The Greenhouse Gas Protocol

a corporate accounting and reporting standard

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The Greenhouse Gas Protocol Initiative

The mission of the *Greenhouse Gas Protocol Initiative (GHG Protocol)* is to develop and promote internationally accepted greenhouse gas (GHG) accounting and reporting standards through an open and inclusive process.

Jointly convened in 1998 by the World Business Council for Sustainable Development (WBCSD) and the World Resources Institute (WRI), the *GHG Protocol* is a unique multi-stakeholder partnership of businesses, NGOs, and governments that serves as the premier source of knowledge about corporate GHG accounting and reporting.

This corporate accounting and reporting standard draws on the expertise and contributions of numerous individuals and organizations from around the world. The resulting standard and guidance are supplemented by a number of user-friendly GHG calculation tools on the *GHG Protocol* website (www.ghgprotocol.org). The standard, guidance, and tools will help companies and other organizations:

- develop a credible GHG inventory underpinned by GHG accounting and reporting principles
- account and report information from global operations in a way that presents a clear picture of GHG impacts, and facilitates understanding as well as comparison with similar reports
- provide internal management with valuable information on which to build an effective strategy to manage and reduce GHG emissions
- provide GHG information that complements other climate initiatives and reporting standards, including financial standards

Introduction

This first edition of the *GHG Protocol* comprises GHG accounting and reporting standards, and guidelines for companies and other types of organizations[1]. It addresses the accounting and reporting of the six greenhouse gases[2] covered by the Kyoto Protocol.

Unlike for financial accounting and reporting, there are no 'generally accepted accounting and reporting practices' for corporate GHG emissions. The *GHG Protocol* is a significant milestone on the journey toward generally accepted GHG accounting and reporting practices. It builds on extensive dialogue, which has taken place between diverse stakeholder groups over the last three years; on the road testing of an earlier draft by more than 30 companies in 10 countries; and on extensive peer reviews. It is intended that in the future the *GHG Protocol* will be revised using feedback from its application.

GHG emissions – a business issue

Many governments are taking steps to reduce GHG emissions through national policies. These include the introduction of permit trading systems; voluntary reduction and reporting programs; carbon or energy taxes; and regulations and standards on energy efficiency and emissions.

In recent years, global warming and climate change have become international issues for both industrialized and developing countries. They will undoubtedly continue to be important politically and economically for generations to come. Increasingly, companies will need to understand and manage their GHG risks in order to maintain their license to operate, to ensure long-term success in a competitive business environment, and to comply with national or regional policies aimed at reducing corporate GHG emissions.

Measuring and reporting GHG emissions

Performance measurement plays an essential role in strategy development and evaluating to what extent organizational objectives have been met. Credible GHG accounting will be a prerequisite for participation in GHG trading markets and for demonstrating compliance with government regulations. At an operational level, GHG emissions performance may be relevant to eco-efficiency involving dematerialization of products and processes, energy efficiency, and the reduction of waste.

The benefits of a common standard

In addition to ensuring that GHG performance measures are relevant and useful, their success will also depend on ensuring that benefits outweigh costs. To achieve this, two objectives must be met.

Firstly, the time and cost of developing GHG accounting and reporting systems must be kept as low as possible. The *GHG Protocol* helps to meet this objective by providing user-friendly and systematic guidance. Secondly, a corporate GHG inventory must be developed in such a way as to be compatible with requirements and standards which may be developed nationally in the future. At present, the diversity of accounting and reporting practices makes it harder to develop such an inventory, and reduces the comparability, credibility, and utility of GHG information.

The *GHG Protocol* builds on the experience and knowledge of many organizations, practitioners, and stakeholders to promote convergence of GHG accounting practices. In this way, it will reduce costs, improve comparability, and strengthen the capacity of managers to make informed decisions on GHG risks and opportunities. The *GHG Protocol* will also render reported information credible and reliable in the eyes of external stakeholders.

As national regulatory schemes governing GHGs are still evolving, it is not possible to predict the exact accounting and reporting requirements of the future. The *GHG Protocol*, however, will help companies better understand their own position as regulatory programs are debated and developed.

Buy-in and flexibility

An important starting point for a company contemplating GHG performance measurement is to understand where the measures link with the company's business drivers, and what their relevance to company performance will be. This will also encourage buy-in to the system from employees and senior management who may be faced with a range of competing objectives. The guidelines have been assembled to reflect these needs and to suit a variety of organizations. Since the *GHG Protocol* is concerned with accounting for emissions at the corporate level, it covers a number of issues that are not touched upon by other reporting schemes and guidelines, such as how to draw organizational and operational boundaries for a GHG inventory.

Relation to other measurement and reporting guidelines

The *GHG Protocol* is compatible with most other emerging GHG reporting schemes since emissions data accounted for on the basis of the *GHG Protocol* will meet the reporting requirements of most of these. The GHG calculation tools available on the website (www.ghgprotocol.org) are consistent with those proposed by the Intergovernmental Panel on Climate Change (IPCC) for the compilation of emissions at the national level (IPCC, 1996a). Many are refined to be user-friendly for non-technical company staff, and to increase the accuracy of emissions data at company level.

Thanks to help from many companies, organizations, and individual experts through an intensive road test and peer review phase, these tools represent current best practice in the evolving area of corporate GHG accounting.

Future activities of the *GHG Protocol*

The *GHG Protocol* will continue to serve as a process by which to improve and further develop accounting and reporting standards in the future, and to broaden the base of users and stakeholder input. This includes building bridges with existing and emerging climate initiatives.

Feedback is invited and encouraged from organizations using these guidelines to account and report on their GHG emissions, as well as from users of reported information. Two additional accounting modules are under development that address accounting for GHG emissions in the value chain and project-based GHG reduction activities. Further information is available at www.ghgprotocol.org

Frequently asked questions

Below is a list of frequently asked questions, with directions to relevant sections of the document.

- What should I consider when setting out to account for and report GHG emissions?
  Chapter 2
- How do I deal with complex company structures and shared ownership?
  Chapter 3
- What is the difference between direct and indirect emissions and what is their relevance?
  Chapter 4
- How do I account for GHG reductions?
  Chapter 5
- What is a base year and why do I need one?
  Chapter 6
- My GHG emissions will change with acquisitions and divestitures. How do I account for these?
  Chapter 6
- How do I identify my company's GHG emissions sources?
  Chapter 7
- What data collection activities and data management issues do my operational facilities have to deal with?
  Chapter 7
- What kinds of tools are there to help me calculate GHG emissions?
  Chapter 7
- What determines the quality and credibility of my GHG emissions information?
  Chapter 8
- What information should I report?
  Chapter 9
- What data must be available to obtain external verification of the inventory data?
  Chapter 10

Navigating your way through this document

Whilst every effort has been made to keep this document as concise as possible, the diversity and complexity of GHG accounting and reporting issues necessitate comprehensive coverage. This section will help you navigate your way through the document.

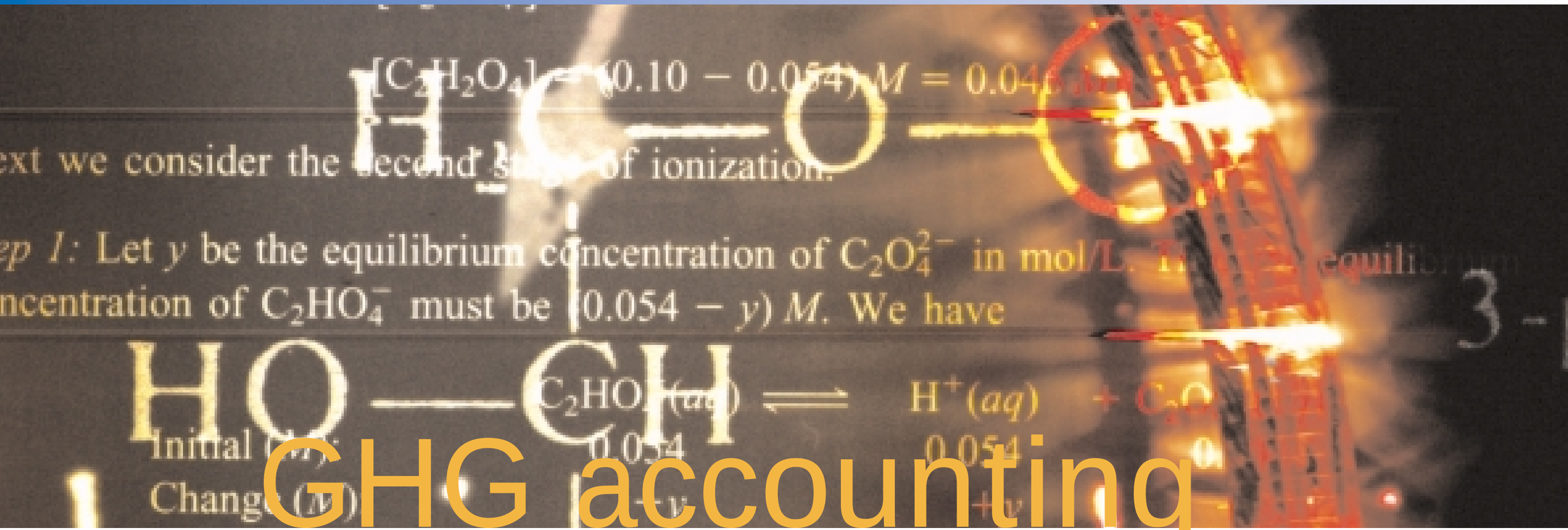
The *GHG Protocol* comprises three types of sections: GHG accounting and reporting standards (blue pages), guidance on applying standards (orange pages), and practical advice ranging from designing a GHG inventory to verifying emissions data (green pages).

The order of contents presented below demonstrates a logical progression for companies aiming to implement the *GHG Protocol*.

Notes

1 Throughout the rest of this document, the term 'company' is used as shorthand for 'companies and other types of organizations'.

2 Carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), Hydrofluorocarbons (HFCs), Perfluorcarbons (PFCs) and Sulphur Hexafluoride (SF_6).



GHG accounting and reporting principles

As with financial reporting, generally accepted GHG accounting principles are intended to underpin GHG accounting and reporting to ensure that:

- the reported information represents a true and fair account of an organization's GHG emissions
- the reported information is credible and unbiased in its treatment and presentation of issues

GHG accounting and reporting is evolving and is new to many. The principles outlined in this chapter are the outcome of a collaborative process involving a wide range of technical, environmental, and accounting disciplines.

GHG accounting and reporting should be based on the following principles:

• Relevance	Define boundaries that appropriately reflect the GHG emissions of the business and the decision-making needs of users.
• Completeness	Account for all GHG emissions sources and activities within the chosen organizational and operational boundaries. Any specific exclusions should be stated and justified.
• Consistency	Allow meaningful comparison of emissions performance over time. Any changes to the basis of reporting should be clearly stated to enable continued valid comparison.
• Transparency	Address all relevant issues in a factual and coherent manner, based on a clear audit trail. Important assumptions should be disclosed and appropriate references made to the calculation methodologies used.
• Accuracy	Exercise due diligence to ensure that GHG calculations have the precision needed for their intended use, and provide reasonable assurance on the integrity of reported GHG information.

Guidance on GHG accounting and reporting principles

Relevance

It is necessary to define accounting and reporting boundaries that appropriately reflect the GHG emissions of your business. The choice of appropriate boundaries depends on the characteristics of the company, the intended purpose of the GHG information, and the needs of the users. When choosing such boundaries, a number of different dimensions need to be considered such as:

- organizational structures: operating licenses, ownership, legal agreements, joint ventures, etc.
- operational boundaries: on-site and off-site activities, processes, services and impacts
- the business context: nature of activities, geographic locations, industry sector(s), purpose of information, users of information
- specific exclusions or inclusions and their validity and transparency

The boundaries should represent the substance and economic reality of the business, and not merely its legal form.

More information on setting appropriate boundaries is provided in:

- Chapter 2: Business goals and inventory design
- Chapter 3: Setting organizational boundaries
- Chapter 4: Setting operational boundaries

Completeness

Ideally all emissions sources within the chosen organizational and operational boundaries should be reported. In practice, a lack of data or the cost of gathering data may be a limiting factor. If specific sources are not reported, this needs to be clearly stated in the report. Sometimes it is tempting to define a materiality threshold, i.e. stating that sources not exceeding a certain size are omitted. However, the materiality of a source can only be established after it has been assessed. This implies that some data is available and can be included in the GHG inventory – even if it is just an estimate. What is considered material will also depend on the needs of users and the size of a company and its emissions sources.

Consistency

Users of GHG information will often want to track and compare GHG emissions information over time in order to identify trends and to assess the performance of the reporting organization. Conformity over time, with the same approach and practices in the calculation and presentation of data, is essential. If there is a change in the basis of reported information, this should be clearly stated.

In addition, when presenting GHG information, it is important to provide sufficient economic/business context to justify and explain any significant changes. This enables continued comparison of like with like. The way in which data and activities are described will affect users' ability to understand GHG information. Technical and scientific terms should be used carefully. Since GHG accounting and reporting is new to many companies and stakeholders, the level of knowledge of different user groups of GHG emissions data may be quite varied.

More information on this is provided in:

- Chapter 6: Setting a historic performance datum
- Chapter 9: Reporting GHG emissions

Transparency

Transparency relates to the degree to which reported information is seen as being reliable. It entails being open with relevant issues and data. Information is usually judged 'transparent' when it conveys a good understanding of the issues in the context of the reporting company, and when it provides a meaningful assessment of performance. An independent external verification is a good way of increasing transparency.

More information on this is provided in:

- Chapter 9: Reporting GHG emissions
- Chapter 10: Verification of GHG emissions

Accuracy

Accurate data is important for making decisions. Poor internal calculation/reporting systems and the inherent uncertainties in the calculation methodology applied can jeopardize accuracy. In an emissions inventory, a poor calculation/reporting system (i.e. a systemic error) can result from an emissions calculation process in which some aspect of real-world emissions production is misstated or is not taken into account. In contrast to a poor reporting system, inherent uncertainties result from the intrinsic variability in the process causing the emissions and the associated calculation methodology. Adhering to prescribed and tested GHG calculation methodologies, and putting in place a robust accounting and reporting system which has appropriate internal and external controls, can improve data accuracy.

More information on how to increase your inventory's accuracy and on how to minimize data uncertainties is provided in:

- Chapter 8: Managing inventory quality

Volkswagen: Maintaining relevance and completeness over time

While working on its 2000 GHG inventory, Volkswagen realized that the structure of its emissions sources had undergone considerable changes over the last five years. Emissions from production processes, which were considered to be irrelevant at a corporate level in 1996, were assessed and found to constitute almost 20 percent of aggregate corporate GHG emissions.

New sites for engine testing and the investment into magnesium die-casting equipment at certain production sites were examples of growing emissions sources. Volkswagen's experience demonstrates that emissions sources have to be regularly re-assessed to maintain a complete and relevant inventory over time.

Business goals and inventory design

Improving your understanding of your company's GHG emissions by compiling a GHG inventory makes good business sense. The four categories of business goals most frequently listed by companies as reasons for compiling a GHG inventory are the following:

- GHG risk management
- public reporting/participation in voluntary initiatives
- GHG markets
- regulatory/government reporting

GHG risk management

- identifying GHG risks and reduction opportunities in the value chain
- setting internal targets, measuring and reporting progress
- identifying cost effective reduction opportunities
- developing process/product innovations
- internal/external benchmarking

Public reporting/participation in voluntary initiatives

- stakeholder reporting, e.g. Global Reporting Initiative
- voluntary non-governmental organization (NGO) programs, e.g. Climate Neutral Network, WWF Climate Savers Program, Environmental Resources Trust
- voluntary government programs, e.g. Canadian Voluntary Challenge Registry, Australian Greenhouse Challenge Program, California Climate Action Registry, and US EPA Climate Leaders Initiative
- eco-labeling and certification

GHG markets

- buying or selling emissions credits
- cap and trade allowance trading programs, e.g. UK Emissions Trading Scheme, Chicago Climate Exchange

Regulatory/government reporting

- directives, e.g. European Integrated Pollution Prevention and Control Directive, European Pollutant Emission Register
- reporting under national or local regulations, e.g. Canadian National Pollutant Release Inventory
- carbon taxes
- baseline protection

This list is not exhaustive – companies may have other important goals for an inventory. In practice, most companies have multiple goals. It therefore makes sense that, from the outset, the inventory is designed to provide information for a variety of different uses and users. To this end, information should be collected in ways that it can be subsequently aggregated and dis-aggregated for different operational and organizational boundaries, and for different business geographic scales, e.g. state, country, Annex 1 countries, non-Annex 1 countries, facility, business unit, and company.

