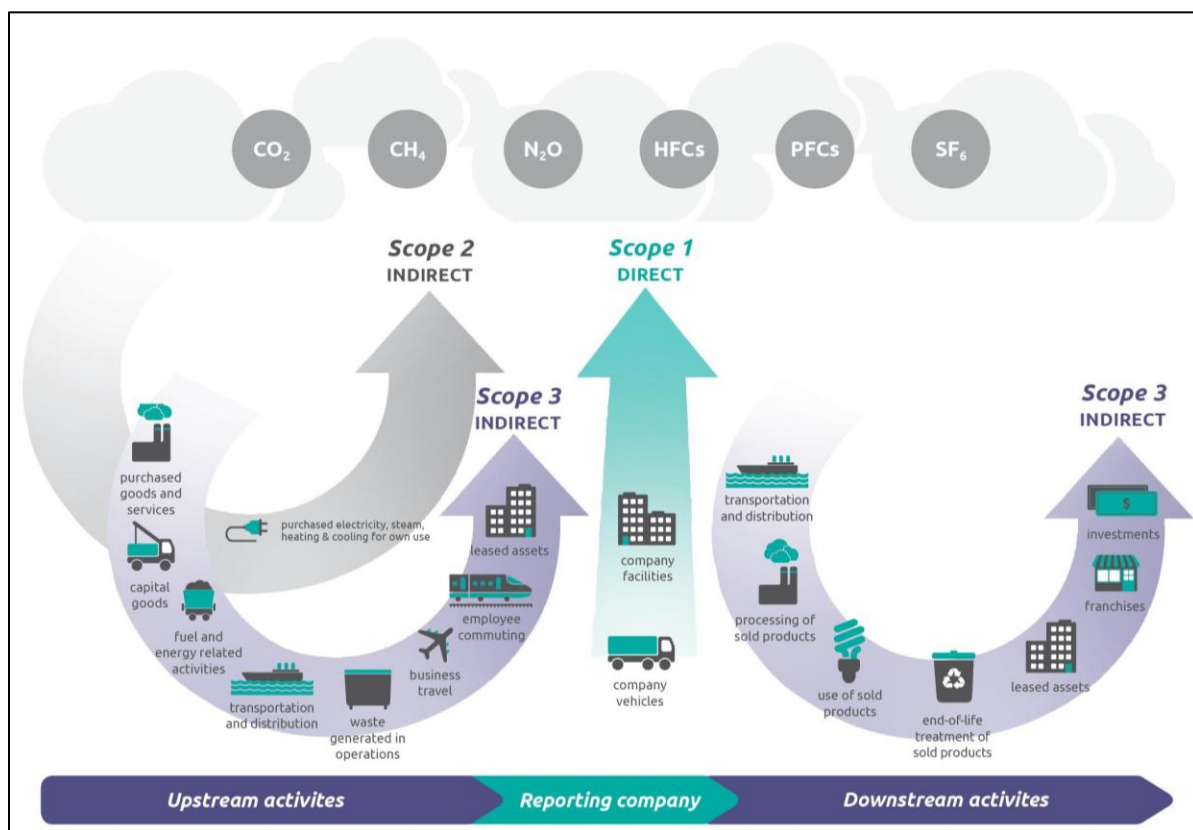


Greenhouse Gas Protocol Offers Standards for Measuring Carbon Footprint of Value Chains and Product Life Cycles

Maggie Y.M. Lee

The Greenhouse Gas Protocol (GHG Protocol) is a widely used accounting tool for government and business leaders worldwide to understand, quantify, and manage greenhouse gas emissions using consistent and universally-accepted standards. According to GHG Protocol's official web site (<http://www.ghgprotocol.org>), more than 85% of the 2,487 respondents to the Carbon Disclosure Project (CDP) 2010 survey used the GHG Protocol Corporate Standard to measure and report their emissions. Here we provide a summary of feature standards and calculation tools offered by the GHG Protocol. Details of each standard or tool can be found on the web site. Readers can also access the latest version of each publication or tool mentioned through the links within this article.



Source: GHG Protocol Corporate Value Chain (Scope 3) Standard (October 2011)
<http://www.ghgprotocol.org/files/ghgp/public/overview-of-scopes.JPG>

Figure 1. Overview of GHG Protocol scopes and emissions across the value chain.

In the 1990s, the World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSD) recognized the need for an international standard for

corporate GHG accounting and reporting as climate change policies evolved. Working with large corporate partners such as British Petroleum and General Motors, WRI released a report “Safe Climate, Sound Business” (<http://www.wri.org/publication/safe-climate-sound-business-action-agenda>) that urged businesses to address climate change and highlighted the call for standardized measurement of GHG emissions. In late 1997, WRI and WBCSD agreed to launch a partnership between non-government organizations (NGOs) and businesses to address standardized methods for GHG accounting in 1998. WRI and WBCSD then assembled a core steering group comprised of members from environmental groups and industry to guide the multi-stakeholder standards development process.

In 2001, the initiative published the first edition of *The Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard* (also called Corporate Standard). Based on the Corporate Standard, it has since developed a suite of calculation tools for companies to calculate their GHG emissions and additional guidance documents such as the GHG Protocol for Project Accounting. WRI and WBCSD have also partnered with governments, businesses, and NGOs in both developed and developing countries to promote the adoption of the GHG Protocol as the foundation for climate change strategies.

The GHG Protocol now serves as the foundation for nearly every GHG standard and program in the world as well as hundreds of GHG inventories prepared by individual companies. The GHG Protocol also offers developing countries an internationally-accepted management tool to help their businesses compete in the global marketplace and to assist their governments make informed decisions about climate change.

