines and office equipment when not in use, installation of automatic lighting controls, using of solar water heaters and geothermal cooling, sealing heating and cooling ductwork, reducing hot water temperature, replacing air filters regularly, inspecting and repairing steam traps, insulating steam distribution lines, implementing waste heat recovery programs, and installing energy efficient lighting fixtures.[31] Another way to lower GHG emissions from electricity use is to increase purchase of "green" electricity from renewable or low-emission fossil sources. Lowering demand for energy reduces energy costs by using less energy during peak times and provides a hedging mechanism against possible energy supply interruptions and price uncertainty.[32]

- *Corporate operations* account for 20.1% (37,684 MT CO2e) of the corporate-wide emissions. Steelcase can start by creating an energy consumption survey for all of its corporate offices in order to identify energy saving opportunities. Initial steps include office guidelines to turn off office equipment when not in use. Many of the aforementioned energy saving tips also apply to office space, including installation of automatic lighting controls and fluorescent energy efficient lighting fixtures, and using geothermal cooling

[31] US DOE, Energy Efficiency and Renewable Energy, Industrial Technologies Program; http://www1.eere.energy.gov/industry/sen/database/index.asp
[32] Rocky Mountain Institute, *The Business Climate Report: A Guide to Lower Carbon Emissions and Better Business Performance* (April 2002); http://www.resourcesaver.org/file/toolmanager/O16F29647.pdf

- *Transportation* accounts for all diesel and gasoline consumption by trucking fleets in Grand Rapids, MI and Kentwood, MI and is responsible for 7% (10,516 MT CO2e) of the corporate-wide GHG emissions. The best approach to lower emissions is to monitor and reduce fuel consumption. Steelcase has a Fuel Management System that was utilized in providing data for this project. It's important to stress that when making truck purchasing the company needs to consider aerodynamics characteristics and component specifications that are optimized to the intended use (i.e., route length, load requirements, etc.).[33] Moreover, it's important to properly maintain tires and major mechanical components (engine, drive trane, axle alignment, etc.). It is also critical to foster fuel saving driving habits among Steelcase drivers, such as reducing idling time, maintaining 55-65 mph average speed, and conserving on the use of heaters and air-conditioning. Recent innovations in idle management systems (i.e., systems that provide heating, cooling and hotel power without the need to idle the truck) will help Steelcase to reduce parasitic energy losses (i.e., mechanical losses from devices driven by engine), idling emissions, and refrigerant leakage from their trucks. Fuel-switching to biodiesel and ethanol gasoline is another viable option to reduce GHG emissions from transportation operations at Steelcase.

It is essential for Steelcase to undertake the aforementioned energy efficiency measures. In fact, these are only initial steps that Steelcase will need to take to fulfill its GHG emissions reduction commitment. Overall, once a company has a comprehensive picture of its GHG footprint, it is well-positioned to analyze its market/regulatory risks and market opportunities. This approach will help the company to focus on emissions reduction efforts where the greatest efficiency gains can be achieved.

Section 10.2 – Observations in Developing and Implementing Protocol

The author identified several key success factors that have contributed to the voluntary GHG emissions reduction commitment and challenges that affected the entire process.

I. **Top Management Buy-In:** Because reducing emissions is a companywide and ongoing process, communicating support from the top of the company is critical to the overall success of the inventory.[34] Top-level communication serves both internal and external communications needs. Senior management support provided a compelling corporate-wide call to action on climate change as it affects Steelcase and office furniture manufacturing industry. Buy-in from key decision-makers in the company set clear goals, provided a clear mandate and established internal communications channels. While support from senior management is important internal corporate communications should be a two-way exchange of information and ideas. This

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[33] Kenworth Truck Company, *White Paper on Fuel Economy, March 2006;* http://www.kenworth.com/FuelEconomyWhitePaper.pdf

[34] Michael Margolick and Doug Russell, Corporate GHG Reduction Targets (*Pew Center on Global Climate 2001 Report)* http://www.pewclimate.org/docUploads/ghg%5Ftargets%2Epdf

approach allows senior managers to know how a company climate policy is impacting business units and allows employees to suggest ways to streamline data reporting process and identify emissions reduction opportunities. However, this project suffered from communication gaps with facility environmental coordinators pertaining to the urgency of data collection, which resulted in substantial data gaps. A more successful approach would have been realized by the creation of cross-functional task forces across business units and departments.

II. **Secure Support from Middle Management and Employees:** It is critical to communicate throughout the company the strategy behind a company-wide climate change action. Sending a letter or an e-mail from corporate leadership to all employees will spur discussion and invite feedback. Development a climate-change awareness program geared to Steelcase products and operations would enable employees to identify new GHG reduction opportunities.

III. **Efficient Utilization of Expertise and Resources:** Key roles and responsibilities were defined. The CEP staff focused on collecting data and conducting the initial analysis. They were able to put together cross-functional teams of legal and operations departments to outline the scope of the inventory. The author's job was defined in providing technical and scientific expertise as it related to design and implementation of this project. The author recognizes the extreme importance of cross-functional and cross-departmental teams that should include a variety of company stakeholders – environmental professional, facility and process engineers, legal, operations management, and facilities' management. Again, this effort was successful within the operational management, legal, marketing and environmental departments but familiarity with emissions data reporting requirements waned at the facility level. An effective utilization of the cross-functional team concept will help ensure the buy-in from middle managers and employees who can assist in measuring and reducing GHGs in their functional areas.

IV. **Develop Action plan**: Climate Leaders methodology helped to develop a consistent action plan that is essential to successful project completion. First, the inventory management plan was created to identify the overall process for data collection and assessment. Second, the inventory aggregated emissions data at the corporate-wide level and provided a conclusive GHG emissions profile of the entire company. Third, the company is in the process of analyzing its GHG footprint to identify cost-efficient emissions management and reduction opportunities. Lastly, the Steelcase will establish an emissions reduction goal to be achieved by the year 2012.

V. **Understanding of Climate Change Issue:** The starting point for Steelcase was gaining an understanding of climate change and how it may affect the company. The political response in the EU and the successful implementation of the EU CO2 Emissions Trading Scheme in January 2005 mandated GHG emissions reduction action plans in European operations. The CEP staff began tracking GHG emissions from North American and European operations in 2001 (see Appendix 1). Driven by corporate mandate to reduce GHG emissions and lower energy costs they started buying "green electricity" generated from recovered landfill gas. In fact, in 2003 Steelcase purchased 3%, in 2004 4.6% and 3% in 2005 of the total electricity demand in Grand Rapids/ Kentwood complexes.

VI. **Identification of Market Opportunities:** Climate change strategy and GHG emissions reduction commitments can be leveraged as a competitive opportunity for Steelcase. Once the final inventory is assembled the company will be able to estimate its GHG emissions profile across business units and corporate operations. As a result, operations management can further promote corporate-wide energy efficiency to capture bottom line savings. Also, a recent survey done by Steelcase marketing department and sales resources team identified that almost 80% of Steelcase customers inquire about the environmental characteristics of products and the environmental performance of the company itself. In other words, a robust climate change strategy and an emission reduction commitment might add to the top line in the form or increased revenues as they are leveraged by marketing and sales. In this regard, Steelcase has proved to be very responsive to changing marketplace.

VII. **Flexibility of Voluntary Emissions Reduction Program Induces Participation:** EPA Climate Leaders was designed to provide businesses with maximum flexibility in reporting and reducing their GHG emissions. This enabled Steelcase to adopt an incremental approach and to concentrate on reporting core direct (i.e., process and fuel combustion emissions generated onsite) and indirect emissions (i.e., emissions from purchased/imported electricity) only. As the GHG emissions inventory and emissions accounting continue to evolve the company will be well-positioned to take on additional commitments such as reporting optional emissions (e.g., total fuel cycle of fuels and materials, business travel, employee commute, etc.). Flexibility of the design principles allows companies to fit the inventory management plan and the emissions inventory with specific sectoral and market demands.

Section 10.3 – Next Steps for Inventory Management

The author emphasizes preliminary status of the inventory. Much work remains to be done, on both corporate and facility levels. The ultimate goal of this effort was to create a protocol that can be utilized by corporate environmental professionals in collecting, analyzing, reporting and managing the GHG emissions data. The inventory is designed to track emissions data through the year 2012 and to record progress toward the reduction target using the year 2004 as the base year. Steelcase formally joined the CL on October 2nd, 2005, as Senior Vice-President of Global Manufacturing Mark Baker signed the CL agreement. EPA expects partner companies to establish an emissions reduction commitment within a year after joining the program. It is paramount for the company to fill all data gaps by the end of May, 2006. The remaining time period from June, 2006 to October, 2006 should be used to analyze energy consumption and emissions management strategy at corporate and facility levels. Once a complete GHG emissions inventory is assembled Steelcase will be able to make a reduction commitment it can fulfill by the end of 2012.