The guidance on operational boundaries in Chapter 4: Setting operational boundaries, provides information on setting boundaries for different inventory goals and uses.

GHG risk management

For companies developing a GHG inventory for the first time, information that helps them more effectively manage the business risks and opportunities associated with potential GHG constraints can be an important motivator.

An inventory of direct GHG emissions, as well as emissions occurring up- and downstream of operations, will provide an assessment of the company’s GHG exposure. It will help the company respond more effectively to any move toward regulations and caps governing GHG emissions, as well as toward shifts in consumer preferences based on corporate GHG performance and reputation. Policies that increase the price of fossil fuels and electricity may have a profound impact on the future competitive performance of companies in the GHG intensive sectors.

Conducting a rigorous GHG inventory is also a prerequisite for setting GHG reduction goals and for identifying opportunities for reductions.

Rio Tinto: Setting a GHG reduction target

Rio Tinto mines and processes natural resources. In 1999, it published a three-year five percent improvement target and has subsequently reported positive annual progress. The GHG reduction goal was set for two reasons. Firstly, it was realised that targets would increase the company’s rate of environmental performance improvement and, secondly, stakeholders were asking which direction the company wanted to go. The reduction target was developed in a manner that the company believed measured actual performance, and was aligned with business improvement. It was only developed after confidence in the GHG accounting methodology had been gained through preparing a number of annual inventories and projections.

Public reporting/participation in voluntary initiatives

Companies with global operations may want to develop a single corporate GHG inventory that enables them to participate in a number of NGO and government schemes in different locations. Companies preparing sustainability reports using the Global Reporting Initiative guidelines will need to report information on their GHG emissions (GRI, 2000).

Adoption of the *GHG Protocol* standard provides sufficient information to meet the GHG accounting requirements of most of these voluntary initiatives. Appendix 1 provides an overview of the GHG accounting and reporting requirements of different voluntary programs on climate change.

Since the accounting guidelines of many voluntary schemes are periodically updated, companies planning to participate are advised to contact the scheme administrator to check what the current requirements are. Some schemes may make more demands on the company than others.

The Australian Greenhouse Challenge Program, for example, requires participants to develop an action plan of GHG reduction measures as well as a forecast of GHG emissions with and without implementation of the action plan. The WWF Climate Savers Program requires participants to commit to an overall GHG reduction goal and to obtain an independent verification of current CO_2 emissions as a baseline for performance.

GHG markets and regulatory/government reporting

GHG markets and regulatory approaches to greenhouse gas emissions are beginning to emerge in some parts of the world. Shell and BP have already established internal GHG emissions trading programs as part of their overall GHG management strategy. It is not possible, however, at this early stage, to design a comprehensive GHG accounting system that will meet the future requirements of all the different regulatory and market based mechanisms. Different schemes will evolve with different inventory requirements. With this in mind, the *GHG Protocol* standard has been designed to provide GHG information building blocks that can be used as the foundation for supporting a variety of information requirements, including those resulting from regulatory or market based systems.

It is likely that future regulatory and trading schemes will impose additional layers of accounting specificity relating to which facilities are included; which GHG sources are addressed; how base years are established; the type of calculation methodology used; the choice of emissions factors; and the monitoring and verification approaches employed. However, the broad participation and best practices incorporated into the *GHG Protocol* are likely to inform the accounting requirements of future schemes. Chapter 4: Setting operational boundaries, describes the GHG reporting requirements under the European Pollutant Emissions Register and Integrated Pollution Prevention Control Directive. Again, it is important to check the specific requirements, as these are subject to change.

For emissions trading, where compliance is to be judged by comparing the inventory with the emissions cap, it is likely that a rigorous and accurate inventory of direct emissions will generally be required. Indirect emissions are difficult to verify and present particular challenges in terms of avoiding double counting of emissions. To facilitate independent verification, emissions trading may require that participating companies establish an audit trail for emissions data (see Chapter 10: Verification of GHG emissions). Over time, as the importance of emissions trading grows, emissions inventories will become increasingly transparent, comparable, and accurate.

Ford Motor Company: Experiences road testing the ***GHG Protocol***

When Ford Motor Company embarked on an effort to understand and reduce its GHG impacts, it wanted to track emissions with enough accuracy and detail to manage them effectively. An internal cross-functional GHG inventory team was formed to accomplish this goal. Although the company was already reporting basic energy and carbon dioxide data at the corporate level, a more detailed understanding of these emissions was essential to set and measure progress against performance targets and evaluate potential participation in external trading schemes.

For several weeks, the team worked on creating a more comprehensive inventory for stationary combustion sources, and quickly found a pattern emerging. All too often the team left meetings with as many questions as answers, and the same questions kept coming up from one week to the next. How should the company draw boundaries? How could acquisitions and divestitures be accounted for? What emissions factors should be used? And perhaps most importantly, how could the methodology be deemed credible with stakeholders? Although the team had no shortage of opinions, there also seemed to be no right or wrong answers – until the team discovered the *GHG Protocol*.

The *GHG Protocol* provided guidance on answering many of the questions. Although at the time, still a road test draft, the *GHG Protocol* offered a framework upon which to base decisions, one supported by a diverse set of stakeholders, and with the promise of becoming a global standard. Because of its flexible and progressive nature, the *GHG Protocol* could be applied at the company's own pace and tailored to meet its specific needs. As a result of the *GHG Protocol*, Ford Motor Company now has a more robust inventory of GHGs from stationary sources, one that can be continually improved to fulfill rapidly emerging GHG management needs.

Setting organizational boundaries

Businesses vary in their legal and organizational structures – these include incorporated and non-incorporated joint ventures, subsidiaries and others. Companies may operate globally and encompass a number of autonomous business streams and business units.

When accounting for GHG emissions from partially-owned entities/facilities, it is important to draw clear organizational boundaries, which should be consistent with the organizational boundaries which have been drawn up for financial reporting purposes.

Financial reporting is based upon the concepts of 'control' and 'influence'. The concepts of 'control' and 'influence' are often defined and applied differently according to a company's specific financial accounting and reporting policies/practices. Where possible, it makes sense to follow company-specific distinctions already in place for financial accounting, provided these are explicitly explained and followed consistently. When applying these concepts the underlying assumption of 'substance over form' should be followed. This assumption is based on the premise that GHG emissions should be accounted and reported in accordance with the company's substance and economic reality and not merely its legal form.

For the purpose of applying the concepts of 'control' and 'significant influence' to GHG accounting, the following definitions may prove helpful.

Control is defined as the ability of a company to direct the operating policies of another entity/facility. Usually, if the company owns more than 50 percent of the voting interests, this implies control. The holder of the operating license often exerts control, however, holding the operating license is not a sufficient criteria for being able to direct the operating policies of an entity/facility. In practice, the actual exercise of dominant influence itself is enough to satisfy the definition of control without requiring any formal power or ability through which it arises.

Significant influence: the issue of whether a company has significant influence over an entity/facility is likely to have been already established by the company-specific financial accounting and reporting policies/practices. However, where it is necessary to determine if one company exerts significant influence over an entity/facility, the following factors should be considered:

- the company owns voting interests of between 20 and 50 percent
- the company has the power to participate in the entity's/facility's financial and operating policy decisions
- the company has a long-term interest in the entity/facility

Definitions of 'control' or 'significant influence' apply to incorporated as well as to non-incorporated operations, i.e. GHG emissions have to be reported from incorporated as well as from non-incorporated entities/facilities. GHG emissions from entities/facilities that are not under significant influence or control (e.g. the company owns less than 20 percent of the voting interests) are generally not reported. This is consistent with financial accounting standards where a company would only recognize revenue if dividends were paid or a loss incurred if the asset was impaired. However, it is recognized that GHG emissions are different in their nature and it may be appropriate for these to be reported to properly reflect the company's overall GHG emissions. If this is the case it is important to state this in the public report.

Companies should preferably account for and report their GHG emissions according to the framework presented in Table 1. This framework is set out to provide GHG emissions information in a transparent manner on the basis of control/influence and equity share basis. Equity share is defined as the percentage of economic interest in/benefit derived from an operation. This approach increases the usability of GHG information for different users and aims, as far as possible, to mirror the approach adopted by financial accounting and reporting standards.

Where there is a contractual arrangement that covers GHG emissions, the company should defer to this for the purposes of emissions allocation.

Table 1: Accounting for GHG emissions on the basis of control and equity share

		Category	What to report	
Reporting for control		**Controlled entities/facilities** Emissions from those entities/facilities, which are defined as being controlled. It is likely that this will already be determined by company-specific financial accounting policies/practices. This category includes entities/facilities that are: • wholly owned • not wholly owned, but controlled • jointly controlled assets/entities The concept of jointly controlled assets/entities will have to be considered based on the specific business and industry context.	Wholly owned Not wholly owned but controlled Jointly controlled	100% of GHG emissions 100% of GHG emissions Equity share of GHG emissions
Reporting for equity share	A	**Controlled entities/facilities** Emissions from those entities/facilities, which are defined as being controlled. It is likely that this will already be determined by company-specific financial accounting policies/practices. This category includes entities/facilities that are: • wholly owned • not wholly owned, but controlled • jointly controlled assets/entities	Equity share of GHG emissions If there is a specific contractual arrangement that covers the division of earnings/production, that arrangement should be considered. This is likely to be most prominent in the upstream oil and gas industry, and is determined by company-specific financial accounting policies/practices.	
	B	**Significant influence – associated entities/facilities** Emissions from entities/facilities over which the reporting company has significant influence but does not control. It is likely that this will already be determined by company-specific financial accounting policies/practices.	Equity share of GHG emissions If there is a specific contractual arrangement that covers the division of earnings/production, that arrangement should be considered. This is likely to be most prominent in the upstream oil and gas industry, and is determined by company-specific financial accounting policies/practices.	
		Equity share of GHG emissions	Equity share of GHG emissions from entities/facilities that are controlled or under significant influence (A + B)	

If the reporting company wholly owns all its facilities/entities, simply report the same number under the control and equity categories and report zero for entities under significant influence.

Depending on the needs of users and the accessibility of GHG information, a company may determine that it is sufficient only to report its controlled GHG emissions, and not to report its equity share of such emissions. If this is the case, it should be clearly stated in the company's public GHG report.

Guidance on setting organizational boundaries

What constitutes 'control' and 'significant influence' may not always be obvious. The definitions provided by different financial accounting and reporting standards such as the International Accounting Standards (IAS) and US Generally Accepted Accounting Principles (US GAAP) do not always converge. Therefore, when accounting for GHG emissions from partially-owned entities/facilities you should follow, as closely as possible, the distinctions of 'control' and 'significant influence' as applied by your company for the financial consolidation of such entities/facilities.

By focusing on degree of control/influence, the framework presented in Table 1 mirrors, as far as possible, the approach adopted by financial accounting and reporting standards. This approach is also based on the concept of 'substance and economic reality over legal form'. Following a reporting approach that is consistent with such standards has several advantages. GHG emissions will, in the near future, become a liability and, therefore, should be accounted for in the same way as financial liabilities. In addition, due to the transparent nature of this framework in terms of the degree of control/influence exerted over GHG emissions sources, companies can better assess their GHG risks and opportunities, leading to well-informed management decisions.

This framework also provides greater transparency and utility of information for the different users and uses of GHG information.

GHG emissions reduction initiatives, and regulatory and trading schemes often focus on control rather than ownership. The company holding the operating license might be asked to report 100 percent of the operations' GHG emissions. It is therefore important to distinguish between operations controlled on the basis of the operating license and those controlled on the basis of majority voting interest or other reasons.

For the purpose of public reporting and to inform internal management decisions, GHG emissions data should show a complete picture of the reporting company's GHG emissions, and therefore cover all categories of control/influence as specified in Table 1.

In some industry sectors, such as the oil and gas industry, the economic interest a party receives from an entity can vary over time depending on the specific agreements in place. For example, a company owns 50 percent of the voting interests in an entity, but, based on funding and production sharing contracts in place, receives 60 percent of the production in the first three years, and in subsequent years 50 percent. Therefore, the equity share in years one to three would be 60 percent, with 50 percent in the subsequent years. In most cases, the equity share will equal the voting interest in the venture.

The following example illustrates how to account for and report GHG emissions from controlled and owned entities/facilities on an equity share-based approach and on a control-based approach.

In the examples presented in Figure 1, it is assumed – with the exception of Company D – that the company holding the majority voting interest also holds the operating license.

Figure 1: Voting interest held by company Alpha and company Beta

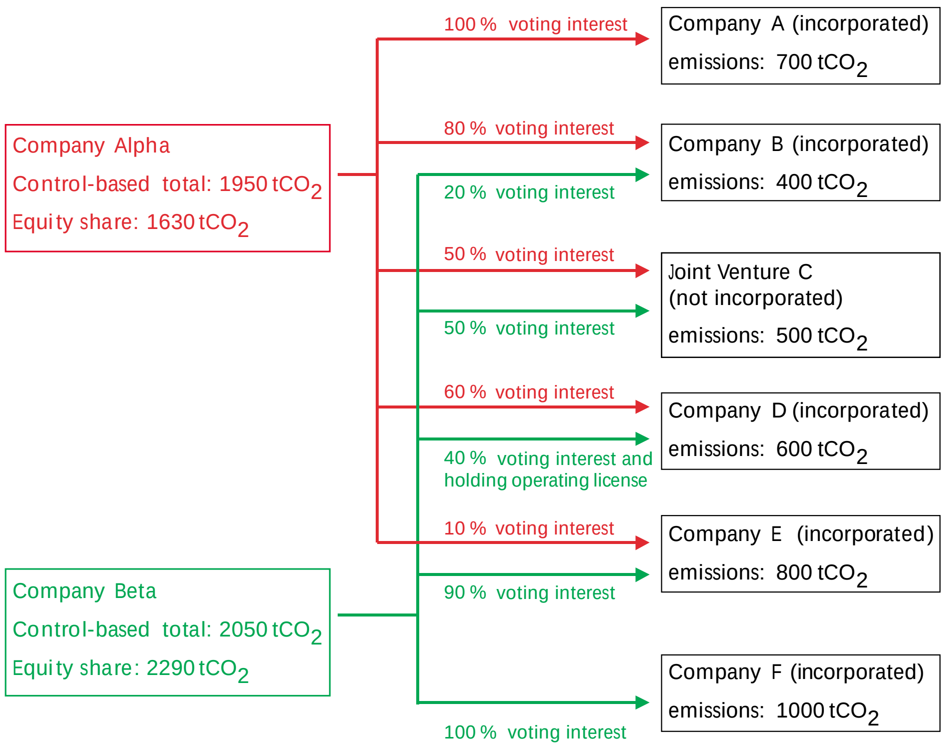


Table 2: Company Alpha: GHG emissions on the basis of control/influence and equity share

	Category	Entities/facilities	What to report	
Reporting for control	wholly owned	Company A (Alpha owns 100%)	100%	700 tCO_2
	not wholly owned, but controlled	Company B (Alpha owns 80%)	100%	400 tCO_2
		Company D (Alpha does not hold operating license but owns 60%)	100%	600 tCO_2
	jointly controlled	Joint Venture C (Alpha controls jointly with Beta)	50%	250 tCO_2
	Control-based total			**1950 tCO_2**
Reporting for equity share	controlled entities/facilities	Company A (Alpha owns 100%)	equity share	700 tCO_2
		Company B (Alpha owns 80%)	equity share	320 tCO_2
		Company D (Alpha does not hold operating license but owns 60%)	equity share	360 tCO_2
		Joint Venture C (Alpha controls jointly with Beta)	equity share	250 tCO_2
	associated entities/facilities - significant influence			
	Equity share total			**1630 tCO_2**

In this example (Figure 1), it is assumed that Company Alpha controls Company D, although Alpha does not hold the operating license for Company D. Based on the definition of control, it has to be considered who actually exercises dominant influence over the operations of Company D. Clearly, investment decisions and other significant financial and operational decisions regarding the operation of Company D can only be taken with the consent of Company Alpha, since it holds the majority voting interest.