In October of 2011, the GHG Protocol launched two new standards, the Corporate Value Chain Standard (also called Scope 3 Standard, <http://www.ghgprotocol.org/standards/scope-3-standard>) and Product Life Cycle Standard (also called Product Standard, <http://www.ghgprotocol.org/standards/product-standard>), which were created in response to inquiries from businesses that seek to better understand and measure their climate impacts beyond their own operations. The new standards provide a comprehensive view of the emissions produced when making a product and across the value chain. Using the standards, companies can analyze the costs for production, labor and transportation of products; make better business decisions; and stimulate innovation of products and production methods.

The Corporate Value Chain Standard unveils opportunities for companies to make more sustainable decisions about their activities and the products they produce, buy, and sell. Companies of all sizes can look strategically at GHG emissions up and down their value chains, showing them where to focus limited resources to maximize impacts.

The Product Life Cycle Standard enables companies to measure the GHG emissions of an individual product. Covering materials, manufacturing, use, and disposal, the product standard will help companies improve and design new products, and provide insights for more informed consumer choices.

These two standards were developed with input from business leaders, NGOs, academics, and policymakers. Over a period of three years, more than 2,300 participants from 55 countries contributed to the process, and 60 companies road tested the new standards. The following companies road-tested one or both of the two new standards:

- 3M
- Abengoa
- Acer Inc.
- Airbus S.A.S.
- AkzoNobel
- Alcoa

- Amcor Ltd.
- Anvil Knitwear, Inc.
- Autodesk, Inc.
- Baosteel Group Corporation
- BASF SE
- Belkin International, Inc.
- Bloomberg LP
- BT Plc
- Coca-Cola Erfrischungsgetränke AG
- Danisco A/S
- Deutsche Post DHL
- Deutsche Telekom AG
- Diversey
- DuPont
- Ecolab, Inc.
- Ford Motor Company
- General Electric Global Research
- GNP Company
- Herman Miller, Inc.
- IKEA
- Italcementi Group
- Kraft Foods
- Kun Shan Tai Ying Paint Co, Ltd.
- Lenovo Corporation
- Levi Strauss & Co.
- Mitsubishi Chemical Holdings Corporation
- National Grid
- New Belgium Brewing Co.
- Ocean Spray Cranberries, Inc.
- PE International
- PepsiCo, Inc.
- Pfizer Inc.
- Pinchin Environmental Ltd.
- PricewaterhouseCoopers Hong Kong
- Procter & Gamble Eurocor
- Public Service Enterprise Group, Inc.
- Quanta Shanghai Manufacturing City/Tech-Front (Shanghai) Computer Co.
- Rogers Communications, Inc.
- RSA Insurance Group, SAP AG
- S.C. Johnson & Son, Inc.
- Shanghai Zidan Food Packaging & Printing Co., Ltd.
- Shell International Petroleum Company Ltd
- Siemens AG
- Suzano Pulp and Paper
- Swire Beverages (Coca-Cola Bottling Partner)
- TAL Apparel Limited
- United States General Services Administration
- Veolia Water
- Verso Paper Corp
- Webcor Builders
- WorldAutoSteel

The new standards complete the GHG Protocol suite of corporate accounting and reporting standards created for businesses (<http://www.ghgprotocol.org/standards>). Together, they establish a much-needed comprehensive, global, standardized framework for companies in all sectors worldwide to manage their value chain and product emissions and to mitigate their climate impacts. They are accompanied by user-friendly guidance and tools developed by the GHG Protocol (<http://www.ghgprotocol.org/calculation-tools/all-tools>). We will discuss the new standards in more detail after the following backgrounder on GHG Protocol standards and calculation tools.

Defining GHG Emissions: Direct or Indirect? Scope 1, 2, or 3?

The GHG Protocol defines direct and indirect emissions as follows:

- Direct GHG emissions are emissions from sources that are owned or controlled by the reporting entity
- Indirect GHG emissions are emissions that are a consequence of the activities of the reporting entity, but occur at sources owned or controlled by another entity

The GHG Protocol Corporate Standard further categorizes these direct and indirect emissions into three broad scopes, as illustrated in Figure 1:

- Scope 1: All direct GHG emissions

- Scope 2: Indirect GHG emissions from consumption of purchased energy (electricity, heat, or steam)
- Scope 3: Other indirect emissions, such as the extraction and production of purchased materials and fuels, transport-related activities in vehicles not owned or controlled by the reporting entity, electricity-related activities (e.g., transmission and distribution losses) not covered in Scope 2, outsourced activities, waste disposal, etc.

The new Corporate Value Chain Standard specifically targets Scope 3 emissions at the corporate level while the Product Life Cycle Standard deals with all emissions at the product level.

Closer Look at GHG Protocol Standards

The GHG Protocol consists primarily of two separate but linked standards: one on the corporate level (Corporate Standard) and one for mitigation project accounting (Project Protocol), both accessible at <http://www.ghgprotocol.org/standards>.

The Corporate Accounting and Reporting Standards, commonly called Corporate Standard (<http://www.ghgprotocol.org/standards/corporate-standard>), is a suite of methodologies for businesses and other organizations to inventory and report all of the GHG emissions they produce. The word “Corporate” here refers to both private and public sector organizations. The Corporate Standard covers the accounting and reporting of the six greenhouse gases covered by the Kyoto Protocol — carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF₆). As stated on the GHG Protocol web site, drawing on the experience and knowledge of over 350 leading experts from businesses, NGOs, governments and accounting associations, the standard was designed:

- To help companies prepare GHG inventories that represent true and fair accounts of their emissions through the use of standardized approaches and principles
- To simplify and reduce the costs of compiling a GHG inventory
- To provide businesses with information that can be used to build an effective strategy to manage and reduce GHG emissions
- To increase consistency and transparency in GHG accounting and reporting among various companies and GHG programs

Over 30 companies in nine countries participated in road tests of the Corporate Standard. By aligning GHG accounting and reporting standards internationally, the GHG Protocol works to ensure that different trading schemes and other climate-related initiatives adopt consistent approaches to GHG accounting. While the GHG Protocol Corporate Standard has been designed to be neutral to government programs or policies, it is compatible with most existing GHG programs. Relevant parts of this standard are also useful to policy makers as a basis for their own GHG accounting and reporting requirements.