The IMP identifies a senior environmental engineer from the CEP as the corporate GHG Inventory Manager. *At the facility level*, emissions data are monitored on a quarterly basis by a facility Environmental Coordinator, and reviewed for inconsistencies and unexpected fluctuations prior to being reported to the corporate GHG Inventory Manager. Each site's Environmental Coordinator will analyze and document any areas of possible error and QA/QC measures undertaken at each site. *At the corporate level*, corporate GHG Inventory Manager is responsible for all corporate-wide QA/QC controls. Emissions data are collected on a quarterly basis and aggregate data analysis is performed on an annual basis. Before the data from each site are accepted and entered into the SCS GHG Inventory the corporate GHG Inventory Manager reviews all data for consistency. Any significant variations from the established benchmark or large quarterly fluctuations are identified and investigated for accuracy. As a result, aggregate emissions data are evaluated based on the appropriate magnitude of each site's emissions for the production output and emissions scale. Throughout the process any areas of possible error are documented and investigated. Periodic audits of site records will be conducted to evaluate the integrity of data collection and monitoring processes.

GHG emissions reporting should be integrated with all existing energy and environmental reporting systems at Steelcase, including VOC emissions, solid waste and material intensity reporting. The author also recommends that an analysis of the corporate GHG footprint is added to the current quarterly environmental reporting procedure for the Senior VP of Global Manufacturing, VP of North American Manufacturing, and President of Steelcase Design Partnerships. It is critical for the operations management at Steelcase to be well-informed of the GHG emissions status and potentials for emissions reductions. Furthermore, the Annual Corporate Environmental Report should contain an overview and a status report of the corporate-wide and facility-specific GHG emissions. Once all manufacturing facilities become ISO 14001 registered the GHG emissions reporting can be integrated into the Environmental Management Systems at each site. Finally, the author hopes that the Climate Leaders partnership and the GHG emissions inventory will pave the way to a comprehensive corporate-wide climate change strategy at Steelcase. The author hopes that the protocol and the inventory will contribute to a new paradigm shift towards environmental sustainability as Steelcase begins to integrate climate change-related impacts with capital allocation planning, design, manufacture and distribution processes.

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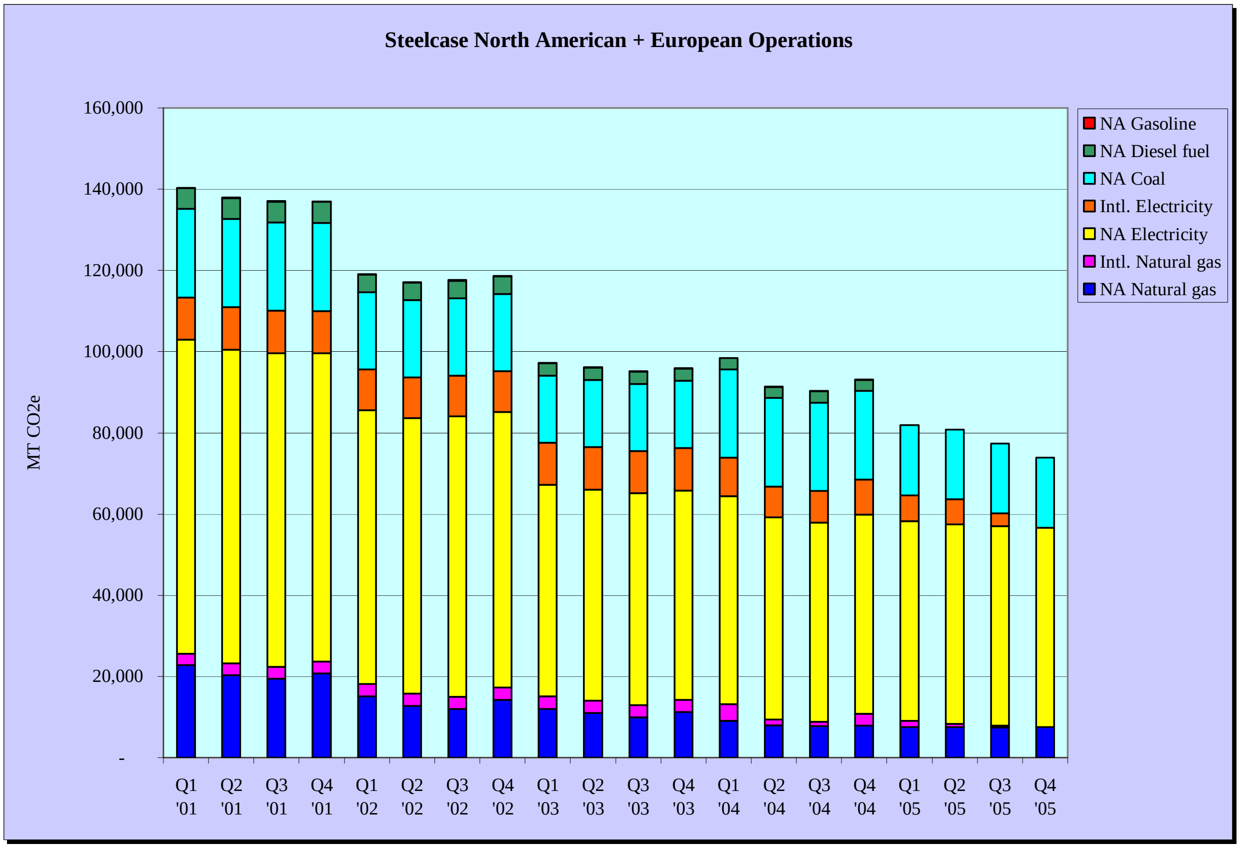
Chapter XII: Appendices

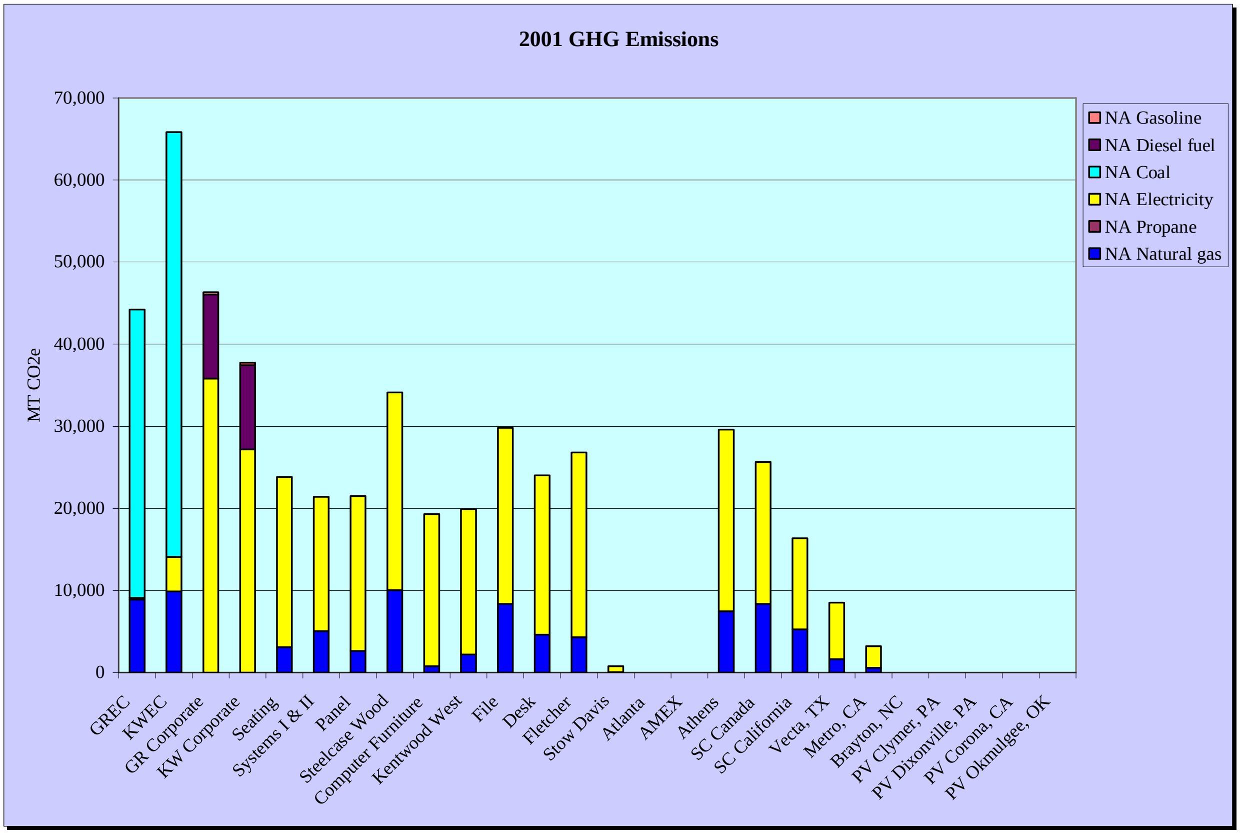
Appendix 1: 2001-2005 Steelcase GHG Emissions (North American and European Operations)
Appendix 2: Inventory Key
Appendix 3: SCS Facilities List by Facility Type and Emissions Source
Appendix 4: IPCC 1996 SAR GWP Values
Appendix 5: Corporate GHG Emissions Inventory Management Plan (approved by Steelcase)

