GREENHOUSE GAS ACCOUNTING GUIDELINES

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Acronym

CDM	Clean Development Mechanism
CEM	Continuous Emission Monitoring
CH_4	Methane
CER	Certified Emission Reduction
CCAR	California Climate Action Registry
CCX	Chicago Climate Exchange
CO_2	Carbon Dioxide
CO_2-e	Carbon Dioxide equivalent
EPER	European Pollutant Emission Register
EU ETS	European Union in Emissions Allowance Trading Scheme
GHG	Greenhouse Gas
GAAP	Generally Accepted Accounting Principles
HFCs	Hydrofluorocarbons
IPCC	Intergovernmental Panel on Climate Change
IPIECA	International Petroleum Industry Environmental Conservation Association
ISO	International Standards Organization
JI	Joint Implementation
N_2O	Nitrous Oxide
NGO	Non-Governmental Organization
PFCs	Perfluorocarbons
SF_6	Sulfur Hexafluoride
T&D	Transmission and Distribution
UK ETS	United Kingdom Emission Trading Scheme
WBCSD	World Business Council for Sustainable Development
WRI	World Resources Institute

1 GHG accounting and reporting principle

CHAPTER

As with the Nine Principle of the Business Responsibility and Sustainability Report of India, established by SEBI, ensuring listed companies disclose and report on their Environmental, Social, and Governance practices. The GHG accounting principles serve as a guide toward GHG accounting and reporting by companies to ensure transparency, clarity, and accuracy of GHG emissions accounted for. Thus, based on general applicability, the GHG accounting and reporting guidance is developed on the working principles of financial accounting and reporting. Integrated from different technical, environmental, and accounting disciplines of stakeholders. The practice although widely accepted remains an emerging trend for some businesses despite its evolving nature over the decade.

GHG accounting and reporting are founded based on the following principles:

Relevance:

Enables internal and external stakeholders to make informed decisions based on GHG inventory accuracy, which reflects the true nature of their GHG emissions.

Completeness:

All scope 1, 2 & 3 sources of emissions and activities leading to such emissions within the identified boundary are accounted for and reported on. Potential exemption explained and justified.

Consistency:

As a uniform system of reporting, the approach for reporting is consistent and allows for strategic comparisons of emissions over time. Ensuring robust and transparent documentation of data, changes in data, inventory boundaries, methods, or any other relevant indicators over time.

Transparency:

Provides detailed understanding and explanation of essential issues coherently, based on sequential audit trial. Relevant assumptions are disclosed and backed based on the accounting and calculation methodologies and data sources used.

Accuracy:

The guidelines ensure a clear and precise GHG emissions quantification process, calculated systematically neither over nor under actual emissions and uncertainties reduced strategically. Total accuracy influences positive decision-making by users with reasonable assurance of the integrity of the reported information.

These guidelines are meant to serve as the foundation for all facets of GHG accounting and reporting. Their use will guarantee that the GHG inventory is an accurate reflection of the company's GHG emissions. Their main job is to direct the GHG Protocol Corporate Standard, especially when the standards' application to particular problems or circumstances is unclear.

Relevance

A company's internal and external stakeholders need to be able to make wise judgments. It advises companies to include the details about their emissions that the report's readers will find most useful. Starting with a complete inventory boundary selection related to business activities. This reflects both the economic realities of their business relationships and the legal structure of the corporation. The features and business model, user requirements, and intended goals of the organization all influence the selection of an inventory limit. The following are some crucial factors to take into account when choosing an inventory boundary per "The Greenhouse Gas Protocol":

- Organizational structures: ownership, ownership rights, legal contracts, joint ventures, etc.
- Operational boundaries: activities, processes, services, and impacts on- and off-site
- Business context: activities, locations, industrial sectors, information's intended use, and information users

Chapters 2, 3, and 4 contain more details on defining an acceptable inventory boundary.

Completeness

To create an accurate and meaningful inventory, all pertinent emissions sources must be taken into consideration within the selected inventory boundary. In actuality, a dearth of data or the expense of collecting data could be a constraining issue. It can be tempting to specify a minimum emissions accounting threshold, also known as a materiality threshold, which would allow a source with emissions below a specific size to be excluded from the inventory. Technically, a threshold of this kind is just a recognized and predetermined negative bias in estimates (i.e., an underestimate).

Although it makes sense in theory, the actual use of such a criterion conflicts with the GHG Protocol Corporate Standard's completeness principle. The emissions from a given source or activity would need to be quantified to make sure they were below the threshold to use a materiality specification. However, the majority of the advantages of establishing a threshold are lost once emissions are quantified.

When deciding whether or not a mistake or omission constitutes a major disparity, a threshold is sometimes used. This differs from a de minimis when defining an exhaustive inventory. Instead, businesses must make a sincere attempt to account for all of their GHG emissions in a thorough, accurate, and consistent manner. It is crucial that incidents where emissions have not been estimated or have been estimated with insufficient accuracy be openly documented and supported. The potential impact and significance of the exclusion or poor quality on the overall inventory report can be assessed by verifiers. In chapters 7 through 10, more information about completeness is given.

Consistency

To spot trends and evaluate the performance of the reporting organization, users of GHG information will want to follow and compare GHG emissions data over time. To produce comparable GHG emissions data throughout time, it is crucial to apply accounting methods, inventory boundaries, and calculation methodology consistently. It is essential to gather GHG data in a way that makes it internally consistent and cross-comparison-able across all operations within an organization's inventory boundaries. Any modifications to the inventory boundary, techniques, data, or other elements affecting emission estimates must be openly accounted for and supported. More information on consistency is provided in chapters 5 and 9.

Mahindra Group

Maintaining completeness over time

The Mahindra Group is a confederation of firms whose goal is to empower its partners, stakeholders, communities, and the entire world to rise through innovative mobility solutions that promote rural prosperity, improve urban living, nurture new businesses, and strengthen communities. Mahindra Group identified significant changes in the structure and scope of its emission sources over the previous few years while completing its GHG inventory and establishing a net zero target. A significant portion of their emissions source now comes from accumulated emissions from scope 3 emissions, which in prior years were not considered when calculating emissions. Scope 3 emissions have increased, which can be ascribed to better Scope 3 emissions category measurements and reporting.

Transparency

According to clear documentation and archives, transparency refers to the extent to which information about the methodologies, assumptions, processes, and constraints of the GHG inventory is published in a factual, neutral, and understandable manner (i.e., an audit trail). The information must be gathered, organized, and evaluated in such a way that internal reviewers and outside verifiers can vouch for its veracity. It is necessary to identify and justify any specific exclusions or inclusions, reveal any assumptions, and cite the correct methodology and data sources when necessary. If given identical source data, the information ought to be sufficient for a third party to arrive at the same conclusions. A "transparent" report will give a precise grasp of the problems in the reporting company's setting and a useful evaluation of performance. A good technique to ensure transparency and confirm that the proper audit trail has been established and documentation has been provided are through independent external verification. Chapters 9 and 10 contain more details about transparency.

Accuracy

Data should be accurate enough to give intended users a fair level of confidence that the information being reported is reliable before making judgments. As far as is reasonably possible, GHG measurements, estimates, or calculations should be systemically neither above nor under the actual emissions number, and uncertainties should be minimized. It is important to reduce the uncertainty during the quantification process. The promotion of credibility and increased transparency can both be achieved by disclosing the steps taken to assure accuracy in the accounting of emissions. In chapter 7, there is more data about accuracy.

“ We must now agree on a binding review mechanism under international law so that this century can credibly be called a century of decarbonization”. *Angela Merkel*

2 Business Goals and Inventory Designs

CHAPTER

Principle six of the Indians Business Responsibility Sustainability Reporting (BRSR) framework insists companies make disclosures regarding their energy consumption. This covers details from all three emissions scopes. Similar to the BRSR, the GHG protocol makes sound business sense to create a GHG inventory to better understand your company's GHG emissions. The following five business objectives are typically cited by companies as justifications for creating a GHG inventory:

Businesses typically want their GHG inventory to be able to accomplish a variety of tasks. As a result, it makes sense to create the process to provide information for a wide range of consumers and uses, both present and future. The GHG Protocol Corporate Standard is a thorough framework for GHG accounting and reporting that offers the information building blocks necessary to support the majority of corporate objectives. As a result, the inventory data gathered per the GHG Protocol Corporate Standard can be combined and divided for different organizational and operational boundaries as well as for various business geographic scales (state, country, Annex 1 countries, non-Annex 1 countries, facility, business unit, company, etc.).
An overview of several GHG initiatives, many of which are based on the GHG Protocol Corporate Standard, is provided in Appendix C. Chapters 3 and 4's guide sections offer more details on how to create an inventory for various purposes.

Business Goals Served By GHG Inventories [1]

Managing GHG risks and identifying reduction opportunities

• Setting GHG targets, monitoring, and reporting progress. Identifying risks related to future GHG limits. Finding options for cost-effective reduction

Public reporting and participation in voluntary GHG programs

Reporting to government and NGO reporting systems, including GHG registries; • Eco-labelling and GHG certification; • Voluntary stakeholder reporting of GHG emissions and progress toward GHG targets;

Participating in mandatory reporting programs

• Participating in national, regional, or local reporting initiatives sponsored by the government

Participating in GHG markets

• Participating in external cap and trade allowance trading schemes; • Supporting internal GHG trading programs; • Calculating carbon/GHG taxes

Recognition for early voluntary action

• Giving evidence in favor of "baseline protection" and/or credit for early action

Managing GHG Risks and Identifying Reduction Opportunities

A company's comprehension of its emissions profile and any potential GHG liability or "exposure" is improved by compiling a thorough GHG inventory. Due to increased scrutiny from the insurance industry, shareholders, and the advent of environmental rules and policies intended to minimize GHG emissions, a company's GHG exposure is increasingly becoming a management concern.

Future GHG regulations may cause considerable GHG emissions throughout a firm's value chain to increase expenses (upstream) or decrease sales (downstream), even if the company itself isn't directly impacted. Thus, considerable indirect emissions upstream or downstream of a company's operations may be seen by investors as possible liabilities that need to be handled and minimized. A firm may miss significant GHG risks and possibilities by limiting its attention to direct emissions from its own operations, which could also misrepresent the company's true GHG exposure.

Positively speaking, what is measured is managed. The best prospects for reduction can be found with the aid of accounting for emissions. This may encourage greater material and energy efficiency as well as the creation of new goods and services that lessen the effects of customers' or suppliers' GHG emissions. In turn, this can save production costs and aid in differentiating the business in a market that is becoming more ecologically concerned. Setting an internal or external GHG objective and then monitoring and reporting progress both require conducting a thorough GHG inventory.

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[1] https://ghgprotocol.org/sites/default/files/standards/ghg-protocol-revised.pdf

IBM: The role of renewable energy in reducing GHG emissions [2]

Under the GHG Protocol Corporate Standard, indirect emissions related to the use of purchased power must be included in any company's accounting and reporting. Purchased power presents a huge opportunity for GHG emission reduction because it is a large source of emissions for businesses. The WRI's Green Power Market Development Group member IBM, a major provider of information technology, has methodically accounted for these indirect emissions and thereby found the substantial opportunity to cut them. The corporation has put in place a number of methods that would lower their need for purchased energy or the intensity of those purchases in terms of greenhouse gas emissions. The market for renewable energy has been targeted as one tactic to lower the GHG intensity of the electricity purchased.

Through a contract for renewable electricity with the local utility firm, Austin Energy, IBM was able to lower its GHG emissions at its plant in Austin, Texas, even while energy demand remained mostly constant. This five-year agreement calls for 5.25 million kWh of wind energy annually beginning in 2001. The facility's inventory of CO_2 was reduced by more than 4,100 tonnes thanks to this zero-emission energy, which accounts for close to 5% of the facility's overall electricity use. Across the board, IBM purchased 66.2 million kWh of renewable energy in 2002, which accounted for 1.3% of its global electricity usage and saved the company 31,550 tonnes of CO_2 from the year before. Wind, biomass, and solar energy are just a few of the renewable energy sources that IBM has purchased globally.

IBM was able to successfully cut a significant source of their overall GHG emissions by taking into consideration these indirect emissions and searching for potential for related reduction.

Public Reporting and Participation in Voluntary GHG Programs

Climate change impact has generated many concerns; corporate bodies continually disclose their GHG information at the increasing request of NGOs, investors, and other stakeholders. Their interest falls on initiatives companies are integrating and benchmarking companies to their competitors in terms of their maturity to emerging regulations.

In meeting emerging trends, a promising number of companies are accounting for their GHG emissions when preparing their stakeholder reports. These are incorporated in their annual broader sustainability/environmental report or stand-alone reports on GHG emissions. For example, following the GHG Protocol Corporate standard (2002), companies should disclose their GHG emissions information in their sustainability report when using the Global Reporting Initiative guidelines. For listed companies in India, the BRSR principle guidelines should be used to communicate information on GHG emissions in addition to any other reporting framework they are associated with. On a more positive note, such sustainability/GHG emissions disclosure ensures effective bonding among and with other stakeholders. For example, brand recognition by customers and investors as a sustainable and responsible business for voluntarily declaring their GHG initiatives.

Companies can disclose their GHG emissions in a public database through the establishment of GHG registries in several nations and jurisdictions. Registries may be run by governmental entities (such as the U.S. Department of Energy 1605b Voluntary Reporting Program), nongovernmental organizations (such as the California Climate Action Registry), or business associations (such as the World Economic Forum Global GHG Registry). Numerous GHG programs also assist businesses in setting voluntary GHG targets.

[2] https://ghgprotocol.org/sites/default/files/standards/ghg-protocol-revised

The majority of voluntarily implemented GHG programs allow or mandate the reporting of both direct emissions from operations (containing all six GHGs) and indirect GHG emissions from electricity purchased. The majority of criteria will typically be compatible with a GHG inventory created in line with the GHG Protocol Corporate Standard (Appendix C offers an overview of the reporting requirements of several GHG programs). Companies wanting to participate are urged to contact the program administrator to confirm the most recent requirements because many voluntary programs routinely change their accounting guidelines.

Participating In Mandatory Reporting Programs

Annually disclosure of emissions is required of GHG emitters by some governments. For some precise geographical scope, the interest is on operated or controlled facility direct emissions resulting from their operations. In Europe, emissions exceeding a specified threshold for each of the six GHGs must be disclosed by facilities falling under the requirements of the Integrated Pollution Prevention and Control (IPPC). The disclosed emissions are included in a European Pollutant Emissions Register (EPER), a publicly accessible internet-based database that permits comparisons of emissions from individual facilities or industrial sectors in different countries (EC-DGE, 2000). The reporting of GHG emissions is required in Ontario under Ontario Regulation 127. (Ontario MOE, 2001).

Participating In GHG Markets

In some countries around the world, new approaches such as market based-approaches are been used in reducing GHG emissions. Emissions trading are exemplified programs implemented, among other approaches adopted by countries including taxation programs in Norway. Two ways by which trading programs are implemented. Either mandatory (e.g., the forthcoming EU ETS) or voluntary basis (e.g., CCX).

Based on some exceptions, some trading programs typically require accounting for only direct emissions. Such trading programs compare emissions with emissions reduction targets to determine compliance. In the UK ETs for example, emissions from purchased electricity should be accounted for by direct entry participants (DEFRA, 2003). As a supplemental reduction arrangement, members of the CCX can count indirect emissions derived from their electricity purchases. It is sometimes difficult to verify some forms of indirect emissions and might lead to double counting. Companies participating in emission trading programs may be required to develop an audit trail of their GHG data to enable independent verification.

Additional areas of computing are sometimes imposed by GHG trading programs, which are selectively related to the approach used in setting organizational boundaries; type of GHG and sources addressed; how the base years are confirmed; methodology for calculation used; emission factors considered, and the employed monitoring and verification approaches. The GHG Protocol Corporate Standard has comprehensive best practices incorporated into it. Which may form the basis in the development of emerging accounting requirement programs, as it has done with past programs.

Tata Steel: Development of institutional capacity in GHG accounting and reporting

Reducing its GHG emissions through energy efficiency is a crucial part of Tata Steel's principal business objective, which is to have its product accepted in global markets. Tata Steel is Asia's first and India's largest integrated private sector steel producer. The corporation introduces many energy-saving projects and less-GHG-intensive operations in an effort to achieve this aim every year. To further enhance its GHG performance, the corporation is also actively exploring GHG trading markets. Tata Steel needs a precise GHG inventory that encompasses all processes and activities, allows for meaningful benchmarking, measures changes, and encourages reliable reporting if it is to be successful in these efforts and be qualified for developing trading schemes.

Tata Steel has acquired the ability to track its development in lowering GHG emissions. The management at Tata Steel has online access to data on the production of waste, byproducts, and other material streams as well as the use of energy and materials. Tata Steel creates two important long-term, strategic performance measures using this information and the GHG Protocol calculation tools: specific energy consumption (Giga calories per tonne of crude steel) and GHG intensity (tonne of CO_2 equivalent per tonne of crude steel). These criteria, which are essential to measuring sustainability in the steel industry globally, support market acceptance and competitiveness.

The organization has embraced the GHG Protocol Corporate Standard, which has improved the structure and efficiency of performance tracking. This solution helps Tata Steel maximize process and material flow efficiencies by giving the company quick, easy access to its GHG inventory.

Recognition for early voluntary action

In future regulatory programs, earlier voluntary emissions reductions of companies may be recognized when their inventory is viable and credible. For example, consider a business that began lowering its GHG emissions in 2000 by switching the fuel for its on-site powerhouse boiler from coal to landfill gas. The emissions reductions made by the green power project before 2003 may not be counted against the program's target if an obligatory GHG reduction program is later established in 2005 and uses 2003 as the baseline against which reductions are to be measured.

However, in the advent of new regulations requiring reductions, a company with confirmed and registered voluntary emissions reductions is likely to be recognized and taken into consideration under the new regulation. For instance, the state of California has announced that it will take all steps to guarantee that companies that submit certified emission results to the California Climate Action Registry are given due consideration under any upcoming global, federal, or state regulatory program concerning GHG emissions.

3 Setting Organizational Boundaries

CHAPTER

The functionalities of a business are defined differently based on their legal and operational structure: these are not limited to wholly-owned operations, incorporated and non-incorporated joint ventures, and subsidiaries. They are handled for financial accounting under predefined guidelines that are based on the organization's structure and the connections between the parties. To describe the companies and operations that make up the firm for the purposes of accounting and reporting GHG emissions, a company first chooses an approach for combining GHG emissions, then consistently utilizes the chosen approach.

The equity share and control methodologies can be used to combine GHG emissions for corporate reporting. Companies are to account for and report their incorporated GHG data under the equity share or control approach as presented below.

A company’s boundary will remain the same whichever approach is used if the company’s entire operations are wholly owned.[3] Unlike wholly owned operations, the organizational boundaries and resulting emissions for joint operational companies may change considering the methodology implemented. Variation may occur in the categorization of emissions. When operational boundaries are established, the choice of strategy may alter how emissions are classified in both totally owned and joint businesses.

The term “operations” is used here as a generic term to denote any kind of business activity, irrespective of its organizational, governance, or legal structures

Equity Share Approach

When using the equity share approach, GHG emissions from a company's activities are accounted for based on the share of equity in the operation. The economic interest, or the degree of a company's rights to the risks and benefits resulting from an operation, is reflected in the equity share. The proportion of an operation that the firm owns determines the number of economic risks and rewards, and the equity share will typically be equal to the ownership percentage. In other scenarios, the legal ownership

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[3] The term “operations” is used here as a generic term to denote any kind of business activity, irrespective of its organizational, governance, or legal structures

form is always superseded by the economic substance of the relationship the firm has with the operation to guarantee that the equity share accurately reflects the percentage of economic interest. The idea of economic substance taking precedence over legal form

The idea that economic substance should take precedence over legal form is in line with accepted practices in international financial reporting. To verify that the correct equity share proportion is applied for each combined operation, the staff creating the inventory may need to speak with the company's accounting or legal personnel. This guarantees the application of the right equity percentage share for each joint operation (Table 1: definitions of financial accounting categories).

Control Approach

The control approach presents a different scenario; companies will have to justify 100 percent of the GHG emissions as long as they have control over the operations. Companies omit GHG emissions from operations when they only own an interest in operations but account for it when they control the operations. Financial or operational designations are used to define control. When a company decides to integrate GHG emissions using the control approach, the company shall do so base on two criteria (operational control or financial control criteria)

Most of the time, using the financial control or operational control criterion does not change whether an operation is within the company's control or not. The oil and gas industry seeks to be an exception among others due to the complexity of ownership & operatorship structures. GHG inventory of companies in this industry can face significant influences due to the choice of control criterion.

Thus, in making a choice, companies should consider how best to match GHG emissions accounting and reporting with financial and environmental reporting, how to best align it with emissions reporting and trading schemes, and which parameters best reflect the company's actual power of control when making this decision.

Financial Control*:* When a company has the authority to direct the financial and operating policies of its operations towards gaining economic benefits from its activities,[4] then such a company is mentioned to have financial control over its operation. For example, when a company has the right to the majority of benefits of the operation, it is termed to have financial control. However, these rights are transferrable. Similar to this, a business is said to have financial control over an operation if it continues to bear the majority of the risks and rewards associated with asset ownership.

According to this standard, the company may have financial control over the operation even if it has less than a 50% interest in it since the economic nature of the relationship between the company and the operation is given priority over the legal ownership status. The influence of possible voting rights, both those owned by the corporation and those held by other parties, is also taken into consideration when determining the relationship's economic substance.

These requirements are compatible with international financial accounting standards; subsequently, a company has financial control over an operation for GHG accounting purposes if the operation is regarded as a group company or subsidiary for financial consolidation, i.e. if the operation is fully consolidated in financial accounts. If companies choose this approach to determine control, emissions from joint ventures where partners have joint financial control are accounted for based on the equity share approach.

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[4] Financial accounting standards use the generic term "control" for what is denoted as "financial control" in this chapter

Operational Control: When a company or its subsidiary has full authority to develop and implement operating policies over its operation, that company is termed to have operational control over its operation. This condition is in accordance with how many businesses currently account for and report on emissions from facilities, they run, which is, they possess the operating license.

For some exceptional circumstances, if a facility is operated by a company or one of its subsidiaries, the authority to introduce and implement its operating policies reside on it and holds onto the operational control. Under the operational control approach, a company or its subsidiaries having operational control is expected to account for 100% of emissions from its operations.
It is important to note that having operational control does not translate to having complete decision-making authority over its operation. For instance, significant capital investments will probably need the consent of all partners who share financial control. Operational control does indicate that a business has the power to establish and carry out its operating policies. Additional information on the relevance and application of the operational control procedures is provided in petroleum industry guidelines for reporting GHG emissions (IPIECA, 2010: IPIECA, 2011).

In cases where joint financial control over an operation exists for a company but not operational control, the contractual arrangement will have to be consulted to determine if either one of the partners has the authority to develop and introduce its operating policies at the operation. Hence, the responsibility to report emissions under operational control resides with the partner. Under operational control, partners with joint financial control over operations will not report emissions, if the operation itself introduces and implement its own operating policies. In the guidance portion of this chapter, Table 1 describes how to choose a consolidation technique at the corporate level and how to determine which joint operations are within the organizational boundary based on that decision.

Consolidation at multiple levels

When all levels of an organization resort to the same emissions compilation policy, data consistency will be achieved when consolidating their GHG emissions data. To start with, the parent company will be required to choose the consolidation approach (i.e., either the equity share or the financial or operational control approach). The selected approach and policy shall be replicated at all levels of the organization.

State-ownership

This chapter explains the applicable rules from industry joint operations that involve state ownership or a mix of private/ state ownership when accounting for GHG emissions.

BP: Reporting On The Basis Of Equity Share

In addition to operations in which BP has an interest but is not the operator, BP discloses GHG emissions on an equity share basis. BP aims to achieve a tight alignment with financial accounting standards when defining the size of the equity share reporting boundary. All operations carried out by BP and its subsidiaries, joint ventures, and affiliated enterprises as indicated by their treatment in the financial records are included within BP's equity share boundary. Investments in fixed assets, or those over which BP has little control, are not included.

According to the BP Group Reporting Guidelines for Environmental Performance, GHG emissions from plants where BP has an equity stake are estimated (BP 2000).

Where BP has an equity stake but is not the operator of the facility, GHG emissions data may be received directly from the operating firm at facilities where BP has an equity stake but is not the operator using a technique in accordance with the BP Guidelines, or is calculated by BP using activity data provided by the operator.

Every year, BP provides its equity portion of GHG emissions. When audited in accordance with the BP Guidelines, independent external auditors have stated since 2000 that the reported total has been found to be free from material misrepresentation.

Table 1. Financial Accounting Categories

Accounting Category	Financial Accounting Definition	Accounting For GHG Emissions According To GHG Protocol Corporate Standard	
		Based On Equity Share	Based On Financial Control
Group companies/ subsidiaries	To get financial gains from its operations, the parent company has the power to influence the company's operating and financial policies. Typically, this category also includes partnerships and joint ventures that are both incorporated and unincorporated and over which the parent firm exercises financial control. Group corporations and their subsidiaries are completely consolidated, which means that all of the income, expenses, assets, and liabilities of the subsidiary are included in the parent company's balance sheet and profit and loss statement, respectively. The consolidated profit and loss account and balance sheet reflect a deduction for the profits and net assets belonging to minority owners where the parent's interest does not equal 100 percent.	Equity share of GHG emission	100% of GHG emissions
Associated/affiliated companies	The parent company has significant influence over the operating and financial policies of the company but does not have financial control. Normally, this category also includes incorporated and non-incorporated joint ventures and partnerships over which the parent company has significant influence, but not financial control. Financial accounting applies the equity share method to associated/ affiliated companies, which recognizes the parent company's share of the associate's profits and net assets.	Equity share of GHG emissions	0% of GHG emissions

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[5] https://ghgprotocol.org/sites/default/files/standards/ghg-protocol-revised

Table 1 Contd

Non-incorporated joint ventures/partnerships /operations where partners have joint financial control	**Joint ventures/ partnerships/operations are proportionally consolidated, i.e., each partner accounts for their proportionate interest in the joint venture's income, expenses, assets, and liabilities.**	**Equity share of GHG emissions**	**Equity share of GHG emissions**
Fixed asset investments	The parent company has neither significant influence nor financial control. This category also includes incorporated and non- incorporated joint ventures and partnerships over which the parent company has neither significant influence nor financial control. Financial accounting applies the cost/ dividend method to fixed asset investments. This implies that only dividends received are recognized as income and the investment is carried at cost	0%	0%
Franchises	Franchises are separate legal entities. In most cases, the franchiser will not have equity rights or control over the franchise. Therefore, franchises should not be included in the consolidation of GHG emissions data. However, if the franchiser does have equity rights or operational/ financial control, then the same rules for consolidation under the equity or control approaches apply	Equity share of GHG emissions	100% of GHG emissions

NOTE: Table 1 is based on a comparison of UK, US, Netherlands, and International Financial Reporting Standards (KPMG, 2000).

When planning the amalgamation of GHG data, differentiating between GHG accounting and GHG reporting is significant. In GHG accounting, emissions from operations in which a parent company has a stake (either control or stock) are recognized, aggregated, and linked to particular operations, sites, regions, business processes, and owners. On the other hand, GHG reporting focuses on the display of GHG data in forms designed to meet the requirements of various reporting uses and users.

The majority of businesses have multiple reporting objectives for greenhouse gases, such as official government reporting requirements, emissions trading programs, or public reporting (see chapter 2). The ability of the system to satisfy various reporting standards should be a primary concern when building a GHG accounting system. Companies will have the most flexibility to meet a variety of reporting obligations if data are collected, recorded, and able to be combined in various forms at a sufficiently disaggregated level.

Double Counting

Emissions from a joint operation could be double counted, when multiple companies having an interest in the same joint operation employ different consolidation approaches (e.g., Company A follows the equity share approach while Company B uses the financial control approach). In cases of voluntary corporate public reporting, using different consolidation approaches may not matter when there is adequate disclosure from the company on its consolidation approach. However, in trading schemes and mandatory government reporting programs, it is essential to avoid double counting emissions.

Reporting Goals and Level of Consolidation

At various organizational levels, thus, from a more aggregated corporate level to a specific local facility, GHG data reporting requirements exist. The reporting drivers are:

• GHG data may be required at a facility level for official government reporting programs or certain emissions trading programs. In these cases, it is not relevant to put together GHG data at a corporate level.

• For some geographical and operational boundaries, Government reporting and trading programs may require consolidation of data (e.g., the U.K. Emissions Trading Scheme)

• Companies may participate in voluntary public reporting, combining GHG data at the corporate level to illustrate the GHG emissions of their complete business operations to wider stakeholders.

Contracts That Cover GHG Emissions

For GHG emissions consolidation, it is important for companies involved in a joint operation to specify the responsibility for managing emissions or the ownership of emissions and associated risk distributed between the parties when drawing up contracts. This is important in clarifying ownership (rights) and responsibility (obligations) issues. In such scenarios, parties involved may voluntarily describe the contractual arrangement and include information on the allocation of CO2-related risks and obligations (see Chapter 9)

Using the Equity Share or Control Approach

Companies may be required to account for their GHG emissions using both equity share or control approaches. This is because different inventory reporting goals may require different data sets. In terms of voluntary GHG emissions reporting, the GHG Protocol Corporate Standard makes no recommendation as to whether reporting should be based on equity share or control approaches. However, companies are encouraged to apply the equity share and the control approach in accounting for their emissions separately. Companies will have to choose the best approach for their business activities and GHG accounting and reporting requirements. Pointers that may influence an approach choice include:

• **Reflection of commercial reality**.