In addition to the 2001 Edition which is also available in French and Japanese, the Revised Edition of the GHG Protocol Corporate Standard has been translated into Chinese (both traditional and simplified), Japanese, Korean, Portuguese, and Spanish.

It is important to note that the Corporate Standard focuses only on the accounting and reporting of emissions. It does not mandate reporting of emissions information to WRI or WBCSD. In addition, while this standard is designed to develop a verifiable inventory, it does not provide a standard for how the verification process should be conducted.

Although the Corporate Standard is suitable for businesses and operations that emit GHGs (e.g., NGOs, government agencies, and universities), it should not be used to quantify the reductions associated with GHG mitigation projects for use as offsets or credits — the GHG Protocol for Project Accounting is specifically designed for this purpose. Commonly called Project Protocol (<http://www.ghgprotocol.org/standards/project-protocol>), it is geared toward calculating reductions in GHG emissions from specific GHG-reduction projects. The Project Protocol is the most comprehensive, policy-neutral accounting tool for quantifying the benefits of projects tackling climate change. It is the culmination of an extensive four-year exchange and consultation process with businesses, NGOs, governments, academics, and others, led by WRI and WBCSD. During those four years, over 20 developers of GHG projects from 10 countries road-tested a prototype version, and more than 100 experts reviewed it. Just like the Corporate Standard, the Project Protocol's strength lies in this collaborative process that was used to clarify and resolve challenging issues.

The Project Protocol is also available in Japanese. Furthermore, the GHG Protocol web site offers additional sector-specific protocols for Agriculture; the Public Sector; Land Use, Land-Use Change and Forestry (LULUCF); and Grid-Connected Electricity Projects; as well as guidelines for Green Power Accounting.

GHG Protocol Calculation Tools

The GHG Protocol Calculation Tools (<http://www.ghgprotocol.org/calculation-tools>) are designed to complement the Corporate Standard and assist businesses in quantifying emissions from their business activities and operations. Included are a number of cross-sector and sector-specific calculation tools (<http://www.ghgprotocol.org/calculation-tools/sector-toolsets>), as well as a guide for small, office-based organizations. These tools provide step-by-step guidance and electronic worksheets to help users calculate GHG emissions from the following specific sources or industries:

- Adipic Acid
- Aluminum
- Ammonia
- Cement
- HCFC-22
- Iron and Steel
- Lime
- Nitric Acid
- Pulp and Paper
- Refrigeration and Air-conditioning equipment (manufacturing, installation, operation and disposal)
- Semiconductors
- Wood Products

These tools are consistent with the ones proposed by the Intergovernmental Panel on Climate Change (IPCC) for compilation of emissions at the national level. They have been edited to be user-friendly for non-technical company staff to increase the accuracy of emissions data at a company level. Consisting of an Excel workbook and a PDF guidance document, each tool reflects best practice methods that have been extensively tested by industry experts. Each PDF document provides step-by-step guidance on the use of a tool, including:

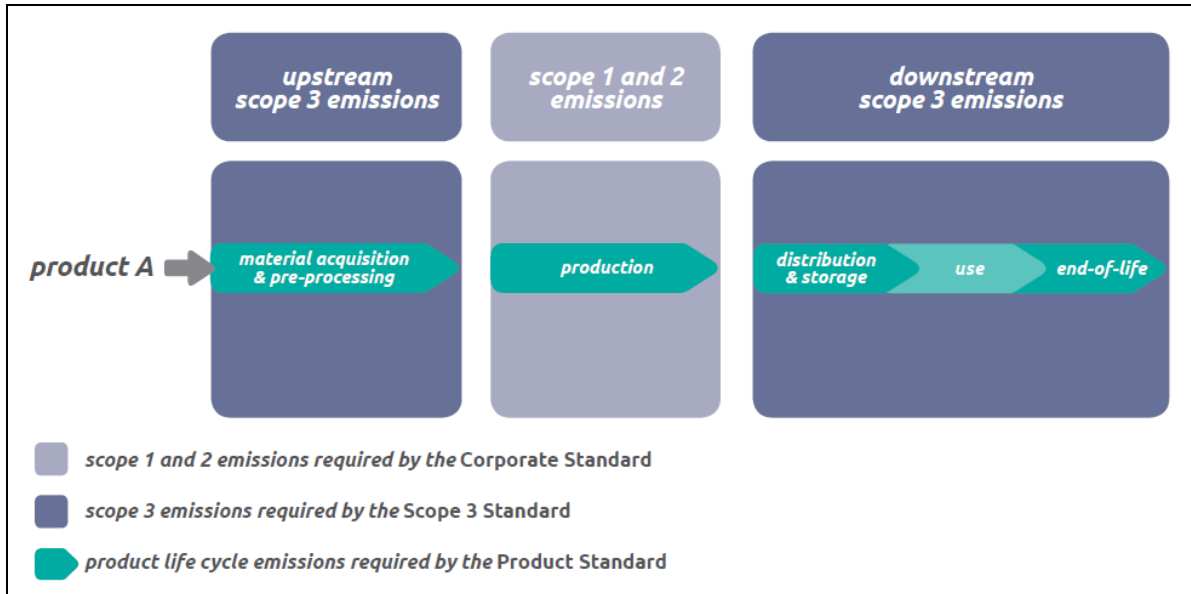
- An overview of the protocol with information on the sector, sources, and process(es) that it covers
- One or more approaches for determining CO₂ and other GHG emissions, e.g., direct measurement, mass balance
- Guidance on collecting activity data and selecting appropriate emission factors
- Likely emissions sources and the scopes they fall under (specific to a particular sector)
- Additional information, such as quality control practices and program-specific information

The spreadsheets are formulated for emissions calculations and most companies will need to apply more than one tool to cover their emissions. In place of custom tools, users from various industry sectors can select applicable spreadsheets from the entire GHG Protocol toolset (<http://www.ghgprotocol.org/calculation-tools/all-tools>) to assemble their own sets of calculation tools to accommodate their corporate structure and manufacturing processes.