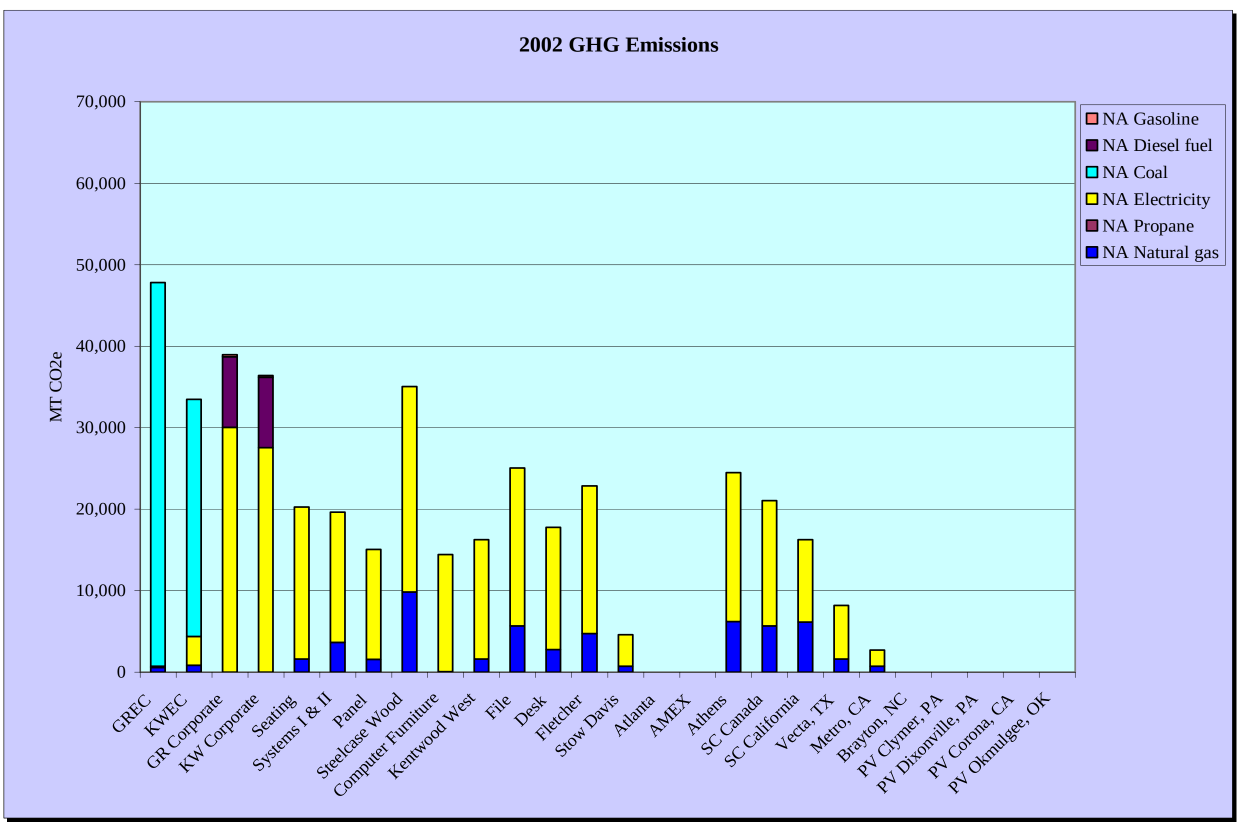
Appendix 1: 2001 – 2005 Steelcase GHG Emissions (North American and European Operations)

These calculations represent the early estimates of GHG emissions done by the CEP. Emissions coefficients used to estimate emissions are presented below.

Conversion unit	Emission Factor	Units
CO2 equiv emission factor	117.1288	lbs CO2 eqv./mmBtu HHV
Natural gas conversion	60.80	tonnes CO2 / mmCF
Electricity conversion	0.000966	tonnes CO2 /kwhr
Coal conversion	2.27	tonnes CO2/ton coal
Diesel fuel conversion	0.0110	tonnes CO2/ gal Diesel fuel
Gasoline conversion	0.0087	tonnes CO2/ gal gasoline




2001 GHG Emissions
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
MT CO2e
NA Gasoline
NA Diesel fuel
NA Coal
NA Electricity
NA Propane
NA Natural gas
GREC
KWEC
GR Corporate
KW Corporate
Seating
Systems I & II
Panel
Steelcase Wood
Computer Furniture
Kentwood West
File
Desk
Fletcher
Stow Davis
Atlanta
AMEX
Athens
SC Canada
SC California
Vecta, TX
Metro, CA
Brayton, NC
PV Clymer, PA
PV Dixonville, PA
PV Corona, CA
PV Okmulgee, OK