It can be argued that a company that makes economic profits from a particular activity should account for GHG emissions arising from such activity. Achieved using the equity share approach since this approach is based on economic interest in business activity and allocates ownership for GHG emissions. Although the control approach has, the advantage that allows a company takes full ownership of all GHG emissions that it can directly influence and reduce, the approach lacks the ultimate ability to reflect the full GHG emissions portfolio of a company’s business activities.

• **Government reporting and emissions trading programs**: programs for exchanging emissions and government reporting, monitoring, and enforcing compliance will always be required of government regulatory initiatives. Governments typically require reporting based on operational control, either through a facility level-based system or involving the consolidation of data within certain geographical boundaries (for example, the EU ETS will allocate emission permits to the operators of certain installations). This is because compliance responsibility typically rests with the operator (not equity holders or the group company that has financial control).

• **Liability and risk management**

Although reporting and regulatory compliance are most likely to continue to be based only on operational control, the group firm that owns an equity stake in the operation or has financial control over it ultimately bears the financial burden. As a result, GHG reporting based on the equity share and financial control methodologies offers a more comprehensive picture for assessing risk. The equity share strategy is probably going to produce the most thorough liability and risk coverage.

Companies may in the future be held liable for the GHG emissions created by joint enterprises in which they have an interest but no financial control. For instance, a firm that owns equity in an operation but has no financial control over it can be required to pay its required portion of the costs associated with GHG compliance by the companies that hold the controlling share.

• **Alignment with financial accounting**.

The best form of alignment between GHG accounting and financial accounting is obtained when using the equity share and financial control approaches. The same consolidation techniques used in financial accounting should be utilized in GHG accounting to evaluate the assets and liabilities a company develops through its joint operations. GHG accounting and financial accounting are more closely aligned as a result of the equity sharing and financial control approaches.

• **Management information and performance tracking**:

The control approach presents the best case for tracking a company's performance since managers are fully accountable for activities under their control.

• **Cost of administration and data access**:

The higher administrative cost is associated with the equity share approach compared to the control approach. Thus, for emissions not under the control of the reporting company, it can be challenging and time-consuming to consolidate GHG emissions data from their joint operations. Hence, to ensure maximum access to operational data whiles meeting the minimal quality standards companies should report based on control.

• **Completeness of reporting**.

Due to the possibility of not finding any matching records or lists of financial assets to verify the operations defined within an organizational boundary, demonstrating completeness of reporting when a company adopts the operational control criterion might be difficult.

4 Setting Operational Boundaries

CHAPTER

A company shall have to set its operational boundaries after determining its organizational boundaries by either control or operations it owns. This involves identifying emissions associated with its operations, categorizing them as direct and indirect emissions, and choosing the scope of accounting and reporting for indirect emissions.

For effective and innovative GHG management, and for a company to better control the entire scope of GHG risk and opportunities that exist along its value chain, it is significant for the company to have a comprehensive operational boundary set out concerning direct and indirect emissions. Emissions from sources owned or controlled by the company are termed direct GHG emissions.[6] While Indirect GHG emissions are emissions that are a consequence of the activities of the company but occur at sources owned or controlled by another company. The consolidation approach (equity share or control) selected for setting the organizational boundary (see chapter 3) defines the classification of emissions as direct and indirect emissions. Figure 1 below shows the relationship between the organizational and operational boundaries of a company.

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 NOx, NMVOC, and CO.

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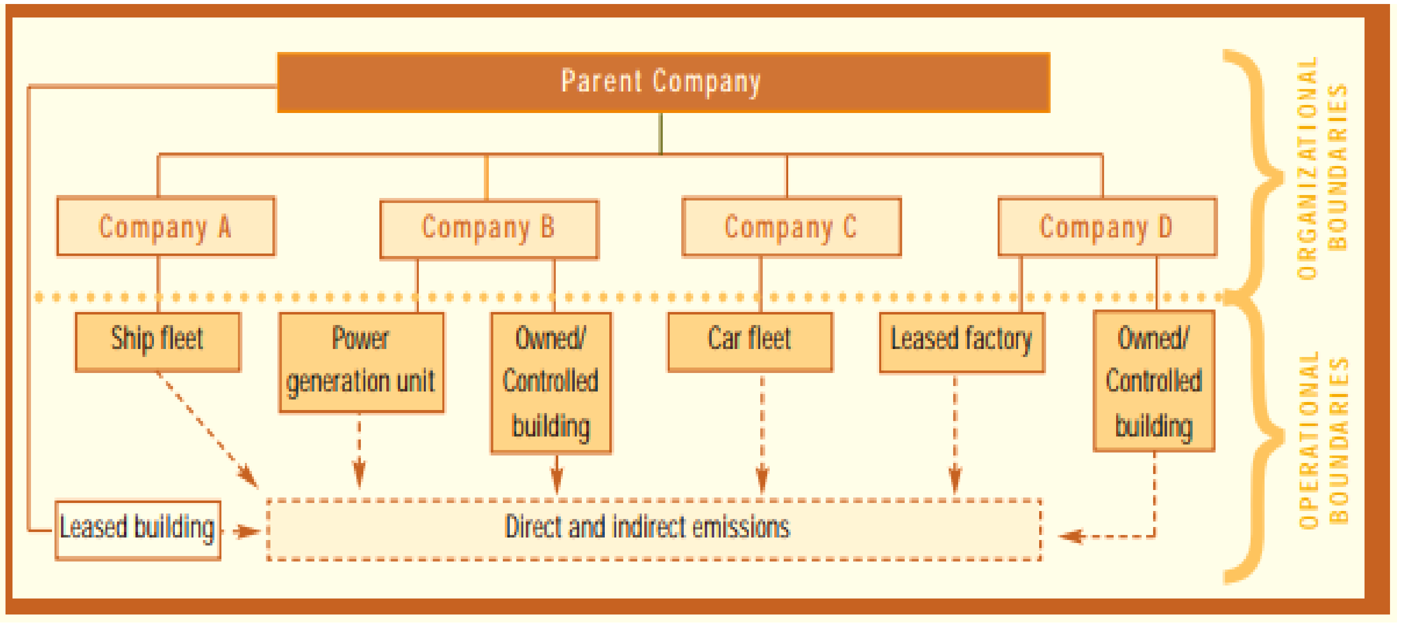
[6] The terms “direct” and “indirect” as used in this document should not be confused with their use in national GHG inventories where ‘direct’ refers to the six Kyoto gases and ‘indirect’ refers to the precursors NOx, NMVOC, and CO.

FIGURE 1. Organizational and operational boundaries of a company



Introducing the concept of "scope"

Three "scopes" (scope 1, scope 2, and scope 3) are developed for GHG accounting and reporting purposes to better distinguish between direct and indirect emission sources, increase transparency, and be useful for various organizational types, climate policies, and business objectives. This guideline precisely defines scopes 1 and 2 to prevent multiple organizations from accounting for emissions under the same scope. The scopes can therefore be used in GHG projects where double counting is important.

Companies must at the very least separately account for and report on scopes 1 and 2 emissions.

Scope 1: Direct GHG emissions

Sources of emissions a company owns or control are referred to as Direct GHG emissions, such as combustion emissions from boilers, furnaces, cars, etc., and chemical manufacturing emissions from owned or managed process equipment. Direct CO_2 emissions from the combustion of biomass must be recorded separately rather than being included in scope 1. CFCs, NOx, and other GHG emissions not covered by the Kyoto Protocol are excluded from scope 1 but may be reported individually (see chapter 9)

Scope 2: Electricity indirect GHG emissions

The GHG emissions from the generation of the purchased electricity[7] that the company uses are taken into account in scope 2. The electricity that has been purchased or brought into the company's organizational border is referred to as purchased electricity. Physically, scope 2 emissions take place at the location where electricity is produced.

Scope 3: Other indirect GHG emissions

All other indirect emissions may be handled under Scope 3, an optional reporting category. Scope 3 emissions result from company operations but come from sources that the company does not own or control. Activities falling under scope 3 include the term "electricity" which is used in this chapter as shorthand for electricity, steam, and heating/cooling

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[7] The term "electricity" is used in this chapter as shorthand for electricity, steam, and heating/cooling

extraction and manufacturing of materials purchased, the transportation of fuels purchased, and the usage of goods and services acquired.

For operations that operate inside a business's designated organizational boundary, an operational boundary specifies the range of direct and indirect emissions. After establishing the organizational border, the operational boundary (scope 1, scope 2, and scope 3) is determined at the corporate level. At each operational level, direct and indirect emissions are then consistently identified and categorized using the chosen operational boundary. An organization's inventory border is made up of its established organizational and operational boundaries.

Organizational and Operational Boundaries

The parent company X, that has full ownership and financial control of operations A and B, but only a 30% non-operated interest and no financial control in operation C.

Setting Organizational Boundary: X would choose whether to account for GHG emissions by equity share or financial control when setting organizational boundaries. If equitable share is chosen, X would also comprise A and B and 30% of C's emissions. If financial control is the method selected, only A and B's emissions would be considered relevant and subject to consolidation by X. The organizational border has been established once this has been chosen.

Setting Operational Boundary: Following the establishment of the organizational boundary, X must choose, based on its business objectives, whether to account for simply scope 1 and scope 2 or whether to incorporate pertinent scope 3 categories for its activities.

Operations A, B, and C implement business policy when defining their operational limits and account for GHG emissions in the scopes defined by X (if the equity approach is chosen).

Accounting and Reporting On Scopes

Scope 1 and scope 2 emissions of a company are accounted and reported for separately. To ensure transparency and allow users to make a comparison of their facilities over time, emissions data may further be subdivided within scopes. For example, the subdivision may take the form of business unit/facility data, country, source type (stationary combustion, process, fugitive, etc.), and activity type (production of electricity, consumption of electricity, generation or purchased electricity that is sold to end users, etc.).

However, companies are required to publish data on other GHG emissions (e.g., Montreal Protocol gases) as defined by the six Kyoto gases. This provides relevant information on potential changes in emission levels of the Kyoto Protocol gases. For example, a switch between CFC and HFC will increase emissions of Kyoto Protocol gases. In a GHG public report, information on emissions of GHGs other than the six Kyoto gases may be provided separately from the scopes.

A comprehensive accounting framework for managing and lowering direct and indirect emissions is provided by the three scopes taken together. The relationship between the scopes and the activities that produce direct and indirect emissions along a company's value chain is shown in broad strokes in Figure 2.

Efficiency improvements across the whole value chain can be advantageous to a company. Accounting for GHG emissions along the value chain may reveal opportunities for greater efficiency and lower costs even in the absence of any policy drivers (for example, the use of fly ash as a clinker substitute in the production of cement that reduces downstream emissions from the processing of waste fly ash, and upstream emissions from clinker production). In the absence of such "win-win" possibilities, indirect emissions reductions may nevertheless be more economically feasible than scope 1 reductions. To maximize GHG reduction and return on investment, it is therefore important to consider indirect emissions. GHG sources and activities are listed in Appendix D. Aspects of the value chain for various business industries

Scope 1: Direct GHG emissions

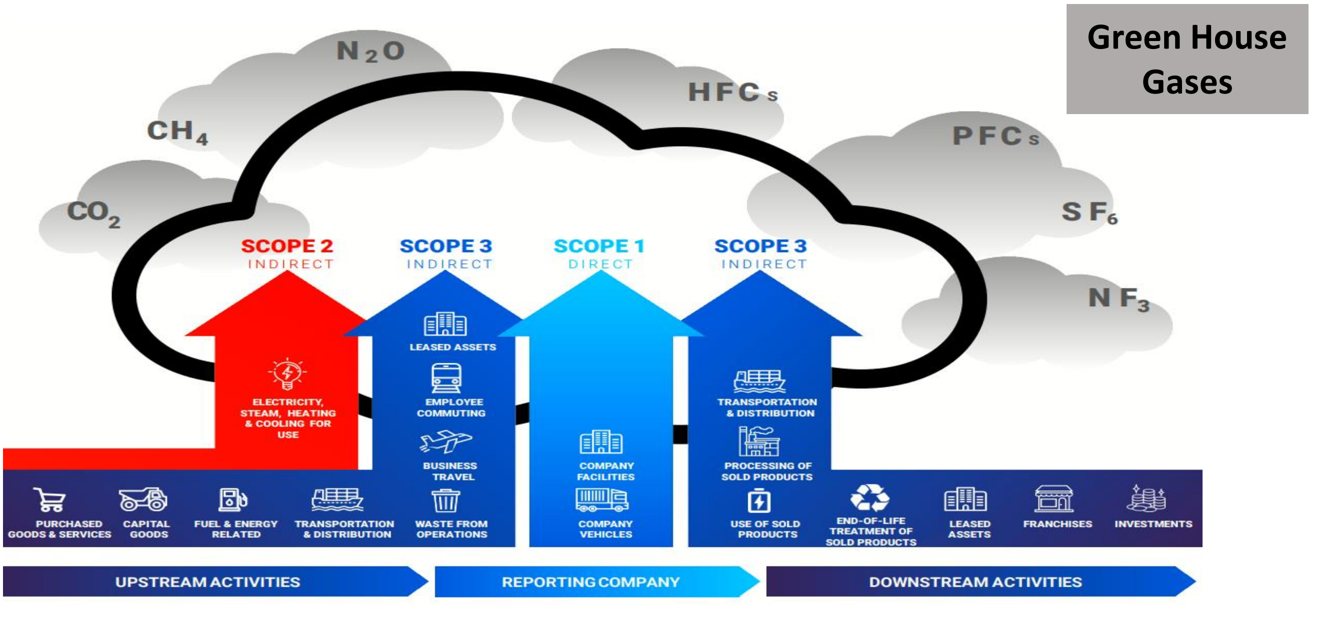
Scope refers to the GHG emissions from sources that the company owns and controls.

1. The sources of direct GHG emissions are the operational activity types listed below.

- **The production of heat, steam, or electricity**: These emissions are the consequence of fuels being used in stationary sources, such as boilers, furnaces, and turbines.
- **Processing that is physical or chemical**:[8] The majority of these emissions come from the production or processing of chemicals and materials, such as the production of cement, aluminum, adipic acid, ammonia, and trash.
- **Transportation of materials, products, waste, and employees:** These emissions are the consequence of fuel being burned in mobile combustion sources that are owned or controlled by the company (e.g., trucks, trains, ships, airplanes, buses, and cars)
- **Escape emissions:** These emissions are the result of deliberate or accidental releases, such as leaks from joints, seals, packing, and gaskets in equipment; methane emissions from coal mines and venting; hydrofluorocarbon (HFC) emissions from the operation of refrigeration and air conditioning equipment; and methane leaks from gas transport.

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

FIGURE 2. Overview of Scopes and Emissions across a Value Chain.



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

Sale of Own-Generated Electricity

No emissions are subtracted or netted from scope 1 in connection with the sale of self-generated electricity to another business. The way sold electricity is handled is consistent with how other sold GHG-intensive items are accounted for, for example, the fact that emissions from the manufacturing of sold clinker by a cement firm or scrap steel by an iron and steel company are not deducted from their scope 1 emissions. Reporting emissions in optional information related to the sale or transfer of self-generated electricity is possible (see chapter 9).

Scope 2: Electricity Indirect GHG Emissions

Emissions covering the generation of purchased electricity consumed in a company's owned or controlled equipment or operation are reported as scope 2. Scope 2 emissions are a special category of indirect emissions. For many companies, the largest source of GHG emissions is purchased electricity, which is an important opportunity to reduce these emissions. Companies get to assess key risks and opportunities associated with changing electricity and GHG emissions costs when they account for their scope 2 emissions. In addition, scope 2 emissions reported are relevant to the development of GHG programs.

By investing in energy-efficient technologies and energy conservation practices, companies can reduce their electricity usage. In addition, opportunities for companies exist within the emerging green power market [9] to switch to less GHG-intensive sources of electricity. For companies wishing to replace their GHG-intensive electricity purchase from the grid, they can install an efficient on-site co-generation plant. It is also significant to report on scope 2 emissions as it ensures transparent accounting of GHG emissions and reductions associated with such opportunities.

Indirect Emissions Associated With Transmission and Distribution

Through a transmission and distribution system, electric Utility companies use this system to resell electricity they have purchased from independent power generators to their end consumers.[10] However, a portion of the electricity purchased by the utility company is consumed (T&D loss) through the process of transmission and distribution. The company that owns or controls the transmission & distribution operation will be required to report emissions from the generation of purchased electricity that is consumed during transmission and distribution as its scope 2 emissions. However, end consumers do not report on the indirect emissions losses because they do not own or control the T&D, operation where the electricity is consumed (T&D loss).

Electricity balance

Generated Electricity	**=**	**Purchased electricity consumed by utility company during T&D** **+** **Purchased electricity consumed by end consumers**

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[9] 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

[10] A T&D system includes T&D lines and other T&D equipment (e.g., transformers).

An advantage to this approach is that it avoids double counting of scope 2 emissions since the accounting of scope 2 emissions and losses is done only by the T&D utility company. Secondly, it makes reporting of scope 2 emissions much simpler by allowing the use of commonly available emission factors that in most cases do not include T&D losses. In addition, under scope 3-category “generation of electricity consumed in a T&D system”, end consumers may report their indirect emissions associated with T&D losses. Appendix A provides more guidance on accounting for emissions associated with T&D losses.

Other Electricity-Related Indirect Emissions

Under scope 3, indirect emissions from operations upstream of an organization's electricity supplier (such as exploration, drilling, flaring, and transportation) are reported. Under the heading "generation of energy that is acquired and then resold to end users," emissions from the production of electricity that has been purchased for resale to end users are reported in scope 3. It is possible to record emissions from the production of electricity that has been purchased for resale to non-end users separately from scope 3 in "optional information." The next two instances demonstrate how greenhouse gas emissions from the production, sale, and consumption of electricity are taken into account.

Example one (Figure 3): Independent power producer Company A is the owner of a power plant. The power plant generates 20 tonnes of emissions annually while producing 100 MWh of electricity. Company B is an energy trader and buys all of its electricity from Company A under a supply agreement. Company B resells the electricity (100 MWh) it has purchased to Company C, a utility firm that owns and/or manages the T&D system. In its T&D system, Company C uses 5 MWh of electricity, and it sells the remaining 95 MWh to Company D. End user Company D uses the electricity it has purchased (95 MWh) for its own purposes. Under scope 1, Company A reports its direct emissions from electricity generation. Company B reports emissions from electricity purchased and supplied to a non-end user separately from scope 3 as optional information. Company C reports the indirect emissions from the generation of the portion of bought power it sells to end users under scope 3 and the portion it consumes in its T&D system under scope 2. In scope 2, End-User D reports the indirect emissions related to its own usage of purchasing power, while in scope 3 reporting of emissions related to upstream T&D losses is optional for End-User D. The accounting of emissions related to these transactions is shown in Figure 4.

Example two: Company D constructs a cogeneration unit and purchases excess electricity from nearby company E for its own use. Company D reports all of the cogeneration unit's direct emissions under scope 1, while Company D reports optional information regarding scope 3's indirect emissions from producing power for export to E. Company E reports indirect emissions from using electricity it has purchased from the cogeneration unit under scope 2 of firm D. See Appendix A for more information on how to account for indirect emissions from purchased electricity.

Scope 3: Other Indirect GHG Emissions

Although scope 3 is optional in reporting, it provides innovative opportunities when managing GHG. Hence, the operational activities that are most relevant to a business, where reliable information does exist should be accounted for and reported by companies. Due to companies’ ability to choose what they want to report under scope 3 accounting, undergoing companywide comparisons for scope 3 may not be efficient.

An indicative list of scope 3 categories is provided in this section, along with case studies on a few of the categories. When sources of emissions are owned and controlled by a company, such activities can be included in the company's scope 1 emission. For instance, if the corporation owns or controls the vehicles used to convey the items). To identify activities that fall under scopes 1& 3, the selected consolidation approach (equity or control) used in setting organizational boundaries should be consulted.

• Extraction and production of purchased materials and fuels [11]

•Transportation-related activities include employee business trips, employee commutes to and from work, transportation of purchased materials or items, transportation of purchased fuels, transportation of sold goods, and transportation of garbage.

• Electricity-related activities not included in scope 2 (Appendix A)

- Fuel production, transportation, and extraction to produce electricity (either purchased or own generated by the reporting company)
- Buying electricity to be sold to a consumer (reported by utility company)
- production of the electricity used in a T&D system (reported by end-user)

• Leased assets, franchises, and outsourced activities,

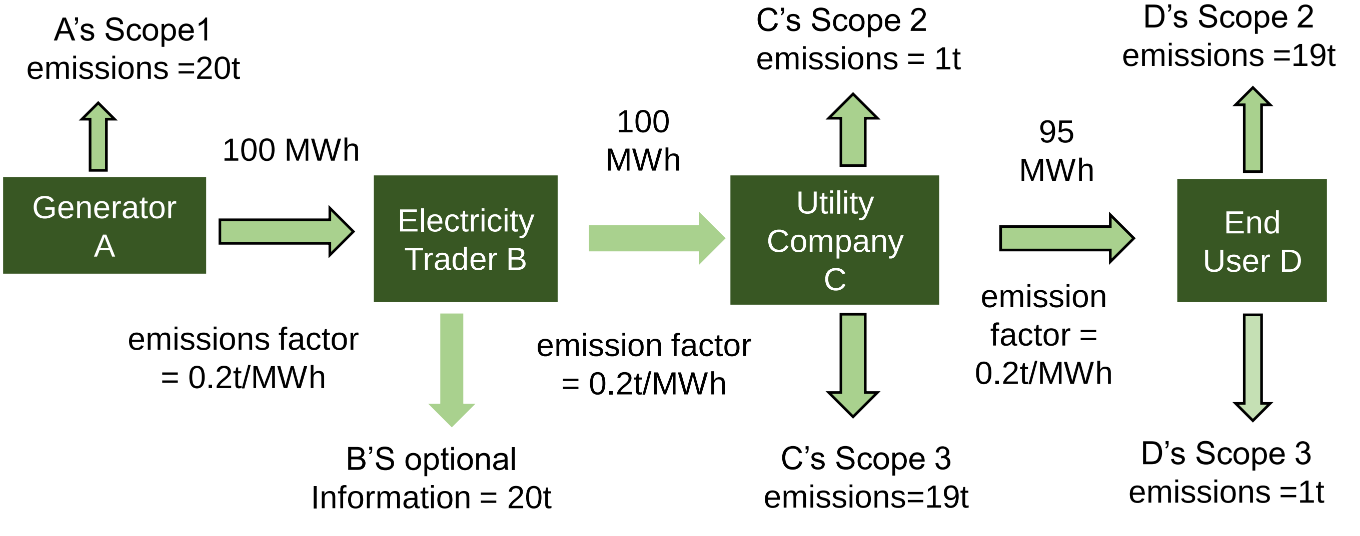
When the selected consolidation approach (equity or control) does not apply to a company activity, emissions from the contractual arrangement are classified only as scope 3. Clarification on the classification of leased assets should be obtained from the company accountant (see the section on leases below).

• Use of sold products and services

• Waste disposal

- Disposal of waste generated in operations
- Disposal of waste generated in the production of purchased materials and fuels
- Disposal of sold products at the end of their life

FIGURE 3. GHG accounting from the sale and purchase of electricity



Accounting For Scope 3 Emissions

A company may not have to undergo a GHG life cycle analysis of all its products and operations before it can account for scope 3 emissions. It can focus on major activities generating its GHG emissions. In as much as it is challenging to have generic guidance on which emission activity should be included in the inventory, some general steps hinged on include:

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[11] "Purchased materials and fuels" is defined as material or fuel that is purchased or otherwise brought into the organizational boundary of the company

1. Describe The Value Chain. Accounting for scope 3 is significant in promoting transparency, as well as providing a general description of the value chain and the associated GHG sources. The scope 3 categories provided can be utilized as a checklist for this stage. Typically, businesses must decide how many levels upstream and downstream to cover in scope 3. These decisions will be guided by the inventory or commercial objectives of the organization as well as the applicability of the various scope 3 categories.

2. Determine Which Scope 3 Categories Are Relevant. Not all upstream or downstream emissions of a company are included in scope 3 categories. The relevance for selecting them comes as a result of;

• They are large relative to the company's scope 1 and scope 2 emissions, or are thought to be large.

• They increase the company's exposure to GHG risk.

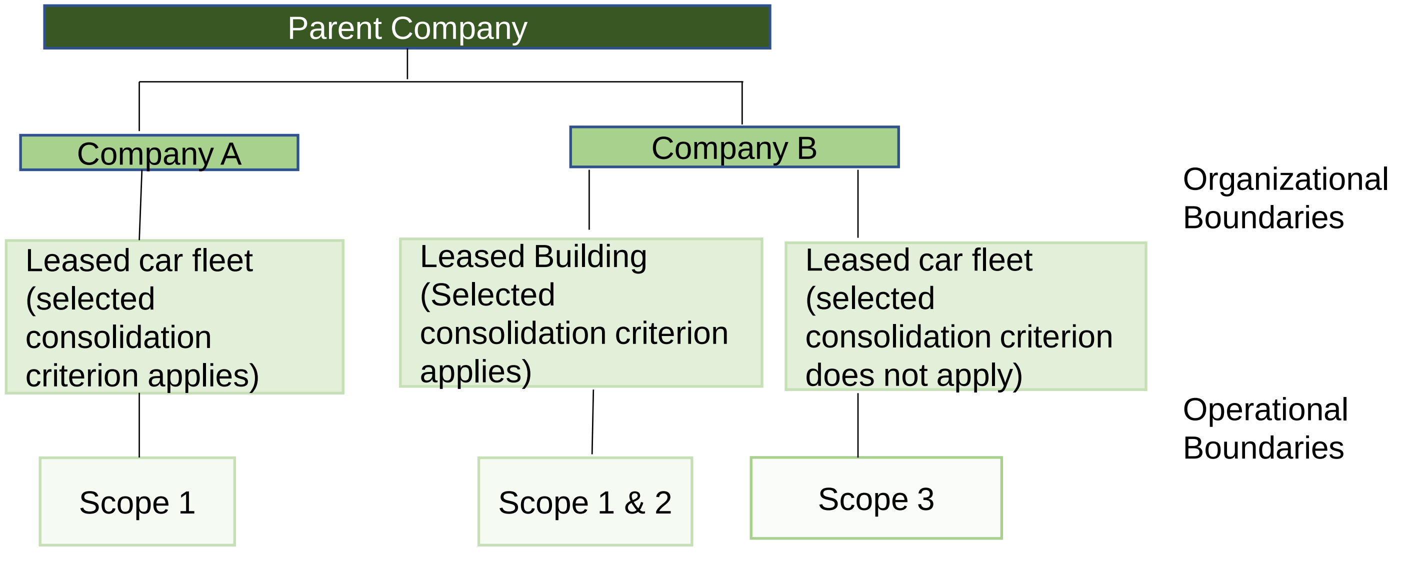
• They are viewed as crucial by important stakeholders (such as comments from clients, suppliers, investors, or the general public).

• The company can take action or influence the decrease of emissions.

The examples below may be useful in determining which scope 3 categories apply to the organization.

Product use phase emissions may be a pertinent category to report if a company's product necessitates the use of energy or fossil fuel. This may be important to businesses that can affect product design features (such as energy efficiency) or consumer behavior that lowers GHG emissions while using the items.

Figure 4. Accounting Of Emissions from Leased Assets



• Scope 3 emissions evaluations frequently include candidates from outsourced activities. When a previously outsourced operation significantly impacted a company's scope 1 or scope 2 emissions, it may be especially crucial to incorporate these

• Businesses may want to consider whether there are opportunities to reduce their consumption of the product or to substitute less GHG-intensive materials if GHG-intensive materials make up a sizable portion of the weight or composition of a product used or manufactured (for example, cement, aluminum).

• Commodity and consumer product companies may want to account for GHGs from carrying raw materials, finished goods, and trash. Large manufacturing enterprises may have large emissions connected to delivering purchased supplies to centralized production sites.

• When a company product used or manufactured (e.g., cement, aluminum) consists of significant GHG-intensive materials, Companies may have to identify opportunities to reduce such product consumption or substitute for less GHG –intensive materials.

• Large manufacturing companies may have significant emissions related to transporting purchased materials to centralized production facilities.

• Commodity and consumer product companies may want to account for GHGs from transporting raw materials, products, and waste.

• Organizations in the service sector may want to report emissions from employee business travel; other types of companies are less likely to consider this source of emissions to be significant (e.g., manufacturing companies).

3. List all of the partners in the value chain.

Find any partners in the value chain that may contribute sizable amounts of GHGs (such as consumers, product manufacturers, energy companies, etc.). This is crucial when attempting to locate sources, gather pertinent information, and compute emissions.

4. Quantify scope 3 emissions. It is acknowledged that data accuracy may be reduced, even though data availability and dependability may have an impact on which scope 3 activities are included in the inventory. Understanding the relative size of and potential changes to scope 3 activities may be more crucial. As long as the estimated methodology is transparent and the data utilized for the analysis are sufficient to meet the goals of the inventory, emission estimates are acceptable. Verification of scope 3 emissions will frequently be challenging and might only be taken into consideration with credible data.

Leased Assets, Outsourcing, and Franchises

Direct and indirect GHG emissions from contractual arrangements such as leased assets, outsourcing, and franchises are also accounted for and classified using the chosen consolidation approach (equity share or one of the control ways). If the chosen equity or control strategy is inapplicable, the business may include emissions from leased assets, outsourcing, and franchises in its coverage. 3. Below is detailed advice about the leased property:

• **Using Equity Share or Financial Control:**

Only emissions from leased assets that are classified as fully owned assets in financial accounting and are shown as such on the balance sheet are taken into account by the lessee (i.e., finance or capital leases).