Each tool generally involves the use of “emission factors,” which relate the amounts of greenhouse gases emitted by a business to a set amount of activity performed by that business. Default values are provided for the emission factors in case businesses cannot develop custom values. Companies may often need only activity data, such as the amount of distance traveled or fuel combusted, to calculate their emissions. The default emission factors are averages based on the most extensive data sets available and they are largely identical to those used by IPCC. However, since industrial processes or the composition of fuels used by businesses may differ with time and by region, the GHG Protocol recommends using custom values whenever possible.

Complementing the Corporate Standard: Scope 3 Standard and Product Standard

The new Scope 3 Standard and Product Standard both take a value-chain or life-cycle approach to GHG accounting. The Scope 3 Standard helps companies identify GHG reduction opportunities, track performance, and engage suppliers at a corporate level, while the Product Standard helps a company meet the same objectives at the individual product level. Together with the GHG Protocol Corporate Standard, the three standards provide a comprehensive approach to value chain GHG measurement and management (Figure 2).



Source: GHG Protocol Product Life Cycle Accounting and Reporting Standard, p. 7 (October 2011)
<http://www.ghgprotocol.org/files/ghgp/Product%20Life%20Cycle%20Accounting%20and%20Reporting%20Standard.pdf>

Figure 2. Relationship between the Corporate, Scope 3, and Product Standards for a company manufacturing product A.

Businesses have found that developing corporate value chain (Scope 3) and product GHG inventories delivers a positive return on investment. The new standards help companies to:

- ✓ Identify and understand risks and opportunities associated with value chain emissions
- ✓ Identify GHG reduction opportunities, set reduction targets, and track performance
- ✓ Engage suppliers and other value chain partners in GHG management and sustainability
- ✓ Enhance stakeholder information and corporate reputation through public reporting

Through these activities, companies can reduce emissions and costs to meet strategic business objectives. Table 1 lists business goals that are served by a Scope 3 GHG inventory.

The new standards provide a foundation for strategies to reduce emissions. They allow businesses to identify the biggest “hot spots” in their value chains — the activities that generate the most emissions — allowing them to focus on achieving the most meaningful reductions, not only from within their operations, but across global value chains. The architects of the GHG Protocol initiative believe that if the standards are successful, product and value chain GHG measurement will become standard business practice and companies around the globe will have the information they need to effectively reduce emissions.

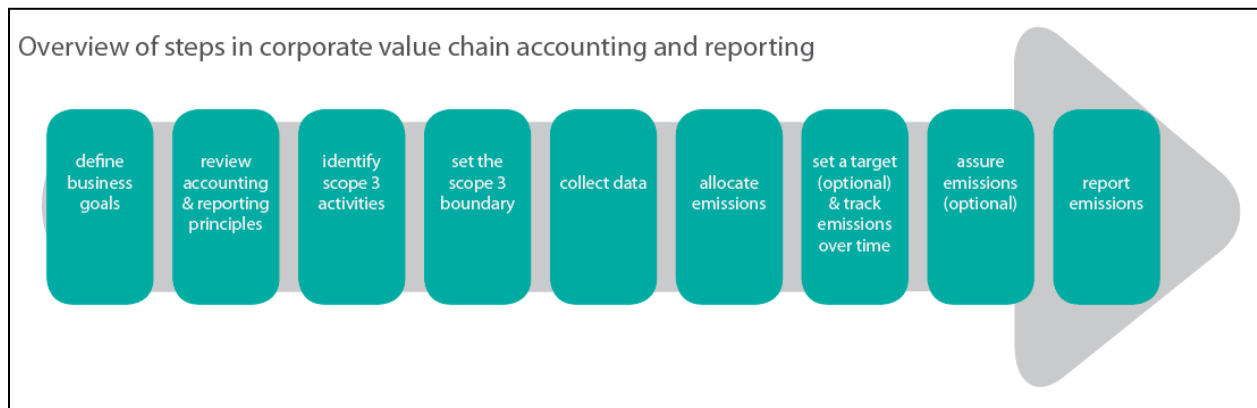
| Business goal | Description |
|--|--|
| Identify and understand risks and opportunities associated with value chain emissions | <ul style="list-style-type: none"> • Identify GHG-related risks in the value chain • Identify new market opportunities • Inform investment and procurement decisions |
| Identify GHG reduction opportunities, set reduction targets, and track performance | <ul style="list-style-type: none"> • Identify GHG “hot spots” and prioritize reduction efforts across the value chain • Set scope 3 GHG reduction targets • Quantify and report GHG performance over time |
| Engage value chain partners in GHG management | <ul style="list-style-type: none"> • Partner with suppliers, customers, and other companies in the value chain to achieve GHG reductions • Expand GHG accountability, transparency, and management in the supply chain • Enable greater transparency on companies’ efforts to engage suppliers • Reduce energy use, costs, and risks in the supply chain and avoid future costs related to energy and emissions • Reduce costs through improved supply chain efficiency and reduction of material, resource, and energy use |
| Enhance stakeholder information and corporate reputation through public reporting | <ul style="list-style-type: none"> • Improve corporate reputation and accountability through public disclosure • Meet needs of stakeholders (e.g., investors, customers, civil society, governments), enhance stakeholder reputation, and improve stakeholder relationships through public disclosure of GHG emissions, progress toward GHG targets, and demonstration of environmental stewardship • Participate in government- and NGO-led GHG reporting and management programs to disclose GHG-related information |

Source: GHG Protocol Corporate Value Chain (Scope 3) Standard, p. 12 (October 2011)
[http://www.ghgprotocol.org/files/ghgp/Corporate%20Value%20Chain%20\(Scope%203\)%20Accounting%20and%20Reporting%20Standard.pdf](http://www.ghgprotocol.org/files/ghgp/Corporate%20Value%20Chain%20(Scope%203)%20Accounting%20and%20Reporting%20Standard.pdf)

Table 1. Description of business goals served by a Scope 3 greenhouse gas inventory.