Table 3: Company Beta: GHG emissions on the basis of control/influence and equity share

	Category	Entities/facilities	What to report	
Reporting for control	wholly owned	Company F (Beta owns 100%)	100%	1000 tCO_2
	not wholly owned, but controlled	Company E (Beta owns 90%)	100%	800 tCO_2
	jointly controlled	Joint Venture C (Beta controls jointly with Alpha)	50%	250 tCO_2
	Control-based total			**2050 tCO_2**
Reporting for equity share	controlled entities/facilities	Company F (Beta owns 100%)	equity share	1000 tCO_2
		Company E (Beta owns 90%)	equity share	720 tCO_2
		Joint Venture C (Beta controls jointly with Alpha)	equity share	250 tCO_2
	associated entities/facilities - significant influence	Company D (Beta holds operating license and owns 40%)	equity share	240 tCO_2
		Company B (Beta owns 20%)	equity share	80 tCO_2
	Equity share total			**2290 tCO_2**

Setting operational boundaries

After a company has determined its organizational boundaries in terms of the entities/facilities that it owns or controls, it must then define its operational boundaries.

For effective and innovative GHG management, setting operational boundaries that are comprehensive with respect to direct and indirect emissions will help a company better manage the full spectrum of GHG risks and opportunities that exist in its upstream and downstream operations.

This involves making choices about how to account for direct and indirect GHG emissions[1].

Direct GHG emissions are emissions from sources that are owned or controlled by the reporting company, e.g. emissions from factory stacks, manufacturing processes and vents, and from company-owned/controlled vehicles.

Indirect GHG emissions are emissions that are a consequence of the activities of the reporting company, but occur from sources owned or controlled by another company, e.g. emissions from the production of purchased electricity, contract manufacturing, employee travel on scheduled flights, and emissions occurring during the product use phase.

Introducing the concept of 'scope'

To help delineate direct and indirect emissions sources, improve transparency, and provide utility for different types of organizations with different needs and purposes, three 'scopes' are defined for GHG accounting and reporting purposes. The *GHG Protocol* recommends that companies account for and report scopes 1 and 2 at a minimum.

Scope 1: Direct GHG emissions

Scope 1 accounts for direct GHG emissions from sources that are owned or controlled by the reporting company. Scope 1 emissions are principally the result of the following activities:

- **production of electricity, heat, or steam**
- **physical or chemical processing**[2], e.g. cement, adipic acid and ammonia manufacture
- **transportation of materials, products, waste, and employees,** e.g. use of mobile combustion sources, such as: trucks, trains, ships, airplanes, buses, and cars
- **fugitive emissions:** intentional or unintentional releases such as: equipment leaks from joints, seals; methane emissions from coal mines; HFC emissions during the use of air conditioning equipment; and CH_4 leakages from gas transport

Scope 2: GHG emissions from imports of electricity, heat, or steam

Scope 2 accounts for indirect emissions associated with the generation of imported/purchased electricity, heat, or steam.

Emissions attributable to the generation of exported/sold electricity, heat, or steam should be reported separately under supporting information. These emissions must also be included in scope 1. To increase data transparency, emissions data associated with imported and exported electricity, heat, or steam should not be netted.

The emissions associated with the generation of imported electricity, heat, or steam are a special case of indirect emissions. For many companies, electricity usage represents one of the most significant opportunities to reduce GHG emissions. Companies can reduce their use of electricity and/or use it more efficiently by investing in energy efficient technologies. Additionally, emerging green power markets[3] enable some companies to switch to less GHG intensive electricity suppliers. Companies can also install an efficient co-generation plant on site to replace the import of more GHG intensive electricity from the grid. Scope 2 facilitates the transparent accounting of such choices.

Scope 3: Other indirect GHG emissions

Scope 3 allows for the treatment of other indirect emissions that are a consequence of the activities of the reporting company, but occur from sources owned or controlled by another company, such as:

- employee business travel
- transportation of products, materials, and waste
- outsourced activities, contract manufacturing, and franchises
- emissions from waste generated by the reporting company when the point of GHG emissions occurs at sources or sites that are owned or controlled by another company, e.g. methane emissions from landfilled waste
- emissions from the use and end-of-life phases of products and services produced by the reporting company
- employees commuting to and from work
- production of imported materials

Double counting

Concern is often expressed that such accounting treatment of indirect emissions will lead to double counting when two different entities include the same emissions in their respective inventories. Whether or not double counting occurs depends on how consistently direct and indirect emissions are reported. Whether or not double counting matters, depends on how the reported information is used.

Double counting needs to be avoided when compiling national inventories under the Kyoto Protocol, but these are usually compiled via a top-down exercise using national economic data, rather than aggregation of bottom-up company data. Compliance regimes are more likely to focus on the 'point of release' of emissions and are more concerned about a company's direct emissions. For participating in GHG markets, it would not be acceptable for two organizations to claim ownership of the same piece of commodity and it is therefore necessary to make sufficient provisions to ensure that this does not occur between participating entities. For GHG risk management and voluntary reporting double counting is less important.

Guidance on setting operational boundaries

Companies should, at a minimum, account and report GHG emissions from scopes 1 and 2. To ensure maximum flexibility and clarity, companies are also encouraged to account and report relevant scope 3 emissions. Together these three scopes represent significant opportunities for reducing emissions. Figure 2 provides an overview of activities that generate GHG emissions along a company's value chain. Appendix 2 lists GHG emissions sources and activities by scopes and sectors.

All scopes:

- Account and report GHG information separately for each scope.
- To facilitate comparability over time, further subdivide emissions data where this aids transparency, e.g. by business units/facilities, country, source types (production of electricity or steam, transportation, processes, etc.).

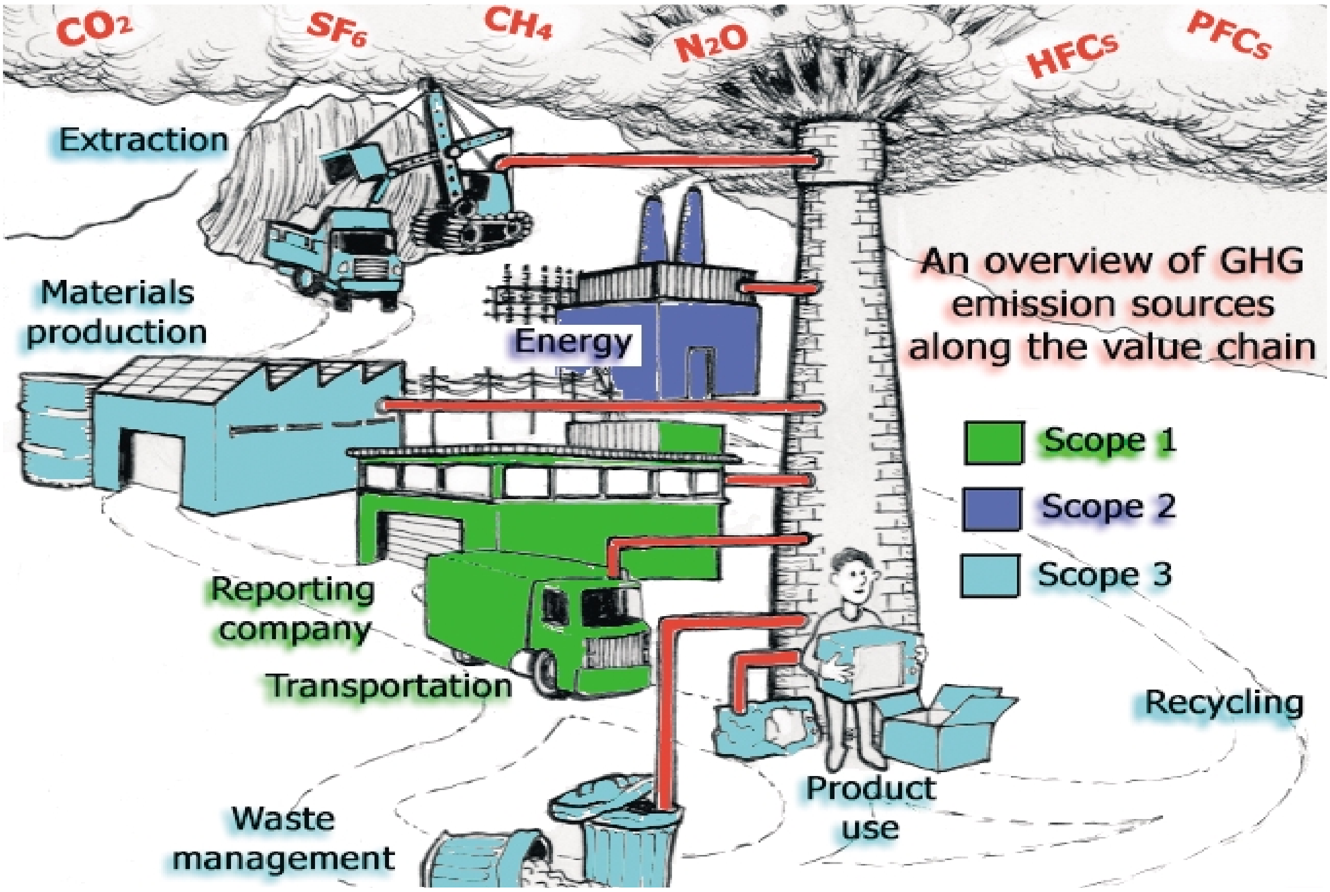
Scope 1:

- All companies report scope 1.

Scope 2:

- All companies report scope 2.
- Emissions from imported electricity can be estimated from purchase records and grid emissions factors. You should use the most reliable emissions factors available and be consistent in their use.
- Purchases of electricity by electric utilities for sale to end-use customers (e.g. an electricity utility that has a supply contract with a power generator) should be reported under scope 2. The rationale for this is that utilities often exercise choice over where they buy their energy and this may present significant opportunities for GHG reductions.
- Trading transactions of electricity should not be reported.
- If you export electricity, heat, or steam to the grid or to another company, the emissions associated with the exports should not be deducted from scope 1.
- Emissions from exported electricity, heat, or steam should be reported under supporting information and not deducted from any imports, as this would be inconsistent with how other exported products are accounted, e.g.

Figure 2: An overview of GHG emissions along the value chain



export of clinker by a cement company or scrap steel by an iron and steel company.

- Three examples are provided below to illustrate GHG accounting from energy generation.
- GHG emissions from activities upstream of your electricity provider, e.g. exploration, drilling, flaring, transportation, and refining should not be reported under scope 2.

Scope 3:

- Scope 3 provides an opportunity to be innovative with GHG management. Emissions reported under scope 3 should be adequately explained and supported by data and evidence.
- It will not be relevant or appropriate for companies to report on all of the activities listed under scope 3. Companies should report those activities that are relevant to their business and goals, and for which they have reliable information.

Reporting GHGs from energy generation

Example one: Company A is an electric utility that owns two power generation plants and has a supply contract with a third power generation plant owned by company B. Company A reports the GHG emissions from the two power plants it owns under scope 1 and the emissions from the electricity supplied to it by B under scope 2. Company B reports all the emissions from its power plant under scope 1.

Example two: Company C installs a co-generation unit, reduces its import of electricity from the grid, and sells surplus electricity to a neighboring company D. Company C reports all emissions from the co-generation unit under scope 1 and increases its direct emissions. Company C also reports a reduction in scope 2 emissions. Emissions from the generation of electricity exported to D are reported by C under supporting information, and by D as scope 2 emissions.

Example three: Company E uses electricity supplied by a co-generation unit that is owned by an energy supplier. Company E reports the GHG emissions associated with its electricity use under scope 2, even if it consumes 100 percent of the power and steam produced. The energy supplier reports all the emissions as direct under scope 1. In countries where GHG emissions are regulated it is possible that related financial impacts associated with GHG emissions are negotiated in the contract between the two parties. This would deal with any extra costs for the energy supplier.

Scopes and business goals

Companies frequently cite four goals as compelling reasons for compiling a GHG inventory:

- GHG risk management
- public reporting/participation in voluntary initiatives
- GHG markets
- regulatory/government reporting

Since most companies have multiple goals, it makes sense to design an inventory from the outset to provide information that will serve all of these. This will require consideration of how data might subsequently be ‘sliced and diced’, e.g. by state, country, facility, business unit, and company.

GHG risk management

From the perspective of GHG management it makes sense to define broad operational boundaries that explore GHG emissions risks and opportunities in all three scopes. This will be important for understanding the competitive environment and for developing a long-term business strategy in a GHG constrained world. For GHG risk management, accuracy is less important, since the goal is to capture a broad overview of a company’s GHG impact.

Narrower focus on direct emissions may miss major GHG reduction opportunities and risks. For example, appliances such as washing machines, refrigerators, and automobiles produce most GHG emissions during their use phase. Whirlpool has estimated that its clothes dryer uses 20 times more energy over its working life than the energy used in manufacturing the dryer, and its washing machines 50 times more (Loreti et al., 2000). Similarly, General Motors (GM) has estimated that all GM vehicles in operation in the United States account for 23 percent of US transportation-related emissions (EIA, 1997). Estimates of GHG emissions from indirect sources both upstream and downstream of your operations will improve your understanding of GHG impacts and help identify opportunities to collaborate with others in your value chain to reduce GHG emissions and to share the benefits.

Public reporting/participation in voluntary initiatives

Some companies, particularly in the electric utility and chemical-manufacturing sector, produce GHG inventories in conjunction with voluntary partnerships with government. Many countries have developed national GHG reporting schemes targeted at business, for example, Canada’s Voluntary Challenge Register, Australia’s Greenhouse Challenge Program, and the US Department of Energy’s Voluntary 1605b Reporting Program. The specific GHG reporting requirements relating to direct and indirect GHG emissions vary between the different initiatives. Some schemes, such as the US Department of Energy 1605b Program, leave the choice of what to include entirely up to the reporting entity, while others are more specific. In the US, several state governments, such as California and New Hampshire, are also developing GHG registries. Partners in the US EPA's voluntary industry-government partnership, Climate Leaders, must compile their GHG inventory to include scope 1 and scope 2 emissions and set a public GHG emissions reduction goal.

Appendix 1 provides an overview of the various GHG accounting and reporting requirements of several voluntary GHG reporting and reduction initiatives. A GHG accounting and reporting system developed according to the *GHG Protocol* should enable you to meet nearly all the accounting and reporting requirements of these initiatives.

GHG markets and regulatory/government reporting

Companies intending to participate in GHG trading systems will need to produce a rigorous and verifiable scope 1 inventory. Where compliance is judged against a datum and emissions cap, as is the case for the US Sulfur Dioxide Trading Program, it is also necessary to produce a robust baseline. Although regulatory and market-based programs typically focus on direct emissions sources, there are exceptions. The UK Emissions Trading Scheme for example, requires direct entry participants to account for GHG emissions from the generation of imported electricity, heat, and steam (DEFRA, 2001).

Regulatory programs often focus on scope 1 emissions from operated or controlled facilities. In Europe, facilities falling under the requirements of the Integrated Pollution and Prevention and Control Directive (IPPC) must report emissions exceeding a specified threshold for each of the six Kyoto gases[4]. From 2003, information on emissions reported under IPPC for the reporting year 2001 and onwards will be included in a European Pollutant Emission Register (EPER) – a publicly accessible internet-based database that permits comparison of emissions of individual facilities or industrial sectors in different countries (EC–DGE, 2000).

Shell Canada: One standard, multiple uses

An important goal of many companies is to build a GHG inventory that serves many uses. One of these is to establish a foundation which anticipates compliance with future national GHG accounting schemes and regulations. Shell Canada's participation in the *GHG Protocol* road test was driven, in part, by the desire to compare the ideas of the *GHG Protocol* with current reporting needs of the Canadian Voluntary Challenge Registry (VCR). Shell Canada undertook a gap analysis to identify components that could be added to the VCR to meet the intentions of the *GHG Protocol*, and also to see how the *GHG Protocol* might be enhanced.

The *GHG Protocol's* three-scope accounting approach for direct and indirect emissions was different to how Shell Canada had traditionally reported GHGs under the VCR scheme. The *GHG Protocol's* scope terminology was found to be very useful for distinguishing between emissions Shell has direct control over and those it indirectly influences. Shell Canada believes the utility of the scope approach will increase as the *GHG Protocol* becomes further defined and is utilized internationally. The formalization of the *GHG Protocol's* three-scope approach in broad international application could significantly improve the clarity of GHG reporting, while not discounting the incentive to become more energy efficient in the use of imported electricity.