• **Using Operational Control:**

The determination of operational and financed lease assets will need consulting with the corporate accountant. In the case of a finance lease, the business accepts all rewards and risks associated with the leased asset, which is treated as fully owned and shown as such on the balance sheet. Conversely, any leases for assets that don't fit the aforementioned requirements are operating leases. The use of consolidation criteria to account for emissions from leased assets is seen in Figure 4.

IKEA: Customer transportation to and from its retail stores

IKEA, a global retailer of home furnishings, made the decision to include scope 3 emissions from customer travel after realizing that these emissions were significant in comparison to scope 1 and scope 2 emissions through participation in the Business Leaders Initiative on Climate Change (BLICC) program. Additionally, the IKEA store business model is particularly pertinent to these emissions. IKEA's choice of store location and the warehouse-shopping concept have a direct impact on customer travel to its stores, which are frequently visited from vast distances.

Calculations of consumer transportation emissions were based on customer surveys at certain stores. Customers were questioned about how far they had to go to the store (depending on their home postal code), how many people were in their car, how many other stores they planned to visit that day at that shopping area, and whether they had access to public transportation. The company determined that 66 percent of its emissions inventory was from scope 3 client travel by extrapolating this data to all IKEA locations, calculating distance by the average vehicle efficiency for each nation, and multiplying the result by the distance. Based on this data, IKEA will significantly affect future scope 3 emissions by taking GHG emissions into account while creating public transportation choices and home delivery services for its current and future customers.

Double Counting

The concern is often expressed that accounting for indirect emissions will lead to double counting when two different companies include the same emissions in their respective inventories. Whether or not double counting occurs depends on how consistently companies with shared ownership or trading program administrators choose the same approach (equity or control) to set the organizational boundaries.

Whether or not double counting matters, depends on how the reported information is used. Under the Kyoto Protocol, double counting must be avoided when creating national (country) inventories, however, this is typically done top-down using national economic data rather than aggregating bottom-up corporate data. The "point of release" of emissions, i.e., direct emissions and/or indirect emissions from the consumption of energy, is more frequently the focus of compliance regimes. Double counting has less of an impact on GHG risk management and voluntary reporting.

Making sufficient procedures to ensure that this does not happen between participating corporations is required since it would be unacceptable for two organizations to claim ownership of the same emissions commodity for participating in GHG markets or acquiring GHG credits (chapter 11).

Scopes and Double Counting

The GHG Protocol Corporate Standard is intended to stop enterprises within scopes 1 and 2 from double counting emissions. For instance, if company A (an electricity generator) and company C (a company A partner organization) consistently use the same control or equity share approach when consolidating emissions, company A's scope 1 emissions can be counted as company B's scope 2 emissions (an electricity end-user), but company A's scope 1 emissions cannot be counted as company C's scope 1 emissions. Similar to the definition of scope 1, scope 2 does not permit the duplicate counting of emissions within scope 2, i.e., scope 2 emissions from the purchase of the same power cannot be counted by two distinct companies. Scope 2 emissions are a helpful accounting category for GHG trading schemes that control end consumers of power since it prevents this kind of double counting.

The robustness of the scope 1 and scope 2 definitions when combined with the consistent use of either the control or equity share approach for defining organizational boundaries allows only one company to exercise ownership of scope 1 or scope 2 emissions when used in external initiatives like GHG trading.

World Resources Institute: Innovations in estimating employee-commuting emissions

The World Resources Institute is dedicated to achieving net zero annual GHG emissions through a combination of internal emission reduction initiatives and purchases of external offsets. Scope 2 indirect emissions related to the use of purchased power are included in WRI's emissions inventory, as are scope 3 indirect emissions related to company air travel, staff commuting, and paper use. Scope 1 direct emissions don't exist at WRI.

It can be difficult to gather information about employee commuting activity from WRI's 140 employees. Employees are surveyed once a year about their typical commuting behaviors. WRI employed an Excel spreadsheet for the first two years of the initiative that was available to all staff members via a shared internal network, but only got 48% of them to participate. Participation increased to 65 percent in the third year thanks to a condensed, web-based survey that downloaded into a spreadsheet. WRI further simplified and enhanced the survey questions based on user input, increased usability, and decreased the survey completion time to under a minute. Participation among employees increased to 88 percent.

In order to assist office-based companies in understanding how to track and control their emissions, WRI has created a guide that is compliant with the GHG Protocol Corporate Standard. Working on climate change from 9 to 5: A number of calculating tools are included with an office guide, one of which can be used to calculate employee commute emissions using a survey method. You can obtain the Guide and resources from the GHG Protocol Initiative website (www.ghgprotocol.org).

The fastest-growing GHG emission category in the US is related to transportation. This covers commuting as well as commercial, business, and personal travel. When commuter emissions are taken into consideration, businesses can discover that there are a number of real opportunities to cut them. For instance, WRI chose a building near public transportation when it relocated to new office space, thereby minimizing the need for employees to travel to work. WRI also acquired access to a locked bike room for staff members who commute by bicycle. Finally, by avoiding or minimizing the need for travel, telework programs greatly minimize commuting emissions.

5 # Tracking Emission Over Time

CHAPTER

Organizational structural changes alter a company's historical emission profile, making meaningful comparisons over time difficult. Such structural changes are not limited to acquisitions, divestments, and mergers. Hence, for companies to maintain consistency and be able to make meaningful comparisons of their data over time, historic emissions data will have to undergo recalculation.

Tracking of emissions over time becomes significant as companies respond to the varying nature of business goals. Which include

- Public reporting
- Establishing GHG targets
- Managing risk and opportunities
- Addressing the needs of investors and other stakeholders.

Companies must establish a performance datum with which to measure current emissions to make meaningful and consistent comparisons of emissions across time. The base year [12] emissions are the performance datum in question. As organizations go through significant structural changes like acquisitions, divestments, and mergers, the base year emissions may need to be recalculated to track emissions consistently through time.

However, choosing a base year is the first stage in the tracking of emissions.

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[12] Terminology on this topic can be confusing. Base year emissions should be differentiated from the term "baseline," which is mostly used in the context of project-based accounting. The term base year focuses on a comparison of emissions over time, while a baseline is a hypothetical scenario for what GHG emissions would have been in the absence of a GHG reduction project or activity.

Choosing a Base Year

It is preferred that companies select and report on a base year for which available and verifiable emissions data do exist, this shall be accompanied by a reason for choosing that specific year. For instance, the U.K. ETS specifies that the reference point for tracking reductions is the average emissions from 1998 to 2000. The exceptional changes in GHG emissions that would render a single year's data unrepresentative of the company's regular emissions profile may be smoothed out by a multi-year average. For most companies, a single year is chosen as the base year. However, it is permissible for a company to select an average of annual emissions over several consecutive years.

The base year for the inventory can also serve as the foundation for establishing and monitoring progress toward a GHG target in which case it is known as a target base year (see chapter 11).

Recalculating Base Year Emissions

Companies must create a base year emissions recalculation policy and explain the rationale and circumstances behind any recalculations in detail. The policy must specify any "significance level" used to determine whether to recalculate historical emissions, if appropriate. A substantial change to the data, inventory boundary, techniques, or any other pertinent aspects is defined by the term "significance threshold," which might be qualitative or quantitative in nature.

The "significance level" that causes base year emissions to be recalculated must be determined and disclosed by the company. Verifying that the business is adhering to its threshold policy is the verifier's obligation. Recalculating base year emissions is required in the following circumstances:

Structural alterations inside the reporting organization significantly affect the emissions of the corporation in the base year. Transferring ownership or control of operations or activities that produce emissions from one company to another constitutes a structural shift.

While a single structural modification might not have a big impact on base year emissions, a series of small structural changes added together can have a big impact. Changes to the structure include:

- Mergers, acquisitions, and divestments
- Outsourcing and insourcing of emitting activities
- A major influence on the base year emissions data is due to changes in calculation methodology or improvements in the accuracy of emission components or activity data
- Finding significant errors, or several cumulative errors that together constitute a significant error.

In summary, to remain appraised with structural changes in a company that has the potential of compromising the consistency and importance of GHG emissions data reported, consecutive recalculation of base year emissions shall be optimal to a company’s operations. In the aftermath of articulating and developing the recalculation policy, The Company shall consistently apply the policy. For instance, it shall recalculate for both increases and decreases in GHG emissions.

Choosing and recalculation a base year are informed by the company’s business goal and context.

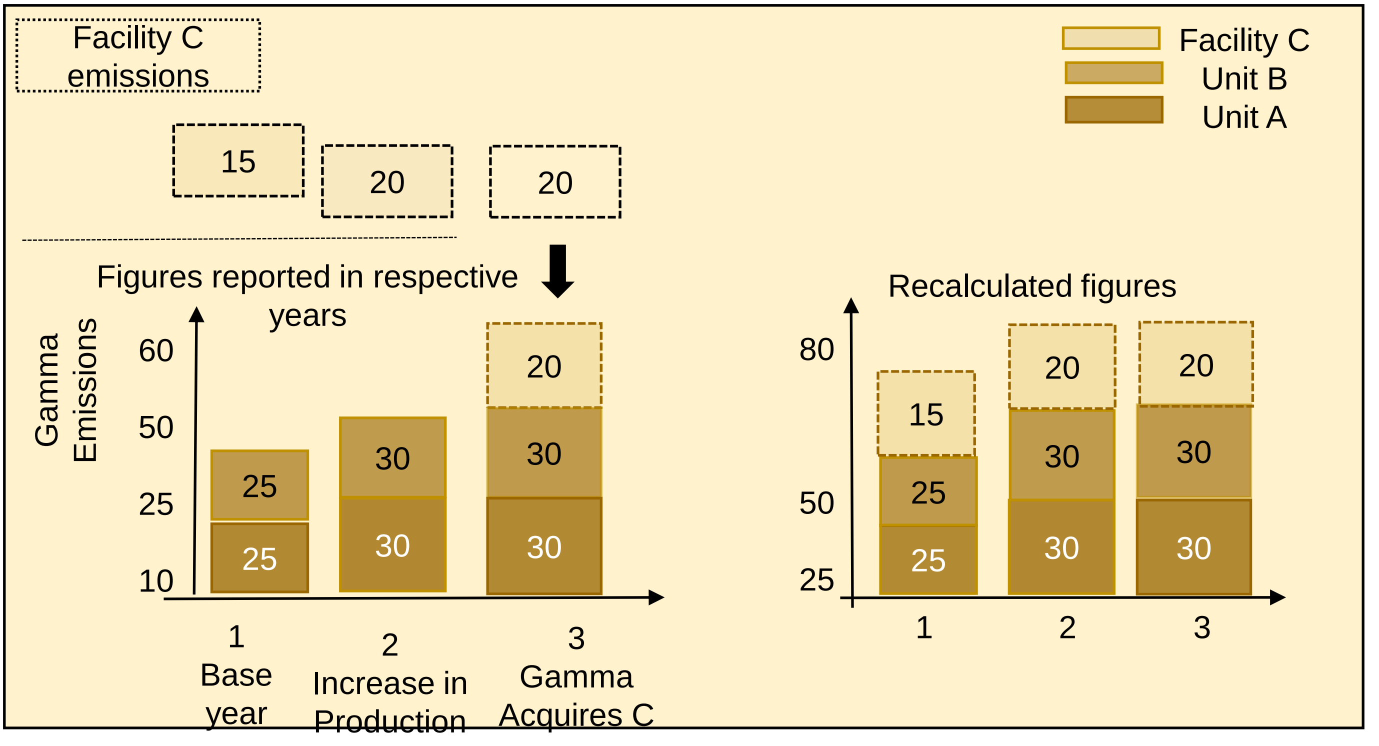
- The guidance in this chapter can be followed in reporting progress toward voluntary public GHG targets

- Companies participating in external GHG programs may be subject to external rules governing the choice and recalculation of base year emissions
- For internal management goals, a company may develop its approach and apply consistently or follow the rules and guidelines recommended in this document

Choosing a Base Year

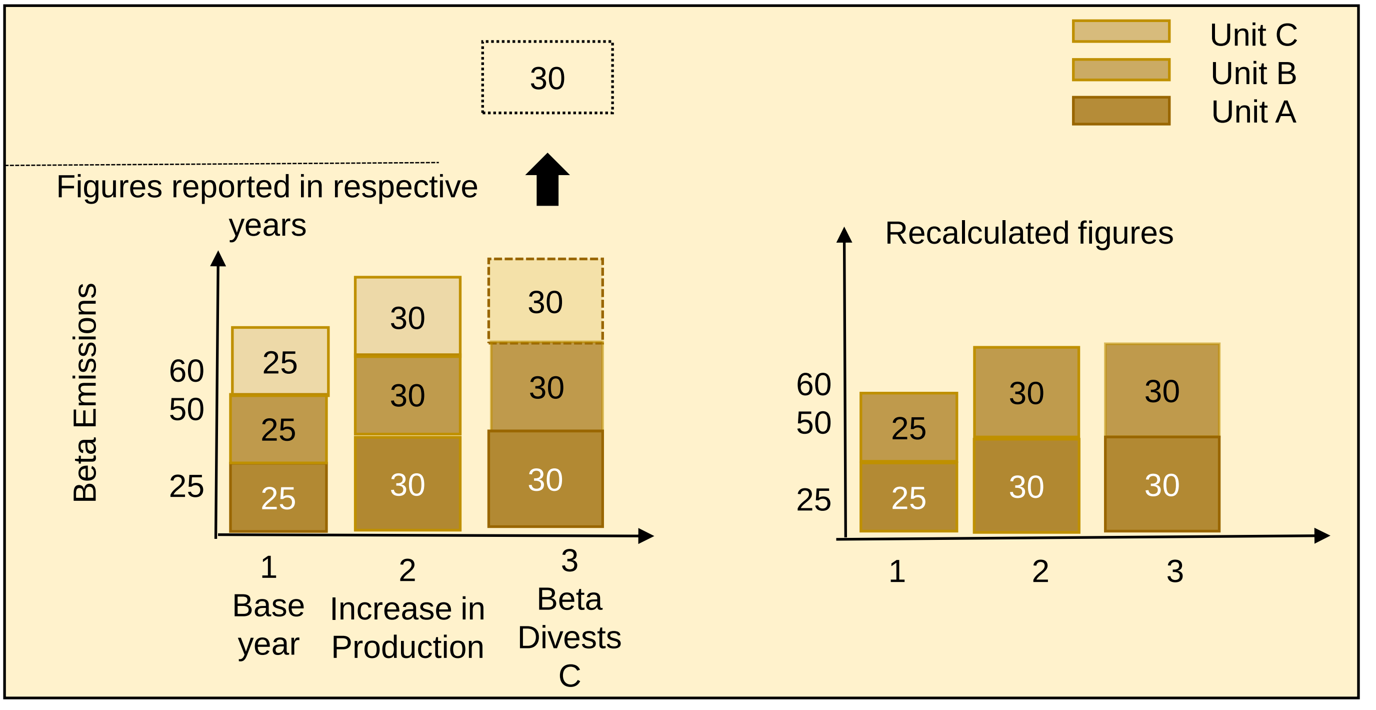
First, it is recommended that companies choose the most recent year for which reliable data are available as the base year. For companies trying to be consistent and aligned with the Kyoto Protocol and choosing the base year of 1990, collecting consistent, significant, and variable data for the year 1990 can be very challenging. If a business keeps making acquisitions to expand, it can implement a policy that periodically "rolls" the base year ahead by a certain number of years. Such a "rolling base year" is outlined in Chapter 11, along with a comparison to the fixed base year strategy discussed in this chapter. The advantage of a fixed base year over a rolling base year method is that it enables like-for-like comparisons of emissions data over a longer time frame. The majority of emissions trading and registry programs demand the implementation of a set base-year policy.

Figure 5. Base Year Emissions Recalculation for an Acquisition



Company Gamma has two business divisions (A and B). Each business unit emits 25 tonnes of CO_2 in its base year (year one). The company experiences "organic expansion" in year two, which raises emissions to 30 tonnes of CO_2 for each business unit, for a total of 60 tonnes of CO_2. In this instance, the base year emissions are not computed. The business purchases production facility C from another business at the start of year three. In year one, facility C's annual emissions were 15 tonnes of carbon dioxide, and in years two and three, they were 20 tonnes. Thus, 80 tonnes of CO_2 were emitted by firm Gamma overall in year three, including facility C. The business recalculates its base year emissions to account for the purchase of facility C to preserve consistency over time. The amount of emissions produced by facility C in the base year of Gamma, or 15 tonnes of CO_2, is added to the base year emissions. Emissions for the revised base year are 65 tonnes of CO_2. As the recalculated emissions for year two, Gamma also (optionally) publishes 80 tonnes of CO_2.

FIGURE 6. Base year emissions recalculation for a divestment



Company Beta has three business divisions (A, B, and C). In the base year, the company's overall emissions were 75 tonnes of CO_2 and each business unit generates 25 tonnes of CO_2 (year one). The company's output increases in year two, increasing emissions to 30 tonnes CO_2 per business unit, or 90 tonnes of CO_2 overall. Beginning with year three, Beta sells off business unit C, resulting in annual emissions of 60 tonnes, or an apparent 15 tonnes less than in the base year. However, the corporation recalculates its base year emissions to account for the divestiture of business unit C to preserve consistency across time. The amount of emissions produced by the business unit C in the base year, or 25 tonnes of CO_2, is deducted from the base year emissions. The recalculated base year emissions are 50 tonnes of CO_2, and during the course of three years, firm Beta's emissions are observed to have increased by 10 tonnes of CO_2. Beta gives the recalculated emissions for year two at 60 tonnes of CO_2 (optionally). Figures 6 and 7 illustrate the effect of structural changes and the application of this standard on the recalculation of base year emissions.

Significance Thresholds for Recalculations

Although base year emissions recalculations are encouraged, this is dependent on the intensity and relevance of the change at a company. This is determined by considering the cumulative effect on base year emissions of several small acquisitions or divestment. The GHG Protocol Corporate Standard makes no specific recommendations as to what constitutes “significant.” However, some GHG programs do specify numerical significance thresholds, e.g., take the California Climate Action Registry, for instance, where the change threshold is 10% of base year emissions, calculated cumulatively from the time the base year is formed.

Base year Emissions Recalculation for Structural Changes

Recalculation is necessary in structural changes since it transfers emissions from one company to another without any significant change in emissions released to the atmosphere, for example, Existing GHG emissions from one company's inventory are the only thing that is transferred after an acquisition or divestiture.

Timing of Recalculations for Structural Changes

In circumstances where a company undergoes a mid-year structural change, recalculation of the base year emissions should be for the entire year and not for the remaining reporting year for which the changes were observed. This prevents the recalculation of base year emissions in the immediately preceding year. Similarly, to maintain consistency with the base year recalculation, the current year's emissions should be recalculated for the entirety of the year. Where recalculation is impossible in the year of structural change (e.g., due to lack of data for an acquired company) the recalculation may be carried out in the preceding year.[13]

Recalculations for Changes in Calculation Methodology or Improvements in Data Accuracy

A company might measure or calculate its emissions differently but present data for the same GHG emissions sources as in the previous years. For instance, a business might have estimated scope 2 emissions in the first reporting year using a national electric power generation emissions factor. Later on, it might be able to receive more precise utility-specific emission factors (for both the present and the past years) that would better capture the greenhouse gas emissions connected to the electricity it has purchased. If there are appreciable differences in emissions as a result of this change, historical data is recalculated using the new information and/or methodology.

Sometimes, it may not be reasonable to apply the more accurate data input to all prior years, or new data points may not be accessible for prior years. The business might then need to backcast these data points, or it might just acknowledge the change in a data source without recalculating. To increase openness, this acknowledgment should be included in the report each year; otherwise, new readers of the report in the two or three years after the modification can infer the wrong things about the company's performance.

A recalculation is not required for any modifications to the emission factor or activity data that reflect actual changes in emissions (such as modifications to the fuel type or technology).

Optional Reporting For Recalculations

Additional data companies may report on recalculations includes: (Optional)

• Recalculated data on GHG emissions for each year between the base year and the reporting year

• All real emissions that were reported in the corresponding years in the past, i.e., the values that were not adjusted. Since it shows how the company's structure has changed over time, reporting both the original and the recalculated data enhances transparency.

No Base Year Emissions Recalculations for Facilities That Did Not Exist In the Base Year

A company shall not recalculate any form of activity or acquisition of (insource) operations that did not exist within the base year. Recalculation can be done for historic data back to the year in which the acquired company came into existence. The same

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[13] For more information on the timing of base year emissions recalculations, see the guidance document “Base year recalculation methodologies for structural changes” on the GHG Protocol website (www.ghgprotocol.org).

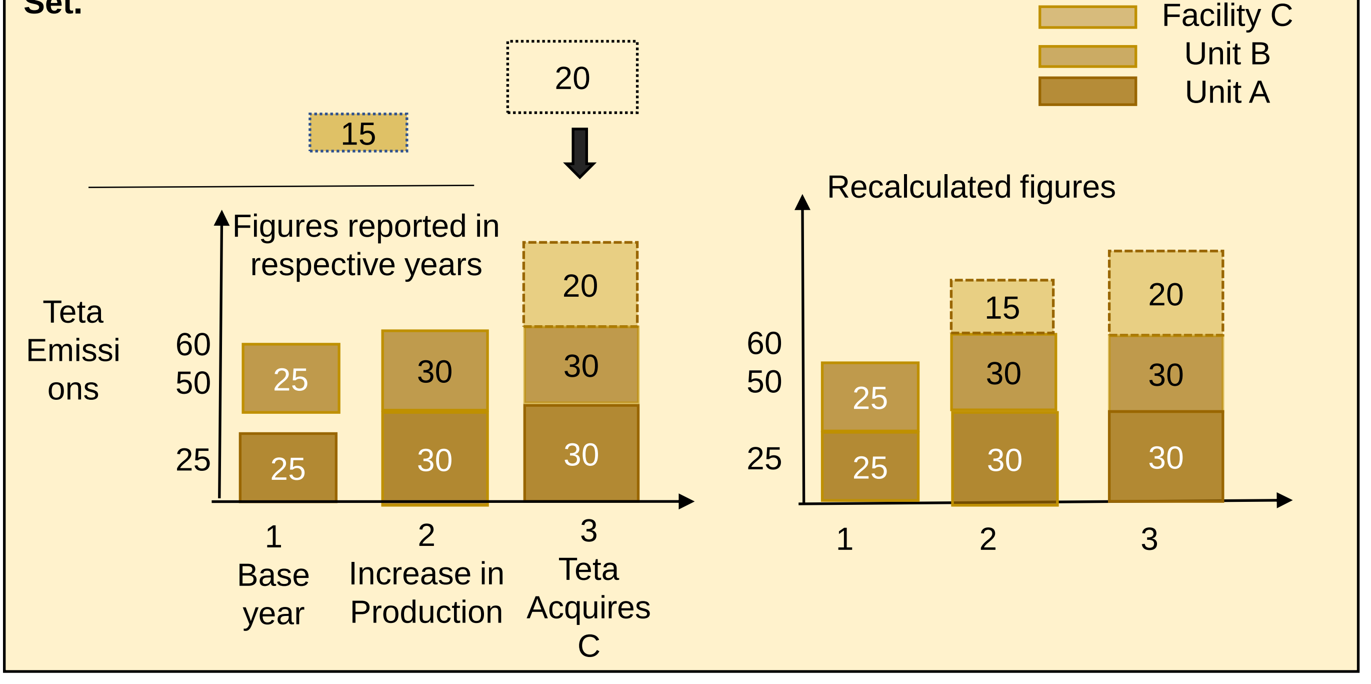
should be consistently applied in cases where the company makes a divestment of (or outsources) operations that did not exist in the base year. Figure 7 illustrates a situation where no recalculation of base year emissions is required since the acquired facility came into existence after the base year was set.

No recalculation for "outsourcing/insourcing" if reported under scope 2 and/or scope 3

If the company reports its indirect emissions from pertinent outsourced or insourced activities, structural changes brought on by "outsourcing" or "insourcing" do not necessitate recalculating base-year emissions. For instance, since scope 2 reporting is required by the GHG Protocol Corporate Standard, outsourcing the production of electricity, heat, or steam does not result in a recalculation of base year emissions. However, when scope 3 is not reported, outsourcing or insourcing that significantly changes emissions between scope 1 and 3 does result in a recalculation of base year emissions (for instance, when a business outsources product transportation).

Base year recalculation is not subject to when a company undergoes structural changes due to "outsourcing" or "insourcing" especially when the company is reporting its indirect emissions from relevant outsourced or insourced activities. For example, outsourcing the production of electricity, heat, or steam does not trigger base year emissions recalculation, since the GHG Protocol Corporate Standard requires scope 2 reporting. However, a base year emissions recalculation is triggered when outsourcing/insourcing that shifts significant emissions between scope 1 and scopes 3 when scope 3 is not reported e.g. when a company outsources the transportation of products). Base year emissions are recalculated for outsourcing or insourcing if a corporation chooses to measure emissions over time independently for various scopes and has distinct base years for each scope.

Figure 7. Acquisition Of A Facility That Came Into Existence After The Base Year Was Set.



Teta Company has two business divisions (A and B). The business produces 50 tonnes of CO_2 in its base year (year one). The company experiences organic growth in year two, increasing emissions to 30 tonnes of carbon dioxide (CO_2) per business unit, or 60 tonnes of CO_2 overall.

In this instance, the base year emissions are not computed. Teta purchased production facility C from another company at the start of year three. Facility C was established in year two, with 15 tonnes of CO_2 in year two emissions and 20 tonnes of CO_2 in year three emissions. Thus, 80 tonnes of CO_2 in total were emitted by firm Teta in year three, including facility C.

Since the acquired plant C did not exist in year one, when Teta's base year was established, the company's base year emissions in this acquisition situation remain unchanged. Teta continues to emit 50 tonnes of CO_2 in its base year. Teta (optionally) provides revised emissions for year two at 75 tonnes.

No Recalculation for Organic Growth or Decline

Emissions from the base year and any prior data are not adjusted to account for organic increase or decline. Organic growth/decline refers to increases or decreases in production output, modifications to the product mix, and the closing and opening of business operations that are under the company's ownership or control. The justification for this is that as organic growth or decline alters emissions to the atmosphere, it must be taken into account when calculating a company's overall emissions profile.

“From the soil to the table, it is essential alternative systems be designed to curb deforestation and stop climate breakdown.” ***Donna Maltz***

6 Identifying and Calculating GHG Emissions

CHAPTER

After a company determines its inventory boundary, the company shall calculate its GHG emissions using the following steps:

1. Determine the sources of GHG emissions

2. Decide on a method for calculating GHG emissions

3. Gather activity information and select emission factors

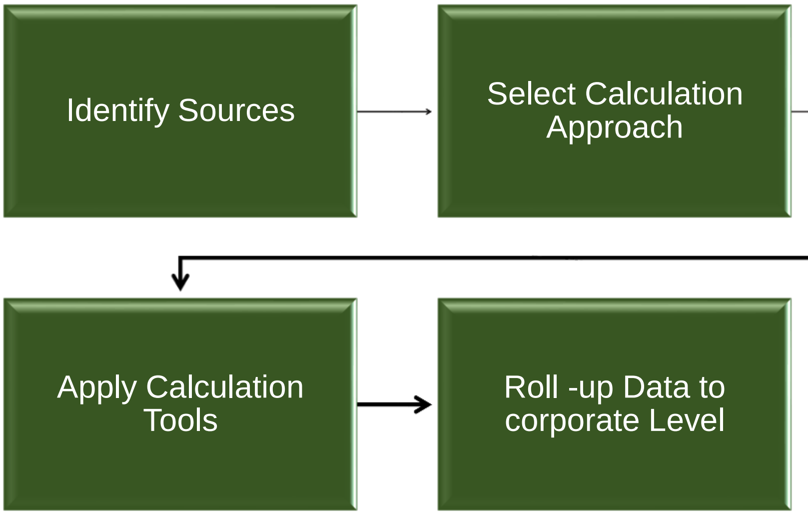
4. Use tools for calculating

5. Consolidate data on GHG emissions to the business level.

These procedures are described in this chapter, together with the calculating tools created by the GHG Protocol. The GHG Protocol Initiative website has the computation tools (www.ghgprotocol.org).

Companies have found it useful to categorize their total emissions into distinct groups to provide an accurate record of their emissions. This enables a business to accurately calculate the emissions from each industry sector and source category using specially created procedures.

Figure 8. Steps In Identifying and Calculating GHG Emissions



Identify GHG emissions sources

As outlined in figure 8, a company shall take the first step in determining and calculating its emissions by categorizing the GHG sources within the identified boundaries. The source categories include:

- **Stationary combustion:** Fuels are burned in stationary machineries such as boilers, furnaces, burners, turbines, heaters, incinerators, engines, flares, and other similar devices during stationary combustion.
- **Mobile combustion**: the burning of fuels in moving vehicles including cars, trucks, buses, trains, planes, boats, ships, barges, and other similar craft.
- **Process emissions**: These include emissions from physical or chemical processes like the calcination phase in the manufacture of cement, catalytic cracking in the processing of petrochemicals, PFC emissions from the smelting of aluminum, etc.
- **Fugitive emissions**: deliberate and accidental releases, including leaks from joints, seals, packing, and gaskets in equipment as well as fugitive emissions from coal heaps, pits used for wastewater treatment, cooling towers, and gas processing facilities, among other sources.

Every company has operations, goods, or services that produce direct or indirect emissions from one or more of the broad source categories mentioned above. Based on these groups, the GHG Protocol computation tools are arranged. The overview of direct and indirect GHG emission sources in Appendix D, organized by industry sectors and scopes, can be used as a starting point when identifying the main GHG emission sources.