2002 GHG Emissions
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
MT CO2e
NA Gasoline
NA Diesel fuel
NA Coal
NA Electricity
NA Propane
NA Natural gas
GREC
KWEC
GR Corporate
KW Corporate
Seating
Systems I & II
Panel
Steelcase Wood
Computer Furniture
Kentwood West
File
Desk
Fletcher
Stow Davis
Atlanta
AMEX
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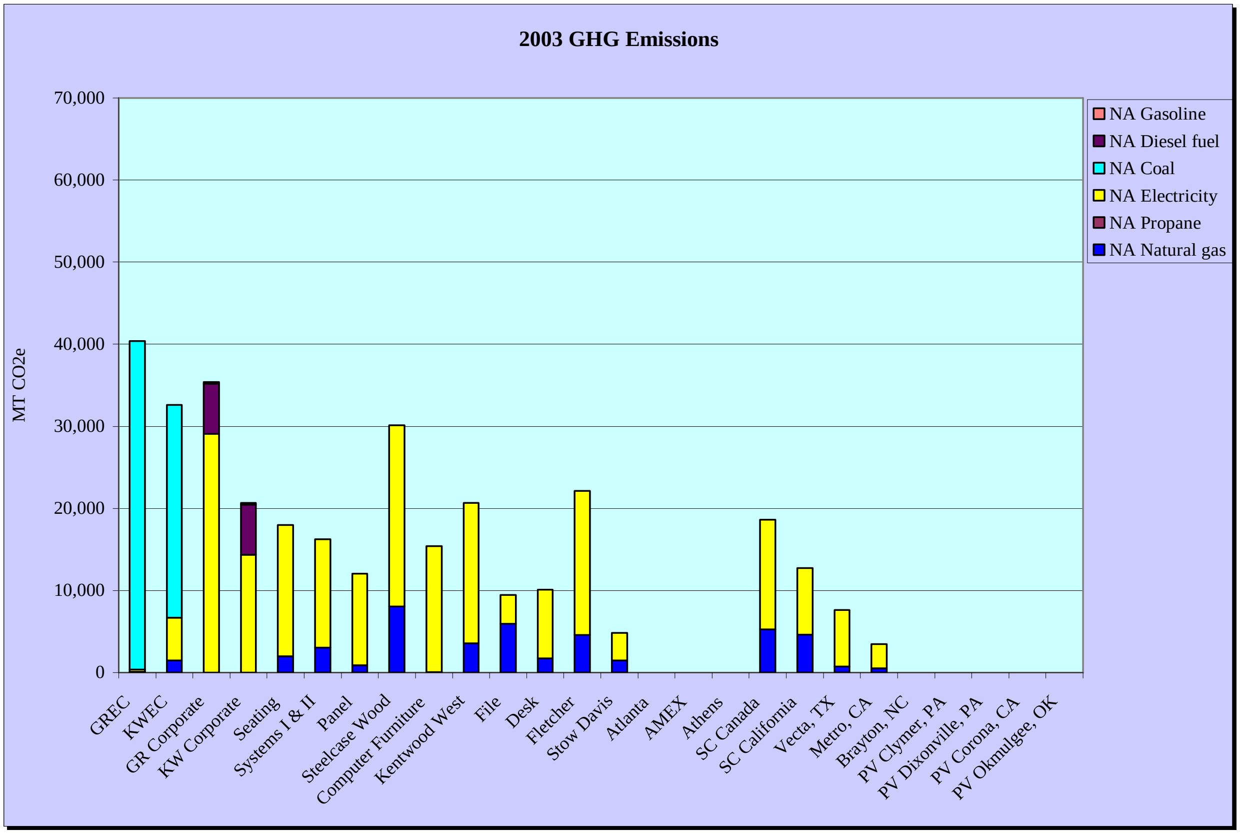
2003 GHG Emissions
MT CO2e
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
NA Gasoline
NA Diesel fuel
NA Coal
NA Electricity
NA Propane
NA Natural gas
GREC
KWEC
GR Corporate
KW Corporate
Seating
Systems I & II
Panel
Steelcase Wood
Computer Furniture
Kentwood West
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Desk
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Atlanta
AMEX
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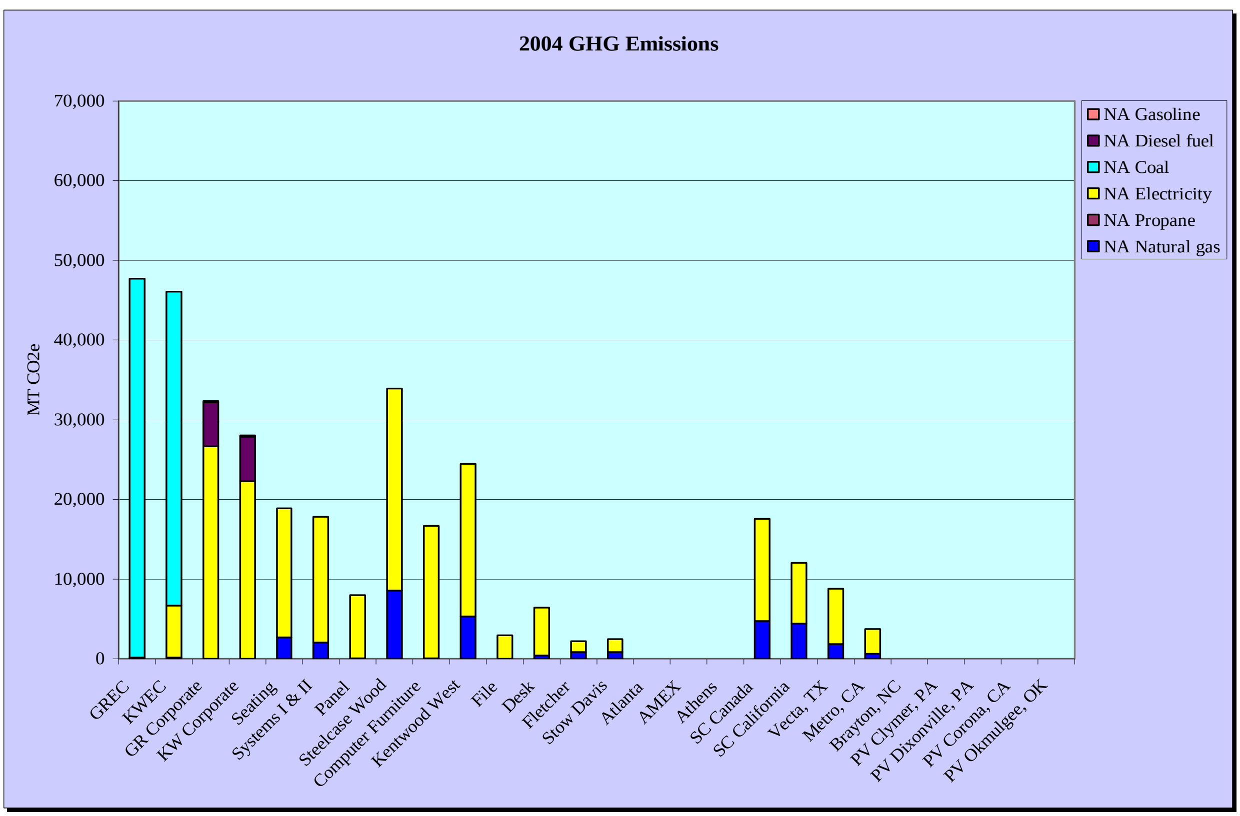
2004 GHG Emissions
MT CO2e
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
NA Gasoline
NA Diesel fuel
NA Coal
NA Electricity
NA Propane
NA Natural gas
GREC
KWEC
GR Corporate
KW Corporate
Seating
Systems I & II
Panel
Steelcase Wood
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PV Clymer, PA
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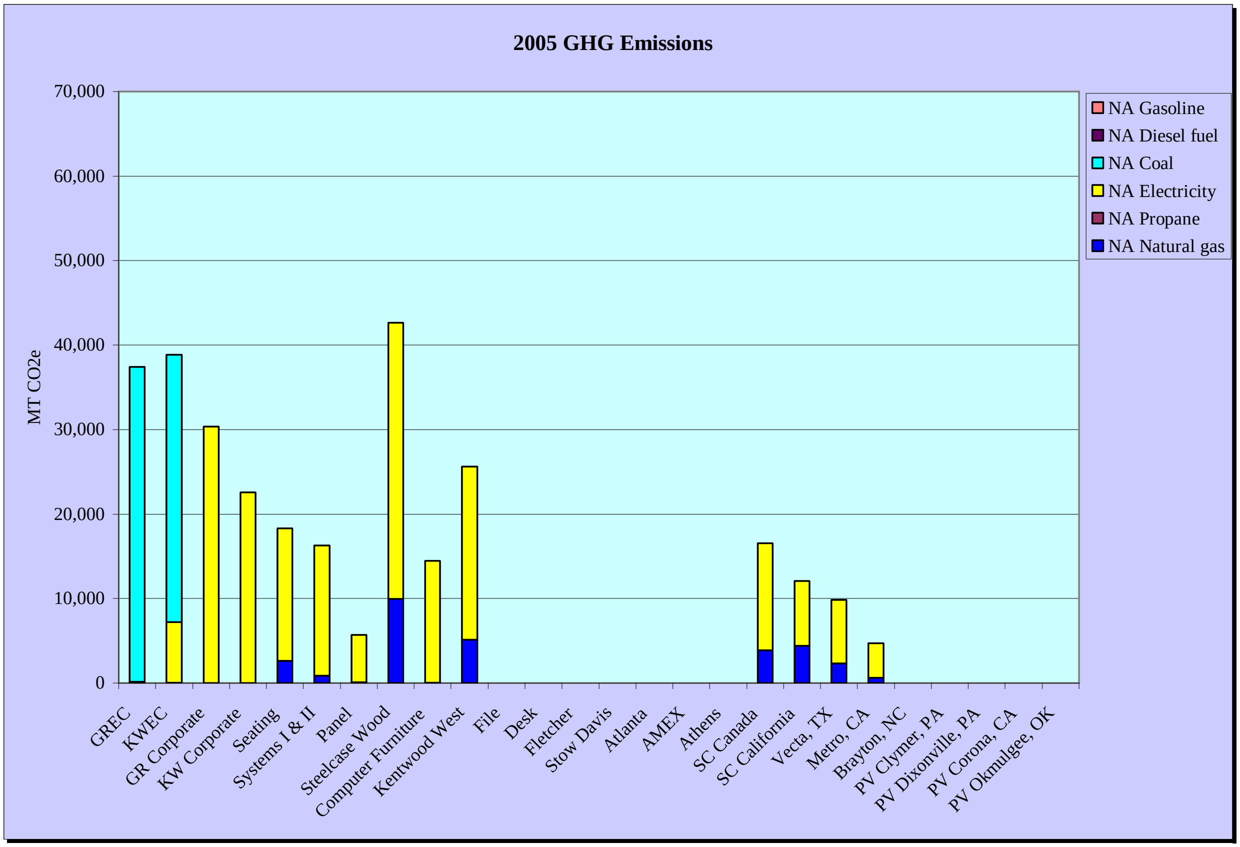
2005 GHG Emissions
MT CO2e
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
NA Gasoline
NA Diesel fuel
NA Coal
NA Electricity
NA Propane
NA Natural gas
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Vecta, TX
Metro, CA
Brayton, NC
PV Clymer, PA
PV Dixonville, PA
PV Corona, CA
PV Okmulgee, OK

Appendix 2: Inventory Key

Inventory Key							
Operational Emissions Category	**Emissions Source Category**	**Corporate emissions source**	**Fuel/GHG sources**	**GHGs**	**Quantification Method**	**Data Required**	**EF/GWP Source**
Core Direct Emission Sources	Stationary Combustion	Power generating units; natural gas T&D compressor stations, etc.	coal, residual oil, distillate oil, natural gas, propane, diesel	CO2	= Fuel Usage x Fuel Specific EF	Fuel Usage & Source Specific EF	EPA Climate Leaders
				CH4			
				N2O			
	Mobile Combustion	Truck Distribution Fleet	gasoline, diesel	CO2	= Fuel Usage x Fuel Specific EF	Fuel Usage & Source Specific EF	EPA Climate Leaders
				CH4			
				N2O			
		Aviation Operations	jet fuel	CO2	= Fuel Usage x Fuel Specific EF	Fuel Usage & Source Specific EF	EPA Climate Leaders
	Fugitive Emissions	air-conditioning	fugitive HFCs from mobile and stationary AC units	HFCs	= (Equipment Size x US HFC Average EF) x GWP	Equipment Size, Specific HFC, Average Leak Rate	EPA Climate Leaders, IPCC GWP
Core Indirect Emission Sources	Purchased Electricity	Utility power purchase agreements	eGrid Subregional grid mix	CO2	= Electric Usage x State/Region Specific EF	Electric Usage & State Specific EF	EPA eGrid
				CH4			
				N2O			
Optional Emissions Sources	Purchased Electricity	Utility power purchase agreements in Canada and Mexico	Country specific grid mix	CO2	= Electric Usage x Country Specific EF	Electric Usage Country Specific EF	IEA