Overall, Shell felt it was largely in agreement with the *GHG Protocol* and with slight modifications could meet the requirements of that accounting system. No substantial barriers were found in VCR that would prevent Shell's GHG inventory from achieving compliance with both reporting systems. With select additions, Shell can offer a future report that achieves both VCR Champion Reporting status domestically and *GHG Protocol* compatibility. This is an important discovery for Shell Canada because it demonstrates the validity of its existing reporting methods and provides a blueprint for its continuous improvement toward a future international standard.

Swiss Re: The bottom line on business travel

When Swiss Re began recording environmental performance indicators, the company gave high priority to energy consumption and business travel since they traditionally constitute the highest GHG impacts of an insurance company.

While acquiring data from energy suppliers proved relatively easy, accessing correlated business travel data from reservation agents proved more challenging. Swiss Re's Business Travel Centre in Zurich began sorting some 800 of almost 5000 travel cards and extrapolating the result for the total number of flights in 1996. Based on this spot-check system, the business travel indicator was projected each year in the same manner until 1999. In 2000, Swiss Re launched a Lotus Notes-based 'travel booking system' for business trips. At first sight, the system permitted a consistent indicator for the first time, but it proved impossible to correlate the number of destinations with the accumulated number of miles flown.

During 2000, Swiss Re decided to make all flight bookings through American Express (AMEXCO), and was able to utilize their Flight Power tool for detailed monitoring of all business travel activities. Not only is it now possible to record the number of destinations and cost per unit, but the miles flown can also be calculated for further evaluation. This solution immediately enhanced both data quality and quantity. American Express provides monthly data to update the miles per unit indicator on a quarterly basis. This parameter is used for internal monitoring and to promote cost consciousness of each cost center.

Norsk Hydro: Learning by doing

In 1990, Norsk Hydro recognized that it did not have a good overview of the GHG emissions from its operations and decided to conduct a first GHG inventory. In addition to CO_2 and CH_4 the company also looked at N_2O from fertilizer production and fluorinated species such as CF gases and SF_6. Norsk Hydro has since developed a web-based system for registering GHGs, other emissions, and energy data to keep track of environmental performance.

Based on the inventory work, the company established good contacts with the scientific community and regulatory authorities. The inventory also provided an excellent basis for identifying emissions reduction potentials through a variety of measures, in particular through improved operational performance and the introduction of new technology. Gradually, Norsk Hydro reduced emissions of CF gases from aluminum electrolysis, and decreased the use of SF_6 in magnesium casting. A major lesson from the 'learning by doing' approach with GHG inventories was realizing the importance of consistent boundary definitions. This produces quantitative, high quality data, which provides a basis for cost-effective abatement measures.

As a consequence of the company's environmental principles – a life cycle view of activities, and a focus on abatement actions, which prove to be cost-effective in a life cycle context – Norsk Hydro extended its analysis to a company-wide life cycle inventory of GHGs in 1996. The study revealed that from a life cycle perspective, about 80 percent of GHG emissions were related to use of the company's products, mainly CO_2 from the use of oil and gas, as well as N_2O from the use of fertilizers.

Notes

1 The terms 'direct' and 'indirect' as used in this document should not be confused with their use in national GHG inventories where 'direct' refers to the six Kyoto gases and 'indirect' refers to the precursors NO_x, NMVOC, and CO.

2 For some integrated manufacturing processes, such as ammonia manufacture, it may not be possible to distinguish between GHG emissions from the process and the production of electricity, heat, or steam.

3 Green power includes renewable energy sources and specific clean energy technologies that reduce GHG emissions relative to other sources of energy that supply the electric grid, e.g. solar photovoltaic panels, geothermal energy, landfill gas, and wind turbines.

4 EPER sets the following facility-based reporting thresholds for Kyoto GHGs (kg/yr): CO_2 – 100,000,000; CH_4 – 100,000; N_2O- 10,000; HFCs – 100; PFCs – 100; SF_6 – 50. Reported emissions data must be accompanied by a one-letter code referring to the methodology of emissions determination (M - measurement, C - calculated, E - non standardized estimate). Source categories should be compatible with NOSE-P categories.

Accounting for GHG reductions

The *GHG Protocol* focuses on accounting and reporting for GHG emissions at the corporate level. The reporting standard provides guidance on how to prepare a summary of GHG information for a company's global operations. GHG reductions can then be measured by comparing absolute changes in the company's overall GHG emissions over time, or by developing ratio indicators to track relative performance.

A company's overall emissions may be reduced, even if increases occur at specific sources, facilities, or operations within a given country. Focusing on the overall company GHG impact has the advantage of helping companies more effectively manage their aggregate GHG risks and opportunities. It also helps guide the transfer of resources to activities resulting in the most cost-effective GHG reductions.

GHG reductions at the scale of a facility or country

From the perspective of the climate it does not matter where GHG emissions reductions occur. From the perspective of national and international policies on global warming, the place where reductions are achieved is relevant since these policies focus on achieving GHG reductions within specific countries or regions. Thus companies with global operations will have to respond to an array of national regulations and requirements that address GHGs from operations or facilities within a specific country.

The *GHG Protocol* calculates GHG emissions using a bottom-up approach. This involves calculating emissions at the level of an individual source and then rolling this up via facilities to the corporate level. This approach enables companies to slice and dice GHG emissions information at different scales, e.g. by individual sources or facilities, or by a collection of facilities within a given country. This allows a company to meet an array of government requirements or voluntary commitments. Reductions can then also be measured by comparing emissions over time for the chosen scale.

Project-based reductions, offsets, credits

International negotiators and domestic policymakers are developing market-based regulatory instruments. It is widely anticipated that corporations, amongst others, will actively trade emissions allowances or emissions reduction credits through these mechanisms.

For example, the Kyoto Protocol sets emissions targets for participating industrialized nations and establishes three market-based mechanisms to promote cost-effective reductions. These are: international emissions trading, joint implementation (JI), and the clean development mechanism (CDM).

Under each mechanism, a party facing high costs in reducing its own emissions can purchase certified emissions reduction credits for lower cost reductions undertaken by another party.

These credits will be generated by financing projects that result in verifiable emissions reductions (e.g. district heating upgrades) or in removing GHGs from the atmosphere (e.g. enhancing carbon sinks via reforestation activities). It is envisioned that both government and corporate entities will use these credits to fulfill obligations under domestic law. At both national and international levels, the rules governing the eligibility of reduction projects and the trade of emissions rights are still under discussion.

A few leading companies are already seeking to turn emissions reductions into competitive advantage and are participating in a variety of 'pre-compliance' or voluntary transactions. Experience from this 'pre-compliance' market in GHG reduction credits highlights the importance of delineating reductions with a robust, valid and quantifiable accounting system that provides credible and verifiable data. Key accounting challenges for project-based credits are establishing ownership of the reduction credits, baseline construction and additionality, and leakage.

Under the Kyoto Protocol, JI and CDM activities must result in GHG reductions that are additional to any that would otherwise occur in the absence of the certified project activity. The baseline provides a reference point for what emissions would have been without the project intervention. Leakage relates to increases or decreases of GHG emissions elsewhere as a result of a project.

The *GHG Protocol* does not address all the accounting challenges associated with project-based reductions, but it can help companies identify and account for those reductions that occur within their organizational and operational boundaries.

The *GHG Protocol* is initiating a task force to explore and develop guidance on accounting for project-based reductions in a manner that is robust and consistent with the potential financial value and integrity of any commodity that may be attached to reductions.

Reporting project-based reductions, offsets, credits

The sale, transfer, or banking of emissions reductions credits achieved from reduction activities within a company's selected operational boundaries (scopes 1, 2 or 3) should be clearly indicated in its public GHG report under the section on supporting information.

The purchase of emissions reduction credits from another organization may also be reported in the public GHG report. Appropriate supporting information addressing the validity and credibility of purchased emissions reduction units should be included.

When companies make changes to their operations that result in GHG reductions, these will usually be captured in one of the three *GHG Protocol* scopes. However, some companies may be able to make changes to their own operations that result in GHG reductions not captured by any of their three scopes, for example:

- Substituting fossil fuel with imported waste-derived fuel that might otherwise be landfill or incinerated without energy recovery. Such substitution may have no direct effect on (or may even increase) the importing company's own GHG emissions. However, it could result in real GHG savings elsewhere, e.g. avoiding landfill GHG emissions and fossil fuel use.

- The installation of an on-site co-generation plant that provides electricity for the company and other organizations. This may increase the company's direct emissions, but decrease the GHG emissions of the organizations using the exported electricity, by displacing more GHG intensive electricity sources.

These reductions may be accounted for in the same way as the purchased project-based reductions described above and reported in a company's public GHG report.

Kansai Electric Power Company: Accounting for GHGs from electricity consumption

In Japan the responsibility for CO_2 emissions from electricity consumption is assigned to end-users. Emissions are calculated by multiplying a CO_2 emissions factor by the amount of electricity consumed. The CO_2 emissions factor is derived by dividing the total amount of CO_2 emitted by an electricity supplier by the corresponding amount of electricity generated from all the supplier's sources, e.g. nuclear, fossil-fueled, and hydroelectric power (the mean emissions factor). Although it is not possible to identify a particular power generation source with a given reduction of electricity in Japan, some organizations have assumed that any reductions they make in electricity leads to a reduction in fossil-fueled power generation. Kansai Electric Power Company points out that this assumption over-estimates GHG reductions from reduced electricity use and is not credible for the following reasons:

- in practice, hydroelectric power is used for the short-term load balancing needed to control frequency, whereas nuclear power is used to balance seasonal load by planning periodic inspections outside of demand peaks
- since the CO_2 emissions factor for fossil-fueled power is greater than the average emissions factor for all power sources, this approach overestimates actual GHG reductions

In the absence of a credible and verifiable alternative, the mean CO_2 emissions factor should thus be used for calculating the CO_2 reductions from lower electricity consumption.

Setting
a historic performance datum

"What sort of comparisons do I need to make over time?"
Emissions performance comparisons can be done against the last accounting period as well as against emissions in a selected reference year.

Comparison only against the last accounting period is unlikely to cater for strategic business goals such as establishment of emissions reduction targets and management of risks and opportunities, or address the needs of investors and other stakeholders.

The *GHG Protocol* recommends setting a historic performance datum for comparing emissions over time. This performance datum is the **base year emissions**. Base year emissions can be differentiated from the term baseline, used in the context of project-based accounting under the Kyoto Protocol. The base year emissions concept aims at a broader footprint intended to allow comparison of emissions performance over time. This datum recognizes that the methods and tools to account and report GHG emissions will improve over time, and that many industries will undergo major changes and consolidation. In contrast, a baseline usually refers to an emissions scenario that would occur in the absensce of the GHG reduction project.

If you intend to participate in a voluntary GHG reductions scheme or a GHG emissions trading scheme, it is important to first check with the scheme to determine whether it has any specific rules governing the establishment of base year emissions or baselines. The UK Emissions Trading Scheme, for example, specifies that the baseline will be the average emissions in the three years up to and including 2000 for direct entry participants (DEFRA, 2001).

Choosing a base year

Companies should choose a base year for which verifiable data is available. Companies should specify their reasons for choosing that particular year.

Base year emissions adjustments

Companies should develop a base year emissions adjustment policy, and clearly articulate the basis for making any adjustments. The policy should state any 'significant threshold'[1] applied for considering base year emissions adjustment.

The following rules should be observed for base year emissions adjustments:

- The base year emissions should be adjusted to maintain comparability if significant structural changes occur in the organization. What defines a significant structural change usually depends on the size of the organization. Examples include mergers, major acquisitions, and divestitures.
- The base year emissions should be adjusted to account for the transfer of ownership/control of emissions sources.
- The base year emissions should not be adjusted for organic growth or decline of the organization. Organic growth/decline refers to increase/decrease in production output, changes in product mix, plant closures and the opening of new plants. The rationale for this is that organic growth results in new or additional emissions to the atmosphere, whereas an acquisition only transfers existing GHG emissions from one company's balance sheet to another.
- The base year emissions should not be adjusted for any changes in outsourcing activities if the company is reporting its indirect emissions from such activities under scopes 2 or 3. The same rule applies to insourcing.
- If significant structural changes occur during the middle of a year, the base year emissions should be adjusted on a pro-rata basis.
- The base year emissions should be adjusted for changes in calculation methodologies that result in significant changes in your calculated GHG emissions data. Discovery of errors, or a number of cumulative errors, that significantly affects base year emissions should result in an adjustment of base year emissions.

In summary, once a company has determined how it will adjust its base year emissions, it should apply this policy in a consistent manner. For example, it should adjust for both GHG emissions increases and decreases. The base year emissions should be retrospectively adjusted to allow for specific changes in the company that would otherwise invalidate the use of its base year emissions as a performance datum, or would compromise the consistency and relevance of the reported GHG information.

Guidance on setting a historic performance datum

The establishment of a base year and adjustment of base year emissions should be related to business goals:

- to achieve certified emissions reduction targets, there may be external rules which influence the choice and adjustment of the base year emissions
- for internal management goals, the company may follow the rules and guidelines recommended in this document, or it may develop its own approach which should be followed consistently
- to report progress toward publicly set GHG reduction goals, the company should follow the rules and guidelines recommended in this document

Choosing a base year

Obtaining reliable data for historical base years such as 1990 is a challenging task. For some GHG sources a consistent and verifiable data set may not be available. If this is the case, particularly for key source categories, it may make sense to choose a more recent base year. Some organizations are adopting 1990 as a base year in order to be consistent with the Kyoto Protocol. The Kyoto Protocol set 1990 as a base year for industrialized countries to reduce their emissions in the first commitment period of 2008-2012.

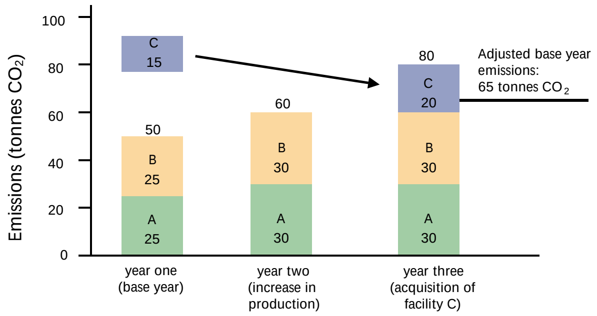
Base year adjustment for structural changes

Base year emissions should be adjusted for structural changes when there is significant impact on the reporting consistency of the organization's total emissions. This may include accounting for the cumulative effect of a number of small acquisitions or divestitures. While adding some complexity, this approach aligns with financial accounting practices, and provides a meaningful basis for measuring performance over time. Examples one and two offer illustrations of possible structural changes and the application of the *GHG Protocol* standard on base year emissions adjustment.

Example one: Base year emissions adjustment for an acquisition – Figure 3

Company Gamma consists of two business units (A and B). In its base year (year one) the company emits 50 tonnes CO_2. In year two, the company undergoes organic growth, leading to an increase in emissions to 30 tonnes CO_2 per business unit, i.e. 60 tonnes CO_2 in total. The base year emissions are not adjusted in this case. In the beginning of year three, Gamma acquires a production facility C from another company. The annual emissions of facility C in year one were 15 tonnes CO_2, and 20 tonnes CO_2 in year two. The total emissions of company Gamma in year three, including facility C are therefore 80 tonnes CO_2. To maintain consistency over time, the company recalibrates its base year emissions to take into account the acquisition of facility C. The base year emissions increase by 15 tonnes CO_2 – the quantity of emissions produced by facility C in Gamma's base year. The adjusted base year emissions are 65 tonnes CO_2.

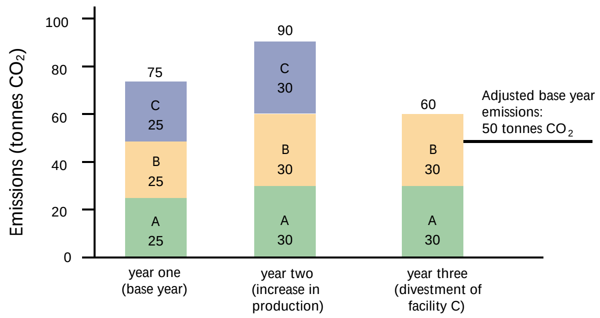
Figure 3



Example two: Base year emissions adjustment for a divestment – Figure 4

Company Beta consists of three business units (A, B, and C). Each business unit emits 25 tonnes CO_2 and the total emissions for the company are 75 tonnes CO_2 in the base year (year one). In year two, the output of the company grows, leading to an increase in emissions to 30 tonnes CO_2 per business unit, i.e. 90 tonnes CO_2 in total. In year three, Beta divests business unit C, and its annual emissions are now 60 units, representing an apparent reduction of 15 units relative to the base year emissions. However, to maintain consistency over time, the company recalibrates its base year emissions to take into account the divestment of business unit C. The base year emissions are lowered by 25 tonnes CO_2 – the quantity of emissions produced by the business unit C in the base year. The adjusted base year emissions are 50 tonnes CO_2, and the emissions of company Beta are seen to have risen by 10 tonnes CO_2 over the three years.