Corporate Value Chain (Scope 3) Accounting and Reporting Standard

The Corporate Value Chain (Scope 3) Standard allows companies to assess their entire value chain emissions impact and identify the most effective ways to reduce emissions. Most of the largest companies in the world now account and report on the emissions from their direct operations (Scopes 1 and 2). The new standards close the GHG gap: businesses can now act on the full range of corporate value chain and product emissions as well. Scope 3 emissions along the value chain often represent a company’s biggest greenhouse gas impacts, which means companies have been overlooking significant opportunities for improvement. For example, during the road test, Kraft Foods found that value chain emissions comprise more than 90% of the company’s total emissions.



Source: GHG Protocol Corporate Value Chain (Scope 3) and Product Life Cycle Standards Factsheet, p. 1 (October 2011)

<http://www.ghgprotocol.org/files/ghgp/public/Factsheet.pdf>

Figure 3. Overview of steps in corporate value chain accounting and reporting.

Developing a full GHG emissions inventory – incorporating corporate-level Scope 1, Scope 2, and Scope 3 emissions – enables companies to understand their full value chain emissions and to focus their efforts on the greatest GHG reduction opportunities (Figure 3).

Users of the new standard can now account for emissions from 15 categories of Scope 3 activities (Figure 1), both upstream and downstream of their operations. The categories are intended to provide companies with a systematic framework to organize, understand, and report on the diversity of Scope 3 activities within a corporate value chain. They are designed to be mutually exclusive so there is no double counting of emissions between categories. Table 2 lists the GHGs emitted from Scope 3 activities.

| | Category | Applicable GHGs |
|---|--|---|
| Upstream Scope 3 Emissions | 1. Purchased goods & services | CO ₂ , CH ₄ , N ₂ O, HFCs, PFCs, SF ₆ |
| | 2. Capital goods | CO ₂ , CH ₄ , N ₂ O, HFCs, PFCs, SF ₆ |
| | 3. Fuel- and energy- related activities not included in scope 1 or scope 2 | CO ₂ , CH ₄ , N ₂ O, SF ₆ |
| | 4. Upstream transportation and distribution | CO ₂ , CH ₄ , N ₂ O, HFCs, PFCs |
| | 5. Waste generated in operations | CO ₂ , CH ₄ , N ₂ O |
| | 6. Business travel | CO ₂ , CH ₄ , N ₂ O |
| | 7. Employee commuting | CO ₂ , CH ₄ , N ₂ O |
| | 8. Upstream leased assets | CO ₂ , CH ₄ , N ₂ O, HFCs, PFCs, SF ₆ |
| Downstream Scope 3 Emissions | 9. Downstream transportation and distribution | CO ₂ , CH ₄ , N ₂ O, HFCs, PFCs |
| | 10. Processing of sold products | CO ₂ , CH ₄ , N ₂ O, HFCs, PFCs, SF ₆ |
| | 11. Use of sold products | CO ₂ , CH ₄ , N ₂ O, HFCs, PFCs, SF ₆ |
| | 12. End-of-life treatment of sold products | CO ₂ , CH ₄ , N ₂ O |
| | 13. Downstream leased assets | CO ₂ , CH ₄ , N ₂ O, HFCs, PFCs, SF ₆ |
| | 14. Franchises | CO ₂ , CH ₄ , N ₂ O, HFCs, PFCs, SF ₆ |
| | 15. Investments | CO ₂ , CH ₄ , N ₂ O, HFCs, PFCs, SF ₆ |

Source: GHG Protocol Guidance for Calculating Scope 3 Emissions, Draft for Public Comment, p. 6 (August 2011)

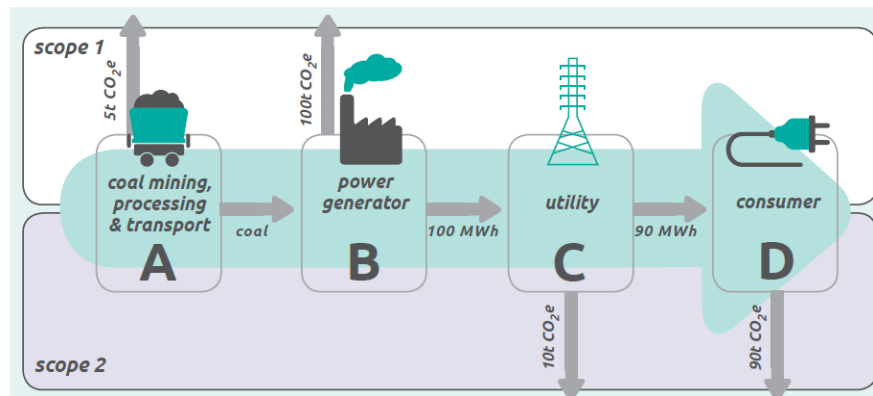
<http://www.ghgprotocol.org/files/ghgp/tools/GHG%20Protocol%20Guidance%20for%20Calculating%20Scope%203%20Emissions%20-%20DRAFT%20August%202011.pdf>

Table 2. Applicable greenhouse gases for each category of Scope 3 emissions.