Appendix 3: SCS Facilities List by Emissions Source and Fuel Type

Facility Type	Name	Nat Gas	Propane	Diesel (mobl)	Diesel (stat)	Gasoline	Coal	Res Oil	Dist Oil	Jet Fuel	HFC sstat	HFC mobl	Electricity Imports
Corporate Offices	Corporate HQ				X						X		X
	CDC				X						X		X
Transport	GR Truck Fleet			X		X					X	X	
	KW Truck Fleet			X		X					X	X	
Manufacturing Facilities	AMEX		X		X						X		X
	Athens Plant		X		X						X		X
	Atlanta Plant		X								X		X
	Chair Plant	X	X								X		X
	Chair Fabric Plant		X								X		X
	Computer Furniture	X	X								X		X
	Desk	X	X								X		X
	KW/GR Distribution Center	X	X		X						X		X
	Kentwood West	X	X								X		X
	Panel Plant	X	X								X		X
	SCS Wood	X	X								X		X
	Systems I & II	X	X								X		X
	SCS Canada	X	X		X						X		X
	SCS California	X	X		X						X		X
Energy Generation Centers	GR Energy Center	X			X		X						X
	KW Energy Center	X			X		X	X	X				X
Aviation Operations	SCS Aviation Dept	X								X	X		X
Steelcase Design Partnerships	Brayton Intl	X	X								X		X
	Custom Cable	X	X								X		X
	Custom Cable	X	X								X		X
	Custom Cable	X	X								X		X
	DesignTex	X	X								X		X
	Details	X	X								X		X
	J.M. Lynne	X	X								X		X
	Metro Furniture	X	X								X		X
	Polyvision HQ	X									X		X
	Polyvision	X	X								X		X
	Polyvision	X	X								X		X
	Polyvision										X		X
	Polyvision										X		X
	Polyvision										X		X
	Polyvision										X		X
	Polyvision										X		X
	Vecta	X	X		X						X		X

Appendix 4: Global Warming Potential values (IPCC)

Global Warming Potentials (100 - year values)	
Greenhouse Gas	**Global Warming Potential**
Carbon dioxide (CO_2)	1
Methane (CH_4) (a)	21
Nitrous oxide (N_2O)	310
HFC-23	11,700
HFC-125	2,800
HFC-134a	1,300
HFC-143a	3,800
HFC-152a	140
HFC-227ea	2,900
HFC-236fa	6,300
HFC-4310mee	1,300
CF_4	6,500
C_2F_6	9,200
C_4F_{10}	7,00
C_6F_{14}	7,400
SF_6	23,900

Source: IPCC 1996; Second Assessment Report (SAR). Although the GWPs have been updated by the IPCC in the Third Assessment Report (TAR), estimates of emissions presented in the US Inventory will continue to use the GWPs from the Second Assessment Report.

a The methane GWP includes the direct effects and those indirect effects due to the production of tropospheric ozone and stratospheric water vapor.

Appendix 5: Corporate GHG Inventory Management Plan (approved by Steelcase)

EPA Climate Leaders
Steelcase, Inc – GHG Emissions Inventory Management Plan

Principles:

1. **Relevance:** Ensure that the GHG inventory appropriately reflects the GHG emissions of the company and serves the decision-making needs of users – both internal and external to the company.
2. **Completeness:** Account for and report all greenhouse gas emission sources and activities within the chosen organizational and operational boundaries. Disclose, specify and justify any specific exclusions.
3. **Consistency:** Use consistent methodologies to allow meaningful comparison of emissions over time. Transparently document any change to the data, data collection, inventory boundary, scientific methods, or any other relevant factors in the time series.
4. **Transparency:** Address all relevant issues in a factual and coherent manner, based on a clear audit trail. Disclose any relevant assumptions and make appropriate references to the accounting and calculation methodologies and data sources used.
5. **Accuracy:** Ensure that the quantification of GHG emissions is systematically neither over nor under actual emissions, as far as can be judged, and that uncertainties are reduced as far as practicable. Achieve sufficient accuracy to enable users to make decisions with reasonable assurance as to the integrity of the reported information.

Contents:

Special Definitions and Abbreviations:

GHG – Greenhouse Gases
EPA – Environmental Protection Agency
CL – Climate Leaders Program
SCS – Steelcase, Inc.
IMP – Inventory Management Plan
SDP – Steelcase Design Partnership
CEP – Corporate Environmental Performance department at Steelcase
IPCC – Intergovernmental Panel of Climate Change

(I.) Partner Information

1. Company Name

    Steelcase Inc.

2. Company Address

    901 44th Street, SE
    Grand Rapids, MI 49508
    United States

3. Corporate GHG Inventory Manager

    Lynn Avery Zimmerman, PE – Senior Environmental Engineer
    Corporate Environmental Performance Department

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(II.) Boundary Conditions

Organizational Boundaries

5. Inclusion of Partially Owned or Controlled Assets

For the purposes of this project SCS organizational boundaries of GHG emissions reporting will be defined by the Operational Control Model. Using this methodology all business entities and facilities over which SCS has full operational control will be included in the inventory. The inventory will account for 100% of GHG emissions from the facilities included in the organizational scope. These entities include:

- Corporate offices including the Corporate Headquarters (HQ) in Grand Rapids, MI and the Corporate Development Center (CDC) in Kentwood, MI
- Manufacturing facilities in the US, Canada and Mexico owned by SCS
- Manufacturing facilities in the US owned by affiliated companies Steelcase Design Partnerships (SDPs)
- Distribution truck fleet owned and operated by SC Transport, a subsidiary of SCS
- Energy Centers located within the manufacturing complexes in Grand Rapids, MI and Kentwood, MI
- Steelcase Aviation Department owned and operated by SCS

The operational control model is consistent with the financial and accounting reporting systems currently used by SCS. In addition, it provides an accurate portrayal of the economic realities facing the company today. As the company moved away from a vertically integrated business model it has become a nexus of production facilities owned by SCS and affiliated companies. It must be noted that SCS owns equity in all of its SDPs. A vast network of dealers is excluded from this inventory. The majority of dealerships are independently owned. In few cases, however, SCS holds majority or minority interest. Regardless of stock ownership status the dealer principals maintain full operational control and have full authority to design and implement new policies. Finally, transportation vendors that currently handle roughly 60% of Steelcase product shipping volume will be excluded from the inventory. These transportation companies are fully independent entities and have full operational control over their operations.

6. Facilities List

Table 1: Facilities List

Facilities				Organizational Boundary
				Operational Control
Operations	**Facility Type**	**Name**	**City/State/Country**	
North American Operations	**Corporate Offices**	Corporate HQ	Grand Rapids, MI	100%
		CDC	Kentwood, MI	100%
	Transportation	Grand Rapids Truck Fleet	Grand Rapids, MI	100%
		Kentwood Truck Fleet	Kentwood, MI	100%
	Manufacturing Facilities	AMEX	Tijuana, Mexico	100%
		Athens Plant	Athens, AL	100%
		Atlanta Plant	Lithia Springs, GA	100%
		Chair Plant	Grand Rapids, MI	100%
		Chair Fabric Plant	Grand Rapids, MI	100%
		Computer Furniture Plant	Kentwood, MI	100%
		Desk	Grand Rapids, MI	100%
		Kentwood/Grand Rapids Distribution Center	Kentwood, MI	100%
		Kentwood West	Kentwood, MI	100%
		Panel Plant	Kentwood, MI	100%
		SCS Wood	Gaines Township, MI	100%
		Systems I & II	Grand Rapids, MI	100%
		SCS Canada	Markham, Ontario	100%
		SCS California	City of Industry, CA	100%
	Energy	Grand Rapids Energy Center	Grand Rapids, MI	100%

	Generation Centers	Kentwood Energy Center	Kentwood, MI	100%
	Aviation Operations	SCS Aviation Department	Grand Rapids, MI	100%
-	**Steelcase Design Partnerships**	Brayton International	High Point, NC	100%
		Custom Cable	Ft. Lauderdale, FL	100%
		Custom Cable	Lake Mary, FL	100%
		Custom Cable	Tampa, FL	100%
		DesignTex	New York, NY	100%
		Details	Athens, AL	100%
		J.M. Lynne	Hauppage, NY	100%
		Metro Furniture	Oakland, CA	100%
		Polyvision HQ	Atlanta, GA	100%
		Polyvision	Beaverton, OR	100%
		Polyvision	Corona, CA	100%
		Polyvision	Dixonville, PA	100%
		Polyvision	New York, NY	100%
		Polyvision	Okmulgee, OK	100%
		Polyvision	Riverside, CA	100%
		Polyvision	Wheeling, IL	100%
		Vecta	Grand Prairie, TX	100%

Note: The facilities list is generated from the GHG Inventory Facilities List.

Operational Boundaries

7. GHG List

CO_2 - Carbon Dioxide
CH_4 - Methane
N_2O – Nitrous Oxide
HFCs – Hydrofluorocarbons (HFC 134a emissions from mobile and stationary air conditioning equipment)

For jet fuel, the CL has provided only CO_2 emissions factor. Thus calculations for CH_4 and N_2O are not included in the inventory. For electricity use in Canada and Mexico only CO_2 emissions factors are available. As additional emissions factors become available, the inventory will be updated.