Identify Scope 1 Emissions

First, based on each of the four source categories mentioned above, a company should determine its direct emission sources. Emissions from a company process are generally more associated and relevant to industry sectors such as oil and gas, aluminum; cement, etc. Process emissions generated from manufacturing companies that own or control a power production facility will likely have direct emissions from all the main source categories. Direct GHG emissions in the case of Office-based organizations may be insignificant unless they own or operate a vehicle, combustion device, or refrigeration and air-conditioning equipment. Companies are often surprised by the amount of GHG emissions generated from sources not recognized at the initial stages

Identify Scope 2 Emissions

Following the determination of direct emissions, sources are to identify your indirect emissions sources. These are mostly referred to as scope 2 emissions and are composed of purchased electricity, heat, or steam consumption. Indirect is associated with almost all companies due to energy consumption in their business process or services.

Identify Scope 3 Emissions

In this optional stage, additional indirect emissions from a company's upstream and downstream operations as well as emissions linked to contract manufacturing, leases, or franchises that are not covered by scope 1 or scope 2 are identified. Businesses can broaden their inventory boundary along their value chain and identify all pertinent GHG emissions by including scope 3 emissions. This gives a comprehensive overview of different business relationships and potential chances for significant GHG emission reductions that might exist upstream or downstream of a company's current operations (see chapter 4 for an overview of activities that can cause GHG emissions along a company's value chain).

Select a Calculation Approach

It is not common for a practice such as direct measurement of GHG emissions by monitoring concentration and flow rate. Most often than not, mass balance or stoichiometric basis specific to a facility or process are used to calculate emissions. However, the application of documented emission factors is the most common approach for calculating GHG emissions. These ratios, which relate GHG emissions to a fictitious indicator of activity at an emissions source, have been calculated. A hierarchy of computation methods and techniques, ranging from the use of general emission factors to direct monitoring, is mentioned in the IPCC guidelines (IPCC, 2006: IPCC 2019).

Accurate emission data can frequently be determined from fuel usage information, especially when direct monitoring is either impossible or excessively expensive. Even modest users typically have access to information on the fuel's carbon content by default carbon content coefficients or more precisely periodic fuel sampling, and they are usually aware of how much fuel is spent as well. Companies should employ the most precise computation method that is suitable for their reporting context and is available to them.

Collect Activity Data and Choose Emission Factors

Data regarding scope 1 GHG emissions for most small to medium-sized companies and many larger companies will be calculated using published emission factors, derived from their purchased quantities of commercial fuels (such as natural gas and heating oil). Metered electricity consumption and supplier-specific, local grid, or other published emission factors will mainly be used in calculating scope 2 GHG emissions whiles scope 3 GHG emissions will primarily be calculated from activity data such as fuel use or passenger miles and published or third-party emission factors. In most scenarios, it is preferable to use source or facility-specific emission factors if available than generic or general emission factors.

Due to the proliferation of approaches and methodologies companies are exposed to, it is required that they consult the sector-specific guidelines of the GHG protocol website (if available) or from their industry associations (e.g., International Aluminum Institute, International Iron and Steel Institute, American Petroleum Institute, WBCSD Sustainable Cement Initiative, International Petroleum Industry Environmental Conservation Association).

Apply Calculation Tools

An overview of the GHG calculation tools and instructions can be found in this section of the GHG Protocol Initiative website (www.ghgprotocol.org). It is recommended that you use these tools since they have been peer-evaluated by professionals in the field and are thought to be the best available. However, using the tools is optional. Companies are free to use their own GHG calculation techniques as long as they are more precise than or at least equivalent to GHG Protocol Corporate Standards procedures.

There are two main categories of calculation tools:

- Tools that can be used in multiple sectors that cross sectors. The usage of HFCs in refrigeration and air conditioning, mobile combustion, measurement, and estimation uncertainty, and stationary combustion are a few of these.
- Sector-specific tools for calculating emissions in particular industries, like aluminum, iron and steel, cement, oil and gas, pulp and paper, and office-based businesses

To account for all of their GHG emission sources, the majority of businesses will need to use multiple calculation tools. For instance, the company would use the calculation tools for aluminum production, stationary combustion (for any consumption of purchased electricity, generation of energy on-site, etc.), mobile combustion (for transportation of materials and products by train, vehicles employed on-site, employee business travel, etc.), and HFC use (for refrigeration, etc.) to determine the GHG emissions from an aluminum production facility. The complete list of tools is in Table 3.

Structure of GHG Protocol Calculation Tools

A common format and a step by step guidance on measuring and calculating emissions data have been made available on the GHG protocol website on both cross-sector and sector-specific calculation tools. Each tool has an instruction section as well as automated worksheets that explain how to utilize it.

The guidance for each calculation tool includes the following sections:

- **Overview:** gives a general description of the tool's purpose and content, as well as its calculating method and a process description.
- **Selecting activity data and emission factors**: offers sector-specific recommendations for best practices and sources for default emission factors.
- **Ways of calculation:** outlines various methods of calculation based on the availability of site-specific activity data and emission parameters.

- **Quality control**: offers recommendations for best practices
- **Internal reporting and documentation**: offers suggestions for internal records to back up emissions calculations

Table 2. Overview of GHG Calculation Tools Available On the GHG Protocol Website [14]

	Calculation Tools	Main Features
Cross-Sector Tools	Stationary Combustion	• Calculates direct and indirect CO2 emissions from fuel combustion in stationary equipment • Provides two options for allocating GHG emissions from a co-generation facility • Provides default fuel and national average electricity emission factors
	Mobile Combustion	• Calculates direct and indirect CO2 emissions from fuel combustion in mobile sources • Provides calculations and emission factors for road, air, water, and rail transport
	HFC from Air Conditioning and Refrigeration Use	• Calculates direct HFC emissions during manufacture, use, and disposal of refrigeration and air-conditioning equipment in commercial applications • Provides three calculation methodologies: a sales-based approach, a life cycle stage-based approach, and an emission factor-based approach
	Measurement and Estimation Uncertainty for GHG Emissions	• Introduces the fundamentals of uncertainty analysis and quantification • Calculates statistical parameter uncertainties due to random errors related to the calculation of GHG emissions • Automates the aggregation steps involved in developing a basic uncertainty assessment for GHG inventory data

[14] https://ghgprotocol.org/sites/default/files/standards/ghg-protocol-revised

Table 2 Contd

Sector-Specific Tools	**Aluminum and other nonferrous Metals Production**	**Calculates direct GHG emissions from aluminum production (CO_2 from anode oxidation, PFC emissions from the "anode effect," and 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, from the 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 CO_2 emissions from the calcination process in cement manufacturing (WBCSD tool also calculates combustion emissions) • Provides two calculation methodologies: the cement-based approach and the 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 the production of HCFC-22
	Pulp and Paper	Calculates direct CO_2, CH_4, and N_2O emissions from the production of pulp and paper. This includes the calculation of direct and indirect CO_2 emissions from the combustion of fossil fuels, biofuels, and waste products in stationary equipment
	Semi-Conductor Wafer Production	Calculates PFC emission from the production of semiconductor wafers
	Guide for Small Office-Based Organizations	Calculates direct CO_2 emissions from fuel use, indirect CO_2 emissions from electricity consumption, and other indirect CO_2 emissions from business travel and commuting

When using the automated worksheet section, it is required that the user inserts relevant activity data as well as selects the appropriate emission factor or factors. It has been made possible for companies to insert customized emission factors that are representative of their operations. Otherwise, users can make use of the default emissions factors provided for covered sectors. The emissions of each GHG (CO_2, CH_4, N_2O, etc.) are calculated separately and then converted to CO_2 equivalents based on their global warming potential. Some tools, like the iron and steel sector tool and the HFC cross-sector tool, adopt a tier system, giving users the option to choose between a straightforward and complex calculation methodology. More accurate emissions estimates can be achieved using advanced methodologies, but this will require a comprehensive knowledge of a company's technology as we all as the collection of more detailed emissions data.

Roll-up GHG Emissions Data to Corporate Level

Total emissions calculations for a corporation will require a company to collate and summarize data from multiple facilities and probably in different countries and business divisions. To accomplish this, it is essential that all facilities collate data consistent with the GHG protocol standard, and requires careful planning to minimize reporting burden, and reduce the risk of errors that might occur while compiling data. Preferably, companies will integrate GHG reporting with their existing reporting tools and processes and take advantage of any relevant data already collected and reported by facilities to divisions or corporate offices, regulators, or other stakeholders.

Available Information and communication infrastructure already existing in a company help determine the tools and approaches chosen for the reporting purposes (i.e., how easy is it to include new data categories in corporate databases). Based on corporate discretion, the tool and process for reporting are dependent on the amount and details of the information they wish to report coming from their facilities.

Data collection and management tools could include:

- Secure databases accessible via the corporate intranet or internet, allowing facilities to enter data directly
- Spreadsheet templates that are completed and emailed to a corporate or division office for additional processing of the data
- Faxing paper reporting forms to a corporate or division office for re-entry into a corporate database. However, if insufficient checks are in place to guarantee the accurate transfer of the data, this strategy may increase the probability of errors.

It is advised to utilize standardized reporting formats for internal reporting up to the corporate level to ensure that data collected from various business units and facilities is comparable and that internal reporting requirements are followed (see BP case study). Using standardized formats can greatly lower the likelihood of errors.

BP: A standardized system for internal reporting of GHG

Energy giant BP has centralized its internal reporting procedures into a single database system and has been gathering GHG data from various aspects of its operations since 1997. Approximately 320 different BP sites and business divisions—referred to as "reporting units"—are in charge of reporting environmental pollutants. Every quarter, all reporting units are required to produce a standard Excel pro-forma spreadsheet with actual emissions data for the previous three months and updated predictions for the current year and the following two years. In addition, all substantial deviations, including sustainable reductions, must be accounted for by reporting units. The reporting units quantify their carbon dioxide and methane emissions in accordance with the same BP GHG Reporting Guidelines "Protocol" (BP, 2000).

The central database automatically emails all pro-forma spreadsheets to the reporting units, and a corporate team uploads the full e-mail returns into the database after vetting the accuracy of the incoming data. By the end of the month after the end of each quarter, the data are then collected to produce the overall emission inventory and projections for comparison with BP's GHG target. A team of impartial outside auditors reviews the inventory in order to provide confidence regarding the reliability and accuracy of the data.

Approaches for rolling up GHG emissions data to the corporate level

Data collection on GHG emissions from a company's facilities can be done in two ways:

- Centralized: GHG emissions are computed at the corporate level from activity/fuel usage data that individual facilities report, such as the amount of gasoline consumed.
- Decentralized: Individual facilities gather activity/fuel use data, compute their GHG emissions directly using vetted techniques, and communicate this information to the corporate level.

Figure 9. Approaches to Gathering Data

	Site Level	Corporate Level
Centralized	Activity Data →	Sites report activity data (GHG emissions calculated at corporate level: activity data X emissions factors = GHG emissions
Decentralized	Activity data X emission factor = GHG emissions →	Sites report GHG emissions

In as much as both approaches lead to the collation and calculation of GHG emissions, in practice, the difference between both approaches is where the emissions calculation takes place. (i.e., where activity data is multiplied by the appropriate emission factors) and in what type of quality management procedures must be put in place at each level of the corporation. Under both approaches, initial data collection resides at the facility-level staff in general.

To prevent double accounting of emission scope, staff at corporate and lower levels of consolidation should ensure the determine and exclude any scope 2 or 3 emissions that are also accounted for as scope 1 emissions by other facilities, business units, or companies included in the emissions inventory consolidation.

Centralized Approach: Individual Facilities Report Activity/Fuel Use Data

The approach requires that facilities report their activities/fuel use data may be the preferred option if:

- Employees at the corporate or divisional level can easily calculate emissions statistics based on activity/fuel consumption data; and
- Various facilities use uniform emission computations.

The approach can also be particularly suitable for an office-based organization.

Decentralized Approach: Individual Facilities Calculate GHG Emissions Data

The approach allows an individual facility to collate and calculate its GHG emissions at the facility level. Which increases their awareness and understanding of the issue. It might also result in resistance, more training requirements, more calculation errors, and a larger necessity for auditing calculations, though.

Requesting that facilities perform their own GHG emission calculations may be the best course of action in the following scenarios:

- In-depth information on the type of equipment being utilized at facilities is necessary for GHG emission calculations;
- Different facilities use different calculation techniques for GHG emissions;
- A significant portion of overall GHG emissions come from process emissions, as opposed to emissions from burning fossil fuels;
- There are resources available to train facility workers to perform and audit these computations;
- For facility-level workers, a user-friendly interface is available to make calculations and reporting tasks simpler;
- Reporting GHG emissions at the facility level is mandated by local rules.

The requirements and characteristics of the reporting company determine the collection strategy to be used. For instance, BP utilizes a decentralized strategy and conducts audits to make sure calculations are accurate, recorded, and adhere to approved methodologies, whereas United Technologies Corporation uses a centralized approach and lets corporate staff decide on emission factors and calculations. Some businesses combine the two strategies to increase accuracy while reducing reporting requirements. While facilities with uniform emissions from common sources only report fuel use, power consumption, and travel activities, complex facilities with process emissions calculate their emissions at the facility level. After that, the reporting tool or corporate database determines the overall GHG emissions for each of these common activities.

The outcomes from the two strategies should be identical and are not mutually exclusive. Thus, businesses wishing to verify the consistency of facility-level calculations can apply both methods and compare the outcomes. Corporate personnel may want to collect activity/fuel use data even when facilities determine their own GHG emissions to verify calculations and look into potential prospects for emissions reductions. Staff at all business levels should have access to and transparency over these data. Additionally, corporate officials should confirm that the inventory boundaries, reporting periods, calculation procedures, etc. used to generate facility-reported data are clear, consistent, and approved.

Common Guidance on Reporting To Corporate Level

All pertinent information as outlined in chapter 9 should be included in reports from the plant level to corporate or division offices. Facilities must report certain categories to their corporate offices since they apply to both centralized and decentralized ways. These consist of

- A succinct summary of the sources of emissions
- A list of sources with justifications for each one's exclusion or inclusion;
- The reporting period that was covered,
- Comparative data from prior years, and any trends in the data
- Achievement of any business target
- A discussion of reported activity/fuel use/emissions data uncertainties, their probable causes, and suggestions for data improvement
- A description of the occurrences and modifications that affect the data that has been reported (acquisitions, divestitures, closures, technological advancements, modifications to the reporting boundaries or techniques used, etc.).

Reporting For the Centralized Approach

Facilities using the centralized approach by reporting activity/fuel use data to the corporate level should report on the following additional information:

- Information on activity related to passenger and freight transportation (e.g., freight transport in tonne-kilometers)
- Activity information for process emissions, such as the amount of waste dumped in landfills or the amount of fertilizer produced.
- Accurate documentation of all computations made to produce activity/fuel use data
- The conversion of fuel use and/or energy use into CO2 emissions requires the application of local emission factors.

Reporting For the Decentralized Approach

Facilities following the decentralized approach by reporting calculated GHG emissions to the corporate level should also report the following additional information:

- An explanation of the GHG calculation methods, including any modifications made since the prior reporting periods
- Ratio markers (chapter 9)
- Information on any data sources consulted for the calculations, especially details on the emission factors utilized.

It is important to keep accurate records of all calculations made to calculate emissions data for any upcoming internal or external verification.

"There's one issue that will define the contours of this century more dramatically than any other, and that is the urgent threat of a changing climate- *Barack Obama "*

7 Managing Inventory Quality

CHAPTER

Companies manage the quality of their GHG emissions inventory for a variety of reasons, such as spotting possibilities for improvement, satisfying stakeholder demands, or being ready for regulations. The GHG Protocol Corporate Standard acknowledges that these factors depend on a company's objectives and anticipated outcomes in the future. A company's corporate inventory design, quality management system implementation and handling of inventory uncertainty should be influenced by its aims for and outlook on the development of the GHG emissions issue.

A corporate GHG inventory program entails all institutional, managerial, and technical arrangements established for data collecting, inventory preparation, and implementation of measures to manage the inventory's quality.[15] The guidance in this chapter is meant to assist businesses in creating and putting into place a quality management system for their inventory.

High-quality information will be more valuable and have more applications in an uncertain future, while low-quality information may have little to no value or use and even face consequences. For instance, a business may be concentrating on a voluntary GHG program right now, but it may also want its inventory data to meet future needs when emissions would have a monetary value.

Establishing an inventory quality managing system promotes inventory consistency and is necessary to guarantee that an inventory upholds the corporate standards of the GHG Protocol and anticipates the needs of upcoming GHG emissions initiatives. Internal and external stakeholders continue to demand high-quality inventory information even though companies might not prepare for possible future regulatory mechanisms.

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[15] Although the term "emissions inventory" is used throughout this chapter, the guidance equally applies to estimates of removals due to sink categories (e.g., forest carbon sequestration).

Hence, it is significant for companies to have some form of a quality management system implemented at their facilities. The GHG Protocol Corporate Standard, in contrast, acknowledges that businesses do not possess limitless resources and that, in contrast to financial accounting, corporate GHG inventories include a degree of technical and scientific complexity. Because of this, businesses should create their inventory program and quality management system in concert with one another, taking into account their resources, the wider development of policy, and their own corporate mission.

A quality management system identifies areas where investments are most likely to improve inventory quality overall and offers a methodical approach for preventing and rectifying errors. However, verifying the accuracy of a company's GHG inventory data is the main goal of quality management. Defining inventory quality is the first step in accomplishing this goal.

Defining inventory quality

Five accounting principles are outlined in the GHG Protocol Corporate Standard, which establishes an implicit benchmark for the accurate portrayal of a company's GHG emissions through its technical, accounting, and reporting activities (chapter 1). By putting these ideas into action, topics and data will be treated and presented credibly and objectively. A corporation must incorporate quality management into its corporate inventory program to adhere to these criteria. A quality management system's objective is to make sure that these principles are followed.

KPMG: The value of integrating GHG management with existing systems

Global consulting firm KPMG discovered that the integration of GHG data management and reporting mechanisms with businesses' core operational management and assurance processes is a crucial component in the derivation of valid, verifiable GHG data.

This is due to:

Expanding the breadth of current embedded management and assurance systems is more effective than creating a distinct function in charge of producing and disclosing GHG data.

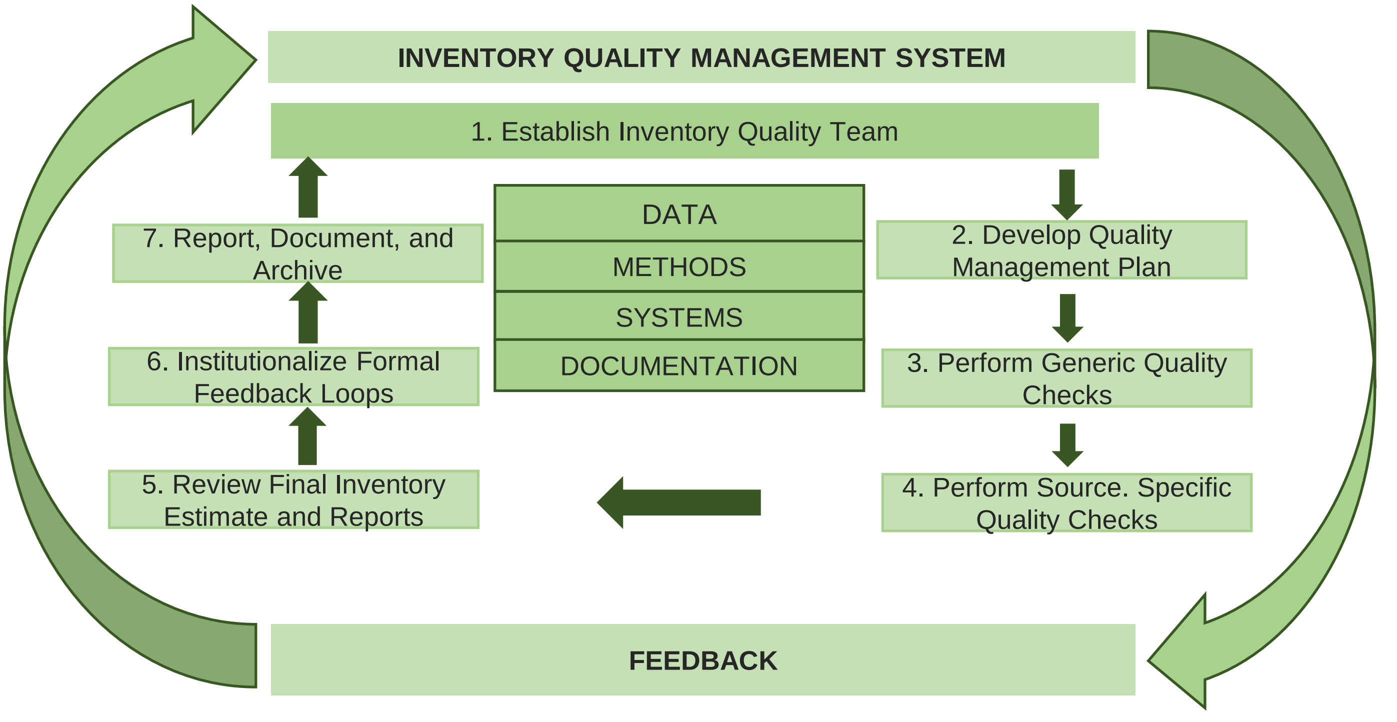
GHG data will draw the same attention as other key performance indicators of enterprises as it becomes more commercialized. In order to report accurate data, management must guarantee that the necessary procedures are in place. The organizational units in charge of corporate governance, internal audit, IT, and corporate reporting are most suited to put these policies into action.

Training of employees and dissemination of GHG objectives are two more factors that are frequently not given enough weight. Systems for data generation and reporting are only as dependable as the people using them. Because the specific reporting requirements of the business are not clearly communicated to those who must interpret a reporting standard and calculating tools, many well-designed systems fail. Inconsistent interpretation of reporting standards is a genuine danger due to the complexity of accounting boundaries and the demand for subjectivity that must accompany source inclusion and equity sharing. It is crucial that personnel in charge of providing input data are aware of its purpose. Only effective communication, sufficient training, and knowledge sharing can reduce this danger.

An inventory program framework

For businesses to envision, design, and plan for future advancements in their quality management systems, a practical framework is required. The following institutional, managerial, and technical elements of an inventory are the emphasis of this framework (Figure 10):

Figure 10: Inventory Quality Management System



- **Method:** These are the technical components of inventory preparation methods. Businesses should choose or create methodologies for emissions estimation that appropriately reflect the traits of their source categories. The GHG Protocol offers a variety of calculating tools and default approaches to support this endeavor. As new research becomes available, changes are made to business operations, or the significance of inventory reporting is increased, the architecture of an inventory program and quality management system should allow for the selection, use, and upgrading of inventory methodology.

- **Data:** These are the fundamental facts about levels of activity, emission factors, procedures, and operations. Although procedures must be sufficiently exacting and rigorous, data quality is more crucial. Poorly gathered input data cannot be made up for by any methodology. The creation of a corporate inventory program should make it easier to acquire accurate inventory data and maintain and develop collecting methods.

- **Inventory Processes and Systems**: These are the technical, managerial, and institutional steps involved in creating GHG inventories. They consist of the personnel and procedures tasked with creating an inventory of the highest caliber. Where applicable, these systems and processes may be integrated with other business quality-related processes to simplify the management of GHG inventory quality.

- **Documentation:** This serves as a record of the procedures, information, systems, and assumptions utilized to create an inventory. It comes with everything staff members require to set up and enhance a business' inventory. Since estimating GHG emissions is fundamentally technical (involves engineering and science), credibility is especially dependent on high-quality, open documentation. Information will not be useful if it is not reliable or if it cannot be successfully shared with internal or external stakeholders.

At each stage of the design of their inventory, businesses should work to assure the quality of these components.

Implementing an inventory quality management system

All four of the aforementioned inventory components should be covered by a company's quality management system. The following actions must be taken by a business in order to install the system:

1. Establish an inventory quality team. The implementation of a quality management system and ongoing improvement of inventory quality should fall under the purview of this team. Interactions between pertinent business units, facilities, and external organizations like government agency programs, research institutes, verifiers, or consulting firms should be coordinated by the team or management.

2. Develop a quality management plan. This plan outlines the measures a firm is taking to put its quality management system into place. This system should be incorporated into the design of the company's inventory program from the start, while additional rigor and coverage of some procedures may be phased in over some years. Procedures for all organizational levels and inventory creation processes—from initial data collecting to final account reporting—should be included in the strategy. Companies should incorporate (and expand as necessary) current quality processes to address GHG management and reporting for efficiency and thoroughness. Like any ISO guidelines. To ensure accuracy, the plan's main emphasis should be on doable steps for putting the quality management system into practice, as outlined in phases three and four.

3. Perform generic quality checks. These apply to all inventory data and operations, concentrating on adequately stringent quality checks for data management, documentation, and emission calculation activities (e.g., ensuring that correct unit conversion are used).

Achieving A Greener Earth, Resonates With Having Accurate And Well Collated GHG Emissions Data.

Table 3. Generic Quality Management Measures[16]

DATA GATHERING, INPUT, AND HANDLING ACTIVITIES
• Check a sample of input data for transcription errors • Identify spreadsheet modifications that could provide additional controls or checks on quality • Ensure that adequate version control procedures for electronic files have been implemented • Others
Data Documentation
• Confirm that bibliographical data references are included in spreadsheets for all primary data • Check that copies of cited references have been archived • Check that assumptions and criteria for selection of boundaries, base years, methods, activity data, emission factors, and other parameters are documented • Check that changes in data or methodology are documented • Others
Calculating Emissions And Checking Calculations
• Check whether emission units, parameters, and conversion factors are appropriately labeled • Check if units are properly labeled and correctly carried through from beginning to end of calculations • Check that conversion factors are correct • Check the data processing steps (e.g., equations) in the spreadsheets • Check that spreadsheet input data and calculated data are clearly differentiated • Check a representative sample of calculations, by hand or electronically • Check some calculations with abbreviated calculations (i.e., back-of-the-envelope calculations) • Check the aggregation of data across source categories, business units, etc. • Check the consistency of time series inputs and calculations • Others

4. **Perform source-category-specific quality checks**.

For particular source categories, this entails more thorough investigations into the proper application of boundaries, recalculation processes, and adherence to accounting and reporting principles, as well as the quality of the data input, used (for instance, whether electricity bills or meter readings are the best sources of consumption data) and a qualitative description of the main sources of data uncertainty. A quantitative assessment of uncertainty can also be supported by the data from these experiments. The section on implementation below offers advice on these investigations.

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[16] https://ghgprotocol.org/sites/default/files/standards/ghg-protocol-revised

5. Review final inventory estimates and reports.

An internal technical review should concentrate on the inventory's engineering, scientific, and other technical facets after it has been finished. An internal managerial assessment should then concentrate on getting the inventory official corporate approval and endorsement. Chapter 10 discusses the third sort of assessment utilizing specialists outside the company's inventory program.

Following the completion of an inventory, is an internal technical review focused on its engineering, scientific, and other technical aspects. Afterward, securing official corporate approval and support for the inventory should be the focus of the internal managerial review. An external expert review of the company's inventory program discussed in chapter 10 will be the final consideration.

6. Institutionalize formal feedback loops.

The individual or team chosen in step one should receive formal feedback procedures' results from the reviews in step five as well as the results of every other part of a company's quality management system. Based on this feedback, mistakes should be fixed and improvements introduced.

7. Establish reporting, documentation, and archiving procedures.

The system should have record-keeping protocols that outline what data will be recorded for internal use, how that data should be maintained, and what data has to be reported to stakeholders outside the system. These record-keeping procedures contain formal feedback channels, just as internal and external reviews.

In line with a company's goals for creating an inventory, the quality management system and entire inventory program should be viewed as changing. The plan should include procedures to guarantee that all quality control results from prior years are effectively addressed as well as the company's strategy for a multi-year implementation (i.e., acknowledge that inventories are a long-term endeavor).

Practical measures for implementation

Any advice on quality management would be lacking without a discussion of useful inventory quality measurements, even though concepts and broad program design guidelines are crucial. These procedures should be put in place by a corporation at various points along the way, from the first data gathering stage through the last corporate inventory approval stage. The beginning phase of data collecting, as well as during calculation and data aggregation, are crucial times to adopt these safeguards in the inventory program because these are the times when errors are most likely to occur. Although the quality of corporate level inventories may be initially prioritized, it is crucial to make sure quality measures are implemented at all levels of disaggregation (e.g., facility, process, geographical, according to a particular scope, etc.) to be better prepared for GHG markets or regulatory requirements in the future.

Additionally, businesses must guarantee the accuracy of their historical emission estimations and trend information. They can accomplish this by using inventory quality measures to reduce biases that may result from changes in the details of the data or procedures used to produce historical emission estimates, as well as by adhering to the standards and recommendations of chapter 5.

The third step of a quality management system, as described above, is to implement generic quality measures. These measures apply to all source categories and all levels of inventory preparation. A typical list of these measurements is provided in Table 3

Source category-specific data quality investigations are the fourth phase in a quality management system. These investigations' findings can be used for both quantitative and qualitative evaluations of data uncertainty (section on uncertainty). The various source-specific quality measurements that can be used for emission factors, activity data, and emission estimates are discussed below.

Emission Factors and Other Parameters

Source categories are different, for some categories, emissions calculation will mainly depend on emissions factors and other parameters (e.g., utilization factors, oxidation rates, methane conversion factors).[17] These variables and conditions could be default variables or published variables based on company-specific data, site-specific data, direct emission data, or other measurements. Except where mass or volume-based factors have been measured at the company- or site-specific level, published emission factors for fuel consumption are typically more accurate than those based on fuel energy content. The representativeness and applicability of emission factors and other metrics to the unique characteristics of an organization must be evaluated in quality investigations. Based on the operational features of the organization, differences between measured and default values need to be qualitatively justified and explained.