Details of each of the 15 categories and the minimum boundaries of each can be found on pp. 34–37 and pp. 38–57 of the Scope 3 Standard. The minimum boundaries are intended to ensure that major activities are included in the Scope 3 inventory, while clarifying that companies need not account for the value chain emissions of each entity in its value chain, ad infinitum. Companies may include emissions from optional activities within each category. They may exclude scope 3 activities included in the minimum boundary of each category, provided that any exclusion is disclosed and justified.

The Scope 3 framework also supports strategies for users to partner with suppliers and customers to address climate impacts throughout the value chain. The Corporate Value Chain Standard has been created through a broad, inclusive, multi-stakeholder process. Over a three year period:

- 2,300 participants were involved from 55 countries
- 96 members participated in technical working groups to draft the standard
- 34 companies from various industries road tested the standard in 2010



| Reporting company | Scope 1 | Scope 2 | Scope 3 |
|---|--|---|--|
| Coal mining, processing, and transport (Company A) | 5 t CO ₂ e | 0 (unless electricity is used during coal mining and processing) | 100 t CO ₂ e from the combustion of sold products (i.e., coal) <i>Reported in category 11 (Use of sold products)</i> |
| Power generator (Company B) | 100 t CO ₂ e | 0 | 5 t CO ₂ e from the extraction, production, and transportation of fuel (i.e., coal) consumed by the reporting company <i>Reported in Category 3 (Fuel- and energy-related activities)</i> Note: The generator does not account for scope 3 emissions associated with sold electricity because the emissions are already accounted for in scope 1. |
| Utility (Company C) | 0 (unless SF ₆ is released from the T&D system) | 10 t CO ₂ e from the generation of electricity purchased and consumed by Company C | 0.5 t CO ₂ e from the extraction, production, and transportation of fuels (i.e., coal) consumed in the generation of electricity consumed by Company C (5 tons from coal mining x 10 percent of electricity generated by B that is consumed by C) 90 t CO ₂ e from the generation of electricity purchased by Company C and sold to Company D <i>Both are reported in category 3 (Fuel- and energy-related activities)</i> |
| End consumer of electricity (Company D) | 0 | 90 t CO ₂ e from the generation of electricity purchased and consumed by Company D | 4.5 t CO ₂ e from the extraction, production, and transportation of coal consumed in the generation of electricity consumed by Company D 10 t CO ₂ e from the generation of electricity that is consumed (i.e., lost) in transmission and distribution <i>Both are reported in category 3 (Fuel- and energy-related activities)</i> |

Source: GHG Protocol Corporate Value Chain (Scope 3) Standard pp. 42–43 (October 2011)
[http://www.ghgprotocol.org/files/ghgp/Corporate%20Value%20Chain%20\(Scope%203\)%20Accounting%20and%20Reporting%20Standard.pdf](http://www.ghgprotocol.org/files/ghgp/Corporate%20Value%20Chain%20(Scope%203)%20Accounting%20and%20Reporting%20Standard.pdf)

Figure 4. Accounting for emissions from the production, transmission, and use of electricity. (Top) Emissions across an electricity value chain. (Bottom) The table explains how each company accounts for GHG emissions.

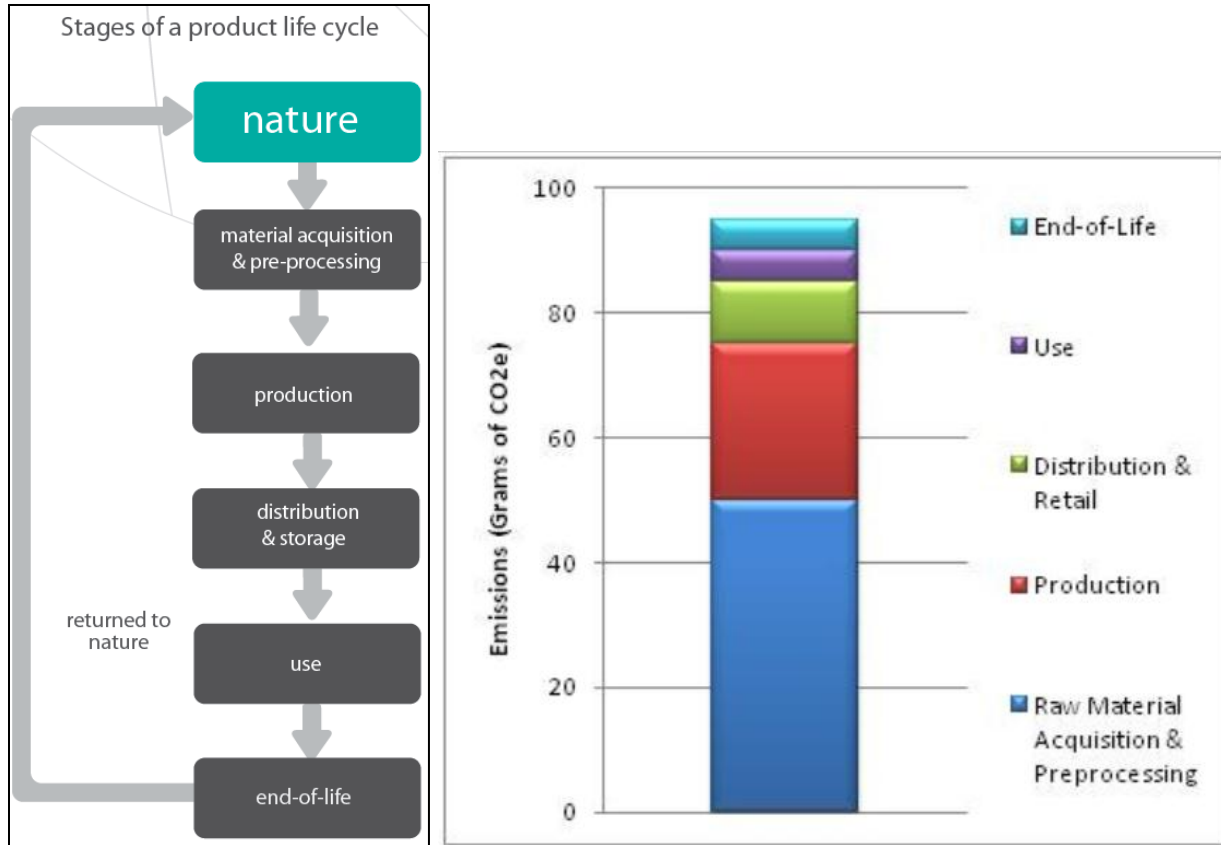
Figure 4 shows an example of GHG accounting across an electricity value chain. A coal mining and processing company (A) directly emits 5 metric tons of CO₂e per year from its operations and sells coal to a power generator (B), which generates 100 MWh of electricity and directly emits 100 metric tons of CO₂e per year. A utility (C) that owns and operates a transmission-and-distribution (T&D) system purchases all of the generator's electricity. The utility consumes 10 MWh due to T&D losses (corresponding to 10 metric tons CO₂e of scope 2 emissions per year) and delivers the remaining 90 MWh to an end user (D), which consumes 90 MWh (corresponding to 90 metric tons CO₂e of scope 2 emissions per year). The table at the bottom of the figure shows how each company accounts for the GHG emissions. In this example, the emission factor of the electricity sold by Company B is 1 t CO₂e/MWh. All numbers are illustrative only.