8. Emission Source Identification Procedure

Each manufacturing site included in the Inventory has an established process for identification of significant GHG emissions sources and processes. Energy use at each manufacturing facility is reported directly to CEP on a quarterly basis. All manufacturing facilities and energy generation centers that are part of Grand Rapids and Kentwood complexes report their energy consumption data (natural gas, coal and electricity) to the internal Powerhouse database. Process emissions of all GHGs are estimated onsite using material balances and other appropriate engineering methods and are reported directly to CEP. Distribution truck fleet fuel consumption data and fuel emissions are calculated using the Steelcase Fuel Management System. On-site energy centers at Grand Rapids, MI and Kentwood, MI track their emissions data using fuel consumption monitoring system. Aggregate data from each manufacturing site, energy generation site and distribution truck fleet is sent for annual analysis to CEP. SCS Aviation department tracks jet fuel purchases at the point of origin, Grand Rapids, MI, and at the refueling outlets nationally. Moreover, energy consumption at the jet hangar is also included. Based on these reporting requirements CEP analyzes data on per facility basis for North American corporate operations and compiles the GHG Emissions Report.

Each corporate office and regional sales office included in the Inventory has a process for identification of significant GHG emission sources. Non-manufacturing sites reporting is limited to electricity and natural gas usage through metering and fuel purchase and delivery receipts. Non-energy emissions are not estimated from office sites because there are no significant sources. As a result, CO_2, CH_4, and N_2O emissions are estimated base on total annual energy usage at each office site.

The GHG Emissions Report containing facility emissions data will be added to the current quarterly corporate-wide Environmental Report presented by the CEP to Senior VP of Global Manufacturing, VP of North American Manufacturing, and President of Steelcase Design Partnerships. All GHG emissions from included sites are presented in the SCS GHG Inventory. The entire portfolio of GHG emissions is tracked by facility and fuel type on quarterly and annual bases. GHG emissions are presented in metric tons of $CO_{2\ \text{equivalents}}$ (MT CO2e). All data is reported using facility-specific approach

- *Manufacturing facilities* – fuel consumption records (internal data provided by facilities' management and energy coordinators through fuel purchase and delivery receipts, and data aggregation)
- *Corporate office facilities* – energy consumption (utility bills, fuel purchase receipts and metering)
- *Energy generation facilities* – fuel consumption, fuel used as feedstock (fuel purchase and delivery records)
- *Distribution truck fleet* – Fleet Fuel Management System tracks diesel and gasoline consumption on quarterly and annual basis for all trucks (fuel purchase receipts)
- *SCS Aviation Department* – fuel purchase receipts at the point of origin (Grand Rapids, MI) and at the national refueling outlets; metering, fuel purchase and delivery receipts for the energy consumption at jet hangar

9. Direct Sources

SCS GHG Inventory includes emissions from stationary and mobile combustion, and process emissions.

- Stationary Sources
- Mobile Sources
- Process Sources

Table 2: Direct GHG Emissions Sources

Fuel Type	Activity
Natural Gas	➢ Ovens and dryers are used for treating parts and pieces before they are powdercoated with paint ➢ Ovens for the curing of powder paint ➢ Make-up air units that warm up air before it enters the plant ➢ Large boilers for steam generation ➢ Small boilers for bathroom facilities onsite ➢ HVAC systems ➢ Hook burn-off ovens used to remove accumulated paint on part hooks
Propane	➢ Large lift trucks used onsite
Diesel	➢ Delivery OTR trucks ➢ Backup generators at the computing centers in HQ and CDC, the Safety Services (Grand Rapids complex), Athens Plant, Fletcher Plant, Steelcase Wood Plant , Vecta Plant, Steeclase Canada Plant (test-fired for 30 min per month) ➢ Diesel powered fire suppression pumps at the Desk and Systems Plants (GR Complex), CDC, Steelcase Wood, Steelcase Canada, Athens Plant, AMEX and Fletcher Plant (test-fired for 30 min per week)
Gasoline	➢ Delivery trucks
Coal	➢ Energy generation centers in Grand Rapids and Kentwood generate steam for process and building heat in the plants
Jet Fuel	➢ Used by the SCS Aviation Department for operation of corporate jets
Distillate Oil #2	➢ Kentwood Energy Center has the capacity to burn #2 oil as a backup fuel in several boilers to produce steam for process and building heat in the plants
Residual Oil #6	➢ Kentwood Energy Center has the capacity to burn #6 oil as a backup fuel in several boilers to produce steam for process and building heat in the plants
HFCs – Fugitive Emissions	➢ Refrigerants and air conditioning units

10. Indirect Sources – Energy Import/Export

All purchased electricity for manufacturing and non-manufacturing sites is included in the inventory. No other sources of indirect energy are included.

Table 3: Indirect GHG Emissions Sources

Sources	Activity
Electrical Grid	➢ Electricity consumption for on site use at all manufacturing plants, energy generation centers, and office facilities (including plants in Mexico and Canada)

11. Optional Sources

Optional sources, which are voluntary under the CL provisions, are not included in the inventory.

(III.) Emission Quantification

12. Quantification Methods

The chosen approach for emissions calculations is based on the application of the CL default emissions factors. Other methods such as continuous emissions monitoring system or fuel analysis to determine carbon content of the fuel are not currently available. To date, this emission factors approach is deemed to be a more cost-effective option. All calculations are done based on facility-specific and fuel-specific data analysis approaches. The emissions factors used can be reviewed in the GHG Inventory:

- Direct Mobile Emissions Factors for CO_2, CH_4, and N_2O emissions
- Direct Stationary Emissions Factors for CO_2, CH_4, N_2O and HFC 134a emissions
- Indirect Electricity Imports/Purchases Emissions Factors for CO_2, CH_4, and N_2O emissions (for electricity purchases in Canada and Mexico only CO_2 are currently available)

All GHG emissions are then converted into metric tons $CO_{2\ equivalents}$ using global warming potential values estimated in the IPCC 1996 Second Assessment Report and approved for use by the EPA CL. Conversion factors are provided by the EPA and can be reviewed in the Conversion Factors sheet of the Inventory. The data is tracked by a fuel type and a facility. All results are reported in MT CO2e with the data for all facilities and emissions sources linked to the GHG Emissions Tracking Tool, which analyses annual emissions and progress toward the corporate GHG emissions reduction goal. Below are examples of calculations for direct mobile and stationary sources, and indirect sources.

Direct emissions from stationary sources in metric tons $CO_{2\ equivalents}$:

- Quantity of fuel (MMcf/year) x Heat content of fuel (MMBtu/MMcf) = Quantity of fuel (MMBtu/year)

- [Quantity of fuel (MMBtu) x Emission factor (lbs CO_2/MMBtu)] / 2205 = CO_2 Emissions (metric tons)
- [Quantity of fuel (MMBtu) x Emission factor (lbs CH_4/MMBtu)] / 2205 = CH_4 Emissions (metric tons)
- [Quantity of fuel (MMBtu) x Emission factor (lbs N_2O/MMBtu)] / 2205 = N_2O Emissions (metric tons)
- CO_2 Emissions (MT) + [CH_4 Emissions (MT) x 21] + [N_2O Emissions (MT) x 310] = Total emissions $CO_{2\ equivalents}$ (metric tons)

Direct emissions from mobile sources in metric tons $CO_{2\ equivalents}$:

- [Miles traveled (ml/year) x Emission factor (grams CO_2/ml)] / 1000 = CO_2 Emissions (kg)
- CO_2 Emissions (kg) / 1000 = CO_2 Emissions (metric tons)
- [Miles traveled (ml/year) x Emission factor (grams CH_4/ml)] / 1000 = CH_4 Emissions (kg)
- CH_4Emissions (kg) / 1000 = CH_4 Emissions (metric tons)
- [Miles traveled (ml/year) x Emission factor (grams N_2O /ml)] / 1000 = N_2O Emissions (kg)
- N_2O Emissions (kg) / 1000 = N_2O Emissions (metric tons)
- CO_2 Emissions (MT) + [CH_4 Emissions (MT) x 21] + [N_2O Emissions (MT) x 310] = Total emissions $CO_{2\ equivalents}$ (metric tons)

Direct fugitive HFC emissions (HFC 134a is used with GWP value of 1300) from stationary and mobile AC units in metric tons $CO_{2\ equivalents}$:

- [HFCs in chiller (kg HFC/tons of cooling) x Annual HFC leakage factor (%)] / Average cooling capacity of chiller (ft2/tons of cooling) = Total annual HFC losses (MT HFC/1000 ft2)
- Total annual HFC losses (MT HFC/1000ft2) x 1300 = Total annual HFC losses (MT $CO_{2\ equivalents}$/ 1000 ft2)
- Total annual HFC losses (MT $CO_{2\ equivalents}$/ 1000 ft2) / 1000 = Total annual HFC losses (MT $CO_{2\ equivalents}$/ ft2) = Emissions factor per ft2
- Air-conditioned facility area (ft2) x Emissions factor (MT $CO_{2\ equivalents}$/ ft2) = Facility fugitive HFC emissions (MT $CO_{2\ equivalents}$)

- [HFC capacity (kg HFC) x Annual leakage factor (%)] x 1300 (GWP) = Emissions ($CO_{2\ equivalents}$/yr)
- Total annual miles (VMT/year) / [fuel economy (mi/gal) x CO_2 Emission factor (kg CO_2/gal) = CO_2 Emissions (kg CO_2/yr)
- Emissions ($CO_{2\ equivalents}$/yr) / CO_2 Emissions (kg CO_2/yr) = HFC Emission factor (HFC emissions ($CO_{2\ equivalents}$) to CO_2 (as %)
- Annual facility CO_2 Emissions (MT) x HFC Emission factor (HFC emissions ($CO_{2\ equivalents}$) to CO_2 (as %)) = Facility fugitive HFC emissions (MT $CO_{2\ equivalents}$)

Note 1: Floor space for stationary combustions in measured in ft2.