Activity Data

The biggest obstacle to business GHG inventories is frequently the collecting of reliable activity data. Therefore, while designing an inventory program for any organization, establishing reliable data gathering techniques needs to be given first attention. The following actions can help to guarantee the accuracy of activity data:

- Create data gathering methods that make it possible to acquire the same data in future years in an efficient manner.
- Before applying carbon content emission factors, convert fuel consumption data to energy units. The energy content of a fuel may be more closely related to emissions than its mass.
- Contrast statistics from this year with earlier trends. When data don't vary consistently from year to year, it's important to look into what's causing these patterns (e.g., changes of over 10 percent from year to year may warrant further investigation).
- When feasible, compare activity data with business data from other reference sources (such as government surveys or statistics provided by trade associations). These checks can guarantee that all parties are receiving data that is consistent.
- Examine activity data that is produced for reasons aside from compiling a GHG inventory. Companies will next need to assess the data's suitability for inventory purposes, including its completeness, consistency with the definition of the source category, and consistency with the chosen emission criteria. For instance, data from various sites may be checked for inconsistencies in measuring methods, operational settings, or technological advancements. It's possible that quality control procedures (like ISO) were already carried out when the data was being initially prepared. These measures can be integrated with the company's inventory quality management system.

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[17] Some emission estimates may be derived using mass or energy balances, engineering calculations, or computer simulation models. In addition to investigating the input data to these models, companies should also consider whether the internal assumptions (including assumed parameters in the model) are appropriate to the nature of the company's operations.

- Verify that the right and consistent use of base year recalculation methods has been made (chapter 5).
- Verify that the decisions made about operational and organizational boundaries have been consistently and correctly applied to the gathering of activity data (chapters 3 and 4)
- Find out if biases or other traits that potentially affect data quality have already been recognized (for instance, by speaking with specialists at a certain institution or elsewhere). A bias can, for instance, result from the unintended removal of operations at smaller facilities or information that does not quite match the organizational boundaries of the business.
- Increase the scope of quality management practices to include any extra data (sales, production, etc.) used to calculate emission intensities or other ratios.

Emission Estimates

To make sure the estimated emissions for a source category are within a suitable range, they can be compared to previous data or other estimates. Potentially incorrect estimations are a reason to evaluate emission factors or activity data and see if method changes, market forces, or other occurrences are valid justifications for the adjustment. The data from monitors can be compared with computed emissions using activity data and emission factors in circumstances when actual emission monitoring happens (for example, CO_2 emissions from power plants).

More thorough examinations into the correctness of the data or the suitability of the procedures may be necessary if any of the aforementioned emission factors, activity data, emission estimate, or other parameter checks point to an issue. These more thorough examinations can also be used to more accurately evaluate the data quality. An evaluation of the uncertainty of the data, both quantitatively and qualitatively, is one potential metric of data quality.

Inventory Quality and Inventory Uncertainty

Making a GHG inventory is by its very nature both a scientific and an accounting effort. The majority of applications for company-level emissions and removal estimates need that these data be presented in a manner resembling that of financial accounting data. Individual point estimations are typically reported in financial accounting (i.e., single value versus a range of possible values). In contrast, reporting quantitative data with estimated error boundaries is the norm for the majority of scientific investigations of GHG and other emissions (i.e., uncertainty). Point estimates in a corporate emission inventory have clear uses, just as financial data in a profit and loss or bank account statement. But how would or ought the use of a quantitative measure of uncertainty be included in an emission inventory?

The major utility of this information would almost definitely be comparative in an ideal scenario if a corporation has exact quantitative information on the uncertainty of its emission projections at all levels. These comparisons may be conducted between businesses, business units, source categories, or over time. In this case, uncertainty would be the objective quantitative criterion for quality, and inventory estimations may even be graded or reduced according to their quality before being employed. Unfortunately, there aren't many estimates of objective uncertainty.

Types of Uncertainties

Scientific uncertainty and estimate uncertainty are two main categories of uncertainties related to GHG inventories. When the science underlying the actual emission and/or removal process is not fully understood, scientific uncertainty results. For instance, there is a great deal of scientific uncertainty surrounding numerous direct and indirect aspects connected with global warming potential (GWP) values that are used to combine emission estimates for different GHGs. Such scientific uncertainty is exceedingly difficult to analyze and quantify, and most firm inventory procedures are unlikely to be able to do so.

Every time GHG emissions are quantified, estimation uncertainty develops. Therefore, there is estimated uncertainty associated with every estimate of emissions or removal.

Model uncertainty and parameter uncertainty are two additional categories for estimation uncertainty. [18]

When we talk about model uncertainty, we're talking about the uncertainty surrounding the mathematical formulas (also known as models) that are used to describe the connections between different parameters and emission processes. For instance, incorrect usage of a mathematical model or unsuitable input into the model may lead to model uncertainty. Similar to estimating scientific uncertainty, estimating model uncertainty is probably beyond the capabilities of the majority of companies. Nevertheless, some businesses may want to make use of their specialized engineering and scientific knowledge to assess the uncertainty in their emission estimation models.

The uncertainty related to estimating the parameters used as inputs (such as activity data and emission variables) into estimation models are referred to as parameter uncertainty. Through the statistical analysis, assessments of the precision of the measuring apparatus, and professional judgment, parameter uncertainties can be assessed. Companies that decide to look into the uncertainty in their emission inventories will primarily concentrate on quantifying parameter uncertainties and then calculating source category uncertainties based on these parameter uncertainties.

Limitations of Uncertainty Estimates

Uncertainty estimates for corporate GHG inventories will always be inaccurate because only parameter uncertainties are within the reach of the majority of businesses. It won't always be possible to quantify the statistical uncertainty [19] in every parameter with complete and reliable sample data. Only one data point may be provided for the majority of factors (such as the number of liters of gasoline purchased or tonnes of limestone consumed). In some circumstances, businesses can use data on equipment accuracy or calibration to guide their estimation of statistical uncertainty. Nevertheless, to quantify

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[18] Emissions estimated from direct emissions monitoring will generally only involve parameter uncertainty (e.g., equipment measurement error).

[19] Statistical uncertainty results from natural variations (e.g., random human errors in the measurement process and fluctuations in measurement equipment). Statistical uncertainty can be detected through repeated experiments or sampling of data

some of the systematic uncertainties connected with parameters and to support statistical. [20]

Companies will typically have to rely on expert judgment for uncertainty estimations. Expert judgment [21] has the drawback of being challenging to get in a comparable (i.e., unbiased) and uniform manner across parameters, source categories, or businesses.

Due to these factors, nearly all extensive assessments of uncertainty for GHG inventories will be imprecise, have a subjective element, and despite the most diligent efforts, are still regarded as highly uncertain. Most of the time, uncertainty estimations cannot be used to determine a product's quality objectively. Additionally, they cannot be used to contrast the accuracy of emission estimates from various source types or businesses.

The following situations are exceptions to this rule where it is considered that instrument precision data or statistical data are available to determine each parameter's statistical uncertainty objectively (i.e., expert judgment is not required):

- The differences in scientific or model uncertainty can, for the most part, be overlooked when two operationally comparable facilities utilize the same emission estimating methodology. Then, it is possible to treat quantified estimates of statistical uncertainty as being comparable across facilities. Some trading programs that specify particular monitoring, estimate, and measurement requirements seek this kind of comparison. Even in this case, the degree of comparability is still influenced by the participants' estimation of emissions' flexibility, the homogeneity of facilities, the degree of enforcement, and the scrutiny of the methodology employed.
- The systematic parameter uncertainties in a source's emission estimates for two years, in addition to the scientific and model uncertainties, are, for the most part,

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[20] Systematic parameter uncertainty occurs if data are systematically biased. In other words, the average of the measured or estimated value is always less or greater than the true value. Biases arise, for example, because emission factors are constructed from non-representative samples, all relevant source activities or categories have not been identified, or incorrect or incomplete estimation methods or faulty measurement equipment have been used. Because the true value is unknown, such systematic biases cannot be detected through repeated experiments and, therefore, cannot be quantified through statistical analysis. However, it is possible to identify biases and, sometimes, to quantify them through data quality investigations and expert judgments

[21] The role of expert judgment can be twofold: First, it can provide the data necessary to estimate the parameter. Second, it can help (in combination with data quality investigations) identify, explain, and quantify both statistical and systematic uncertainties.

the same when a single facility employs the same estimation approach each year. [22] The uncertainty in an emission trend (for example, the difference between the estimates for two years) is typically lower than the uncertainty in total emissions for a single year since the systematic parameter errors then balance out. In such a case, quantified uncertainty estimates can be used to monitor relative changes in the accuracy of a facility's emission predictions for that source category and can be viewed as being comparable over time. A facility's emissions reduction target can be established using these estimations of emission trend uncertainty. Due to the inherent issues with the comparability of uncertainty estimates across gases, sources, and facilities, trend uncertainty estimates are likely to be less helpful for setting broader (e.g., corporate-wide) targets (chapter 11).

Given these constraints, the following are some of the functions of qualitative and quantitative uncertainty assessments in creating GHG inventories:

- Supporting a thorough process of learning and feedback.
- Assisting with efforts to qualitatively comprehend and record the sources of uncertainty and contribute to the discovery of strategies for enhancing inventory quality. For instance, gathering the data necessary to ascertain the statistical features of activity data and emission factors necessitates asking challenging questions and meticulously and methodically examining data quality.
- Creating channels of communication and receiving feedback from data suppliers to pinpoint particular chances to raise the caliber of the data and the techniques employed.
- Giving reviewers, verifiers, and managers useful data to help them prioritize efforts in bettering data sources and techniques.

An additional guidance document on uncertainty assessments ("Guidance on uncertainty assessment in GHG inventories and calculating statistical parameter uncertainty") and an uncertainty calculation tool have been created by the GHG Protocol Corporate Standard and are both accessible on the GHG Protocol website. The instructions for using the calculating tool to aggregate uncertainty are provided in the guideline document. Additionally, it goes into greater detail about the many kinds of uncertainties, the drawbacks of quantitative uncertainty assessment, and the right interpretation of uncertainty estimates.

EPA's Emissions Inventory Improvement Program, Volume VI: Quality Assurance/Quality Control (1999) and chapter 6 of the IPCC's Good Practice Guidance contain additional advice and details on assessing uncertainty, as well as optional methods for creating quantitative uncertainty estimates and soliciting expert opinions (2000a).

- Promoting broader learning and quality feedback process.
- Enable efforts towards qualitative understanding and detailing cases of uncertainty and help discover opportunities to improve inventory quality. For example, collating data needed to decide the statistical properties of activity data and emission factors encourages one to ask hard questions and carefully and systematically investigate data quality.
- Initiate lines of communication and feedback with data suppliers to point out precise opportunities to improve the quality of the data and methods used.
- Supplying beneficial information to reviewers, verifiers, and managers for setting priorities for investments into improving data sources and methodologies.

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[22] It should be recognized, however, that biases may not be constant from year to year but instead may exhibit a pattern over time (e.g., may be growing or falling). For example, a company that continues to disinvest in collecting high quality data may create a situation in which the biases in its data get worse each year. These types of data quality issues are extremely problematic because of the effect they can have on calculated emission trends. In such cases, systematic parameter uncertainties cannot be ignored.

The GHG Protocol Corporate Standard has an additional guidance document on uncertainty assessments (“Guidance on uncertainty assessment in GHG inventories and calculating statistical parameter uncertainty”) along with an uncertainty calculation tool, both of which are available on the GHG Protocol website. The guidance document describes how to use the calculation tool in aggregating uncertainties. It also discusses in more depth different types of uncertainties, the limitations of quantitative uncertainty assessment, and how uncertainty estimates should be properly interpreted. Additional guidance and information on assessing uncertainty—including optional approaches to developing quantitative uncertainty estimates and eliciting judgments from experts— can also be found in EPA's Emissions Inventory Improvement Program, Volume VI: Quality Assurance/Quality Control (1999) and in chapter 6 of the IPCC’s Good Practice Guidance (2000a).

Balancing the Scale will require an equal amount in emissions reduction as well as residual removal of GHG to that being emitted

8

Accounting for GHG Reduction

CHAPTER

It is becoming more and more important for businesses to comprehend the ramifications of accounting for changes in GHG emissions over time on the one hand, and accounting for offsets or credits that result from GHG reduction projects on the other, as external GHG programs, emission trading systems, and voluntary reporting all develop. This chapter explains the various problems connected to "GHG reductions."

Accounting and reporting for GHG emissions at the corporate or organizational level are the main objectives of the GHG Protocol Corporate Standard. Corporate emissions reductions are determined by analyzing variations in the company's actual emissions inventory over time in comparison to a base year. The advantage of helping businesses manage their aggregate GHG risks and opportunities more effectively is the focus on total corporate or organizational level emissions. It also aids in concentrating resources on tasks that yield the most affordable GHG reductions.

The upcoming GHG Protocol Project Quantification Standard is focused on the quantification of GHG reductions from GHG mitigation projects that will be utilized as offsets, as opposed to corporate accounting. To make up for (or "offset") GHG emissions elsewhere, such as to reach a voluntary or mandated GHG target or cap, offsets are discrete GHG reductions. The baseline used to calculate offsets is a fictitious scenario of what emissions would have been in the absence of the project.

Corporate GHG Reductions at Facility or Country Level

The location of GHG emissions or reductions is irrelevant from the standpoint of the earth's atmosphere. The location of GHG reductions is important from the standpoint of national and international policymakers tackling global warming because policies typically concentrate on attaining reductions within certain countries or areas, as stated, for example, in the Kyoto Protocol. A variety of local, national, or regional policies and procedures that address GHGs from activities or facilities within a particular geographic area will therefore need to be addressed by businesses with global operations.

The GHG Protocol Corporate Standard uses a bottom-up method to determine GHG emissions. This entails figuring out emissions at the facility or source level and then summing them up to the business level. As a result, even if there are increases at some sources, facilities, or operations, a company's overall emissions may go down, and vice versa. Companies can disclose GHG emissions data at various scales, such as by individual sources or facilities, or by a group of facilities within a specific nation, thanks to this bottom-up approach.

By comparing real emissions over time for the applicable scale, businesses can satisfy a variety of governmental requirements or voluntary commitments. This data can also be applied at the business level to create and track advancement toward a GHG target (chapter 11).

Companies may find it helpful to offer information on the nature of these changes to track and explain variations in GHG emissions over time. For instance, BP requests that each of its reporting units submit such data in the following categories using an accounting movement format (BP 2000):

• Mergers and acquisitions

• Finishing/Closure

• Actual cuts or reductions (e.g., increased productivity, material or fuel substitutions)

• Modification in output level

• Modifications to the estimate process

• Other

At the corporate level, this information can be condensed to give a summary of the company's success through time.

Reductions in Indirect Emissions

Scope 2 and 3 emission reductions over time might not always fully reflect the actual emissions reduction. In most circumstances, there is no direct cause-and-effect relationship between the reporting company's activities and the resulting GHG emissions. For instance, cutting back on air travel would lower a company's scope 3 emissions, which are typically calculated using the average amount of fuel used by each passenger. However, a variety of variables control how these cuts affect the amount of GHG emissions into the atmosphere. This includes whether or whether the "empty seat" is filled by another individual or whether the unused seat eventually results in less air traffic. In a similar vein, depending on the characteristics of the grid, applying an average grid emissions factor to determine scope 2 emissions reductions may either overestimate or underestimate the actual decrease.

In general, any such worries over accuracy shouldn't prevent businesses from disclosing their indirect emissions as long as the accounting of indirect emissions over time recognizes activities that collectively impact global emissions. It might be appropriate to do a more thorough evaluation of the actual reduction utilizing a project quantification technique in situations where accuracy is more crucial.

Project Based Reductions And Offsets/Credits:

An offsetting project meant for emission reduction should be quantified using a project quantification method, such as the impending GHG Protocol Project Quantification Standard, that addresses the following accounting issue:

• **Selection of a Baseline Scenario and Emission**.

What would have happened in the absence of the initiative is represented by the baseline scenario. The potential emissions related to this situation are known as baseline emissions. Because it is a speculative scenario for what may have occurred in the absence of the project, choosing a baseline scenario always includes some degree of uncertainty. The difference between baseline and project emissions is used to compute the project reduction. Contrary to how corporate or organizational reductions are calculated in this document—that is, for a real historical base year—this is different.

• Demonstration of Additionality.

This has to do with whether the project has caused additional emission reductions or removals beyond what would have happened in its absence. The quantification process should address additionality and show that the project itself is not the baseline and that project emissions are lower than baseline emissions if the project reduction is utilized as an offset. The integrity of the fixed cap or target for which the offset is employed is guaranteed by additionality. The organization or facility with a cap or target may emit one more unit of emissions for every reduction unit from a project that is utilized as an offset. The amount of reduction units awarded to the project will increase world emissions if it proceeds as planned (i.e., if it is not additional).

• Identification and Quantification of Relevant Secondary Effects.

These project-related changes in GHG emissions are not included in the project's main effects (s).[23] The modest, unanticipated GHG repercussions of a project are known as secondary impacts, and they include leakage (changes in the quantity or availability of a good or service that affects GHG emissions elsewhere) as well as changes in GHG emissions upstream and downstream of the project. Secondary impacts should be taken into account when calculating the projected decrease, if applicable.

• Consideration of Reversibility

Some programs reduce atmospheric carbon dioxide levels by absorbing, extracting, and/or storing carbon through biological or non-biological sinks (for example, forestry, land use management, and subterranean reservoirs). However, carbon dioxide that has been removed from the atmosphere in the past may return to it in the future due to planned or unintentional actions such as the harvesting of forests or forest fires. [24] The reduction initiative might only be temporary, which is the cause. As a result, it's crucial to evaluate the likelihood and risk of reversibility together with any compensatory or mitigating measures incorporated into the project design.

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[23] Primary effects are the specific GHG reducing elements or activities (reducing GHG emissions, carbon storage, or enhancing GHG removals) that the project is intended to achieve.

[24] This problem with the temporary nature of GHG reductions is sometimes referred to as the “permanence” issue.

• **Avoidance of Double Counting.**

To prevent double counting, the project reductions that result in the offset must take place at sources or sinks that are not part of the target or cap for which the offset is employed. To prevent duplicate counting, it is also advisable to specify who owns reductions that occur at sources or sinks managed or owned by parties other than those involved in the project.

When utilized to satisfy an objective imposed from outside, offsets may be transformed into credits. Credits are often granted by an outside GHG program and are convertible and transferrable. They are often produced as a result of an activity, like an emissions reduction effort, and utilized to reach a goal in a system that is otherwise closed, such as a collection of facilities that are subject to an absolute emissions cap. Even though credit is typically based on the computation of the underlying decrease, the conversion of an offset into credit is typically governed by tight guidelines that can vary from program to program. For instance, the Clean Development Mechanism of the Kyoto Protocol issues credits called Certified Emission Reductions (CERs). When it is issued, this credit can be exchanged and eventually applied to the achievement of Kyoto Protocol goals. The need of defining project reductions that are to be utilized as offsets with a reliable quantification approach capable of delivering verifiable data is highlighted by experience from the "pre-compliance" market in GHG credits.

Reporting Project-Based Reductions

The physical inventory emissions of a firm's selected inventory boundary must be reported separately and independently from any GHG trades the company engages in during the reporting process. Reporting on the company's GHG trade should be done in the optional information area of the public GHG report. It is stated that either a target (see chapter 11) or corporate inventory is involved (see chapter 9).

There should be accurate information on the dependability of offsets or credits that have been bought or traded. The majority of the time, businesses report a decrease in their inventory boundaries as a result of their internal GHG reduction efforts. These reductions do not need to be reported individually unless they are sold, exchanged externally, or used in any way as an offset or credit.

- However, some businesses may be able to make adjustments to their own operations that lead to changes in GHG emissions at sources outside of their own inventory boundaries or that are missed when comparing changes in emissions over time. For instance: Using waste-derived fuel in place of fossil fuel that would otherwise be disposed of in a landfill or burned without energy recovery. Such substitution might not directly affect a company's own GHG emissions (or might even raise them). However, it might lead to emissions reductions elsewhere by a different organization, for as by avoiding the use of fossil fuels and landfill gas.
- Installing an on-site power generation facility (such as combined heat and power, or CHP, plant) that sells surplus energy to other businesses could increase a company's direct emissions while decreasing the amount of grid electricity the businesses receiving the energy use. The company building the on-site plant won't account for any subsequent emissions savings at the facilities where this electricity would have otherwise been generated.
- An on-site power production facility (such as a CHP) may increase a company's direct GHG emissions while lowering the GHG emissions linked to the generation of grid electricity if purchased grid electricity is replaced by it. This reduction may be overstated or understated when only comparing scope 2 emissions over time, if the latter is measured using an average grid emission factor, depending on the GHG intensity and the supply structure of the electricity grid.

Similar to the GHG trades mentioned above, these reductions may be individually quantified, for instance using the GHG Protocol Project Quantification Standard, and included in a company's public GHG report as optional information.

Our path to redeeming the Ecosystem will require Climate Change to go Unchecked

CHAPTER

9 Reporting GHG Emissions

An accurate, complete, consistent, and transparent GHG emissions report delivers pertinent data. Although creating a comprehensive company inventory of GHG emissions takes time, understanding will advance with practice in gathering and analyzing data. Consequently, it is advised that a public GHG report:

• Be founded on the most up-to-date information while being honest about its limitations.

• Disclose any significant inconsistencies found in prior years.

• Take into account the company's gross emissions for the inventory boundary it has selected, apart from and unrelated to any possible GHG trades.

Reportable data must be "appropriate, comprehensive, consistent, transparent, and accurate." According to the GHG Protocol Corporate Standard, scope 1 and scope 2 emissions must be reported at a minimum.

Required Information

The following details must be included in a public GHG emissions report that complies with the GHG Protocol Corporate Standard.

Description of the Company and Inventory Boundary

- A description of the organizational divisions, together with the consolidation strategy used.
- A description of the operational boundaries picked, and, if scope 3 is included, a list indicating the categories of activities covered.
- The reporting period was covered.

Information on Emissions

Total emissions under scopes 1 and 2 without regard to any GHG transactions include allowance sales, purchases, transfers, and banking.

- Separate emissions data for each scope.
- Information on emissions for each of the six GHGs (CO_2, CH_4, N_2O, HFCs, PFCs, NF_3, and SF_6) separately, both in metric tonnes and in tonnes of CO_2 equivalent.
- The base year's selected year and an emissions profile over time that is in line with and makes clear the base year emissions recalculations policy.
- Appropriate context for any significant emissions changes (acquisitions/divestments, outsourcing/insourcing, changes in reporting boundaries or calculation methodology, etc.) that result in base year emissions recalculation.
- Emissions data are published independently from the scopes for direct CO_2 emissions from biologically sequestered carbon, such as CO_2 from burning biomass or biofuels.
- The computation or measurement techniques employed, together with a reference or link to any instruments that were used.
- Any specific sources, locations, or operations that are excluded.

Optional information

A public GHG emissions report should include, when applicable, the following additional information:

Information on Emissions and Performance

- Emissions data from relevant scope 3 emissions activities for which reliable data can be obtained.
- Emissions data further subdivided, where this aids transparency, by business units/facilities, country, source types (stationary combustion, process, fugitive, etc.), and activity types (production of electricity, transportation, generation of purchased electricity that is sold to end users, etc.).
- Emissions are attributable to the own generation of electricity, heat, or steam that is sold or transferred to another organization (see chapter 4).
- Emissions are attributable to the generation of electricity, heat, or steam that is purchased for re-sale to non-end users (see chapter 4).
- A description of performance measured against internal and external benchmarks.
- Emissions from GHGs not covered by the Kyoto Protocol (e.g., CFCs, NOx,), are reported separately from scopes.
- Relevant ratio performance indicators (e.g. emissions per kilowatt-hour generated, tonne of material production, or sales).
- An outline of any GHG management/reduction programs or strategies.
- Information on any contractual provisions addressing GHG-related risks and obligations.
- An outline of any external assurance provided and a copy of any verification statement, if applicable, of the reported emissions data.
- Information on the causes of emissions changes that did not trigger a base year emissions recalculation (e.g., process changes, efficiency improvements, plant closures).
- GHG emissions data for all years between the base year and the reporting year (including details of and reasons for recalculations, if appropriate)
- Information on the quality of the inventory (e.g., information on the causes and magnitude of uncertainties in emission estimates) and an outline of policies in place to improve inventory quality. (chapter 7).

- Information on any GHG sequestration.
- A list of facilities included in the inventory.
- A contact person

Information on Offsets

- Information on offsets, broken down into GHG storage/removal and emissions reduction initiatives that have been acquired or created beyond the inventory boundaries. Indicate whether the offsets have been reviewed, certified, and/or approved by an outside GHG program (such as the Clean Development Mechanism or Joint Implementation) (see chapter 8).

- Details on cuts made at sources inside the inventory boundary that were transferred or sold to a third party as offsets. Indicate whether the reduction has been confirmed, certified, or approved by an outside GHG program (chapter 8).

By adhering to the reporting criteria of the GHG Protocol Corporate Standard, users adopt a thorough standard with the essential detail and openness for reliable public reporting. The goals and target audience for the report can help establish the appropriate level of reporting for optional information categories. Reporting requirements may differ for national or voluntary GHG programs, or for internal management purposes (Appendix C explains the requirements of several GHG programs).

For public reporting, it is crucial to distinguish between a full public report that contains all the required data as specified by the reporting standard outlined in this volume and a summary of a public report that is, for instance, published on the Internet or in Sustainability/Corporate Social Responsibility reporting (e.g., Global Reporting Initiative). Not every circulating report needs to have all the information required by this standard, but there needs to be a link or reference to a full report that is publicly accessible and contains all the information. Giving data on emissions for particular GHGs, facilities, or business units, or disclosing ratio indicators, may threaten company confidentiality to some companies. If this is the case, the data can, provided anonymity is protected, be made available to persons auditing the GHG emissions data without having to be publicly publicized.

Companies should make an effort to produce reports that are as transparent, precise, consistent, and thorough as they can be. This can be done structurally by using the standard's reporting categories as the foundation of the report, such as the required description of the company and inventory boundary, the mandatory disclosure of corporate emissions, the optional disclosure of emissions and performance, and the mandatory disclosure of offsets. When describing the reporting company's inventory efforts qualitatively, it may be helpful to discuss the company's strategy and goals for GHG accounting, any unique difficulties or trade-offs encountered, the context of decisions on boundaries and other accounting parameters, and an analysis of emissions trends.

Double Counting

Businesses must be careful to recognize and exclude from reporting any scope 2 or scope 3 emissions that are already reported as scope 1 emissions by other facilities, business units, or businesses included in the emissions inventory consolidation (see chapter 6)

Use of Ratio Indicators

Management and stakeholders are interested in two main GHG performance factors. One relates to a company's overall GHG effect, or the precise volume of GHG emissions emitted into the atmosphere. The other relates to a ratio indicator created by normalizing the company's GHG emissions by a business metric. Reporting of ratio indicators is not required by the GHG Protocol Corporate Standard, although reporting of absolute emissions is.

Ratio indicators can be used to compare similar products and processes across time and provide information on the performance of a certain business type. Companies may opt to provide GHG ratio indicators for the following reasons:

- Evaluate and compare the performance of the company over time (e.g., relate data from several years, spot trends in the data, and demonstrate performance in relation to goals and base years) (chapter 11).
- Create a connection between data from several categories. For instance, a business might seek to connect the value an action delivers (such as the cost of a tonne of goods) to the effects it has on people or the environment (e.g., emissions from product manufacturing).
- Normalizing data improves the comparability across various business sizes and processes. (For instance, by evaluating the effects of various business sizes on the same scale).

It is crucial to understand that misleading signs might occur due to the intrinsic diversity of businesses and the specifics of each company. A seemingly insignificant adjustment in a method, product, or location can have a big impact on the environment. Therefore, to properly create and evaluate ratio indicators, one must be aware of the business context.

Businesses may create ratios that make the most sense for their company and meet their needs for making decisions. They can choose ratios for external reporting that help their stakeholders better understand and analyze their performance.

It's critical to offer some context on issues like scale and indication restrictions so that consumers may comprehend the nature of the information being delivered. Businesses should think about which ratio indicators best reflect the advantages and consequences of their operations, their products, and their effects on the market and the overall economy. Here are a few illustrations of various ratio indicators.

Productivity/Efficiency Ratios.

Productivity/efficiency ratios represent a business's worth or accomplishment to its influence on greenhouse gases. Efficiency ratios are rising, which indicates an improved performance. Resource productivity, such as sales per GHG, and process eco-efficiency, such as production volume per GHG, are two examples of productivity/efficiency ratios.

Intensity Ratios.

The impact of GHGs on each unit of physical activity or economic production is expressed by intensity ratios. When combining or contrasting different firms that offer comparable items, a physical intensity ratio is appropriate. When combining or contrasting multiple enterprises that make various products, an economic intensity ratio is appropriate. A decreasing intensity ratio indicates an improved performance. Utilizing intensity ratios, many businesses have historically monitored environmental performance. Ratios of intensity are frequently referred to as "normalized" environmental effect data. Examples of intensity ratios include those for product emissions (such as tonnes of CO_2 emissions per unit of electricity generated), service intensity (such as GHG emissions per function or service), and sales intensity (e.g., emissions per sales).

Percentages:

A ratio between two comparable problems (with the same physical unit in the numerator and denominator) is referred to as a percentage indicator. Current GHG emissions stated as a percentage of base year GHG emissions are an example of a percentage that can be useful in performance reports. Refer to CCAR, 2003, GRI, 2002, and Verfaillie and Bidwell, 2000 for more information on ratio indicators.