Product Life Cycle Accounting and Reporting Standard

The Product Standard can be used to understand the full life cycle emissions of a product and focus efforts on the greatest GHG reduction opportunities. This is the first step towards more sustainable products. Using the new standard, companies can measure the greenhouse gases associated with the full life cycle of products including raw materials, manufacturing, transportation, storage, use and disposal. The results can create competitive advantage by enabling better product design, increasing efficiencies, reducing costs, and removing risks. The standard will also help companies respond to customer demand for environmental information and make it easier to communicate the environmental aspects of products. As with all GHG Protocol standards, the Product Life Cycle standards have been created through a broad, inclusive, multi-stakeholder process. Over a three year period:

- 2,300 participants were involved from 55 countries
- 112 members formed technical working groups to draft the standards
- 38 companies from various industries road tested the standards in 2010

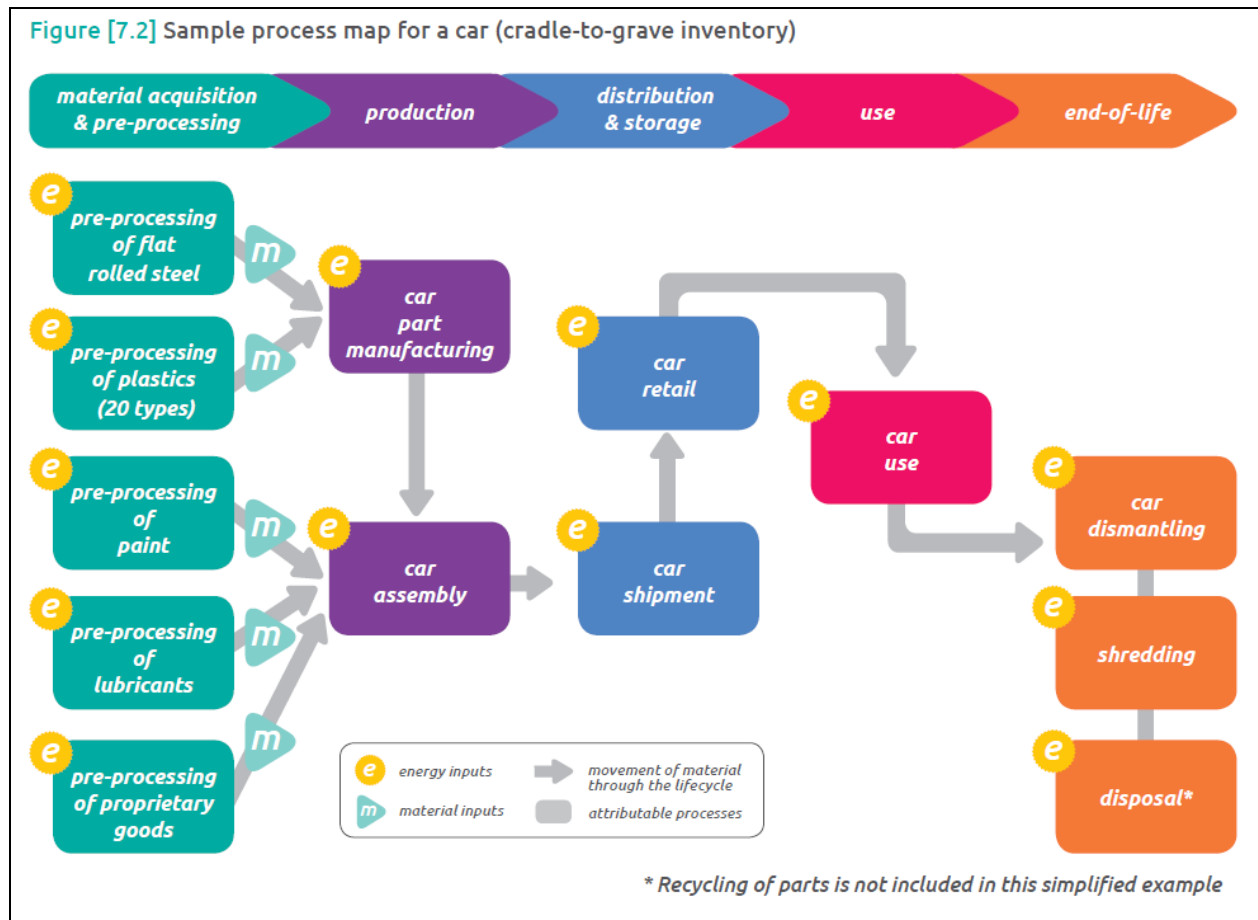
Figure 5 shows an example of GHG emissions across a product's life cycle. In the case of a car, a more complicated process map will be necessary for compiling the cradle-to-grave GHG inventory, as illustrated in Figure 6.