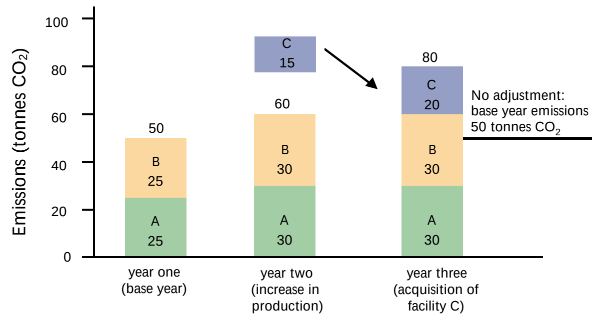
Figure 4



Example three: Acquisition of a facility that came into existence after the base year was set – Figure 5

Company Teta consists of two business units (A and B). In its base year (year one) the company emits 50 tonnes CO_2. In year two, the company undergoes organic growth, leading to an increase in emissions to 30 tonnes CO_2 per business unit, i.e. 60 tonnes CO_2 in total. The base year emissions are not adjusted in this case. In the beginning of year three, Teta acquires a production facility C from another company. Facility C came into existence in year two, its emissions being 15 tonnes CO_2 in year two and 20 tonnes CO_2 in year three. The total emissions of company Teta in year three, including facility C are therefore 80 tonnes CO_2. In this acquisition case, the base year emissions of company Teta do not change because the acquired facility C did not exist in year one when the base year of Teta was set. The base year emissions datum of Teta therefore remains at 50 tonnes CO_2.

Figure 5



No adjustment for organic growth or decline

Organic growth or decline is not considered a condition for base year emissions adjustment. Opening a new facility is considered a case of organic growth because it represents new sources of GHG emissions that did not exist prior to the setting of a base year. Similarly, the acquisition of companies or parts of companies that came into existence after the company's base year was set are regarded as organic growth because these changes represent new GHG emissions that occurred after the base year was set. In the following cases, there should be no adjustment to the base year:

- an operating unit that was set up after the base year was established is shut down
- a new operating unit is started
- an acquisition of a company or part/s of a company that came into existence after the base year of the acquiring company was set (see Example three)
- 'outsourcing' of operations that came into existence after the base year was set
- 'insourcing' of operations that came into existence after the base year was set

No adjustment for 'outsourcing' reported under scope 2 and/or scope 3

Structural change due to 'outsourcing/contract manufacturing' is not considered a condition for base year emissions adjustment if the company is reporting its indirect emissions from relevant 'outsourcing' activities under scope 2 (outsourcing of energy for use) or under scope 3 (outsourcing/contract manufacturing). The same rule applies to 'in-sourcing'. An example of 'in-sourcing' is when a company starts its own generation of electricity and thus reduces its use of imported electricity.

Notes

1 'Significant threshold' is a qualitative or quantitative criteria used to define a significant structural change. It is the responsibility of the company/verifier to determine the 'significant threshold' for considering base year emissions adjustment. In most cases the 'significant threshold' depends on the use of the information, the characteristics of the company, and the features of structural changes.

Identifying and calculating GHG emissions

Once the organizational and operational boundaries have been established, companies generally calculate GHG emissions via the following steps:

- identify GHG emissions sources
- select an emissions calculation approach
- collect activity data and choose emissions factors
- apply calculation tools to estimate GHG emissions
- roll-up GHG data to corporate level

These steps are described in the following sections. A short description of the calculation tools developed by the *GHG Protocol* is also provided. The calculation tools are available on the *GHG Protocol* website at www.ghgprotocol.org

Identify GHG emissions sources

To facilitate the selection of applicable calculation tools, emissions of GHGs are categorized here in terms of key sources. Appendix 2 relates emissions sources with the activities identified in Chapter 4: Setting operational boundaries.

Emissions of GHGs typically occur from the following source categories:

- **stationary combustion**: combustion of fuels in stationary equipment such as boilers, furnaces, burners, turbines, heaters, incinerators, engines and flares
- **mobile combustion**: combustion of fuels in transportation devices such as automobiles, trucks, trains, aeroplanes, and ships
- **process emissions:** emissions from physical or chemical processes, e.g. CO_2 from the calcination step in cement manufacturing, CO_2 from catalytic cracking in a petrochemical processing, PFC emissions from aluminum smelting, etc.
- **fugitive emissions:** intentional and unintentional releases such as equipment leaks from joints, seals, packing and gaskets, etc. This may also include fugitive emissions from coal piles, wastewater treatment, pits, cooling towers, fugitive CH_4 emissions from gas processing facilities

Every business has some processes, products or services that generate direct and/or indirect emissions from one or more of the above source categories. Appendix 2 provides an overview of direct and indirect GHG emissions sources organized by scopes and industry sectors. It may be used as an initial guide to identify your major GHG sources.

Identifying scope 1 emissions

As a first step in identifying GHG sources, a company should undertake an exercise to track down its direct emissions sources in each of the four broad categories described above – stationary combustion, mobile combustion, process, and fugitive. The power industry has direct emissions from all the main source categories, except process emission sources. Process emissions are specific to certain industry sectors like oil and gas, aluminum, cement, etc. Manufacturing companies that generate process emissions and also own or control a power production facility, will have direct emissions from all the main source categories. Office based organizations may not have any direct GHG emissions except in cases where they own or operate a combustion device or refrigeration and air-conditioning equipment. Often companies are surprised to realize that a significant amount of emissions come from sources which are not initially obvious (see UTC box).

Identifying scope 2 emissions

The next step is to identify indirect emissions sources from the use of purchased electricity, heat, or steam. Almost all businesses generate indirect emissions due to the use of imported electricity for their processes or products/services.

Identifying scope 3 emissions

This step is needed if a company also plans to report its scope 3 emissions. It involves identification of other indirect emissions from the reporting company's upstream and downstream activities. All companies use raw materials or goods that have generated emissions during their mining or processing phases. Indirect emissions due to transportation are also common to all businesses. These include transportation in vehicles owned or controlled by another organization, e.g. transport of raw materials/goods and products, employees commuting to and from work, and business-related travel by employees. Product use is an important category of indirect emissions for companies manufacturing automobiles, appliances, and fuels.

United Technologies Corporation (UTC): More than meets the eye

Back in 1996, the team responsible for setting boundary conditions for UTC's new Natural Resource Conservation, Energy and Water Use Reporting Program, met to decide what sources of energy were going to be included in the program's annual report of energy consumption. The team decided to include jet fuel in the annual report; jet fuel was used by a number of UTC divisions for engine and flight hardware testing and for test firing. Although the amount of jet fuel used in any given year was subject to wide variability due to changing test schedules, the total amount consumed in an average year was not expected to be large. Jet fuel consumption reports, however, proved that UTC's initial belief was wrong. Jet fuel had accounted for between nine and 13 percent of the corporation's total annual use of energy since the program commenced. Had UTC not included the use of jet fuel in annual data collection efforts, a significant energy source would have been overlooked.

A comprehensive identification of indirect emissions sources also includes accounting for GHGs associated with 'outsourcing/contract manufacturing' or franchises, e.g. drilling operations, building construction, facilities management, printing, waste management, retail outlets, etc.

By looking at scope 3 emissions, businesses are encouraged to expand their inventory boundary across their value chain and to identify all relevant GHG emissions. Figure 2 in Chapter 4: Setting operational boundaries (guidance), provides an overview of activities that generate GHG emissions along a company's value chain.

Identification of emissions sources does not imply that a business will be able to calculate emissions for all indirect emissions sources. In some cases it may be difficult to obtain good quality data from contractors/suppliers. Nevertheless, identification of GHG sources along the value chain provides a broad overview of various linkages and possible opportunities for GHG reductions.

Select an emissions calculation approach

Direct measurement of GHG emissions by monitoring exhaust gas concentration and flow rate is rare. In most instances accurate estimates can be obtained by using appropriate calculation methods employing derived emissions factors. Table 5 in Chapter 8: Managing inventory quality, provides a comparison of various calculation methods. The IPCC guidelines (IPCC, 1996b) refer to several calculation approaches or techniques ranging from the application of derived emissions factors, through to direct monitoring. One important exception to this hierarchy is the calculation of CO_2 emissions from fuel use data. In many instances, even small users know both the amount of fuel consumed, and the carbon content of the fuel. CO_2 emissions can then be calculated with an accuracy of two to three percent. This is far better than the accuracy achieved by direct monitoring of CO_2 emissions.

Apart from some process emissions, which can be calculated based on a mass balance, the most common approach for calculating GHG emissions is through application of emissions factors. Emissions factors are documented information relating GHG emissions to some characteristic of the emissions sources. The emissions are calculated by multiplying the emissions factor by an appropriate activity factor (fuel consumed, quantity of output produced, etc.). Activity factors relating to transportation include: total fuel consumed, vehicle miles traveled, passenger miles traveled, or volume of goods transported. Usually activity data based on fuel use will provide the most accurate estimate of GHG emissions for transportation sources.

Collect activity data and choose emissions factors

For most small to medium-sized companies and for many larger companies, scope 1 emissions will be calculated based on the purchased quantities of commercial fuels (such as natural gas and heating oil) using published emissions factors. Scope 2 emissions will be calculated from metered electricity consumption using published emissions factors. Scope 3 emissions will be calculated from activity factors such as passenger miles and published or third-party emissions factors. In all these cases, if source/facility specific emissions factors are available, it is preferable that they be used. User-friendly calculation tools are available on the *GHG Protocol* website to assist in these calculations.

Companies involved in fuels extraction and processing, chemicals, minerals, waste management, and primary metals will be faced with a wider range of alternative approaches/methodologies. They should seek guidance from the sector specific guidelines on the *GHG Protocol* website (where available) or from their industry associations, e.g. International Aluminium Institute, American Petroleum Institute, WBCSD project: Toward a Sustainable Cement Industry, etc.

Apply calculation tools to estimate GHG emissions

This section provides an overview of the GHG calculation tools available on the *GHG Protocol* website (www.ghgprotocol.org). Use of these tools is encouraged as they have been peer reviewed by experts and industry leaders and are believed to be the best available. The tools, however, are optional. Companies may use their own GHG calculation tools, provided they are consistent with the approaches described.

There are two main categories of calculation tools:

- **cross-sector tools** that can be applied to many different sectors: stationary combustion, mobile combustion, and HFC use in refrigeration and air-conditioning
- **sector-specific tools**, e.g. aluminium, iron and steel, cement, etc.

Most companies will need to apply more than one calculation tool to cover all their GHG sources. For example, to calculate GHG emissions from an aluminium smelter, the company would use the calculation tools for aluminium production, stationary combustion (for any import of electricity, steam and heat, generation of energy on-site), and mobile combustion (for transportation of materials and products, vehicles employed on-site, and employee business travel).

Structure of calculation tools

All cross-sector and sector-specific calculation tools are based on a similar structure and offer step-by-step guidance on measuring and calculating emissions data. Each calculation tool comprises of a guidance section and automated worksheets with explanations on how to use them.

The general structure of the guidance section is as follows:

- **overview:** provides an overview of the purpose and scope of the tool, the calculation method used in the tool, and a process description
- **choosing activity data and emissions factors:** provides good practice guidance and references for default emissions factors
- **calculation methods:** describes different calculation methods depending on the availability of site-specific activity data and emissions factors
- **quality control:** provides good practice guidance
- **internal reporting and documentation:** provides guidance on internal documentation to support emissions calculations

In the automated worksheet section, it is only necessary to insert activity data into the worksheets and to select the appropriate emissions factors. Default emissions factors are provided, but it is also possible to insert customized emissions factors if more accurate emissions factors are available. The emissions of different GHGs are calculated separately and then converted to CO_2 equivalents on the basis of their global warming potential.

Some of the tools take a tiered approach, offering a choice between a simple and a more advanced calculation approach. The more advanced approach results in more accurate emissions data but usually require a higher level of data detail

Table 4: Overview of GHG calculation tools available on the ***GHG Protocol*** website

	Calculation tools	Main features
Cross-sector tools	Stationary combustion	• calculates direct and indirect CO_2 emissions from combustion of fuels in stationary equipment • provides two options for allocating emissions from a co-generation facility • default emission factors provided for different fuels, and country averages for grid electricity
	Mobile combustion	• calculates direct and indirect GHG emissions (CO_2) from mobile sources • mobile sources included are road, air, water, and rail transport • default emission factors provided
	HFC from air conditioning and refrigeration	• calculates direct HFC emissions during manufacture of refrigeration and air-conditioning (RAC) equipment, and use of RAC equipment in commercial applications • two calculation methodologies are provided: a sales-based approach, and an emission factor based approach
Sector-specific tools	Aluminium and other non-ferrous metals production	• calculates direct GHG emissions from aluminium production (CO_2 from anode oxidation and PFC emissions from the 'anode effect') • guideline and calculation approach provided for emissions of SF_6 used in non-ferrous metals production as a cover gas
	Iron and steel	• calculates direct GHG emissions (CO_2) from oxidation of the reducing agent and calcination of the flux used in steel production and from the removal of carbon from the iron ore and scrap steel used
	Nitric acid manufacture	• calculates direct GHG emissions (N_2O) from the production of nitric acid
	Ammonia manufacture	• calculates direct GHG emissions (CO_2) from ammonia production. This is for the removal of carbon from the feedstock stream only; combustion emissions are calculated with the stationary combustion module.
	Adipic acid manufacture	• calculates direct GHG emissions (N_2O) from adipic acid production
	Cement	• calculates direct GHG emissions from cement manufacturing (CO_2 from the calcination process) • two calculation methodologies are provided: cement-based approach and clinker-based approach
	Lime	• calculates direct GHG emissions from lime manufacturing (CO_2 from the calcination process)
	HFC-23 from HCFC-22 production	• calculates direct HFC-23 emissions from production of HCFC-22
	Semiconductors	• calculates direct PFC emissions from production of semiconductor wafers

and a more thorough understanding of the technologies used in the business operations.

Table 4 provides an overview of the calculation tools available at the *GHG Protocol* website, and their main features. In addition, a user-friendly guide for calculating GHG emissions from small office-based organizations is under development.

Roll-up GHG data to corporate level

To report a corporation's total GHG emissions, companies will usually need to gather and summarize data from multiple sites, possibly in different countries and business divisions. It is important to plan this process carefully to minimize the reporting burden, and to reduce the risk of random errors that might occur while compiling data. Ideally, corporations will integrate GHG reporting with their existing reporting tools and processes, and take advantage of any relevant data already collected or reported by sites to division or corporate offices.

The tools and processes chosen for a site to report data will depend upon the information and communication infrastructure already in place (i.e. how easy is it to include new data categories in corporate databases). It will also depend upon the amount of detail that corporate headquarters wish to be reported from sites. Data collection and management tools could include:

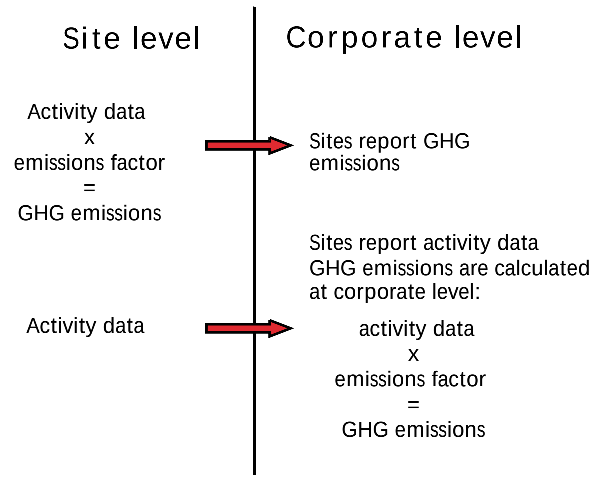
- secure databases available over the company intranet or internet, for direct data entry by sites
- spreadsheet templates filled out and e-mailed to a corporate or division office, where data is processed further
- paper reporting forms faxed to a corporate or division office where data is re-entered in a corporate database. However, this method will increase the likelihood of random errors.