“The Earth is a fine place and worth fighting for- *Ernest Hemingway”*

10 Verification GHG Emissions

CHAPTER

GHG emissions inventory verification is an important aspect of GHG reporting. Verification is an objective evaluation of the completeness, correctness, and adherence to accepted GHG accounting and reporting rules of provided GHG information. Although the process of verifying corporate GHG inventories is still in its infancy, the emergence of widely accepted standards, like the GHG Protocol Corporate Standard and the upcoming GHG Protocol Project Quantification Standard, should aid in the uniformity, credibility, and acceptance of GHG verification.

This chapter further elaborates on key components and major considerations in the GHG verification process. Companies are encouraged to ascertain for themselves an independent verification of their GHG emission results and system. This applies to companies having existing inventory information, developing or considering doing so. Furthermore, as the process of developing a verifiable inventory is largely the same as that for obtaining reliable and defensible data, this chapter is also relevant to all companies regardless of any intention to commission a GHG verification.

Verification entails evaluating the likelihood of significant differences in reported data. Discrepancies are inconsistencies between data that has been reported and data that has been produced using the correct standards and techniques. Verification in practice entails the verifier directing their efforts in a priority order toward the data and related systems that have the biggest effects on the quality of the data as a whole.

Relevance of GHG Principles

The main goal of verification is to assure users that the information that has been published and the assertions that go along with it are an accurate representation of a company's GHG emissions. For verification, it is essential to make sure that the inventory data is transparent and verifiable. It will be easier to verify an organization's emissions data and processes if they are more open, well-managed, and well-documented. There are a variety of GHG accounting and reporting rules that must be followed while creating a GHG inventory, as described in chapter 1. The foundation of a successful verification is adherence to these principles and the presence of an open, well-documented system (also known as an audit trail).

Goals.

Companies are advised to precisely define their goal and determine whether this goal best meets the standards of external verification, before entering into an independent verification. Common reasons for undertaking a verification include:

- Increasing the credibility of publicly disclosed emissions data and GHG target progress to increase stakeholder trust.
- Increasing the trust of senior management in the presented data as a foundation for investment and goal-setting decisions.
- Possibility to enhance internal accounting and reporting procedures (e.g., computation, recording, internal reporting systems, and the use of GHG accounting and reporting standards), as well as to broaden internal knowledge sharing.
- Getting ready for GHG program mandated verification criteria.

Internal Assurance

While a neutral, external third party frequently conducts verification, this may not always be the case. Numerous businesses looking to improve their GHG inventories may submit their data for internal validation by staff unrelated to the GHG accounting and reporting procedure. The techniques and processes for internal and external verification should be consistent. The credibility of the GHG inventory is anticipated to be greatly increased for external stakeholders by external third-party verification. Independent internal checks, however, can also offer significant assurance over the accuracy of information.

Before hiring a third party to conduct an external verification, a corporation may find that conducting internal verification is a valuable learning experience. Additionally, it can give external verifiers useful data to get started on their work.

The Concept of Materiality

Grasp the verification process requires an understanding of the term "materiality." The relationship between the idea of materiality and the principle of completeness is helpfully explained in Chapter 1. Any information that is either included or left out of a report and has the potential to affect the choices or actions made by its readers is regarded as relevant to the report. A considerable discrepancy is a mistake that causes a reported amount or statement to diverge materially from its true value or meaning (for instance, due to oversight, omission, or miscalculation). To be able to give an opinion on data or information, a verifier would need to create a perspective on the materiality of all discovered errors or doubts.

While the idea of "materiality" involves a value judgment, the "materiality threshold"—the point at which a difference becomes significant—is typically pre-established. An error is generally seen as materially deceptive.

The verifier must carry out a thorough context assessment for the error within which the information is supplied if the error value exceeds 5% of the total inventory for the section of the organization being verified. For instance, it would probably be deemed substantial if a 2% error prevented a corporation from meeting its corporate goal. Businesses will be better able to determine whether the exclusion of a specific source or activity from their inventory is likely to raise issues of materiality if they are aware of how verifiers apply a materiality standard.

Depending on who is demanding the verification and why materiality criteria may either be specified in the requirements of a particular GHG program or defined by a national verification standard. Verifiers might focus their efforts on areas that are more likely to result in materially misleading errors by using a materiality criterion to provide insight into what might be an immaterial discrepancy. Diminish emissions, or the permitted amount of emissions that a corporation can omit from its inventory, are not the same as a materiality criterion.

Assessing the Risk of Material Discrepancy

The components of the GHG information collection and reporting process shall be a subject of assessment to determine the risk of material discrepancy by verifiers. The objective is to be able to plan and direct the verification process. The risk assessment takes into consideration such as:

- The organizational structure and the method used to assign responsibility for monitoring and reporting GHG emissions
- Management's strategy and dedication to GHG monitoring and reporting
- Creating and implementing procedures and policies for monitoring and reporting, including methodologies that are documented and explain how data is produced and assessed.
- Procedures for examining and evaluating calculating methods
- Operation complexity and nature
- The complexity of the information processing system that uses computers
- The structure of the organization and the approach used to assign responsibility for monitoring and reporting GHG emissions
- The calibration and upkeep status, as well as the sorts of meters, utilized,
- Data input availability and dependability
- Estimates and assumptions were used
- Compilation of information from several sources
- Additional assurance procedures (such as internal audits, external reviews, and certifications) to which the systems and data are submitted.

Establishing the Verification Parameters

The objectives of the organization and/or any particular jurisdictional requirements will have an impact on the extent of independent verification and the level of confidence it delivers. The complete GHG inventory or only a portion of it can be verified. Discrete components can be specified based on their geographical location, organizational structure, facility type, and emission type. The verification process may also look at more general managerial issues such as internal review procedures, managerial knowledge, resource availability, clearly defined roles, and the separation of duties. The scope, level, and goal of the verification should be agreed upon in advance by the company and the verifier.

This agreement (often referred to as the scope of work) will cover matters like which data is to be included in the verification (for example, information from all sites or just the head office consolidation), the level of scrutiny to which chosen data will be subjected (for example, desktop review or on-site review), and the intended use of the verification's results. Another factor to take into account while determining the work's scope is the materiality level. It is related to the verification's goals and will be an important factor for both the verifier and the firm.

For the organization, the verifier, and external stakeholders to be able to make informed and appropriate judgments, a well-defined scope of work is crucial. Verifiers will make sure that certain exclusions weren't introduced just to boost the performance of the business. Companies should make the scope of work publicly available to increase transparency and credibility.

Site visits

The verification of GHG information reported may require some site visits by verifiers. This is to enable them to obtain sufficient, appropriate evidence of the completeness, accuracy, and reliability of reported information. Nevertheless, this is also dependent on the level of assurance required from verification. The sites visited should be representative of the organization as a whole. Consideration for site section and visit:

- Each site's specific operations and sources of GHGs
- The difficulty of gathering and calculating emissions data
- Each site's percentage contribution to overall GHG emissions
- The possibility that online data will be significantly incorrect
- The abilities and education of important employees
- The outcomes of earlier reviews, checks, and uncertainty analyses

Timing of the verification

At several stages of the GHG preparation and reporting process, a verifier may be engaged. To make sure that GHG data standards are being maintained and continually enhanced, some businesses may create a semi-permanent internal verification team. A reporting period's worth of verification enables any reporting errors or data problems to be fixed before the final report is written. The preparation of high-profile public reports by businesses may find this to be very helpful. However, some GHG programs (such as the EU ETS, the Greenhouse Challenge program in Australia, and the World Economic Forum Global GHG Registry) may demand that independent verification of the GHG inventory be made after the submission of a report. In both instances, the verification cannot be completed until the last piece of data for the period has been sent in.

Selecting a verifier

When choosing a verifier, some things to take into account are:

- prior expertise and proficiency in performing GHG verification
- comprehension of GHG concerns, including calculation techniques
- knowledge of the business's operations and sector
- Independence, objectivity, and trustworthiness.

It is crucial to understand that the knowledge and credentials of the person or people conducting the verification may be more significant than those of the company or companies they work for. Businesses should choose organizations based on the expertise and credentials of their real verifiers, and they should also make sure that the lead verifier allocated to them has the necessary experience. Effective verification of GHG inventories frequently calls for a combination of specialized skills, both technical (such as engineering experience or industry experts) and business-related (e.g., verification and industry specialists).

PricewaterhouseCoopers: GHG inventory verification— lessons from the field

For the past ten years, the global services firm PricewaterhouseCoopers (PwC) has been conducting GHG emissions verifications in a number of industries, including pulp and paper, energy, chemicals, metals, and semiconductors. Two crucial steps are included in PwC's verification process:

1. An assessment of the effectiveness of the GHG accounting and reporting technique (such as the GHG Protocol Corporate Standard).

2. The location of any significant errors.

PwC's development of a successful GHG verification methodology has benefited greatly from the GHG Protocol Corporate Standard. The accuracy and verifiability of reported GHG statistics have rapidly improved since the first edition's publication, according to PwC. Particularly, there has been a significant improvement in the estimation of combustion emissions and non-CO2 GHGs. The WBCSD cement sector tool has made it simpler to verify emissions from the cement industry. Since most businesses have accurate information on MWh consumed and emission factors are readily accessible to the public, GHG emissions from purchased power are similarly simple to verify. The majority of companies' GHG data for 1990, however, has proven to be too inaccurate to serve as a credible base year for tracking emissions over time or establishing GHG targets. Auditing GHG emissions from waste fuels, co-generation, passenger travel, and shipping also continues to provide difficulties.

PwC has observed a progressive change in GHG verification processes over the past three years, going from "customized" and "voluntary" to "standardized" and "mandated." A kind of emissions verification is required by the California Climate Action Registry, the Global GHG Registry maintained by the World Economic Forum, and the upcoming EU ETS (which will apply to 12,000 industrial sites in Europe). GHG verifiers in the EU ETS will probably need to be accredited by a national body. Processes for GHG verifier accreditation have previously been created in California for registering emissions in the CCAR and in the UK for its domestic trading program.

Preparing for a GHG verification

The internal procedures outlined in chapter 7 are probably comparable to those used by an impartial verifier. As a result, the materials required by the verifiers are comparable. An external verifier would probably need the following information:

- Specifics on the company's primary operations and GHG emissions (such as the categories of GHG produced and a description of the activity that results in GHG emissions).
- Details about the business, groups, or organization (including a list of subsidiaries and their locations, ownership details, and financial entities that are part of it).
- Information on any organizational changes made by the company over time, including the justification for how these changes affected emissions statistics.
- Information about any joint venture agreements, outsourcing and contractor agreements, production sharing agreements, emissions rights, or other legal or contractual papers that specify the organizational and operational boundaries.
- Procedures that are written out for locating emissions sources inside organizational and operational boundaries
- Details on additional assurance procedures that the systems and data are subjected to (e.g. internal audit, external reviews, and certifications)

Data used for calculating GHG emissions. This might, for example, include:

- Information on energy use (bills, delivery notes, weigh-bridge tickets, and meter readings for electricity, gas pipes, steam, and hot water, among other things).
- Production information (such as the tons of materials or kWh of power produced).
- Information on the raw materials used (bills, delivery notes, weighbridge tickets, etc.) for mass balance calculations.
- Emission components (laboratory analysis etc.).

Information about the methodology used to compute GHG emissions:

- The basis for the use of other parameters as well as the emission factors
- Details on alternative measurement processes and the accuracy of meters and weighbridges (such as calibration records).
- The presumptions used to construct estimations.
- Allocations of equity shares and how they relate to financial reporting.
- Information on any GHG sources or activities that are excluded for, say, technical or financial reasons.

Information gathering process:

- An explanation of the processes and tools used to gather, record, and analyze data on GHG emissions at the plant and company level.
- An explanation of the quality control techniques used (internal audits, comparison with data from the previous year, second-person recalculation, etc.).

Other information:

- chosen consolidation strategy as described in chapter 3
- A list of the individuals in charge of gathering data on GHG emissions at each site (and access to them) and corporate level.
- Uncertainty information, both qualitative and, if accessible, quantitative.

There must the GHG inventory independently verified. It is impossible to verify management claims for which there is no supporting documentation. External verification will be challenging when a reporting company has not yet put procedures in place for consistently accounting and documenting GHG emissions data, which could prevent the verifier from being able to provide an opinion. In these situations, the verifiers may offer suggestions on how to enhance the existing data gathering and collation procedure so that a conclusion can be reached in subsequent years.

To generate an audit trail of how the inventories were put together, it is the responsibility of the company to ensure the existence, quality, and retention of documentation. A corporation should keep all pertinent historical documents to support the base year data if it offers a specific base year to measure its GHG performance against. When developing and implementing GHG data processes and procedures, these concerns should be kept in mind.

Using the Verification Findings

Verifiers may require a company to adjust any material errors that were identified during the course of the verification before such inventory is declared to have met the relevant quality standard. The verifier may not be able to provide the company with an unqualified opinion if both parties are not able to agree on relevant adjustments. All material errors (individually or in aggregate) need to be amended before the final verification sign-off. In addition to giving an opinion on whether the reported information is free from material discrepancy, and based on the agreed scope of work, the verifiers may also issue a verification report containing some recommendations for future improvements.

Depending on the agreed-upon scope of work, the verifiers may also provide an opinion on whether the given information is free from material discrepancy in addition to delivering a verification report that includes several suggestions for future development. Verification should be seen as an important part of the process of ongoing improvement. Regardless of whether verification is carried out for internal review, public reporting, or to verify compliance with a specific GHG program, it will probably include important information and guidelines on how to develop and improve a company's GHG accounting and reporting system. Similar to the process of choosing a verifier, persons chosen to be in charge of evaluating and putting into practice solutions to the verification results should also have the necessary abilities and knowledge of GHG accounting and reporting concerns.

11 Setting a GHG Target

CHAPTER

Most often in a corporate system, the next after developing a GHG inventory is setting up of GHG emission reduction target. Thus, setting targets is the traditional business practice that foresees relevant issues are stared towards the direction of top management and factored into relevant decisions about what products and services to provide and what materials and technologies to use.

This chapter offers instructions on how to establish and report on a corporate GHG objective. Many of the factors that are taken into account, even though the chapter concentrates on emissions (Appendix B), also apply to GHG sequestration. This chapter's focus is on the stages involved, the decisions to be taken, and the effects of those decisions rather than on what a company's aim should be.

Why Set a GHG Target?

Setting goals for revenues, sales, and other essential business metrics, as well as monitoring progress toward those goals, are necessary components of every effective business strategy. Similarly, establishing a GHG target is necessary for efficient GHG management. Corporate-wide GHG objectives are frequently significant components of these initiatives as corporations adopt strategies to reduce the GHG emissions of their goods and operations, even if some portions of the organization are or will be subject to mandated GHG limitations. The following are typical factors for setting a GHG target:

• Minimizing and Managing GHG Risks

Understanding a company's boundaries and developing its inventory are relevant steps to identify potential risks and opportunities in managing and reducing its GHG emissions. In addition to this, setting a GHG target is very instrumental in the plan to realize the goal of GHG emissions reduction. A GHG target will ensure that the topic is on the business agenda and help increase internal knowledge of the risks and opportunities posed by climate change. This can help to reduce and manage the business risks related to climate change more skillfully.

• Achieving Cost Savings and Stimulating Innovation

The company's desire for operational improvement through potential innovations and responsible resource consumption and efficiency are been realized by having set its GHG target. Ultimately, these results in cost savings when fully integrated into the business. Reducing product emissions can drive R&D, such focus leads to products and service rendering that can increase market shares and reduce emissions associated with product usage.

• Preparing For Future Regulations

Companies can respond strategically and more effectively to forthcoming GHG regulations through their internal accountability and incentive mechanisms established to promote target implementation. For instance, several businesses have discovered that testing internal GHG trading programs has helped them better comprehend the potential effects of future trading schemes on the business.

• Demonstrating Leadership and Corporate Responsibility

Companies are on the verge of improving their public standing and developing more trust from stakeholders and enhancing brand reputation. In current scenarios of climate crises and GHG regulations, committing to reducing GHG emissions and making it known publicly by reporting and publishing has championed the company's positions as an industry leader and corporate responsibility.

• **Participating In Voluntary Programs**

To promote and support businesses in setting, putting into practice, and monitoring progress toward GHG targets, an increasing number of voluntary GHG initiatives are emerging. Participation in voluntary initiatives can help a corporation improve its GHG accounting and reporting capabilities and knowledge, gain public recognition, and make it easier for future legislation to recognize early action.

Steps in Setting a Target

A company's goals, relevant policy context it is subject to and discussion by stakeholders to inform decisions and choices the company makes towards its GHG emission target setting. Reporting companies will have to make strategic and game-changing choices when setting targets and achieving GHG reduction.

Although the procedures are listed in order, in practice, setting targets includes switching back and forth between them. Before carrying out these actions, it is presumable that the company has created a GHG inventory. The steps are summarized below:

1. Obtain Senior Management Commitment

GHG reduction programs at the corporate level are best achieved with the support of senior management. The endorsement and commitment of the board/CEO of a company is a prerequisite for the program's success. Behavioral and decision–making changes are necessary steps in a company when implementing a reduction target program. More importantly, accomplishing the goal, also necessitates creating an internal responsibility and incentive framework and allocating sufficient resources. Which is not attainable without senior management commitment.

2. Decide on the Target Type

An absolute target focused on the overall reduction in the amount of GHG emitted to the atmosphere. Expressed as a specific quantity of GHG emission reduction over time, with a unit typically being tonnes of CO_2-e. On the other hand.

An intensity target is a reduction in the ratio or percentage of GHG emissions relative to another business metric.[25] Focused on intensity target reduction in emissions relative to a specific business metric, such as sales, revenues or office space, or production output of the company. (E.g. tonne CO_2-e per tonne product, per kWh, per tonne mileage) The company needs to select the preferred and right metrics when using intensity targets.

Businesses that use intensity targets must additionally report the absolute emissions from the sources covered by the targets. Some companies have both an absolute and Intensity target. Below is a summary of the advantages and disadvantages of each type of target and selected corporate GHG targets

3. Decide On the Target Boundary

The reporting company shall set its GHG emission target boundary covering its GHGs, operational locations, emission sources, and all other activities defined as part of the target. The target and inventory boundary can be identical, or the target may address a specified subset of the sources included in the company inventory. A comprehensive GHG inventory is key to making such informed choices and decisions. Addressed questions include:

• **Which GHGs**? The company shall clarify in its target which of the named GHGs by the Kyoto protocol is associated with their business. Targets may include one or more of the GHGs. It is significant for companies to broaden their GHGs scope to increase the range of reduction opportunities and not limit it to CO_2 GHG sources only. However, for smaller sources, there can be practical monitoring restrictions.

[25] Some companies may formulate GHG efficiency targets by formulating this ratio the other way around.

Comparing Absolute and Intensity Targets

Absolute Targets reduce absolute emissions over time (Example: reduce CO_2 by 25 percent below 1994 levels by 2010)

Advantages

• Designed to achieve a reduction in a specified quantity of GHGs emitted to the atmosphere

• Environmentally robust as it entails a commitment to reduce GHGs by a specified amount

• Transparently addresses potential stakeholder concerns about the need to manage absolute emissions

Disadvantages

• Target base year recalculations for significant structural changes to the organization add complexity to tracking progress over time

• Does not allow comparisons of GHG intensity/efficiency

• Recognizes a company for reducing GHGs by decreasing production or output (organic decline, chapter 5)

• May be difficult to achieve if the company grows unexpectedly and growth is linked to GHG emissions

Intensity Targets reduce the ratio of emissions relative to a business metric over time (Example: reduce CO_2 by 12 percent per tonne of clinker between 2000 and 2008)

Advantages

• Reflects GHG performance improvements independent of organic growth or decline

• Target base year recalculations for structural changes are usually not required (see step 4)

• May increase the comparability of GHG performance among companies

Disadvantages

• No guarantee that GHG emissions to the atmosphere will be reduced—absolute emissions may rise even if intensity goes down and output increases

• Companies with diverse operations may find it difficult to define a single common business metric

• If a monetary variable is used for the business metric, such as dollar of revenue or sales, it must be recalculated for changes in product prices and product mix, as well as inflation, adding complexity to the tracking process

• **Which Geographical Operations?** For companies with global operations, it is best to include only operational locations with available, robust, and reliable emissions inventory for all their operations. However, only country or regional operations that present well-comprehensive inventory data should be included in the target. For companies involved in existing GHG trading programs,[26] the company will have to choose whether or not to include the emissions sources covered in the trading program in their corporate target. Companies should think about how they will handle any double counting that results from the trading of GHG reductions in the trading program if there is an overlap in the sources covered between the corporate target and the trading program.

• **Which Direct and Indirect Emission Sources?** The availability of more cost-effective reduction opportunities is made possible by including indirect GHG emissions in a target. However, indirect emissions are typically more difficult to reliably quantify and verify than direct emissions, however, some categories, such as scope 2 emissions from purchased power, may be possible. Since indirect emissions are, by definition,

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[26] Examples include the U.K. ETS, the CCX, and the EU ETS

someone else's direct emissions, including indirect emissions can create ownership and double counting problems.

• **Separate Targets For Different Types Of Businesses?** Companies with diversified business operations are supposed to set individual GHG targets for different core businesses. Especially when using an intensity target where the most meaningful business metric for defining the target varies across business units (e.g., GHGs per tonne of cement produced or barrel of oil refined).

Examples of Corporate GHG Targets

Absolute Targets

• ABB Reduce GHGs by 1 percent each year from 1998 through 2005

• Alcoa Reduce GHGs by 25 percent from 1990 levels by 2010, and 50 percent from 1990 levels over same period, if inert anode technology succeeds

• BP Hold net GHGs stable at 1990 levels through 2012

• Dupont Reduce GHGs by 65 percent from 1990 levels by 2010

• Intel Reduce PFCs by 10 percent from 1995 levels by 2010

• Johnson & Johnson Reduce GHGs by 7 percent from 1990 levels by 2010, with interim goal of 4 percent below 1990 levels by 2005

Intensity Targets

• Kansai Electric Power Company Reduce CO_2 emissions per kWh sold in fiscal 2010 to approx. 0.34 kg-CO_2/kWh

• Miller Brewing Company Reduce GHGs by 18 percent per barrel of production from 2001 to 2006

• National Renewable Energy Laboratory Reduce GHGs by 10 percent per square foot from 2000 to 2005

Combined Absolute & Intensity Targets

• SC Johnson GHG emissions intensity reduction of 23 percent by 2005, which represents an absolute or actual GHG reduction of 8 percent

• Lafarge Reduce absolute gross CO_2 emissions in Annex I countries 10 percent below 1990 levels by the year 2010. Reduce worldwide average specific net CO_2 emissions 20 percent below 1990 levels by the year 20103

4. Choose the Target Base Year

Two general approaches to choosing a base year; a fixed target base year or a rolling target base year. To ensure target credibility, it is important to be transparent in defining target emissions regarding its historical emission data.

• Using A Fixed Target Base Year.

Most GHG objectives are expressed as a percentage drop in emissions from a predetermined base year (e.g., reduce CO_2 emissions 25 percent below 1994 levels by 2010). Chapter 5, it is explained how businesses should monitor their inventory of emissions over time with a set fixed base year. Although it is permissible for companies to have their inventory base year different from their target base year. it usually makes sense to use the same year both to simplify the inventory and target reporting process. It is crucial to guarantee that the emissions statistics for the target base year are accurate and verifiable, just like for the inventory base year. A multi-year average target base year may be used. The same factors that were discussed in chapter 5 for multi-year average base years are still relevant.

To assure like-with-like comparisons across time, Chapter 5 offers criteria on when and how to recalculate base year emissions when structural changes (such as acquisitions/divestitures) or changes in measurement and calculation methodology alter the emissions profile over time. This method will typically work well for recalculating data for a specific target base year.

• Using A Rolling Target Base Year.

If getting and keeping accurate data for a set target base year is going to be difficult, businesses may think about utilizing a rolling target base year (for example, due to frequent acquisitions). With a rolling target base year, the base year advances consistently, often by one year, ensuring that emissions are constantly compared to the year prior. [27]

Emission reductions might still be stated collectively across several years, though. An illustration might be that "emissions will be lowered by 1% annually from 2001 through 2012, compared to the prior year."

Recalculations only need to be done to the prior computations when structural or methodological changes occur a year. [28] Because of this, like-for-like comparisons of the "target starting year" (2001 in and "goal completion year," for instance (2012) cannot be made since emissions for all years back to the target starting year are not recalculated.

The criteria for what necessitates recalculating base-year emissions are the same as they are for the fixed base-year approach. The main distinction is the period for which emissions are computed. The rolling and fixed base year approaches are compared in Table 4, and Figure 11 highlights one of the significant differences.

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[27] It is possible to use an interval other than one year. However, the longer the interval at which the base year rolls forward, the more this approach becomes like a fixed target base year. This discussion is based on a rolling target base year that moves forward at annual intervals

[28] For further details on different recalculation methodologies, see the guidance document “Base year recalculation methodologies for structural changes” on the GHG Protocol website (www.ghgprotocol.org)

Table 4. Comparing Targets with Rolling and Fixed Base Years [29]

	Fixed Target Base Year	Rolling Target Base Year
How might the target be stated?	A target might take the form of "we will emit X% less in year B than in year A"	A target might take the form of "over the next X years we will reduce emissions every year by Y% compared to the previous year".[30]
What is the target base year?	A fixed reference year in the past	The previous year
How far back is a like-with-like comparison possible?	The time series of absolute emissions will compare like with like	If there have been significant structural changes the time series of absolute emissions will not compare like with like over more than two years at a time
What is the basis for comparing emissions between the target base year and completion year? (see also Figure 11)	The comparison over time is based on what is owned/controlled by the company in the target completion year	The comparison over time is based on what was owned/controlled by the company in the years the information was reported. [31]
How far back are recalculations made?	Emissions are recalculated for all years back to the fixed target base yea	Emissions are recalculated only for the year prior to the structural change, or ex-post for the year of the structural change which then becomes the base year.
How reliable are the target base year emissions?	If a company with a target acquires a company that did not have reliable GHG data in the target base year; the backcasting of emissions becomes necessary, reducing the reliability of the base year.	Data from an acquired company's GHG emissions are only necessary for the year before the acquisition (or even only from the acquisition onwards), reducing or eliminating the need for back-casting
When are recalculations made?	The circumstances which trigger recalculations for structural changes etc. (chapter 5) are the same under both approaches	

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[29] https://ghgprotocol.org/sites/default/files/standards/ghg-protocol-revised.pdf

[30] Note that simply adding the yearly emissions changes under the rolling base year yields a different result from the comparison over time made with a fixed base year, even without structural changes. In absolute terms, an X% reduction every year over 5 years (compared to the previous year) is not the same as an (X times 5) reduction in year 5 compared to year 1.

[31] Depending on which recalculation methodology is used when applying the rolling base year, the comparison over time can include emissions that occurred when the company did not own or control the emission sources. However, the inclusion of this type of information is minimized. See also the guidance document "Base year recalculation methodologies for structural changes" on the GHG Protocol website (www.ghgprotocol.org).

Recalculations under Intensity Targets

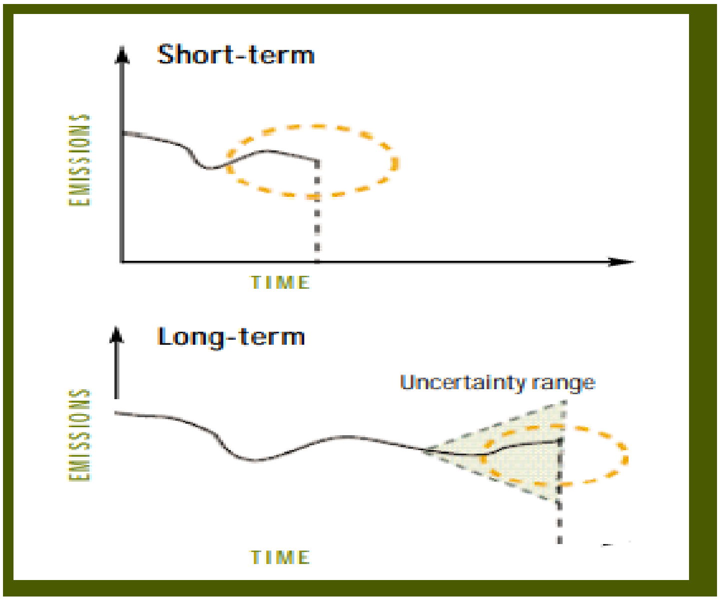
Although the requirement in chapter 5 applies to enterprises utilizing intensity targets' absolute inventory emissions, recalculations for structural modifications for the target are typically not required unless the structural change significantly alters the GHG intensity. Recalculations for structural changes should be made for both the business metric and the absolute emissions, though, if they are being done for the objective. A target may need to be reformulated if the target business statistic loses relevance due to structural changes (such as when a company shifts its focus to another industry after previously using an industry-specific business metric).

5. Define the Target Completion Date

Whether an aim is generally short- or long-term depends on the anticipated completion date. Long-term targets (e.g., with a completion year ten years after the target's setting) make it easier to plan for sizable capital projects with reduced greenhouse gas emissions in the future. They might, however, promote a later phase-out of less effective machinery. Long-term goals typically rely on ambiguous future events, which might present both opportunities and threats, as shown in Figure 11.