Source: GHG Protocol Corporate Value Chain (Scope 3) and Product Life Cycle Standards Factsheet, p. 2 (October 2011)
<http://www.ghgprotocol.org/files/ghgp/public/Factsheet.pdf>

Source: WRI Press Release, "Sixty Corporations Begin Measuring Emissions from Products and Supply Chains," (January 20, 2010)
<http://www.wri.org/press/2010/01/sixty-corporations-begin-measuring-emissions-products-and-supply-chains>

Figure 5. Example of GHG emissions across a product's life cycle



Source: GHG Protocol Product Life Cycle Accounting and Reporting Standard, p. 36 (October 2011)
<http://www.ghgprotocol.org/files/ghgp/Product%20Life%20Cycle%20Accounting%20and%20Reporting%20Standard.pdf>

Figure 6. Process map for compiling cradle-to-grave GHG inventory in the life time of a car.

Complete list of GHG Protocol tools

As can be seen in the above examples, establishing the GHG inventory and allocating emissions require attention to details and extensive records of activity data. The availability of calculation tools and guidelines from the GHG Protocol has drastically simplified and streamlined the process. Readers can download the initiative's publications, standards, tools from the official web site. The following is a complete list of all the tools provided by the GHG Protocol:

Cross Sector Tools

These tools are applicable to many industries and businesses regardless of sector.

| Calculation Tool | Version | Guidance | Worksheet |
|--|----------------|-----------------|------------------|
| GHG emissions from stationary combustion (English) | 4.0 (Oct 2010) | ✓ | ✓ |
| GHG emissions from stationary combustion (Chinese) | 4.1 (Jul 2011) | | ✓ |
| GHG emissions from purchased electricity | 4.3 (Aug 2011) | ✓ | ✓ |
| GHG emissions from transport or mobile sources | 2.3 (Oct 2011) | | ✓ |
| Measurement and Estimation Uncertainty of GHG Emissions | 1.0 (Sep 2003) | ✓ | ✓ |
| Allocation of Emissions from a Combined Heat and Power (CHP) Plant | 1.0 (Sep 2006) | ✓ | ✓ |
| Emission Factors from Cross-Sector Tools | 1.2 (Sep 2011) | | ✓ |
| GHG emissions from refrigeration and air-conditioning | 1.0 (Jan 2005) | ✓ | ✓ |
| GHG Protocol tool for energy consumption (Chinese) | 1.0 (Sep 2011) | ✓ | ✓ |
| Global Warming Potential Values | 1.0 (Oct 2011) | ✓ | |

Sector Specific Tools

These tools are principally designed for the specific sector or industry listed, though they may be applicable to other situations.

| Calculation Tool | Version | Guidance | Worksheet |
|---|----------------|-----------------|------------------|
| GHG emissions from the production of aluminum | 2.0 (Mar 2008) | ✓ | ✓ |
| CO2 emissions from the production of cement (US EPA) | 1.0 (Aug 2002) | ✓ | ✓ |
| CO2 emissions from the production of iron and steel | 2.0 (Mar 2008) | ✓ | ✓ |
| CO2 emissions from the production of lime | 2.0 (Mar 2008) | ✓ | ✓ |
| CO2 emissions from the production of ammonia | 2.0 (Mar 2008) | ✓ | ✓ |
| CO2 emissions from the production of cement (CSI) - English | 2.0 (Jun 2005) | ✓ | ✓ |
| N2O emissions from the production of nitric acid | 2.0 (Mar 2008) | ✓ | ✓ |
| HFC-23 emissions from the production of HCFC-22 | 2.0 (Mar 2008) | ✓ | ✓ |
| GHG emissions from pulp and paper mills | 1.3 (Dec 2008) | ✓ | ✓ |
| N2O emissions from the production of adipic acid | 2.0 (Mar 2008) | ✓ | ✓ |

Additional Guidance Documents

These additional documents provide further clarification on quantification and reporting issues.

| Calculation Tool | Version | Guidance | Worksheet |
|---|----------------|-----------------|------------------|
| Hot Climate, Cool Commerce: A Service Sector Guide to Greenhouse Gas Management | | ✓ | |
| Working 9 to 5 on Climate Change (for use by small office-based organizations only) | | ✓ | |
| Base Year Adjustments | | ✓ | |
| Categorizing GHG Emissions Associated with Leased Assets | | ✓ | |
| A Corporate Accounting and Reporting Standard (Corporate Standard) | | ✓ | |

Customized Calculation Tools

These GHG calculation tools have been customized for particular developing countries.

| Calculation Tool | Version | Guidance | Worksheet |
|--|----------------|-----------------|------------------|
| CO2 emissions from the production of cement (US EPA) - customized tool for India | 1.0 (Jul 2005) | ✓ | ✓ |
| Pulp and Paper Tool - customized for Mexico (Spanish version) | 1.0 (Oct 2007) | ✓ | ✓ |
| Pulp and Paper Tool - customized for Mexico (English version) | 1.0 (Oct 2007) | ✓ | ✓ |
| CO2 emissions from the production of cement (CSI) – Chinese version | 1.0 (Oct 2009) | | ✓ |

Maggie Lee can be reached at mlee@gasesmag.com