For internal reporting up to the corporate level, it is recommended that standardized reporting formats be used to ensure that data received from different business units and facilities is comparable, and that internal reporting rules are observed (see BP box). Standardized formats can significantly reduce the risk of random errors.

There are two basic approaches for gathering data on GHG emissions from a corporation's sites:

- individual sites directly calculate their GHG emissions and report this data to the corporate level
- individual sites report activity/fuel use data (such as quantity of fuel used) to the corporate level, where GHG emissions are calculated

The difference between these two approaches is where the emissions calculations occur, i.e. where activity data is multiplied by the appropriate emissions factors.



Individual sites collect GHG emissions data

Asking facilities to calculate GHG emissions themselves will help to increase their awareness and understanding of the issue. However, it may also lead to resistance, increased training needs, an increase in calculation errors, and a greater need for auditing of calculations. Requesting that facilities calculate GHG emissions themselves may be the preferred option if:

- emissions calculations require detailed knowledge of the kind of equipment being used at facilities
- emissions calculations are not standardized across a number of facilities
- process emissions (in contrast to emissions from burning fossil fuels) make up an important share of total GHG emissions
- resources are available to train facility staff to conduct these calculations and to audit them
- a user-friendly tool is available to simplify the calculation and reporting task for site-level staff

Individual sites collect activity/fuel use data

This approach may be particularly suitable for office-based organizations. Requesting that facilities report their own activity/fuel use data may be the preferred option if:

- the staff at the corporate or division level can calculate emissions data in a straightforward manner on the basis of activity/fuel use data
- emissions calculations are standardized across a number of facilities

The choice of collection approach depends on the needs and characteristics of the reporting company. Corporations have taken different approaches. BP provides sites with a calculation protocol, requests that they calculate and report their total GHG emissions, and follows up with audits to ensure calculations are correct and documented. United Technologies Corporation requests that its sites report fuel and travel details, leaving the choice of emissions factors and calculations to corporate staff. The two approaches should produce the same result and they are not mutually exclusive.

To maximize accuracy and minimize reporting burdens, some companies combine both approaches. A small number of large, complex sites with process emissions are asked to calculate their emissions at the site level, and these calculations are carefully reviewed. Larger numbers of small sites with uniform emissions from standard sources are asked only to report fuel use and travel activity. The corporate database or reporting tool then calculates total emissions for each of these standard activities.

Even when facilities calculate their own emissions, corporate staff may still wish to gather activity/fuel use data to double-check calculations and to better understand the opportunities for emissions reductions. Corporate staff should also verify that facility-reported data is based on approved reporting periods, units, and inventory boundaries.

Internal reporting of emissions data to corporate level

Reports from site level to corporate or division offices should include all relevant information as specified in Chapter 9: Reporting GHG emissions, and a number of additional reporting categories. Some reporting categories are common to both facility level data collection approaches. These include:

- a brief description of the emissions sources
- a list and justification of specific exclusion or inclusion of sources
- comparative information from previous years
- the reporting period covered
- any trends seen in data
- progress toward any business targets
- an estimation of accuracy of activity/fuel use data reported
- a description of events and changes that have an impact on reported data (acquisitions, divestitures, closures, technology upgrades, changes of reporting boundaries or calculation methodologies applied, etc.)

Individual sites report GHG emissions data to corporate level

In addition to the aforementioned common categories of reporting data, facilities using this approach should also report the following details:

- description of GHG calculation methodologies, and any changes made to methodologies relative to previous reporting periods
- ratio indicators (see Chapter 9: Reporting GHG emissions)
- details on any data references used for the calculations, in particular information on emissions factors used

Clear records of calculations undertaken to derive emissions data should be kept for any future internal or external verification.

Individual sites report activity/fuel use data to corporate level

In addition to the aforementioned common categories of reporting data, facilities using this approach should also report the following details:

- fuel use data (fuel types used at facility and electricity consumption)
- activity data for freight and passenger transport activities (e.g. freight transport in tonnes x kilometers)
- activity data for process emissions (e.g. tonnes of fertilizer produced, tonnes of waste landfilled)
- clear records of calculations undertaken to derive activity/fuel use data
- any other conversion factors necessary to translate fuel use into CO_2 emissions

BP: A standardized system for internal reporting of GHGs

BP has been collecting GHG data from the different parts of its operations for more than four years and has recently consolidated its internal reporting processes into one central database system. The responsibility for reporting emissions lies with about 320 individual BP facilities and business departments, which are termed ‘reporting units‘. All reporting units have to complete a standard Excel reporting pro-forma every quarter stating actual emissions for the preceding three months, and updates to forecasts for the current year and the next two years. In addition, reporting units are asked to account for all significant variances, including sustainable reductions. The reporting units all use the same BP reporting guidelines (BP, 2000) for quantifying their emissions of carbon dioxide and methane.

All pro-forma spreadsheets are e-mailed automatically by the central database to the reporting units, and the completed e-mail returns are uploaded into the database by a corporate team, who check the quality of the incoming data. The data is then compiled, by the end of the month following each quarter end, to provide the total emissions inventory and forecasts for analysis against BP’s GHG targets. Finally the inventory is reviewed by a team of independent external auditors to provide assurance on the quality and accuracy of the data.

Managing inventory quality

There are several reasons why companies should plan and implement appropriate activities to address inventory quality:

- to temper their decisions and conclusions when numbers are ‘soft‘
- to identify opportunities to improve the accuracy of their inventory
- to provide defensible data of relative certainty when, and if, these are required by government regulation, emissions trading plans, or eco-labeling programs
- to avoid costs if the inventory development has to be redone

For public reporting, it may be sufficient to document inventory assumptions and to note major sources of uncertainty. Other inventory uses may require calculation and reporting of relative uncertainty. It is possible that for future cap and trade systems, participation in the market may be limited to those firms that can meet minimum inventory and base year emissions standards. This is because performance against a target is impossible to gauge if either the base year data or the inventory is unreliable. In fact, reductions achieved by companies or projects whose inventories are seen as less reliable may be heavily discounted in credit-based trading.

Emissions trading, eco-certification and labeling may require a higher degree of accuracy than general stakeholder reporting. This is because the success of such programs depends on reliably differentiating between small changes in GHG performance, and between companies competing in the same markets.

Ensuring inventory quality

To develop a high quality inventory, it is essential to plan an inventory quality system that includes suitable reviews and accuracy checks for activity data, emissions factors, emissions calculations, and that applies uncertainty analysis tools to qualify data. There are two main sources of uncertainty in any emissions inventory:

Systemic uncertainty is a consistent difference between a measurement and its true value that is not due to random chance. Systemic uncertainty depends on the internal system adopted to calculate and report emissions data to corporate level. Usually a company has direct control over the choice and management of calculation protocols and internal reporting system. Therefore, companies can ensure low systemic uncertainty by adopting appropriate quality assurance practices (see the section on 'steps to improve inventory quality' in this chapter).

Inherent uncertainty is a difference due to random error, or due to fluctuations between a measurement and its true value. Inherent uncertainty depends on the calculation methodology used, and the measurement of activity/emissions data. In all methods for inventory development, some sources of inherent uncertainty will always be present.

Broadly speaking, there are two calculation methodologies that can be used to generate emissions data:

- Emissions factor method: emissions factors applied in this approach are either obtained from published sources, or derived from site-specific and/or source-specific data. Use of derived emissions factors is always preferred as it leads to higher certainty in emissions data. Activity data usually have lower uncertainties as they are linked with economic activity and so there are generally financial incentives to keep accurate records. In cases where activity data are measured using instruments, uncertainty is a function of instrument capabilities and proper calibration.
- Direct monitoring system: inventory quality procedures required for a direct monitoring system are more detailed. Precision in direct monitoring of GHG emissions may require measurement of both the exit stream and the uncontrolled stream. The sources of uncertainty in this case are due to instrument capabilities and calibration.

The need for appropriate tools to characterize uncertainty are discussed in the section on 'Undertaking an uncertainty analysis'. In order to minimize uncertainties, the companies developing inventories should employ consistent inventory quality procedures.

Steps to improve inventory quality

1. **Adopt and apply GHG accounting and reporting principles**
   The first step toward increasing credibility is to implicitly follow the GHG accounting and reporting principles in all phases of the inventory development process (see Chapter 1: GHG accounting and reporting principles).

2. **Use a standardized system for calculation and internal reporting of GHGs across multiple business units/facilities** (Chapter 7: Identifying and calculating GHG emissions).

3. **Select an appropriate calculation methodology**
   The desired level of inventory quality relates to inventory end uses. For an overall assessment of GHG emissions for internal management purposes, published emissions factors may be acceptable. If the inventory goal, however, is to participate in an emissions trading scheme, emissions factors may need to be derived from site-specific fuel and equipment data, or, for certain sources, on a continuous emissions monitoring system. Table 5 provides a comparison of various calculation methods.

4. **Set up a robust data collection system**
   Designing a good data collection can greatly reduce possible sources of errors such as data inaccuracy and/or data input mistakes. Some good practices in the data collection process are provided below:
   - request data in familiar unit/s (e.g. natural gas data in volume units)

Table 5: Comparison of calculation approaches

Calculation approaches	Inventory quality	Data requirements	Cost
Published emission factors	Fair – Good[1]	Low	Low
Derived emission factors	High	Moderate	Moderate
Emissions or parameters monitoring	Good – High	High	High

- request data from metered or measured sources as they may be more accurate than purchase records
- establish internal control systems to catch errors (e.g. request both activity use data and activity cost data to enable a cross check for data errors, compare and check with previous year(s) data)

Where fuel activity data is provided in other units (currency, mass, volume) it should preferably be converted to energy units before calculating the carbon content. The CO_2 emissions from burning a unit of a specific fuel will be more exactly determined if the amount of energy units burned is known.

5. **Establish appropriate information technology controls**
To ensure authorized use of relevant computer applications, such as calculation protocols, databases, internal and external reporting files, and back-up information.

6. **Undertake regular accuracy checks for technical errors**
Technical errors can result from various sources such as:
   - incomplete identification of emissions sources
   - use of incorrect methods or assumptions
   - errors in converting measurement units
   - use of incorrect data
   - mistakes in data entry
   - incorrect use of spreadsheets or calculation tools
   - mathematical miscalculations

   The inventory development process should include numerous quality checks on a regular basis to spot any of the technical errors listed above. The quality checks can take various forms, such as:
   - track and verify data input
   - check spreadsheet formulae
   - compare derived emissions factors with published factors
   - compare facility level fuel purchase with total fuel use from all identified combustion emissions sources

7. **Conduct periodic internal audits and technical reviews**
Internal experts who are not directly involved in the inventory development process should carry out periodic technical reviews and audits.

8. **Ensure management review of the GHG information**
To help in the identification of additional issues of misreporting and inaccuracies, and to enhance utility of the GHG inventory.

9. **Organize regular training sessions for inventory development team members**

10. **Perform uncertainty analysis**
Qualifying and/or calculating the error range of an emissions estimate should be carried out to evaluate the quality of emissions estimates. Uncertainty, its sources, and methods for its quantification are discussed in following sections.

11. **Obtain independent external verification**

Undertaking an uncertainty analysis

Uncertainty analysis is normally undertaken to help identify areas where accuracy needs to be improved, and to prioritize inventory quality efforts. The uncertainty estimates can also be useful in reviewing the choice of calculation methodology. For some inventory end-uses, it may be necessary to communicate the actual reliability of the emissions data. In such cases, companies may need to carry out an uncertainty analysis as an essential element of the complete inventory.

Vauxhall Motors: The importance of regular accuracy checks

When setting up GHG information collection systems it is important to pay attention to detail as illustrated by the following example from UK automotive manufacturer, Vauxhall Motors. The company wished to calculate GHG emissions from staff air travel. However, when determining the impact of flight travel, it is important to make sure that the round trip distance is used when calculating emissions. Fortunately, Vauxhall realized this fact early on and avoided reporting emissions that were 50 percent lower than the actual value.

Identifying sources of uncertainty

As discussed in the previous section on 'Ensuring inventory quality', uncertainty in emissions estimates can be either due to systemic errors or inherent errors, or a combination of both.

Systemic uncertainty results from choices such as follows:

- use of factors that are poorly researched and uncertain (e.g. factors for CH_4 and N_2O from combustion processes)
- use of 'average case' factors not perfectly matched to specific and varying circumstances (e.g. average miles per gallon, average $kgCO_2$/MWh generated)
- deliberate estimation to compensate for missing data (e.g. non-reporting facilities, or missing fuel bills)
- assumptions that simplify calculation of emissions from highly complex processes

Inherent uncertainty results from random errors such as:

- imprecise measurement of emissions-producing activity (e.g. miles traveled in aeroplanes or rental vehicles, hours per year specific equipment is used)
- insufficient frequency of measurement to account for natural variability
- poor calibration of measuring instruments
- human errors of calculation and omission

Approaches for characterizing uncertainty

The first step toward characterizing uncertainty associated with emissions data is to understand and quantify the different sources of variability and inaccuracies in the data being used. This analysis should include an assessment of both systemic and inherent uncertainty. Depending on the desired level of quality, companies should then work toward minimizing both sources of uncertainty. They can choose from three different methods to characterize uncertainty of emissions totals. In an emissions inventory these can be applied to specific line items, subtotals, or grand totals.

1. The simplest approach for estimating uncertainty is to note the main sources of systemic and inherent uncertainty in the inventory. If possible, the direction (over- or underestimates) of any systemic uncertainty and an estimate of the relative magnitude (e.g. 30 percent) of the specific source of uncertainty should be stated. This will usually be sufficient for internal management and public reporting purposes.

2. Alternatively, companies can use an ordinal ranking system to characterize uncertainty of emissions data (semi-quantitative ranking). The number of levels and the confidence intervals used are left to the discretion of the individual company. For instance, an ordinal ranking system could take the following form:
   - high certainty – actual emissions likely to be within +/- 5% of reported total
   - good certainty – actual emissions likely to be within +/- 15% of reported total
   - fair certainty – actual emissions likely to be within +/- 30% of reported total
   - poor certainty – actual emissions could vary by more than +/- 50% from reported total

3. Finally, companies can use numerical estimates for confidence intervals (e.g. plus or minus seven percent) to provide a quantitative uncertainty value for emissions data. Numerical estimates may be based on professional experience, or they may be calculated from available statistics. This approach usually requires considerable effort and data.

Quantifying uncertainty at emissions source level and corporate level

A facility's reported emissions total is usually computed by adding together several single-source subtotals such as: emissions from combustion of natural gas, emissions from electricity use, and emissions from vehicle fleet operation.

If needed by regulatory schemes, certainty judgements can be made for each reported subtotal and for the grand total. If a firm has multiple sites, its corporate total is the result of further addition across sites. Companies aiming to calculate or rank certainty therefore need to employ two methods – one for single-source subtotals and the other for sums combining these subtotals. These methods are explained in detail in the guidelines on quantification of uncertainty available at the *GHG Protocol* website: www.ghgprotocol.org

NOTES

[1] For commonly-used fossil fuels, the inventory quality can be good.

Reporting

GHG emissions

Reported information should be ‘relevant, complete, consistent, transparent and accurate‘. The *GHG Protocol* specifies reporting to a minimum of scopes 1 and 2.

GHG reports should be based on the best data available at the time of publication. At the outset, it is better to be open about any limitations, and over time, correct and communicate any discrepancies identified in subsequent years.