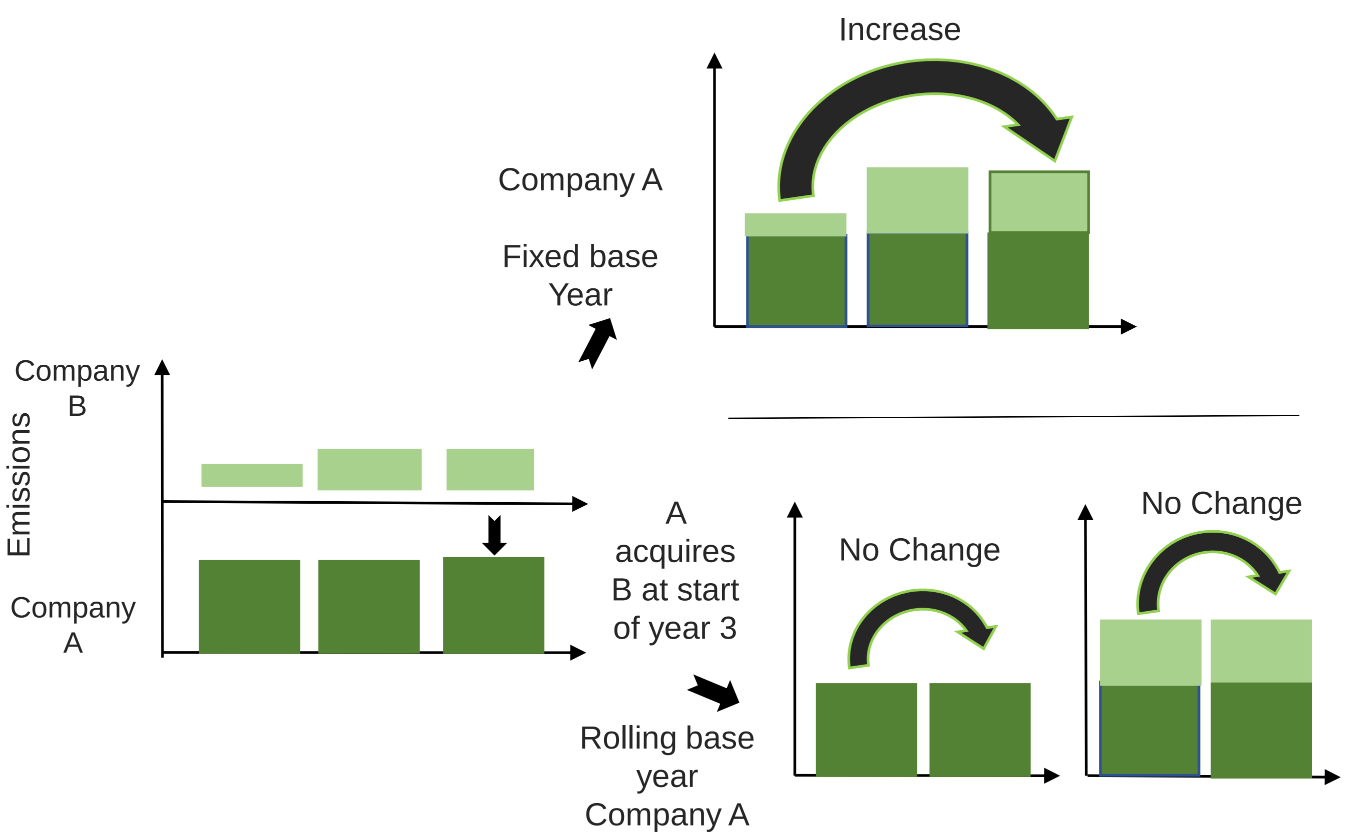
For firms with shorter planning cycles, a five-year target timeframe can be more workable.

Figure 11. Defining the Target Completion Date



A stabilization aim seeks to keep emissions constant over time (Figure 12). The year when business A acquires firm B, which has seen a rise in organic GHG since that year, serves as the desired base year (or "starting" year) in this scenario. The rolling method states that the acquired company's (B) increase in emissions from year 1 to year 2 does not appear to be a rise in emissions relative to the target set by the acquiring company. Therefore, firm A would achieve its stabilizing objective if it adopted the rolling strategy as opposed to the fixed method. Under the rolling technique, historical GHG rise or fall at divested facilities (GHG changes before the divestiture) would have an impact on target performance, whereas, under the fixed approach, it would not be taken into account, similar to the example in chapter 5.

Figure 12. Comparing a Stabilization Target under the Fixed and Rolling Target Base Year Approach.



6. Define the length of the commitment period

The period in which emissions performance is measured against the target is defined as the commitment period. It ends with the target completion date. Although the Kyoto Protocol, for example, specifies a multi-year "first commitment period" of five years (2008 –2012), most companies only adopt a single–year commitment period. The commitment level of a company to pursue GHG reductions at each period is determined by the length of the target commitment period to start with. Generally, the longer the target commitment period, the longer the period during which emissions performance counts towards the target.

• **Example of a Single Year Commitment Period**.

By the commitment year 2010, Company Beta hopes to have cut emissions by 10% from their target base year of 2000. It is sufficient for Beta's emissions to be no more than 90% of the year 2000 emissions in 2010 for it to achieve its goal.

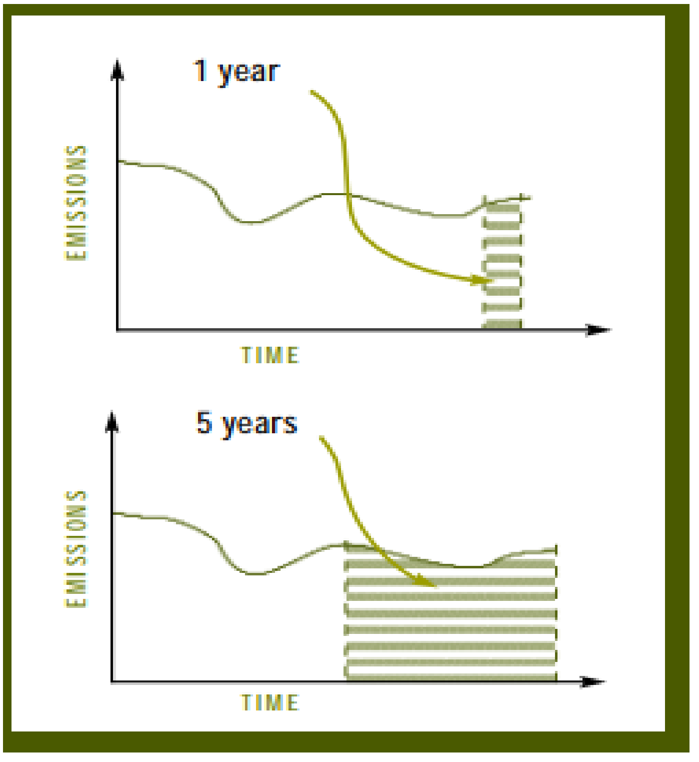
• **Example of A Multi-Year Commitment Period**.

By the commitment period of 2008–2012, Company Gamma intends to reduce emissions by 10% from its goal base year of 2000. For Gamma to accomplish its goal, its total emissions from 2008 to 2012 cannot be greater than 90% of the emissions from the year 2000 multiplied by five (number of years in the commitment period). In other words, its average emissions over those five years must not be higher than 90% of the emissions from the year 2000.

Objective commitment periods longer than one year can be utilized to reduce the risk of unforeseen events affecting performance against the target in a specific year. Figure 13 demonstrates how the number of emissions that are genuinely pertinent to target performance depends on the target commitment period's length.

With a rolling base year target, the commitment period is in effect from the time the objective is set until the target completion date. Emission performance is regularly assessed against the target during this time.

Figure 13. Short Vs. Long Commitment Periods



7. Decide on the use of GHG offsets or credits [32]

A GHG target can be completely accomplished by internal reductions at sources inside the target boundary or by employing offsets in addition to GHG reduction initiatives that increase sinks or reduce emissions at sources outside the target boundary. [33] When the cost of internal reductions is considerable, there are few chances for reductions, or the company is unable to fulfill its target due to unforeseen events, the use of offsets may be suitable. It should be stated whether offsets are used and how much of the target reduction was accomplished using them when reporting on the target.

The credibility of Offsets and Transparency

There are no universally acknowledged methods for calculating GHG offsets at the moment. It is challenging to prove that an offset is of a size equal to the internal emissions it is balancing due to the ambiguities surrounding GHG project accounting. [34] For this reason, businesses should never provide a net figure when reporting their own internal emissions; instead, they should do so in separate accounts from offsets utilized to reach the target (step 10). Additionally, when reporting, it's critical to identify the source and type of any offsets employed and to carefully evaluate their trustworthiness. Data is required, including;

- The project's type.
- Geographic origin, and organizational structure
- The methods used to calculate offsets
- Whether outside programs have acknowledged them (CDM, JI, etc.)

For an offset to be credible, it needs to demonstrate that the methodology for quantification satisfactorily addresses key project accounting challenges in chapter 8. Considering these challenges, the impending GHG Protocol Project Quantification Standard aims to improve the consistency, credibility, and rigor of project accounting. Companies need to be vigilant and ensure that offsets have not been pre-counted towards another organization's GHG target.

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[32] As noted in chapter 8, offsets can be converted to credits. Credits are thus understood to be a subset of offsets. This chapter uses the term offsets as a generic term

[33] For the purposes of this chapter, the terms “internal” and “external” refer to whether the reductions occur at sources inside (internal) or outside (external) the target boundary

[34] This equivalence is sometimes referred to as “fungibility.” However, “fungibility” can also refer to equivalence in terms of the value in meeting a target (two fungible offsets have the same value in meeting a target, i.e., they can both be applied to the same target).

It is also crucial to confirm that offsets have not already been applied to another organization's GHG objective. A contract transferring ownership of the offset between the buyer and seller may be necessary for this situation.

Step 8 offers more details on how to account for GHG exchanges in connection to a business target, including creating a double-counting strategy.

Offsets and Intensity Targets

All of the aforementioned considerations are relevant when employing offsets under intensity objectives. The offsets can be deducted from the absolute emissions figure (the numerator) to determine compliance with the target; the resulting difference is then divided by the relevant metric. However, offsets and the business metric must continue to be reported independently from absolute emissions (step 9 below).

8. Establish a target double counting policy

Double counting of GHG reductions and offsets, as well as allowances provided by external trading programs, are addressed in this stage. It only applies to businesses that trade (sell or buy) GHG offsets or whose corporate target limits intersect with those of other businesses or external initiatives. Companies should create their own "Target Double Counting Policy" because there is currently no agreement on how such double counting issues should be handled. This should outline how trades and reductions related to other goals and initiatives will be accounted for concerning the corporate target, as well as what kinds of double counting scenarios are taken into consideration in that regard.

Here are some instances of double counting that the policy may need to address.

- **Double Counting Of Offsets.**

While a GHG offset is taken into account when determining the target by both the selling and buying companies, this can happen. For instance, business A launches an internal reduction project to cut GHGs from sources that are part of its own target. Then, while still counting toward its own aim, Company A sells this project decrease to Company B for use as an offset toward its goal. In this instance, reductions are measured against targets that cover several emission sources by two independent organizations.

To remedy this, trading applications utilize registries that assign a serial number to each traded offset or credit and make sure the serial numbers are retired once they have been used. A contract between the seller and buyer could address this in the absence of registries.

- **Double Counting Due to Target Overlap [35]**

This might happen when sources covered by a business's corporate target are additionally constrained by an external program or the target of another company.

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[35] Overlap here refers to a situation when two or more targets include the same sources in their target boundaries.

Two instances:

• Sources of GHG are part of Company A's corporate objective, which is likewise governed by a trading program. In this instance, business A uses cost savings at the shared sources to achieve both its corporate aim and the trade program target. A corporate objective of Company B is to lower its direct emissions from the production of electricity. [36] Company C, which buys power straight from Company B, likewise has a corporate goal that takes electricity purchase indirect emissions into account (scope 2). Company C implements energy-saving measures to lessen the indirect emissions it generates from using electricity. Typically, they will manifest in targets being lowered by both companies. [37]

These two instances show that when the GHG sources where the reductions occur are included in several targets of the same or separate organizations, double counting is inevitable. It might be challenging to prevent this kind of double counting without restricting the scope of targets, and it probably makes no difference if the double counting is limited to organizations using the same sources in their targets (i.e., when the two targets overlap).

• **Double Counting Of Allowances Traded In External Programs**.

This happens when a corporate target crosses over with an external trading program, and allowances that cover the shared sources are sold in the trading program for use by another organization and reconciled with the regulatory target but not with the corporate target. In contrast to the preceding example, this one involves double counting over two distinct targets that are not overlapping (i.e., they do not cover the same sources).

If the company selling the allowances reconciles the trade with its corporate aim, this kind of double counting could be prevented. Whatever the corporation chooses to do in this case, it must consistently address the buying and selling of allowances in trading programs to preserve confidentiality. For instance, if it decides not to count any allowances of the same type that it acquires to fulfill its corporate target, it should likewise decide not to count allowances of the same type that it sells in a trading program.

If doing so compromises the aim's environmental integrity, a corporation should ideally avoid double counting in its corporate target. Additionally, any avoided duplicate counting between two organizations gives one of these businesses an extra incentive to cut emissions even further. However, in practice, it might be difficult to avoid double counting, especially for businesses that are subject to several external programs and when indirect GHG emissions are taken into account when setting the target.

Therefore, businesses should be open about their double counting policy and provide any justifications for their decision to ignore certain double counting scenarios.

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[36] Similarly, company A in this example could be subject to a mandatory cap on its direct emissions under a trading program and engage in trading allowances covering the common sources it shares with company B. In this case, the example in the section “Double counting of allowances traded in external programs” is more relevant

[37] The energy efficiency measures implemented by company C may not always result in an actual reduction of company B’s emissions. See chapter 8 for further details on reductions in indirect emissions.

9. Decide on The Target Level.

All of the above actions should be taken into consideration when deciding on the goal level. There are also the following factors to consider:

• Recognizing the main factors influencing GHG emissions by comparing them to other business indicators like production, manufacturing space square footage, employee count, sales, revenue, etc.

• Creating various reduction plans based on the significant potential for reduction that is currently available and analyzing their impacts on overall GHG emissions. Examine how various mitigating measures affect emission forecasts.

• Examining the company's future in relation to GHG emissions.

• Taking into account pertinent growth elements including production schedules, income or sales goals, and Return on Investment (ROI) or other factors that influence investment strategy.

• Examining whether any current energy or environmental goals, capital expenditures, product or service changes, or targets will have an impact on GHG emissions. Exist existing plans for fuel switching, on-site power generation, and/or renewable energy expenditures that may impact the trajectory of future GHG emissions?

• Comparing GHG emissions with businesses of a similar size. Organizations that haven't made prior investments in reducing their usage of energy and other GHGs should generally be able to reach more aggressive reduction targets since they have more chances for cost-effective reduction.

10. Track and Report Progress

Once the goal has been established, it is crucial to monitor progress toward it to ensure compliance and preserve credibility. This includes reporting emissions and any external reductions in a consistent, thorough, and transparent manner.

• **Carry Out Regular Performance Checks**.

Linking the aim to the yearly GHG inventory process and conducting regular assessments of emissions concerning the target is crucial for tracking success towards a goal. For this, some businesses utilize interim targets (interim targets are automatically included in targets with rolling target base years every year).

• **Report Information In Relation To the Target**.

The following information is required when setting and reporting target progress:

1. Description of the target

• Outline the target boundaries chosen

- Give a brief description of the selected target borders.
- Describe the objective type, base year, completion date, and commitment term in detail.
- Indicate whether offsets can be utilized to fulfill the target and, if so, what kind and how much.
- Explain the target double-counting policy.
- Define the target level.

2. Information on emissions and performance concerning the target

- Separately from any GHG exchange, report emissions from sources inside the target border.
- Report absolute emissions from within the goal boundary separately, including any GHG trades and the business metric, if employing an intensity target.
- Describe GHG transactions that are important for determining whether the target has been met, including the number of offsets employed.
- Describe any internal project cuts that were sold or transferred to another organization as an offset.
- Describe overall results regarding the target.

“The future will be green or not at all- *Jonathon Porritt*”

APPENDIX A

Accounting for Indirect Emissions from Purchased Electricity

Information on how to track and report indirect emissions connected to the purchase of power is provided in this appendix. An overview of the transactions related to electricity purchases and the resulting emissions is shown in Figure A-1.

Purchased electricity for own consumption

Scope 2 of the report includes emissions connected to the production of power purchased and consumed by the reporting enterprise. Scope 2 only takes into account the number of direct emissions from producing electricity that the company uses. A business that buys power and distributes it through a T&D system that it controls or owns must disclose the emissions linked to T&D losses under scope 2. However, the emissions related to T&D losses are not reported under scope 2 if the reporting entity owns or controls the T&D system but creates (rather than purchases) the electricity transferred through its wires because they would already be accounted for under scope 1. When generation, transmission, and distribution networks are vertically integrated and owned or under the control of the same organization, this occurs.

Purchased electricity for resale to end-users

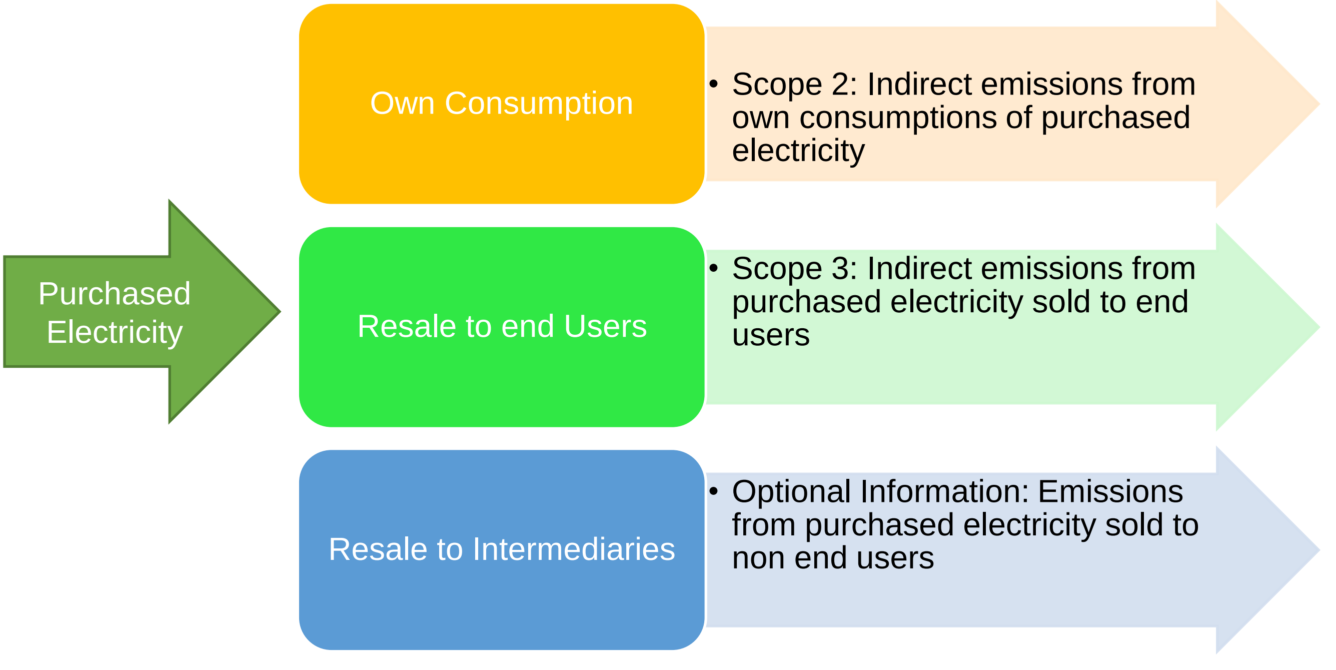
The category "generation of purchased electricity that is sold to end-users" under scope 3 is where emissions from the production of power purchased for resale to end-users, such as purchases by a utility company, may be reported. Utility firms that buy wholesale electricity from IPPs for resale to their customers should pay particular attention to this reporting area. This gives utility companies and electricity suppliers an essential advantage because they frequently choose where to buy electricity.

GHG reduction opportunity (see chapter 4's case study on Seattle City Light). Scope 3 is optional, thus businesses may decide not to report these emissions if they are unable to track their electrical sales in terms of end users and non-end users. Instead, under the heading "Optional Information" in the category "Generation of Purchased Electricity, Heat, or Steam for Resale to Non-End Users," companies might report the total emissions related to the purchased electricity that is sold to both end- and non-end-users.

Purchased electricity for resale to intermediaries

The category "Generation of purchased electricity, heat, or steam for re-sale to non-end users" allows for the optional reporting of emissions related to the generation of purchased electricity that is resold to an intermediary (such as in trading operations). Examples of trading transactions include brokerage/trading room deals involving electricity purchases, as well as any other deals involving the direct purchase of electricity from one source or the spot market, followed by a resale to a middleman (e.g., a non-end user). Since there may be several trading activities before the electricity is used by the end user, these emissions are disclosed under optional information independently from scope 3. A sequence of electricity trading transactions for the same electricity may result in redundant reporting of indirect emissions as a result of this.

Figure A-1. Accounting For Indirect GHG Emissions Associated With Purchased Electricity



GHG emissions upstream of the generation of electricity

The category "extraction, production, and transportation of fuels consumed in the generating of electricity" in scope 3 may be used to report emissions related to the extraction and production of fuels used in the generation of purchased power. These emissions take place before power is made. Examples include emissions from coal mining, gasoline refinement, natural gas extraction, and hydrogen manufacturing (if used as a fuel).

Choosing electricity emission factors

The GHG Protocol Corporate Standard advises businesses to get source/supplier-specific emission factors for the power they buy to calculate scope 2 emissions. In the absence of these, regional or grid emission factors ought to be applied. Visit the applicable GHG Protocol calculation tools on the GHG Protocol website for further details on selecting emission factors (www.ghgprotocol.org).

GHG Emissions Associated With the Consumption of Electricity in T&D

End-users may report emissions in scope 3 under the category "production of energy that is consumed in a T&D system" to the Environmental Protection Agency. T&D losses are typically excluded from published emission factors for the electrical system. It could be essential to use supplier- or location-specific T&D loss factors to determine these emissions. Businesses who buy electricity and use their own T&D infrastructure to transport it must declare the percentage of electricity used for T&D under scope 2.

Accounting for indirect emissions associated with T&D losses

Emission factor at generation (EFG) and emissions factor at consumption are the two different forms of electricity emission factors (EFC). EFG is computed by dividing CO_2 emissions from electricity generation by the total quantity of power produced. EFC is determined by dividing CO2 emissions from generation by the quantity of electricity used.

$$\text{EFC} = \frac{\text{Total Co2 Emissions From Generation}}{\text{Electricity Generated}}$$

$$\text{EFC} = \frac{\text{Total Co2 Emissions From Generation}}{\text{Electricity Consumed}}$$

$$\text{Efc X Electricity Consumed}$$

$$=$$

$$\text{Efg X (Electricity Consumed + T\&D Losses)}$$

$$\text{EFC} = \text{EFG} \quad \text{X} \quad \frac{(\ 1 + \ \text{T \& D Losses})}{\text{Electricity Consumed}}$$

These equations show that the sum of emissions attributable to electricity consumed during end use, transmission, and distribution is obtained by multiplying EFC by the quantity of electricity consumed. However, when EFG is multiplied by the quantity of power consumed, only emissions attributable to electricity used for end-use are produced.

The GHG Protocol Corporate Standard mandates the use of EFG to compute scope 2 emissions following the scope 2 definitions (see chapter 4). The application of EFG promotes internal consistency in the handling of upstream emission categories connected to electricity and prevents double counting in scope 2. Additionally, using EFG has several other benefits, including:

1) It is more accessible and easier to calculate, and it is extensively published in regional, national, and worldwide sources.

2) It is based on a method that is frequently used to determine the intensity of emissions, or the emissions per unit of production output.

3) It guarantees accuracy in the reporting of unintentional emissions from T&D losses.

Local laws in some nations, like Japan, may compel utility providers to give their customers both EFG and EFC, and consumers may be required to utilize EFC to compute indirect emissions from the usage of purchasing power. A corporation must still use EFG to declare its scope 2 emissions in this scenario for a GHG report created in line with GHG Protocol Corporate Standard.

The following equation must be used to account for emissions linked to T&D losses:

EFG X Electricity Consumed During T&D	**=**	**Indirect Emissions From Consumption Of Electricity During T&D**

Our path to redeeming the Ecosystem will require Climate Change to go Unchecked

APPENDIX B
Accounting for Sequestered Atmospheric Carbon

The GHG Protocol Corporate Standard's main goal is to give businesses advice on how to create inventories that give a precise and comprehensive picture of their GHG emissions from both their direct activities and those along the value chain. [38] This is impossible for certain corporations to do without taking into account their effects on atmospheric carbon that has been sequestered.[39]

Sequestered Atmospheric Carbon

Plants take carbon (in the form of CO_2) out of the environment during photosynthesis and store it in plant tissue. This carbon is stored in one of several "carbon pools" until it is recycled back into the atmosphere. These pools include (a) vegetation found in woods, farms, and other terrestrial habitats (e.g., vegetation), (b) biomass found below the surface of the ground (e.g., roots), and (c) biomass-based products (e.g., wood products), both when in use and when stored in a landfill.

[38] In this Appendix, "value chain" means a series of operations and entities, starting with the forest and extending through end-of-life management, that (a) supply or add value to raw materials and intermediate products to produce final products for the marketplace and (b) are involved in the use and end-of-life management of these products.

[39] In this Appendix the term "sequestered atmospheric carbon" refers exclusively to sequestration by biological sinks.

Some of these pools of carbon can hold carbon for lengthy periods, even decades. When the stock of sequestered carbon in these pools rises, it means that carbon has been net removed from the atmosphere; when it falls, it means that carbon has been net added to the atmosphere.

Why Include Impacts On Sequestered Carbon In Corporate GHG Inventories?

As a result, these impacts on sequestered carbon are frequently taken into account in national inventories because it is widely acknowledged that changes in stocks of sequestered carbon and the associated exchanges of carbon with the atmosphere are significant for national-level GHG emissions inventories (UNFCCC, 2000). Similar to this, impacts on sequestered carbon in a company's direct operations as well as along their value chain will result in some of the most important aspects of a company's overall impact on atmospheric CO_2 levels for businesses in biomass-based industries, such as the forest products industry. In their corporate GHG inventories, some forest product firms have started to consider this component of their GHG footprint (Georgia Pacific, 2002). Additionally, a project that will further explore carbon measurement, accounting, reporting, and ownership issues related to the forest products value chain is being developed by the WBCSD's Sustainable Forest Products Industry Working Group, which represents a sizeable cluster of integrated forestry companies operating internationally.

Information on a company's effects on atmospheric carbon sequestration can be utilized for stakeholder education, strategic planning, and chances to raise the company's GHG profile. Additionally, there may be opportunities to add value from value reductions made along the value chain by businesses acting independently or in collaboration with raw material suppliers or clients.

Accounting For Sequestered Carbon In The Context Of The GHG Protocol Corporate Standard

Under the GHG Protocol Corporate Standard, consensus accounting techniques for stored atmospheric carbon as it passes through the value chain of biomass-based enterprises have not yet been devised. The GHG Protocol Corporate Standard's existing guidelines can be used to investigate some of the concerns that would need to be addressed when addressing impacts on sequestered carbon in corporate inventories, as indicated below.

Setting Organizational Boundaries

The equity share approach and the control approach are the two methods for combining GHG data that are described in the GHG Protocol Corporate Standard. In some circumstances, it might be possible to directly apply these methods to emissions and removals related to atmospheric carbon that has been sequestered. The ownership of stored carbon under the many kinds of contractual agreements involving land and wood ownership, harvesting rights, and control of land management and harvesting decisions is one of the matters that may need to be explored. It might also be necessary to handle the transfer of ownership as carbon flows up the value chain. Some companies may be interested in undertaking value chain analyses of sequestered carbon without respect to ownership or control, similar to what they might do for scope 2 and 3 emissions, as part of a risk management program, for example.

Setting Operational Boundaries

Setting operational limitations for sequestered carbon inventories, similar to GHG emissions accounting, would assist businesses in transparently reporting their effects on sequestered carbon throughout their value chain. Companies could, for instance, describe how the value chain captures influences that are significant to the analysis's findings. Which pools are included in this should Include in the analysis, excluded from it, and the justification for the choices. This information can be included in the "optional information" portion of a GHG inventory created using the GHG Protocol Corporate Standard until consensus methodologies for assessing impacts on sequestered atmospheric carbon along the value chain are developed.

Tracking Removals over Time

To account for the year-to-year fluctuation anticipated of these systems, base year data for impacts on sequestered carbon may need to be averaged over several years, as is occasionally the case with accounting for GHG emissions. In sequestered carbon accounting, the spatial scale that is employed and the temporal scale that is used are frequently tightly related. It is also necessary to consider how to adjust base years to take into account land acquisition and divestment, changes in land use, and other activities.

Identifying and Calculating GHG Removals

The GHG Protocol Corporate Standard does not include accepted techniques for estimating the amount of sequestered carbon. As a result, businesses ought to describe their procedures. In some cases, it may be possible to quantify sequestered carbon at the company level using the same quantification techniques employed in national inventories. The IPCC (1997; 2000b) offers helpful guidance on how to achieve this. The IPCC is anticipated to release Good Practice Guidance for Land Use, Land Use Change, and Forestry in 2004, which will include details on how to quantify the carbon trapped in forests and forest products. Companies could also find it helpful to review the procedures for creating national inventories for the nations where important portions of their value chain are located.

In addition, although corporate inventory accounting differs from project-based accounting (as discussed below), it may be possible to use some of the calculation and monitoring methods derived from project-level accounting of sequestration projects.