Note 2: Each plant has an air-conditioned office space that amounts to 25% of the total facility square footage. This 25/75 rule will be used to estimate HFC emissions from plants.

Indirect emissions from electricity purchase in metric tons $CO_{2\ equivalents}$:

- [Electricity used (kWh/year) x Regional Emission factor (lbs CO_2/kWh)] / 2205 = CO_2 Emissions (metric tons)
- [Electricity used (kWh/year) x Regional Emission factor (lbs CH_4/kWh)] / 2205 = CH_4 Emissions (metric tons)
- [Electricity used (kWh/year) x Regional Emission factor (lbs N_2O/kWh)] / 2205 = N_2O Emissions (metric tons)
- CO_2 Emissions (MT) + [CH_4 Emissions (MT) x 21] + [N_2O Emissions (MT) x 310] = Total emissions $CO_{2\ equivalents}$ (metric tons)

Note: Regional emission factors are obtained from the 2000 eGrid Subregion Emission Rates database

All of the above calculations constitute the basis of quantitative analysis presented in the excel-based GHG Inventory.

13. Emissions Factors and Other Constants

The emissions factors for the CO_2, CH_4, N_2O and HFCs emissions are the EPA default emissions factors. Other emissions estimation methods such as continuous emissions monitoring system or fuel analysis approach to determine carbon content of the fuel are not available. The emissions factors for direct combustion from stationary and mobile sources are provided by the EPA CL.[35] The emissions factors for indirect combustion from electricity imports/purchases are based on the eGrid Subregion Emission Rates that are estimated for 27 subregions that make up the US electrical grid.[36] The emissions factors for electricity purchases in Canada and Mexico are provided by the International Energy Agency (IEA, 2004). Finally, the CL has adopted the IPCC Second Assessment Report methods of comparing the radiative forcing ability of individual GHGs by using a relative measure of each GHG, measured in 100-year global warming potentials (GWPs). As mentioned in the previous section, all specific emissions factors used can be found and verified in the GHG Inventory. Conversion factors were provided by the EPA[37].

(IV.) Data Management

14. Activity Data

[35] They can accessed through the CL website via Cross Sector Core Modules Guidance;
- Stationary combustion - http://www.epa.gov/climateleaders/docs/stationarycombustionguidance.pdf
- Mobile combustion - http://www.epa.gov/climateleaders/docs/mobilesourceguidance.pdf
- HFCs fugitive emissions - http://www.epa.gov/climateleaders/docs/refrige_acequipuseguidance.pdf

[36] The emission rates for 27 subregions and off-grid generation were obtained from the EPA Climate Leaders (contact person: Vincent Camobreco through a personal communication by Greg Keoliean)

[37] http://www.epa.gov/cppd/pdf/brochure.pdf and http://www.epa.gov/climateleaders/docs/design_princ_app2.pdf

The most accurate and reliable data that is readily available is used to calculate Steelcase corporate GHG emissions. Primary data that may be used to calculate energy use are electricity bills, fuel purchase bills or purchase agreements, fuel flow meter records. Fuel data for Steelcase distribution fleet is analyzed using Fleet Fuel Management System. Manufacturing facilities and energy centers based in Grand Rapids and Kentwood report all energy data to the Powerhouse database. The onsite EHS professional determines what data is available and submits to CEP for further operational analysis. Onsite responsibility is to determine possible sources of error in the data and document any quality control procedures that are used to minimize these errors. For sites registered under ISO 14001, consistent with each site's environmental management system the facility manager maintains the site's list of primary records that are used to determine their emissions and energy data. Below is the detailed list of activity data origins:

- *Manufacturing facilities* – fuel consumption records; internal data provided by facilities' management and energy coordinators through fuel purchase, delivery receipts, and data aggregation
- *Corporate office facilities* – energy consumption; utility bills, fuel purchase receipts and metering
- *Energy generation facilities* – fuel consumption, fuel used as feedstock; fuel purchase and delivery records
- *Distribution truck fleet* – Fleet Fuel Management System tracks diesel and gasoline consumption on quarterly and annual basis for all trucks; fuel purchase receipts
- *SCS Aviation Department* – fuel purchase receipts at the point of origin, Grand Rapids, MI, and at the national refueling outlets; metering, fuel purchase and delivery receipts for the energy consumption at the jet hangar

Below is the description of activity level by fuel type at each facility:

Table 4: Activity Level

Facility Type	Name	Nat Gas	Propane	Diesel (mobl)	Diesel (stat)	Gasoline	Coal	Res Oil	Dist Oil	Jet Fuel	HFCs (stat)	HFCs (mobl)	Electricity Imports
Corporate Offices	Corporate HQ				X						X		X
	CDC				X						X		X
Transport	GR Truck Fleet			X		X					X	X	
	KW Truck Fleet			X		X					X	X	
Manufacturing Facilities	AMEX		X		X						X		X
	Athens Plant		X		X						X		X
	Atlanta Plant		X								X		X
	Chair Plant	X	X								X		X
	Chair Fabric Plant		X								X		X
	Computer Furniture	X	X								X		X
	Desk	X	X								X		X

	KW/GR Distribution Center	X	X		X						X		X
	Kentwood West	X	X								X		X
	Panel Plant	X	X								X		X
	SCS Wood	X	X								X		X
	Systems I & II	X	X								X		X
	SCS Canada	X	X		X						X		X
	SCS California	X	X		X						X		X
Energy Generation Centers	GR Energy Center	X			X		X						X
	KW Energy Center	X			X		X	X	X				X
Aviation Operations	SCS Aviation Dept	X								X	X		X
Steelcase Design Partnerships	Brayton Intl	X	X								X		X
	Custom Cable	X	X								X		X
	Custom Cable	X	X								X		X
	Custom Cable	X	X								X		X
	DesignTex	X	X								X		X
	Details	X	X								X		X
	J.M. Lynne	X	X								X		X
	Metro Furniture	X	X								X		X
	Polyvision HQ	X									X		X
	Polyvision	X	X								X		X
	Polyvision	X	X								X		X
	Polyvision										X		X
	Polyvision										X		X
	Polyvision										X		X
	Polyvision										X		X
	Polyvision										X		X
	Vecta	X	X		X						X		X

15. <u>Data Management</u>

Data is collected quarterly at each site and transferred to the Corporate GHG Inventory Manager at the CEP. Onsite emissions data providers are facility Environmental Coordiantors, a group that includes plant engineers, EHS staff, and/or facility managers who check reported data prior to submissions. The Corporate GHG Inventory Manager compiles data for quarterly Environmental Reports to senior corporate executives and analyzes data on annual basis for the annual Corporate Environmental Report. At this stage, data points are checked against previous quarterly and annual results for the same activity and emissions sources at each facility. As SCS moves forward with its plan to have all of its manufacturing plants to be ISO 14001 registered, certified GHG emissions reporting will be incorporated in the Environmental Management Systems reporting protocol. Facility managers at the non-manufacturing sites will proceed with the adopted quarterly reporting procedure.

16. Normalization Factors (TBD)

It is the goal of SCS to remain an environmental leader in the industry. As part of this commitment we pledge to reduce corporate GHG emissions footprint. The normalizations factor selected by SCS is a million US$ of annual sales. The use of normalization factors closely mimics productivity analyses and other environmental tracking methods used at SCS. Normalized reduction will be measured in metric tons CO2e per Million US$ sales.

17. Data Collection for Normalization Factors

As stated above, in section 16, SCS will use normalization factor (MT CO2e per million US$ annual sales) to track its emissions reduction progress. The SCS Emissions Tracking Tool in the corporate Inventory tracks emissions by facility, emission sources (direct, indirect, and aggregate), and normalized factors. Normalized values are reported quarterly and analyzed annually by the Corporate GHG Inventory Manager. These values are routinely checked for consistency with data from past quarters and years. Annual emission reduction results can be verified in the SCS Emissions Tracking Tool.