A public GHG emissions report should include the following information:

Description of the reporting organization and its boundaries

- provide an outline of the organization and the reporting boundaries chosen
- specify the reporting period covered
- justify specific exclusions of sources

Information on emissions and performance

- report emissions data both on a control-based and an equity share-based approach
- report emissions data separately for each scope
- report emissions data for all six GHGs separately (CO_2, CH_4, N_2O, HFCs, PFCs, SF_6) in metric tonnes and in metric tonnes of CO_2 equivalent
- illustrate performance over time and, if appropriate, relative to a base year datum and a target
- subdivide emissions data further, where this aids transparency, e.g. by business units/facilities, country, source types (optional)
- report relevant ratio performance indicators (optional)
- illustrate performance against internal and external benchmarks (optional)

Supporting information

- describe the methodologies used to calculate and account for emissions, or provide a reference or link to the calculation tools used
- provide appropriate context for any significant emissions changes, such as extended process shut downs, acquisitions/divestitures, outsourcing/insourcing, plant closures/openings, process changes, changes in reporting boundaries or calculation methodologies
- report any emissions reduction credits that are banked, purchased from, or sold to a third party. Specify if the reduction is verified/certified and provide appropriate supporting information (see Chapter 5: Accounting for GHG reductions)
- report emissions from biologically-sequestered carbon (e.g. CO_2 from burning biomass/biofuels)
- report emissions attributable to the generation of exported electricity and steam (by a non-electric utility) (see Chapter 4: Setting operational boundaries)
- outline any GHG management/reduction programs or strategies, as well as information on GHG reduction projects accruing outside the reporting boundaries, subdivided for sinks and sources reduction projects. Specify if the project is verified/certified and provide appropriate supporting information (see Chapter 5: Accounting for GHG reductions) (optional)
- report emissions from GHGs not covered by the Kyoto Protocol, e.g. CFCs, NO_x, etc. (optional)
- outline external assurance provided over the reported emissions data (optional)
- provide a contact person

Guidance on reporting GHG emissions

By following the *GHG Protocol* reporting requirements, users adopt a comprehensive standard with the necessary detail for credible public reporting. For national or voluntary GHG reporting, trading, and regulatory schemes, or for internal management purposes, reporting requirements may vary or be less detailed (Appendix 1 summarizes the requirements of several voluntary GHG initiatives).

For public reporting, it is important to differentiate between frontline reports that are, for example, published on the internet or in brochures, and background reports that contain all necessary data. Not every frontline report must contain all information as specified by the *GHG Protocol* standards, but it should provide a link or reference to a publicly available background report where all the required information is available.

In addition to the six Kyoto gases, companies may also want to provide emissions data for other GHGs (e.g. Montreal gases) to put changes in the emissions levels of Kyoto gases into context. Switching from CFCs to HFCs, for example, will increase emissions of Kyoto gases. Information on the emissions of GHGs, other than the six Kyoto gases, should be reported separately in a public report as supporting information (see Texaco box). Emissions from bio-fuels such as wood should also be reported separately under supporting information.

For some companies, providing emissions data for specific GHGs and business units, or reporting ratio indicators, may compromise business confidentiality. If this is the case, the data need not be publicly reported, but can be made available to those auditing the GHG emissions data, assuming confidentiality is secured.

It takes time to develop a rigorous and complete inventory of GHG emissions. Knowledge will improve over several years of estimating and reporting data. It is therefore recommended that the GHG report:

- is based on the best data available at the time of publication, while being open about its limitations
- openly communicates any discrepancies identified in subsequent years

When reporting changes to boundaries or emissions calculation methodologies, and when mergers, divestitures, acquisitions or closures occur, it is important to provide additional information to users. This allows current emissions data to be compared to data from previous years. If improved measurement, calculation and collection procedures lead to significant differences in reported GHG data, companies are encouraged to adjust the data reported for previous years. Chapter 6: Setting a historic performance datum, describes how corporate base year emissions should be adjusted to account for structural changes such as mergers, acquisitions, divestitures or closures.

Texaco: Reporting non-Kyoto GHGs

One objective of the independent review of Texaco's GHG emissions inventory was to make recommendations for enhancing the accuracy and completeness of the company's inventory.

A key finding from the review of the company's protocol related to the types of GHGs included. By taking into account the Kyoto gases which concern the oil and gas industry (CO_2, CH_4, and N_2O), as well as other non-Kyoto gases such as NO_x, CO, VOCs, H_2S, and SO_x, Texaco obtained the flexibility to participate in potential multi-pollutant trading scenarios which are likely to develop in the future, such as those proposed in the U.S. However, combining these emissions in a CO_2 equivalent total could provide an inconsistent comparison for benchmarking Texaco's emissions against other petroleum industry companies.

This theory was tested by examining the relative impact of NO_x, CO and VOC on total GHG emissions from commonly used natural gas-fired combustion equipment. The assessment indicated that the contribution of NO_x to the total CO_2 equivalent GHG emissions represented three to four percent of the total emissions from gas heaters, nine to ten percent of emissions from natural gas turbines, and 50 percent of emissions from natural gas IC engines. Emissions of CO and VOC are negligible (< 0.2 percent) for gas heaters and turbines, and < one percent for IC engines. Therefore, inclusion of NO_x in the GHG inventory does, for some sources, have a significant impact on the total estimated emissions; while CO and VOC are unlikely to be material to gas-fired combustion source GHG emissions. Based on these findings, the URS/KPMG team recommended that CO_2, CH_4 and N_2O emissions be tracked separately from the criteria pollutants to maintain consistency between Texaco's emissions reporting and other industry and international practices.

Use of ratio indicators

There are two principal aspects of GHG performance, which are of interest to management and stakeholders. One concerns the overall GHG impact of a company or an organization – that is the absolute quantity of GHG emissions. The other concerns the performance in reducing GHG emissions, measured in ratio indicators.

Ratio indicators provide information on relative performance. Ratios can facilitate comparison between similar products and processes. However, it is important to recognize the inherent diversity of businesses, and the circumstances of individual companies. Apparently minor differences in process, product or location can be significant in terms of environmental effect. It is necessary to know the business context in order to be able to interpret ratio indicators correctly. Companies may choose to report GHG ratio indicators for a number of reasons. These include:

- looking at performance over time, i.e. relating figures from different years, and in relation to targets and base years
- establishing a relationship between figures from different categories, e.g. the relation between the value that an action provides compared to its impact on society or on the environment
- improving comparability between different sizes of business and operations by normalizing figures , i.e. by assessing the impact of different sized businesses on the same scale

Corporations should form ratios using the performance data that make sense for their business and that supports their decision-making. They should select ratios for external reporting that permit a better understanding and interpretation of their performance for their stakeholders. It is important to provide some perspective on issues such as scope and limitations of indicators in such a way that users understand the nature of the information provided.

Corporations should think about what ratio indicators could best capture the benefits and impacts of their business, i.e. its operations, its products, and its effects on the marketplace and on the entire economy. Some examples of different ratio indicators are provided below.

Productivity/efficiency ratios

Productivity/efficiency ratios express the value or achievement of a business related to its GHG impact. Increasing efficiency ratios reflect a positive performance improvement. Examples of productivity/efficiency ratios include resource productivity (e.g. sales per GHG), and process eco-efficiency (e.g. production volume per amount of GHGs).

Intensity ratios

Intensity ratios express the GHG impact per unit of activity or unit of value. A declining intensity ratio reflects a positive performance improvement. Many companies historically tracked environmental performance with intensity ratios. Intensity ratios are often called ‘normalized’ environmental impact data. Examples of intensity ratios include emissions intensity (e.g. tonnes of CO_2 emissions per electricity unit generated) and resource intensity (e.g. GHG emissions per function or per service).

Percentages

A percentage indicator is a ratio between two similar issues (with the same physical unit in numerator and denominator). Examples of percentages that can be meaningful in performance reports include current GHG emissions expressed as a percentage of base year GHG emissions.

For further guidance on ratio indicators refer to Verfaillie, H. and Bidwell, R., 2000; ISO 1999; NRTEE, 1999; and GRI, 2000.

Verification
of GHG emissions

Verification is the objective and independent assessment of whether the reported GHG inventory properly reflects the GHG impact of the company in conformance with the pre-established GHG accounting and reporting standards.

Verification involves testing certain assertions of the GHG inventory, such as accuracy and completeness. Verification also requires evaluating and testing the 'supporting' evidence (in the form of an audit trail) of how the GHG inventory was generated, compiled/aggregated and reported.

The practice of verifying corporate GHG inventories is still in its infancy, and the absence of generally accepted GHG accounting and reporting standards means that reporting standards against which verifications have taken place have varied from company to company.

With the emergence of generally accepted accounting and reporting standards, such as the *GHG Protocol*, verification practices should become more uniform, credible, and widely accepted. This section provides guidance on conducting an independent verification of a GHG inventory. Even if a company decides not to conduct an independent verification at this time, it should still develop its inventory so that it may be verified in the future.

Objectives

Before commissioning and planning an independent verification, the reporting company should clearly define its objectives (more information in Chapter 2: Business goals and inventory design), and decide whether an external verification is the best way to enhance those. Reasons for undertaking a verification include:

- to add credibility to publicly reported information and reduction goals, and to enhance stakeholder trust in the reporting organization
- to increase management and board confidence in reported information
- to improve internal GHG accounting and reporting practices (data calculation, recording and internal reporting systems, application of GHG accounting principles, e.g. checks for completeness, consistency, accuracy), and to facilitate learning and knowledge transfer within the organization
- to meet or anticipate the requirements of future trading programs

A key driver for the independent verification of BP's GHG inventory was to demonstrate to outside stakeholders the company's commitment to its reduction target, and also to provide a sound basis for its internal emissions trading program.

BP's verification involved a team of third-party reviewers from several consulting, verification and financial auditing firms, supported by an independent expert panel which included representatives from government, NGOs, academia, and the United Nations. There are other ways to improve the quality, reliability, and usefulness of GHG information, such as those described in Chapter 8: Managing inventory quality.

Scope of verification

The scope of an independent verification and the level of assurance it provides should be influenced by the company goals and verification objectives. It is possible to verify either the entire inventory data or specific parts of it. Parts may be specified in terms of geographic location, business units and facilities, and type/scope of emissions.

The verification process should also examine more general managerial issues, such as internal control procedures, managerial awareness, availability of resources, clearly defined responsibilities, segregation of duties, and internal review procedures. The reporting company and the verifier must reach an agreement up-front on the level of assurance to be provided. This addresses issues such as: should the auditor simply review the data (low level of assurance) or actually audit it (high level of assurance); and whether the verification should involve site visits or be limited to a desktop review of documentation. Companies such as BP and Texaco have conducted independent verifications that have focused solely on GHG emissions, while others, such as Shell, have incorporated the verification of their GHG emissions into the verification of environmental reporting.

Selecting a verifier

The selection and engagement of a verifier should take place during the GHG reporting period in question, not at the end. Defining the inventory scope and designing the processes for data collection and internal documentation are much easier when it is known in advance that the inventory must be verifiable.

Some factors to consider when selecting a verifier include: their experience in GHG verification, their understanding of GHG issues and the company's operations and their objectivity and independence. The knowledge and qualifications of the individual(s) conducting the verification is more important than those of the organization they come from.

The reporting company and the selected verifier should jointly define an appropriate approach on which to base the design and subsequent execution of the work plan. This also includes deciding what type of information is necessary to complete the verification. The verifier and the organization usually discuss the approach before the external verification is commissioned.

Material needed for a GHG verification

1. **All information as specified by Chapter 9: Reporting GHG emissions**

2. **Information about the company:**
   - information about the company's main activities and their GHG emissions (type of GHG produced, description of activity that causes GHG emissions)
   - company group organization (list of subsidiaries and their geographic location, ownership structure)

3. **Data sources used for calculating GHG emissions. This might, for example, include:**
   - energy consumption data (invoices, delivery notes, weigh-bridge tickets, meter readings for electricity, gas pipes, steam and hot water)
   - production data (tonnes of material produced, kWh of electricity produced)
   - raw material consumption data for mass balance calculations (invoices, delivery notes, weigh-bridge tickets)
   - activity data to calculate indirect emissions (invoices for employee travel, invoices from shipping companies)

4. **Description of how GHG emissions data have been calculated:**
   - emissions factors used and their justification
   - assumptions on which estimations are based

5. **Information gathering process:**
   - description of the systems used to collect, document and process GHG emissions data at the facility and corporate level
   - description of internal control procedures applied (internal audits, comparison with last year's data, recalculation by second person, etc.)

6. **Other information:**
   - consolidation spreadsheets
   - list of persons responsible for collecting GHG emissions data at every site and at the corporate level (e-mail and telephone numbers)
   - information on uncertainties, quantified or otherwise

Documentation

Appropriate evidence needs to be available to support the information in the GHG inventory being subjected to external verification. Assertions by management for which there is no available supporting evidence cannot be verified. Where a reporting organization has not yet implemented systems for routinely measuring and recording GHG emissions data, an external verification cannot be undertaken.

Reporting entities need to guarantee the existence, quality and retention of documentation so as to create an audit trail of how the inventory was compiled. Reporting entities designing and implementing the processes and procedures for creating an inventory should, therefore, make a point of creating a clear audit trail.

Information that underpins GHG inventory data should be recorded in an electronic database or in another systematic manner. Some of the required information for a GHG inventory may already be in normal management/account records, or in environmental management systems such as ISO 14001 and the EU Eco-Management and Audit Scheme (EMAS).

While emissions reported under scopes 1 and 2 can be verified fairly easily, verifying scope 3 emissions is more complex since this usually requires access to data held by another company or organization.

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Appendix 1

Appendix 1 provides an overview of the GHG accounting and reporting requirements of different voluntary GHG initiatives.

Voluntary initiative	**Focus** entity (company) or project	**Gases covered**	**Operational boundaries** (direct/indirect emissions)	**Organizational boundaries**
Australian Greenhouse Challenge	Entity (Australian operations)	Six Kyoto gases	Scopes 1 and 2	Distinguishes between GHGs the entity controls and those it influences, reductions from influenced activities are reported separately
California GHG Registry	Entity (see legislation for details)	Six Kyoto gases	Scopes 1 and 2 required, scope 3 to be determined	Consistent with *GHG Protocol*
Canada Climate Change Voluntary Challenge and Registry	Entity	CO_2 required, other Kyoto gases optional	Flexible (scopes 1, 2, or 3)	100 percent of emissions from operated facilities
Environmental Resources Trust – GHG Registry	Entity and project (with verifiable baseline)	Six Kyoto gases	Scope 1	Case-by-case basis, depending upon ownership structure and operating control
US EPA Climate Leaders Initiative	Entity (US operations required, global operations optional)	Six Kyoto gases	Scopes 1 and 2 required, scope 3 optional	Consistent with *GHG Protocol*
US Voluntary Reporting on GHG (1605b Program)	Entity or project (US and international operations of any US company)	Six Kyoto gases and ozone precursors	Flexible (scopes 1, 2, or 3)	Identification of other potential reporters to same emission reduction required
World Wildlife Fund Climate Savers Program	Entity	Energy related CO_2, other gases on a negotiated basis	Scopes 1 and 2 required, scope 3 optional	Consistent with *GHG Protocol*

Provision of GHG calculation worksheets	Reporting requirements	Base year	Independent verification	Notes
Workbooks (paper form) with emissions factors and methodologies addressing most GHG sources	Entity GHG emissions with base year, reports are confidential, but company profiles and summary information are publicly reported, standard reporting formats are being introduced	Most recent year prior to joining, it is encouraged to report 1990, 1995 and/or 2000, uses a static (frozen) efficiency calculation to assess performance	Random independent verification conducted by third party verifiers managed by the program	Participants must prepare an action plan for GHG reductions and a forecast of emissions with and without implementation of action plan, information: www.greenhouse.gov.au
Planned	Standard reporting format (see legislation for details)	On or after 1990, adjustment rules consistent with *GHG Protocol*	Required	Information: www.climateregistry.org
No	Optional template provided, three-tiered reporting scheme (gold, silver, or bronze), status depending on the level of reporting	Must select a base year, but choice of year flexible, no guidance on base year emissions adjustment	Not required	Information: www.vcrmvr.ca
Work with clients to develop appropriate reporting protocol	Sufficient detail to verify entity-level emissions	Earliest reasonably verifiable year	Required	Information: www.ert.net www.ecoregistry.org
Consistent with *GHG Protocol*	Standard reporting forms, facility and gas-specific reporting, data not public	Base year defined as the year when company joins program	Not required	Company must set ten-year reduction target based on the year it joins the program, companies may record inventory back to 1990, information: cummis.cynthia@epa.gov
Calculation instructions and selected worksheets for project-based analysis	Standard reporting forms (short and long versions), information is made available via public database	Flexible	Not required, although reporters are required to self-certify information	Information: www.eia.doe.gov/oiaf/1605/frntvrgg.html
Consistent with *GHG Protocol*	Corporate level information on fuel use history	Any year from 1990	Required	Must set five or ten- year GHG reduction target, program goal is to demonstrate GHG reductions can be cost-effective, information: www.worldwildlife.org/climate

Appendix 2

Appendix 2 indicates examples of GHG emissions by scopes and industry sectors. These examples are not exhaustive and the reporting company should refer to Chapter 4 and interpret the relevant emissions for its own situation.