Accounting for Removal Enhancements

Annual removals inside the corporate inventory border can be recorded using a corporate inventory. The GHG Protocol Project Quantification Standard, on the other hand, will calculate project reductions that will be utilized as offsets to a fictitious baseline scenario for what would have happened in the absence of the project. Projects in the forestry industry take the form of removal improvements.

Some of the problems that must be resolved when accounting for offsets from GHG reduction projects are covered in Chapter 8 of this document. A lot of this advice also applies to efforts aimed toward improving removal. An illustration is the problem of reversibility of removals, which is also briefly discussed in chapter 8.

Reporting GHG Removals

This data can be included in the inventory's "optional information" section until consensus methodologies for assessing impacts on atmospheric carbon sequestered along the value chain are developed (See chapter 9). Project-based reductions at sources outside the inventory border should not be combined with information on sequestered carbon within the company's inventory boundary. Within a company's inventory boundaries, removal enhancement projects usually result in an increase in carbon removals over time, though they can also be disclosed in optional information. To prevent double counting, they should also be identified separately. This is crucial when they are offered to a third party as credits or offsets.

More information on the level of accuracy to be expected from these methods will become accessible as businesses gain experience utilizing different methodologies for evaluating impacts on sequestered carbon. However, as they gain more expertise, businesses could find it challenging to gauge the level of uncertainty attached to the estimates. As a result, they might need to take more caution in how they communicate the estimates to stakeholders.

C Overview of GHG Programs

APPENDIX

Name of Program	Voluntary Registry	Organization (Project Possible in 2004)	Organizations report CO_2 for the first three years of participation, and all six GHGs thereafter	Equity share or control for California or US operation
US EPA Climate Leaders www.epa.gov/climateleaders	Voluntary reduction program	Organization	Six	Equity share or control for US operations at a minimum
WWF Climate Savers www.worldwildlife.org/climatesavers	Voluntary registry	Organization	CO_2	Equity share or control for worldwide operations
World Economic Forum Global GHG Register www.weforum.org	Voluntary registry	Organization	SIX	Equity share or control for worldwide operations
EU GHG Emissions Allowance Trading Scheme www.europa.eu.int/comm/environment/	Mandatory allowance trading scheme	Facility	Six Kyoto gases as well as other pollutants	Facilities that fall under the EU IPPC directive
Chicago Climate Exchange www.chicagoclimateexchange.com	Voluntary allowance trading scheme	Organization and project	Six	Equity share
Respect Europe BLICC www.respecteurope.com/rt2/blicc/	Voluntary reduction program	Organization	Six	Equity share or control for worldwide operations

Operational Boundaries	Nature/Purpose Of Program	Base Year	Target	Verification
Scope 1 and 2 are required, and scope 3 is to be decided	Baseline protection, public reporting, possible future targets	Specific to each organization, recalculation consistent with GHG Protocol Corporate Standard required	Encouraged but optional	Required through certified third party verified
Scope 1 and 2 required, scope 3 optional	Public recognition, assistance in setting targets and achieving reductions	The year that the organization joins the program, recalculation consistent with GHG Protocol Corporate Standard required	Required, specific to each organization	Optional provides guidance and a checklist of components that should be included if undertaken
Scope 1 and 2 required, scope 3 optional	Achieve targets, public recognition, expert assistance	Chosen year since 1990, specific to each organization, recalculation consistent with GHG Protocol Corporate Standard required	Required, specific to each organization	Third-party verified
Scope 1 and 2 required, scope 3 optional	Baseline protection, public reporting, and targets are encouraged but optional	Chosen year since 1990, specific to each organization, recalculation consistent with GHG Protocol Corporate Standard required	Encouraged but optional	Third-party verifier or spot checks by WEF
Scope 1	Achieve annual caps through tradable allowance market, initial period from 2005 to 2007	Determined by member country for allowance allocation	Annual compliance with allocated and traded allowances, EU committed to 8% overall reduction below 1990	Third party verifier

Scope 1 required	Permit individual industrial facilities	Not applicable	Not applicable	Local permitting authority
Direct combustion and process emission sources and indirect emissions optional.	Achieve annual targets through tradable allowance market	Average of 1998 through 2001	1% below its baseline in 2003, 2% below baseline in 2004, 3% below baseline in 2005 and 4% below baseline in 2006	Third party verifier
Scope 1 and 2 required, scope 3 strongly encouraged	Achieve targets, public recognition, expert assistance	Specific to each organization, recalculation consistent with GHG Protocol Corporate Standard required	Mandatory, specific to each organization	Third party verifier

D Industry Sectors and Scopes

APPENDIX

Sector	Scope 1 Emissions Sources	Scope 2 Emission Sources	Scope 3 Emissions Sources.
Energy			
Energy Generation	• Stationary combustion (boilers and turbines used in the production of electricity, heat or steam, fuel pumps, fuel cells, flaring) • Mobile combustion (trucks, barges and trains for transportation of fuels) • Fugitive emissions (CH_4 leakage from transmission and storage facilities, HFC emissions from LPG storage facilities, SF_6 emissions from transmission and distribution equipment)	• Stationary combustion (consumption of purchased electricity, heat or steam)	• Stationary combustion (mining and extraction of fuels, energy for refining or processing fuels) • Process emissions (production of fuels, SF_6 emissions2) • Mobile combustion (transportation of fuels/waste, employee business travel, employee commuting) • Fugitive emissions (CH_4 and CO_2 from waste landfills, pipelines, SF_6 emissions
Oil and Gas	• Stationary combustion (process heaters, engines, turbines, flares, incinerators, oxidizers, production of electricity, heat, and steam) • Process emissions (process vents, equipment vents, maintenance/turnaround activities, non-routine activities) • Mobile combustion (transportation of raw materials/products/waste; company-owned vehicles) • Fugitive emissions (leaks from pressurized equipment, wastewater treatment, surface impoundments)	• Stationary combustion (consumption of purchased electricity, heat or steam)	•Stationary combustion (product use as fuel or combustion for the production of purchased materials) • Mobile combustion (transportation of raw materials/products/waste, employee business travel, employee commuting, product use as fuel) • Process emissions (product use as feedstock or emissions from the production of purchased materials) • Fugitive emissions (CH_4 and CO_2 from waste landfills or from the production of purchased materials)

Coal Mining	**• Stationary combustion (methane flaring and use, use of explosives, mine fires)** **• Mobile combustion (mining equipment, transportation of coal)** **• Fugitive emissions (CH4 emissions from coal mines and coal piles)**	**• Stationary combustion (consumption of purchased electricity, heat or steam)**	**• Stationary combustion (product use as fuel)** **• Mobile combustion (transportation of coal/waste, employee business travel, employee commuting)** **• Process emissions (gasification)**
Metals			
Aluminum	• Stationary combustion (bauxite to aluminum processing, coke baking, lime, soda ash and fuel use, on-site CHP) • Process emissions (carbon anode oxidation, electrolysis, PFC) • Mobile combustion (pre- and post-smelting transportation, ore haulers) • Fugitive emissions (fuel line CH_4, HFC and PFC, SF_6 cover gas)	• Stationary combustion (consumption of purchased electricity, heat or steam)	• Stationary combustion (raw material processing and coke production by second party suppliers, manufacture of production line machinery) • Mobile combustion (transportation services, business travel, employee commuting) • Process emissions (during production of purchased materials) • Fugitive emissions (mining and landfill CH_4 and CO_2, outsourced process emissions)
Iron and Steel	• Stationary combustion (coke, coal and carbonate fluxes, boilers, flares) • Process emissions (crude iron oxidation, consumption of reducing agent, carbon content of crude iron/ferroalloys) • Mobile combustion (on-site transportation) • Fugitive emission (CH_4, N_2O)	• Stationary combustion (consumption of purchased electricity, heat or steam)	• Stationary combustion (mining equipment, production of purchased materials) • Process emissions (production of ferroalloys) • Mobile combustion (transportation of raw materials/products/waste and intermediate products) • Fugitive emissions (CH_4 and CO_2 from waste landfills)

Chemicals			
Nitric acid, Ammonia, Adipic acid, Urea, and Petrochemicals	• Stationary combustion (boilers, flaring, reductive furnaces, flame reactors, steam reformers) • Process emissions (oxidation/reduction of substrates, impurity removal, N_2O byproducts, catalytic cracking, myriad other emissions individual to each process) • Mobile combustion (transportation of raw materials/products/waste) • Fugitive emissions (HFC use, storage tank leakage)	• Stationary combustion (consumption of purchased electricity, heat or steam)	• Stationary combustion (production of purchased materials, waste combustion) • Process emissions (production of purchased materials) • Mobile combustion (transportation of raw materials/products/waste, employee business travel, employee commuting) • Fugitive emissions (CH_4 and CO_2 from waste landfills and pipelines)
Minerals			
Cement & Lime	• Process emissions (calcination of limestone) • Stationary combustion (clinker kiln, drying of raw materials, production of electricity) • Mobile combustion (quarry operations, on-site transportation)	• Stationary combustion (consumption of purchased electricity, heat or steam)	• Stationary combustion (production of purchased materials, waste combustion) • Process emissions (production of purchased clinker and lime) • Mobile combustion (transportation of raw materials/products/waste, employee business travel, employee commuting) • Fugitive emissions (mining and landfill CH_4 and CO_2, outsourced process emissions)
Waste			
Landfills, Waste combustion, Water services	• Stationary combustion (incinerators, boilers, flaring) • Process emissions (sewage treatment, nitrogen loading) • Fugitive emissions (CH_4 and CO_2 emissions from waste and animal product decomposition) • Mobile combustion (transportation of waste/products)	• Stationary combustion (consumption of purchased electricity, heat or 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 & Paper			
Pulp & Paper	• Stationary combustion (production of steam and electricity, fossil fuel-derived emissions from calcination of calcium carbonate in lime kilns, drying products with infrared driers fired with fossil fuels) • Mobile combustion (transportation of raw materials, products, and wastes, operation of harvesting equipment) • Fugitive emissions (CH_4 and CO_2 from waste)	• Stationary combustion (consumption of purchased electricity, heat or steam)	• Stationary combustion (production of purchased materials, waste combustion) • Process emissions (production of purchased 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 & HCFC 22 Production			
HCFC 22 production	• Stationary combustion(production of electricity, heat or steam) • Process emissions (HFC venting) • Mobile combustion (transportation of raw materials/products/waste) • Fugitive emissions (HFC use)	• Stationary combustion (consumption of purchased electricity, heat or steam)	• Stationary combustion (production of purchased materials) • Process emissions (production of purchased 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)

Semiconductor Production			
Semiconductor production	• Process emissions (C_2F_6, CH_4, CHF_3, SF_6, NF_3, C_3F_8, C_4F_8, N_2O used in wafer fabrication, CF_4 created from C_2F_6 and C_3F_8 processing) • Stationary combustion (oxidation of volatile organic waste, production of electricity, heat or steam) • Fugitive emissions (process gas storage leaks, container remainders/heel leakage) • Mobile combustion (transportation of raw materials/products/waste	• Stationary combustion (consumption of purchased electricity, heat or steam)	• Stationary combustion (production of imported materials, waste combustion, upstream T&D losses of purchased electricity) • Process emissions (production of purchased materials, outsourced disposal of returned process gases and container remainder/heel) • Mobile combustion (transportation of raw materials/products/waste, employee business travel, employee commuting) • Fugitive emissions (landfill CH4 and CO2 emissions, downstream process gas container remainder/ heel leakage)
Other Sectors			
Service sector/ 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 (consumption of purchased electricity, heat or steam)	• Stationary combustion (production of purchased materials) • Process emissions (production of purchased materials) • Mobile combustion (transportation of raw materials/ products/ waste, employee business travel, employee commuting)

Glossary

Absolute target	A target defined by reduction in absolute emissions over time e.g., reduces CO2 emissions by 25% below 1994 levels by 2010. (Chapter 11)
Additionality	A criterion for assessing whether a project has resulted in GHG emission reductions or removals in addition to what would have occurred in its absence. This is an important criterion when the goal of the project is to offset emissions elsewhere. (Chapter 8)
Allowance	A commodity giving its holder the right to emit a certain quantity of GHG. (Chapter 11)
Annex 1 countries	Defined in the International Climate Change Convention as those countries taking on emissions reduction obligations: Australia; Austria; Belgium; Belarus; 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.
Associated/affiliated company	The parent company has significant influence over the operating and financial policies of the associated/affiliated company, but not financial control. (Chapter 3)
Audit Trail	Well organized and transparent historical records documenting how an inventory was compiled.
Baseline	A hypothetical scenario for what GHG emissions, removals or storage would have been in the absence of the GHG project or project activity. (Chapter 8)
Base year	A historic datum (a specific year or an average over multiple years) against which a company's emissions are tracked over time. (Chapter 5)
Base year emissions	GHG emissions in the base year. (Chapter 5)
Base year emissions recalculation	Recalculation of emissions in the base year to reflect a change in the structure of the company, or to reflect a change in the accounting methodology used. This ensures data consistency over time, i.e.,comparisons of like with like over time. (Chapter 5, 11)

Biofuels	Fuel made from plant material, e.g. wood, straw and ethanol from plant matter (Chapter 4, 9, Appendix B)
Boundaries	GHG accounting and reporting boundaries can have several dimensions, i.e. organizational, operational, geographic, business unit, and target boundaries. The inventory boundary determines which emissions are accounted and reported by the company. (Chapter 3, 4, 11)
Cap and trade system	A system that sets an overall emissions limit, allocates emissions allowances to participants, and allows them to trade allowances and emission credits with each other. (Chapter 2, 8, 11)
Capital Lease	A lease which transfers substantially all the risks and rewards of ownership to the lessee and is accounted for as an asset on the balance sheet of the lessee. Also known as a Financial or Finance Lease. Leases other than Capital/Financial/Finance leases are Operating leases. Consult an accountant for further detail as definitions of lease types differ between various accepted financial standards. (Chapter 4)
Carbon sequestration	The uptake of CO_2 and storage of carbon in biological sinks.
Clean Development Mechanism (CDM)	A mechanism established by Article 12 of the Kyoto Protocol for project-based emission reduction (CDM) activities in developing countries. The CDM is designed to meet two main objectives: to address the sustainability needs of the host country and to increase the opportunities available to Annex 1 Parties to meet their GHG reduction commitments. The CDM allows for the creation, acquisition and transfer of CERs from climate change mitigation projects undertaken in non-Annex 1 countries.
Certified Emission Reductions	A unit of emission reduction generated by a CDM project. CERs are tradable commodities that can be (CERs) used by Annex 1 countries to meet their commitments under the Kyoto Protocol.
Co-generation unit/Combined /heat and power (CHP)	A facility producing both electricity and steam/heat using the same fuel supply. (Chapter 3)
Consolidation	Combination of GHG emissions data from separate operations that form part of one company or group of companies. (Chapter 3, 4)

Control	The ability of a company to direct the policies of another operation. More specifically, it is defined as either operational control (the organization or one of its subsidiaries has the full authority to introduce and implement its operating policies at the operation) or financial control (the organization has the ability to direct the financial and operating policies of the operation with a view to gaining economic benefits from its activities). (Chapter 3)
Corporate inventory program	A program to produce annual corporate inventories that are in keeping with the principles, standards, and guidance of the GHG Protocol Corporate Standard. This includes all institutional, managerial and technical arrangements made for the collection of data, preparation of a GHG inventory, and implementation of the steps taken to manage the quality of their emission inventory.
CO2 equivalent (CO2-e)	The universal unit of measurement to indicate the global warming potential (GWP) of each of the six greenhouse gases, expressed in terms of the GWP of one unit of carbon dioxide. It is used to evaluate releasing (or avoiding releasing) different greenhouse gases against a common basis.
Cross-sector calculation tool	A GHG Protocol calculation tool that addresses GHG sources common to various sectors, e.g. emissions from stationary or mobile combustion. See also GHG Protocol calculation tools (www.ghgprotocol.org).
Direct GHG emissions	Emissions from sources that are owned or controlled by the reporting company. (Chapter 4)
Direct monitoring	Direct monitoring of exhaust stream contents in the form of continuous emissions monitoring (CEM) or periodic sampling. (Chapter 6)
Double counting	Two or more reporting companies take ownership of the same emissions or reductions. (Chapter 3, 4, 8, 11)
Emissions	The release of GHG into the atmosphere.
Emission factor	A factor allowing GHG emissions to be estimated from a unit of available activity data (e.g. tonnes of fuel consumed, tonnes of product produced) and absolute GHG emissions. (Chapter 6)
Emission Reduction Unit (ERU)	A unit of emission reduction generated by a Joint Implementation (JI) project. ERUs are tradable commodities which can be used by Annex 1 countries to help them meet their commitment under the Kyoto Protocol.
Equity share	The equity share reflects economic interest, which is the extent of rights a company has to the risks and rewards flowing from an operation. Typically, the share of economic risks and rewards in an operation is aligned with the company's percentage ownership of that operation, and equity share will normally be the same as the ownership percentage. (Chapter 3)

Estimation uncertainty	Uncertainty that arises whenever GHG emissions are quantified, due to uncertainty in data inputs and calculation methodologies used to quantify GHG emissions. (Chapter 7)
Finance lease	A lease which transfers substantially all the risks and rewards of ownership to the lessee and is accounted for as an asset on the balance sheet of the lessee. Also known as a Capital or Financial Lease. Leases other than Capital/Financial/Finance leases are Operating leases. Consult an accountant for further detail as definitions of lease types differ between various accepted accounting principles. (Chapter 4)
Fixed asset investment	Equipment, land, stocks, property, incorporated and non-incorporated joint ventures, and partnerships over which the parent company has neither significant influence nor control. (Chapter 3)
Fugitive emissions	Emissions that are not physically controlled but result from the intentional or unintentional releases of GHGs. They commonly arise from the production, processing transmission storage and use of fuels and other chemicals, often through joints, seals, packing, gaskets, etc. (Chapter 4, 6)
Green power	A generic term for renewable energy sources and specific clean energy technologies that emit fewer GHG emissions relative to other sources of energy that supply the electric grid. Includes solar photovoltaic panels, solar thermal energy, geothermal energy, landfill gas, low-impact hydropower, and wind turbines. (Chapter 4)
Greenhouse gases (GHG)	For the purposes of this standard, GHGs are the six gases listed in the Kyoto Protocol: carbon dioxide (CO_2); methane (CH_4); nitrous oxide (N_2O); hydrofluorocarbons (HFCs); perfluorocarbons (PFCs); and sulphur hexafluoride (SF_6).
GHG capture	Collection of GHG emissions from a GHG source for storage in a sink.
GHG credit	GHG offsets can be converted into GHG credits when used to meet an externally imposed target. A GHG credit is a convertible and transferable instrument usually bestowed by a GHG program. (Chapter 8, 11)
GHG offset	Offsets are discrete GHG reductions used to compensate for (i.e., offset) GHG emissions elsewhere, for example to meet a voluntary or mandatory GHG target or cap. Offsets are calculated relative to a baseline that represents a hypothetical scenario for what emissions would have been in the absence of the mitigation project that generates the offsets. To avoid double counting, the reduction giving rise to the offset must occur at sources or sinks not included in the target or cap for which it is used.

GHG program	A generic term used to refer to any voluntary or mandatory international, national, sub-national, government or non-governmental authority that registers, certifies, or regulates GHG emissions or removals outside the company. e.g. CDM, EU ETS, CCX, and CCAR.
GHG project	A specific project or activity designed to achieve GHG emission reductions, storage of carbon, or enhancement of GHG removals from the atmosphere. GHG projects may be stand-alone projects, or specific activities or elements within a larger non-GHG related project. (Chapter 8, 11)
GHG Protocol calculation tools	A number of cross-sector and sector-specific tools that calculate GHG emissions on the basis of activity data and emission factors (available at www.ghgprotocol.org).
GHG Protocol Initiative	A multi-stakeholder collaboration convened by the World Resources Institute and World Business Council for Sustainable Development to design, develop and promote the use of accounting and reporting standards for business. It comprises of two separate but linked standards—the GHG Protocol Corporate Accounting and Reporting Standard and the GHG Protocol Project Quantification Standard.
GHG Protocol Project Quantification Standard	An additional module of the GHG Protocol Initiative addressing the quantification of GHG reduction projects. This includes projects that will be used to offset emissions elsewhere and/or generate credits. More information available at www.ghgprotocol.org. (Chapter 8, 11)
GHG Protocol sector specific	A GHG calculation tool that addresses GHG sources that are unique to certain sectors, e.g., process calculation tools emissions from aluminum production. (see also GHG Protocol Calculation tools) GHG public report Provides, among other details, the reporting company's physical emissions for its chosen inventory boundary. (Chapter 9)
GHG registry	A public database of organizational GHG emissions and/or project reductions. For example, the US Department of Energy 1605b Voluntary GHG Reporting Program, CCAR, World Economic Forum's Global GHG Registry. Each registry has its own rules regarding what and how information is reported. (Introduction, Chapter 2, 5, 8, 10)
GHG removal	Absorbtion or sequestration of GHGs from the atmosphere.
GHG sink	Any physical unit or process that stores GHGs; usually refers to forests and underground/deep sea reservoirs of CO_2.
GHG source	Any physical unit or process which releases GHG into the atmosphere.

GHG trades	All purchases or sales of GHG emission allowances, offsets, and credits.
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.
Group company / subsidiary	The parent company has the ability to direct the financial and operating policies of a group company/subsidiary with a view to gaining economic benefits from its activities. (Chapter 3)
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 operations of the reporting company, but occur at sources owned or controlled by another company. (Chapter 4)
Insourcing	The administration of ancillary business activities, formally performed outside of the company, using resources within a company. (Chapter 3, 4, 5, 9)
Intensity ratios	Ratios that express GHG impact per unit of physical activity or unit of economic value (e.g. tonnes of CO_2 emissions per unit of electricity generated). Intensity ratios are the inverse of productivity/efficiency ratios. (Chapter 9, 11)
Intensity target	A target defined by reduction in the ratio of emissions and a business metric over time e.g., reduce CO_2 per tonne of cement by 12% between 2000 and 2008. (Chapter 11)
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 quantified list of an organization's GHG emissions and sources.
Inventory boundary	An imaginary line that encompasses the direct and indirect emissions that are included in the inventory. It results from the chosen organizational and operational boundaries. (Chapter 3, 4)
Inventory quality	The extent to which an inventory provides a faithful, true and fair account of an organization's GHG emissions. (Chapter 7)
Joint Implementation (JI)	The JI mechanism was established in Article 6 of the Kyoto Protocol and refers to climate change mitigation projects implemented between two Annex 1 countries. JI allows for the creation, acquisition and transfer of "emission reduction units" (ERUs).

Kyoto Protocol	A protocol to the United Nations Framework Convention on Climate Change (UNFCCC). 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 of 2008–12.
Leakage (Secondary effect)	Leakage occurs when a project changes the availability or quantity of a product or service that results in changes in GHG emissions elsewhere. (Chapter 8)
Life Cycle Analysis	Assessment of the sum of a product's effects (e.g. GHG emissions) at each step in its life cycle, including resource extraction, production, use and waste disposal. (Chapter 4)
Material discrepancy	An error (for example from an oversight, omission, or miscalculation) that results in the reported quantity being significantly different to the true value to an extent that will influence performance or decisions. Also known as material misstatement.(Chapter 10)
Materiality threshold	A concept employed in the process of verification. It is often used to determine whether an error or omission is a material discrepancy or not. It should not be viewed as a de minimus for defining a complete inventory. (Chapter 10)
Mobile combustion	Burning of fuels by transportation devices such as cars, trucks, trains, airplanes, ships etc. (Chapter 6)
Model uncertainty	GHG quantification uncertainty associated with mathematical equations used to characterize the relationship between various parameters and emission processes. (Chapter 7)
Non-Annex 1 countries	Countries that have ratified or acceded to the UNFCC but are not listed under Annex 1 and are therefore not under any emission reduction obligation (see also Annex 1 countries).
Operation	A generic term used to denote any kind of business, irrespective of its organizational, governance, or legal structures. An operation can be a facility, subsidiary, affiliated company or other form of joint venture. (Chapter 3, 4)
Operating lease	A lease which does not transfer the risks and rewards of ownership to the lessee and is not recorded as an asset in the balance sheet of the lessee. Leases other than Operating leases are Capital/Financial/Finance leases. Consult an accountant for further detail as definitions of lease types differ between various accepted financial standards. (Chapter 4)

Operational boundaries	The boundaries that determine the direct and indirect emissions associated with operations owned or controlled by the reporting company. This assessment allows a company to establish which operations and sources cause direct and indirect emissions, and to decide which indirect emissions to include that are a consequence of its operations. (Chapter 4)
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. (Chapter 5)
Organizational boundaries	The boundaries that determine the operations owned or controlled by the reporting company, depending on the consolidation approach taken (equity or control approach). (Chapter 3)
Outsourcing	The contracting out of activities to other businesses. (Chapter 3, 4, 5)
Parameter uncertainty	GHG quantification uncertainty associated with quantifying the parameters used as inputs to estimation models. (Chapter 7)
Primary effects	The specific GHG reducing elements or activities (reducing GHG emissions, carbon storage, or enhancing GHG removals) that the project is intended to achieve. (Chapter 8)
Process emissions	Emissions generated from manufacturing processes, such as the CO_2 that is arises from the breakdown of calcium carbonate ($CaCO_3$) during cement manufacture. (Chapter 4, Appendix D)
Productivity/efficiency ratios	Ratios that express the value or achievement of a business divided by its GHG impact. Increasing efficiency ratios reflect a positive performance improvement. e.g. resource productivity (sales per tonne GHG). Productivity/efficiency ratios are the inverse of intensity ratios. (Chapter 9)
Ratio indicator	Indicators providing information on relative performance such as intensity ratios or productivity/efficiency ratios. (Chapter 9)
Renewable energy	Energy taken from sources that are inexhaustible, e.g. wind, water, solar, geothermal energy, and biofuels.
Reporting	Presenting data to internal management and external users such as regulators, shareholders, the general public or specific stakeholder groups. (Chapter 9)
Reversibility of reductions	This occurs when reductions are temporary, or where removed or stored carbon may be returned to the atmosphere at some point in the future. (Chapter 8)

Rolling base year	The process of shifting or rolling the base year forward by a certain number of years at regular intervals of time. (Chapter 5, 11)
Scientific Uncertainty	Uncertainty that arises when the science of the actual emission and/or removal process is not completely understood. (Chapter 7)
Scope	Defines the operational boundaries in relation to indirect and direct GHG emissions. (Chapter 4)
Scope 1 inventory	A reporting organization's direct GHG emissions. (Chapter 4)
Scope 2 inventory	A reporting organization's emissions associated with the generation of electricity, heating/ cooling, or steam purchased for own consumption. (Chapter 4)
Scope 3 inventory	A reporting organization's indirect emissions other than those covered in scope 2. (Chapter 4)
Scope of works	An up-front specification that indicates the type of verification to be undertaken and the level of assurance to be provided between the reporting company and the verifier during the verification process. (Chapter 10)
Secondary effects (Leakage)	GHG emissions changes resulting from the project not captured by the primary effect(s). These are typically the small, unintended GHG consequences of a project. (Chapter 8)
Sequestered atmospheric carbon	Carbon removed from the atmosphere by biological sinks and stored in plant tissue. Sequestered atmospheric carbon does not include GHGs captured through carbon capture and storage.
Significance threshold	A qualitative or quantitative criteria used to define a significant structural change. It is the responsibility of the company/ verifier to determine the "significance threshold" for considering base year emissions recalculation. In most cases the "significance threshold" depends on the use of the information, the characteristics of the company, and the features of structural changes. (Chapter 5)
Stationary Combustion	Burning of fuels to generate electricity, steam, heat, or power in stationary equipment such as boilers, furnaces etc.
Structural change	A change in the organizational or operational boundaries of a company that result in the transfer of ownership or control of emissions from one company to another. Structural changes usually result from a transfer of ownership of emissions, such as mergers, acquisitions, divestitures, but can also include outsourcing/ insourcing. (Chapter 5)
Target base year	The base year used for defining a GHG target, e.g. to reduce CO2 emissions 25% below the target base year levels by the target base year 2000 by the year 2010. (Chapter 11)

Target boundary	The boundary that defines which GHG's, geographic operations, sources and activities are covered by the target. (Chapter 11)
Target commitment period	The date that defines the end of the target commitment period and determines whether the target is relatively short- or long-term. (Chapter 11)
Target double counting policy	A policy that determines how double counting of GHG reductions or other instruments, such as allowances issued by external trading programs, is dealt with under a GHG target. It applies only to companies that engage in trading (sale or purchase) of offsets or whose corporate target boundaries interface with other companies' targets or external programs. (Chapter 11)
Uncertainty	1. Statistical definition: A parameter associated with the result of a measurement that characterizes the dispersion of the values that could be reasonably attributed to the measured quantity. (e.g., the sample variance or coefficient of variation). (Chapter 7) 2. Inventory definition: A general and imprecise term which refers to the lack of certainty in emissions related data resulting from any causal factor, such as the application of non-representative factors or methods, incomplete data on sources and sinks, lack of transparency etc. Reported uncertainty information typically specifies a quantitative estimates of the likely or perceived difference between a reported value and a qualitative description of the likely causes of the difference. (Chapter 7).
United Nations Framework Convention on Climate Change	Signed in 1992 at the Rio Earth Summit, the UNFCCC is a milestone Convention on Climate Change treaty that provides an overall framework for international efforts to (UNFCCC) mitigate climate (UNFCCC) change. The Kyoto Protocol is a protocol to the UNFCCC.
Value chain emissions	Emissions from the upstream and downstream activities associated with the operations of the reporting company. (Chapter 4)
Verification	An independent assessment of the reliability (considering completeness and accuracy) of a GHG inventory. (Chapter 10)

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Presentation of the technical report called **"Greenhouse Gas Accounting Guidelines**".

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