18. Data Collection Process and Quality Assurance

SCS will adopt the GHG Inventory Quality Assurance Procedure that will ensure reporting consistency and completeness. As part of this effort each site's Environmental Coordinator will analyze and document any areas of possible error and QA/QC measures undertaken at each site. Emissions data is monitored on a quarterly basis by the facility's Environmental Coordinator and reviewed for inconsistencies and unexpected fluctuations prior to being reported to the Corporate GHG Inventory Manager.

At the corporate level the Corporate GHG Inventory Manager is responsible for all QA/QC controls. Emissions data is collected on quarterly basis and the aggregate data analysis is performed on an annual basis. Before that data from each site is accepted and entered into the SCS GHG Inventory the Corporate GHG Inventory Manager reviews all data for consistency. Any significant variations from the established benchmark or large quarterly fluctuations are identified and investigated for accuracy. As a result, aggregate emissions data is evaluated based on the appropriate magnitude of each site's emissions for the production output and emissions scale. Throughout the process any areas of possible error are defined and documented. Periodic audits of site records will be conducted to evaluate the integrity of data collection and monitoring processes.

19. Data Collection Security System

Each manufacturing and non-manufacturing site is responsible for maintaining their site's records. As a general practice, each facility retains hard (original or printed) copies of emissions data, fuel purchase and fuel delivery records supported by scheduled computer system backup. A site Environmental Coordinator can only provide data for his/her site. The Corporate GHG Inventory Manager controls access to SCS GHG Inventory and can also change data for any site and for corporate-wide categories given the GHG Inventory Quality Assurance Procedure.

Given the fact that SCS is just developing data management requirements for the GHG Inventory, definition and scope of data collection and system security will be further defined and, if necessary, broadened.

20. Integrated Tools (optional)

The CEP is committed to integrate GHG emissions reporting with all existing energy and environmental reporting systems, including VOCs, solid waste and material intensity reporting. The analysis of corporate GHG footprint and its emissions reduction goal will be made part of quarterly GHG emissions facility-specific and corporate reporting will be added to the current quarterly environmental reporting procedure to Senior VP of Global Manufacturing, VP of North American Manufacturing, and President of Steelcase Design Partnerships. Furthermore, Annual Corporate Environmental Report will contain a detailed analysis of corporate-wide GHG emissions. Finally, once all manufacturing facilities become ISO 14001 registered the GHG emissions reporting will be integrated into the Environmental Management System.

21. Frequency

Emissions data is reported to the CEP on a quarterly schedule. The Corporate GHG Inventory Manager compiles quarterly emissions reports and analyzes corporate-wide emissions on an annual basis. Data is reported to the SCS GHG Inventory annually. Annual emissions data is reported to CL via Annual GHG Inventory Summary and Goal Tracking Form.

(V.) Base Year

22. Adjustments – Structural Changes

The base year 2004 for the 2012 reduction goal will be adjusted for mergers, acquisitions and divestitures according to the CL historic emissions recalculation procedures.[38] Actual annual emissions from an acquisition will be added to base year and each subsequent year, provided the facility existed in 2004. Actual annual emissions from divestitures will be subtracted from the base year and each subsequent year, provided the facility was included in the organizational boundaries of the inventory. Any merger will be treated as an acquisition with emissions added to the base year and each subsequent year, provided newly added facilities existed in 2004. In an event of organic growth or organic decline no base year adjustments will be made. All adjustments will be made if the structural changes exceed the *significance threshold of 1%* of base year emissions.

SCS has adopted lean manufacturing principles throughout the North American operations. This allows for consolidation of production capacity that is accomplished by plant closure. Despite a reduced number of facilities production output has stayed the same or even increased. In an event of a plant closure, total GHG emissions from a facility are divided into

[38] CL Design Principles, Chapter 5, *Basic Rules for Base Year Emissions Recalculation* (http://www.epa.gov/climateleaders/docs/design_princ_ch5.pdf)

emissions from a building and emissions from equipment based on a 70/30 rule (70% emissions – plant equipment; 30% of emissions – facility). If the old equipment (from a now closed plant) is moved to a new facility the increase in emissions will trigger recalculation if it exceeds the stated significance threshold of 1%.

If SCS reduces its distribution truck fleet, thus increasing volume of product shipments handled by independent transportation vendors, historical emissions including base year will be adjusted. There are no planned adjustments for other types of outsourcing. In the event of fuel switching to less carbon-intensive fuel sources such as the use of biodiesel, biomass, hydrogen, and other fuel types, no historical emissions recalculation is required.

23. Adjustments – Methodology Changes

Changes will be made to quantitative methods and emissions factors only if driven by evolving EPA CL specifications and regulatory changes. If fuel compositions change over time, i.e., changes in heating values and/or oxidation factors affect changes in emissions factors, this will not trigger emissions recalculation unless required otherwise by the CL. All changes will be discussed with the CL staff prior to be executed. If an adjustment is necessary, change will be noted in a log together with a description of the procedure. All authorized changes will be applied throughout to the entire spectrum of historic emissions. If an error in either data collection or data analysis approach is detected, it will be promptly corrected and the change will be noted in the log.

(VI.) Management Tools

24. Roles and Responsibilities

SCS has adopted a two-tier reporting structure: facility reporting and corporate reporting. Overall, emissions data is collected at the facility level, and is analyzed, quantified and reported at the corporate level.

- *Facility Level:* data collection and quarterly report to the CEP are conducted by a facility Environmental Coordinator. Duties primarily include facility data collection and data quality control, and quarterly reporting to corporate level.
- *Corporate Level:* data analysis, quantification and reporting are conducted by the Corporate GHG Inventory Manager. Duties include aggregation of facility quarterly reports and compilation of the annual GHG Emissions Report. This data is recorded in the SCS GHG Inventory, presented to SCS Management, and displayed in the Annual Environmental Report.

Given the fact that SCS is just developing management tools for the GHG Inventory, definition and scope of roles and responsibilities will be further defined and, if necessary, broadened.

25. Training

The Corporate GHG Inventory Manager is required to read the training materials, the GHG IMP, Climate Leaders Design Principles and Reporting Requirements. The Corporate GHG Inventory Manager is required to review any changes to the CL Program. The Corporate GHG Inventory Manager is responsible for the development and implementation of training materials and/or training sessions for facility Environmental Coordinators. These training materials should cover critical aspects of the CL and corporate obligations as a program member. All facility Environmental Coordinator must be familiar with the IMP and be kept well-informed of all future changes. Each facility Environmental Coordinator is responsible for reading the training materials and/or attending training sessions and working with the Corporate GHG Inventory Manager to resolve any issues pertaining to their site's emissions inventory.

Given the fact that SCS is in the early stages of developing management tools for the GHG Inventory, definition and scope of training will be further defined and, if necessary, broadened.

26. Document Retention and Control Policy

All CL documents, the GHG Inventory records and processes will be retained indefinitely in both electronic and hardcopy formats. Primary records and site-specific procedures will be stored onsite. Aggregate emissions data analysis and reporting will be stored at CEP. Each version of the IMP will be reviewed, approved and updated by the Corporate GHG Inventory Manager. Following review and approval, only the current version of the IMP and all auxiliary documents will be made available to facility Environmental Coordinators.

Given the fact that SCS is in the early stages of developing management tools for the GHG Inventory, definition and scope of document retention and control policy will be further defined and, if necessary, broadened.

(VII.) Auditing and Verification

27. Internal Auditing

The IMP and the GHG Inventory will be audited for compliance with current protocols on an annual basis, before the Annual GHG Inventory Summary and Goal Tracking Form is submitted to CL. The audit will be conducted by the Corporate GHG Inventory Manager. Spot audits of individual facilities will be performed by the Corporate GHG Inventory Manager and corrective action, if necessary, will be determined. As SCS moves ahead with ISO 14001 registration for all of its manufacturing facilities GHG Emissions audits will be incorporated into the Environmental Management Systems auditing procedure.

28. External Validation and/or Verification (optional)

At this time SCS has no policy for an external audit of the IMP, baseline data, calculations, and records.

29. Management Review

The SCS GHG Inventory data will be reviewed and approved by the Director of CEP. Goal setting, progress toward meeting goals, and any additional action or options necessary to meet emissions reduction goals will be reviewed by the Director of CEP.

Given the fact that SCS is in the early stages of developing management review procedures for the GHG Inventory, definition and scope of management review will be further defined and, if necessary, broadened.

30. Corrective Action

Any findings revealed though The GHG Inventory Quality Assurance Procedures and internal audits will trigger immediate correction pending a formal review and approval process by the Corporate GHG Inventory Manager. All corrective actions will be handled in much the same way as the correction of an error in the inventory. All subsequent changes at the facility level will be entered into the facility change log with corrective action relayed to the corporate level. All changes at the corporate level will be documented into the corporate change log. Along with the quarterly emissions data reporting each facility Environmental Coordinator is required to submit a facility change log.

Given the fact that SCS is in the early stages of developing corrective action procedures for the GHG Inventory, definition and scope of these actions will be further defined and, if necessary, broadened.