Sector	Scope 1 emission sources	Scope 2 emission sources	Scope 3 emission sources[1]
Energy			
Energy generation	• stationary combustion (production of electricity, heat or steam) • mobile combustion (transportation of fuels) • fugitive emissions (fugitive leakages, transmission losses, HFC emissions in use of a refrigeration and air-conditioning equipment)	• stationary combustion (import of electricity and steam for sale to end use customers)	• stationary combustion (import of fuels) • process emissions (SF_6 emissions[2], production of imported fuels) • mobile combustion (transportation of fuels/waste, employee business travel, employee commuting) • fugitive emissions (CH_4 and CO_2 from waste landfills)
Oil and gas industry[3]	• stationary combustion (production of electricity, heat and steam) • process emissions • mobile combustion (transportation of raw materials/products/waste) • fugitive emissions (CH_4 releases in transportation of natural gas, HFC use)	• stationary combustion (import of electricity and steam)	• stationary combustion (product use as fuel) • mobile combustion (transportation of raw materials/products/waste, employee business travel, employee commuting, product use as fuel) • process emissions (product use as feedstock) • fugitive emissions (CH_4 and CO_2 from waste landfills)
Coal mining	• stationary combustion (production of electricity, heat or steam) • mobile combustion (transportation of coal) • fugitive emissions (CH_4 emissions from coal mines and coal piles)	• stationary combustion (import of electricity and steam)	• stationary combustion (product use as fuel) • mobile combustion (transportation of products/waste, employee business travel, employee commuting)
Metals			
Aluminium	• stationary combustion (production of electricity, heat or steam) • process emissions • mobile combustion (transportation of raw materials/products/waste) • fugitive emissions (HFC use)	• stationary combustion (import of electricity and steam)	• stationary combustion (production of imported materials, waste combustion) • process emissions (production of imported materials) • mobile combustion (transportation of raw materials/products/waste, employee business travel, employee commuting) • fugitive emissions (CH_4 and CO_2 from waste landfills)
Iron and steel	• stationary combustion(production of electricity, heat or steam) • process emissions • mobile combustion (transportation of raw materials/products/waste) • fugitive emissions (HFC use)	• stationary combustion (import of electricity and steam)	• stationary combustion (production of imported materials) • process emissions (production of imported materials) • mobile combustion (transportation of raw materials/products/waste, employee business travel, employee commuting) • fugitive emissions (CH_4 and CO_2 from waste landfills)
Other non-ferrous metals	• stationary combustion (production of electricity, heat or steam) • process emissions • mobile combustion (transportation of raw materials/products/waste) • fugitive emissions (HFC use)	• stationary combustion (import of electricity and steam)	• stationary combustion (production of imported materials, waste combustion) • process emissions (production of imported materials) • mobile combustion (transportation of raw materials/products/waste, employee business travel, employee commuting) • fugitive emissions (CH_4 and CO_2 from waste landfills)
Chemicals			
Nitric acid, ammonia, adipic acid, urea, and petrochemicals	• stationary combustion (production of electricity, heat or steam) • process emissions • mobile combustion (transportation of raw materials/products/waste) • fugitive emissions (HFC use)	• stationary combustion (import of electricity and steam)	• stationary combustion (production of imported materials, waste combustion) • process emissions (production of imported materials) • mobile combustion (transportation of raw materials/products/waste, employee business travel, employee commuting) • fugitive emissions (CH_4 and CO_2 from waste landfills)
Minerals			
Cement and lime[4]	• stationary combustion (production of electricity, heat or steam) • process emissions • mobile combustion (transportation of raw materials/products/waste) • fugitive emissions (HFC use)	• stationary combustion (import of electricity and steam)	• stationary combustion (production of imported materials, waste combustion) • process emissions (production of imported materials) • mobile combustion (transportation of raw materials/products/waste, employee business travel, employee commuting) • fugitive emissions (CH_4 and CO_2 from waste landfills)

Waste[5]			
Landfills, waste combustion, and water service companies	• stationary combustion (production of electricity, heat or steam, waste combustion) • fugitive emissions (CH_4 and CO_2 emissions from waste landfills) • mobile combustion (transportation of waste/products)	• stationary combustion (import of electricity and steam)	• stationary combustion (recycled waste used as a fuel) • process emissions (recycled waste used as a feedstock) • mobile combustion (transportation of waste/products, employee business travel, employee commuting)
Pulp and paper[6]			
Pulp and paper	• stationary combustion (production of electricity, heat or steam) • mobile combustion (transportation of raw materials/products/waste) • fugitive emissions (HFC use, landfill CH_4 and CO_2 emissions)	• stationary combustion (import of electricity and steam)	• stationary combustion (production of imported materials, waste combustion) • process emissions (production of imported materials) • mobile combustion (transportation of raw materials/products/waste, employee business travel, employee commuting) • fugitive emissions (landfill CH_4 and CO_2 emissions)
HFC, PFC, SF_6 and HCFC 22 production[7]			
HCFC 22 production	• stationary combustion(production of electricity, heat or steam) • process emissions • mobile combustion (transportation of raw materials/products/waste) • fugitive emissions (HFC use)	• stationary combustion (import of electricity and steam)	• stationary combustion (production of imported materials) • process emissions (production of imported materials) • mobile combustion (transportation of raw materials/products/waste, employee business travel, employee commuting) • fugitive emissions (fugitive leaks in product use, CH_4 and CO_2 from waste landfills)
Other sectors[8]			
General manufacturing and consumer products	• stationary combustion (production of electricity, heat or steam) • mobile combustion (transportation of raw materials/products/waste) • fugitive emissions (mainly HFC emissions in refrigeration and air-conditioning equipment, foam blowing)	• stationary combustion (import of electricity and steam)	• stationary combustion (production of imported materials, product use, waste combustion) • mobile combustion (transportation of raw materials/products/waste, employee business travel, employee commuting, product use) • fugitive emissions (CH_4 and CO_2 from waste landfills, HFC emissions in foam blowing)
Retailing	• stationary combustion (production of electricity, heat or steam) • mobile combustion (transportation of raw materials/products/waste) • fugitive emissions (mainly HFC emissions during use of refrigeration and air-conditioning equipment)	• stationary combustion (import of electricity and steam	• stationary combustion (production of imported materials) • process emissions (production of imported materials) • mobile combustion (transportation of raw materials/products/waste, employee business travel, employee commuting)
Food retailing	• mobile combustion (transportation of raw materials/products/waste) • fugitive emissions (mainly HFC emissions during use of refrigeration and air-conditioning equipment)	• stationary combustion (import of electricity and steam)	• stationary combustion (production of imported materials, waste combustion) • process emissions (production of imported materials) • mobile combustion (transportation of raw materials/products/waste, employee business travel, employee commuting) • fugitive emissions (CH_4 and CO_2 from waste landfills)
Service sector and office based organizations	• stationary combustion (production of electricity, heat or steam) • mobile combustion (transportation of raw materials/waste) • fugitive emissions (mainly HFC emissions during use of refrigeration and air-conditioning equipment)	• stationary combustion (import of electricity and steam)	• stationary combustion (production of imported materials) • process emissions (production of imported materials) • mobile combustion (transportation of raw materials/products/waste, employee business travel, employee commuting)

Notes

1 Scope 3 activities of outsourcing, contract manufacturing and franchises are not addressed in this table as specific GHG sources depend on the nature of the outsourced activity.
2 Guidelines on 'SF_6 use' are to be developed.
3 Guidelines on 'oil and gas sector' are to be developed. The American Petroleum Institute has published a compendium of GHG emissions estimation methodologies for this industry (API, 2001).
4 The WBCSD project: Toward a Sustainable Cement Industry, has developed guidelines and tools to calculate GHG emissions from the Cement sector.
5 Waste sector guidelines are under development.
6 Guidelines for pulp and paper sector are under development.
7 Guidelines for HFC, PFC and SF_6 production are to be developed.
8 Businesses in 'other sectors' can calculate GHG emissions using the cross-sectoral calculation tools – stationary combustion, mobile(transportation) combustion, HFC use, and waste.

Glossary

Accounting	Covers the company-internal compilation of GHG data.
Additionality	Refers to a situation where a project results in emissions reductions additional to those that would have taken place in the absence of the project activity (see also Chapter 5: Accounting for GHG reductions).
Annex 1 countries	Defined in the International Climate Change Convention as those countries taking on emissions reduction obligations: Australia, Austria, Belgium, Bulgaria, Canada, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Latvia, Liechtenstein, Lithuania, Luxembourg, Monaco, Netherlands, New Zealand, Norway, Poland, Portugal, Romania, Russian Federation, Slovakia, Slovenia, Spain, Sweden, Switzerland, Ukraine, United Kingdom, USA.
Base year	A historic datum (a specific year) for comparing emissions over time (see also Chapter 6: Setting a historic performance datum).
Base year emissions	GHG emissions in the base year (see also Chapter 6: Setting a historic performance datum).
Baseline	A reference point for what emissions would have been without the intervention of the GHG reduction project (see also Chapter 5: Accounting for GHG reductions).
Biofuels	Fuels made from plant material, e.g. wood, straw and ethanol from plant matter.
Boundaries	GHG accounting and reporting boundaries can have several dimensions, i.e. organizational, operational, geographic, sectoral, business unit, and other.
Calculation tools	A number of cross-sector and sector-specific tools that calculate GHG emissions on the basis of activity data and emissions factors (available at www.ghgprotocol.org).
Cap and trade system	A system that sets an overall emissions limit, allocates emissions allowances to participants, and allows them to trade emissions credits with each other.
Co-generation unit/combined heat and power (CHP)	A facility producing electricity and steam/heat using the waste heat from electricity generation.
Control	The ability of a company to direct the operating policies of another company or organization (see also Chapter 3: Setting organizational boundaries).
CO_2 equivalent	The quantity of a given GHG multiplied by its global warming potential. This is the standard unit for comparing the degree of harm which can be caused by emissions of different GHGs.
Cross-sector calculation tool	A GHG calculation tool that addresses GHG sources common to various sectors, e.g. emissions from stationary or mobile combustion (see also calculation tools).
Direct GHG emissions	Emissions from sources that are owned or controlled by the reporting company (see also Chapter 4: Setting operational boundaries).

Direct monitoring	Direct monitoring of exhaust stream contents in the form of continuous emissions monitoring (CEM) or periodic sampling (see also Chapter 8: Managing inventory quality).
Emissions	The intentional and unintentional release of GHGs into the atmosphere.
Emissions credit	A commodity giving its holder the right to emit a certain quantity of GHGs. Emissions credits will, in the future, be tradable between countries and other legal entities.
Emissions factor	A factor relating activity data (e.g. tonnes of fuel consumed, tonnes of product produced) and absolute GHG emissions (see also Chapter 7: Identifying and calculating GHG emissions).
Equity share	The percentage of economic interest in/benefit derived from an operation.
Fugitive emissions	Intentional and unintentional releases of GHGs from joints, seals, packing, gaskets, etc. (see also Chapter 7: Identifying and calculating GHG emissions).
GHG accounting principles	General accounting principles to underpin GHG accounting and reporting (See also Chapter 1: GHG accounting and reporting principles).
GHG Protocol Initiative and GHG Protocol	A multi-stakeholder collaboration convened by the World Resources Institute and the World Business Council for Sustainable Development to design, develop and promote the use of an international standard for calculating and reporting business GHGs.
Global warming potential (GWP)	A factor describing the radiative forcing impact (degree of harm to the atmosphere) of one unit of a given GHG relative to one unit of CO_2.
Green power	Includes renewable energy sources and specific clean energy technologies that reduce GHG emissions relative to other sources of energy that supply the electric grid. Includes solar photovoltaic panels, geothermal energy, landfill gas, and wind turbines.
Greenhouse gases (GHGs)	For the purposes of this standard/guidance, GHGs are the six gases listed in the Kyoto Protocol: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydroflurocarbons (HFCs), perfluorocarbons (PFCs), and sulphur hexafluoride (SF_6).
Heating value	The amount of energy released when a fuel is burned completely. Care must be taken not to confuse higher heating values (HHVs), used in the US and Canada, and lower heating values, used in all other countries (for further details refer to the calculation tool for stationary combustion available at www.ghgprotocol.org).
Indirect GHG emissions	Emissions that are a consequence of the activities of the reporting company, but occur from sources owned or controlled by another company (see also Chapter 4: Setting operational boundaries).
Intergovernmental Panel on Climate Change (IPCC)	International body of climate change scientists. The role of the IPCC is to assess the scientific, technical and socio-economic information relevant to the understanding of the risk of human-induced climate change (www.ipcc.ch).
Inventory	A list of an organization's GHG emissions and sources.

Inventory quality The extent to which an inventory provides accurate information (see also Chapter 8: Managing inventory quality).

Kyoto Protocol A protocol to the International Convention on Climate Change – once entered into force it will require countries listed in its Annex B (developed nations) to meet reduction targets of GHG emissions relative to their 1990 levels during the period 2008-12.

Mobile combustion Burning of fuels by transportation devices such as cars, trucks, trains, aeroplanes, ships etc. (see also Chapter 7: Identifying and calculating GHG emissions).

Non-Annex 1 countries Defined in the International Convention on Climate Change as those countries not taking on emissions reduction obligations (see also Annex 1 countries).

Offset An emissions reduction achieved by undertaking a GHG reduction project (see also Chapter 5: Accounting for GHG reductions).

Organic growth/decline Increases or decreases in GHG emissions as a result of changes in production output, product mix, plant closures and the opening of new plants (see also Chapter 4: Setting operational boundaries).

Outsourcing The contracting out of activities to other businesses (see also Chapter 4: Setting operational boundaries)

Permit A marketable instrument giving its holder the right to emit a certain quantity of GHGs

Process emissions Emissions generated from manufacturing processes, such as cement or ammonia production (see also Chapter 7: Identifying and calculating GHG emissions)

Project reduction module An additional module of the *GHG Protocol* covering GHG emissions accounting for GHG reduction projects. This is work in progress. More information is available at www.ghgprotocol.org

Ratio indicator Indicators providing information on relative performance, e.g. GHG emissions per production volume (see also Chapter 9: Reporting GHG emissions).

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

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

Reporting for control An approach for setting organizational boundaries. This requires reporting 100 percent of GHG emissions from controlled entities/facilities (see also Chapter 3: Setting organizational boundaries).

Reporting for equity share An approach for setting organizational boundaries. This requires reporting the equity share equivalent of GHG emissions from entities/facilities under control and significant influence (see also Chapter 3: Setting operational boundaries).

Scope Defines the operational boundaries in relation to indirect and direct GHG emissions (see also Chapter 4: Setting operational boundaries).

Scope 1 inventory — A reporting organization's direct GHG emissions (see also Chapter 4: Setting operational boundaries).

Scope 2 inventory — A reporting organization's emissions from imports of electricity, heat, or steam (see also Chapter 4: Setting operational boundaries).

Scope 3 Inventory — A reporting organization's indirect emissions other than those covered in scope 2 (see also Chapter 4: Setting operational boundaries).

Sector specific calculation tools — A GHG calculation tool that addresses GHG sources that are unique to certain sectors, e.g. process emissions from aluminium production (see also Calculation tools).

Sequestration — The uptake and storage of CO_2. CO_2 can be sequestered by plants and in underground/deep sea reservoirs.

Significant influence — For definition, refer to Chapter 3: Setting organizational boundaries.

Significant threshold — A qualitative or quantitative criteria used to define a significant structural change. It is the responsibility of the company/verifier to determine the 'significant threshold' for considering base year emissions adjustment. In most cases the 'significant threshold' depends on the use of the information, the characteristics of the company, and the features of structural changes.

Sink — Place where carbon is stored, mostly used for forests and underground/deep sea reservoirs of CO_2.

Source — Any process or activity, which releases GHGs into the atmosphere.

Stationary combustion — Burning of fuels to generate electricity, steam or heat (see also Chapter 7: Identifying and calculating GHG emissions).

Structural change — A significant change in the size or kind of operation of a business (see also Chapter 6: Setting a historic performance datum).

Uncertainty — The likely difference between a reported value and a real value (see also Chapter 8: Managing inventory quality).

Value chain module — An additional module of the *GHG Protocol* covering GHG emissions accounting for activities happening upstream and downstream from a business. This is work in progress. More information available at www.ghgprotocol.org

Verification — Verification is the objective and independent assessment of whether the reported GHG inventory properly reflects the GHG impact of the company in conformance with the pre-established GHG accounting and reporting standards (see also Chapter 10: Verififcation of GHG emissions).

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