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Protocols, Guidelines and Standards Used in Carbon Footprint Calculation

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Abstract

The world's population is increasing, and consumption and luxury habits are increasing. Consequently, the number of institutions, factories and various facilities has increased to meet the needs of the increase in population . This increase has resulted in an increase in pollutants and an increase in the concentration of some gases such as greenhouse gases. This has led to an increase in the Earth's temperature in global warming. The impact of global warming on the planet's climate change, and this change directly affects people. As a result of these effects, the concept of the carbon footprint emerged, and it can be defined as the amount of greenhouse gas emitted into the atmosphere by a person, organization, or society in the form of carbon dioxide. Therefore, various institutions must measure and determine their carbon footprint, know the most influential activity in producing this footprint, and work to reduce it. In order to measure and determine the carbon footprint of institutions, factories, and others, there are many protocols, standards, and institutions that work on this. The most important of them are the greenhouse gas protocols, the ISO 14064 standard, and the principles of IPCC. Each of them participates in determining the carbon footprint to contribute to reducing its impact on climate change, as it provides Protocols structure, principles provide necessary requirements and guidance, and standards provide specific methodologies for calculating the carbon footprint. Each plays a crucial role in ensuring accurate carbon footprint calculations.

Keywords: Greenhouse Gases; Carbon Footprint; GHG Protocol; ISO 14064; IPCC

Introduction

Persistent global warming refers to the long-term and continuing increase in the Earth's average surface temperature, primarily due to greenhouse gases released by human activities, such as the burning of fossil fuels. This phenomenon is a major aspect of climate change and has many consequences for our planet.

Greenhouse Gases

Greenhouse gases are gases in the Earth's atmosphere that trap heat, contributing to global warming, which in turn leads to climate change. The primary greenhouse gas emitted by human activities is carbon dioxide. Other important greenhouse gases include methane, nitrous oxide, and fluorinated gases. These gases allow sunlight to pass through them but prevent heat from escaping, thus maintaining the Earth's temperature. However, the increase in the concentration of these gases due to various human activities has led to increased global warming and climate change [4, 23].

Human-caused global warming contributes to an increase in the Earth's average surface temperature. This process leads to rapid climate change, also known as climate change [19, 31].

Climate Change

Climate change refers to long-term shifts in temperatures and weather patterns, leading to changes in the Earth's local, regional and global climates [20]. This phenomenon is manifested through key indicators such as rising global temperatures, rising sea levels, loss of ice at the poles, and changes in extreme weather patterns. The effects of human-caused global warming are occurring now and cannot be reversed on the time scale of people living today [19]. Current global warming is occurring at a rate about ten times faster than the average rate of warming after the Ice Age, and the effect of human activity on the warming of the climate system has evolved from theory to established fact. Some changes associated with climate change occur, such as drought, forest fires, heavy rains, etc [21].

Climate change can increase ground-level ozone, which is associated with many health problems, including decreased lung function and increased incidence of premature deaths. In addition to an increase in particulate matter, which can have warming and cooling effects on the climate, it causes longer warm seasons and this means longer pollen seasons, which may increase allergies and asthma attacks. Increased wildfires linked to climate change can significantly reduce air quality and affect people's health in various ways [8]. Climate change has significant economic consequences, such as increased health care costs and decreased productivity due to poor air quality. It is necessary to address the sources of greenhouse gas emissions and work to reduce air pollution, to mitigate the effects of global warming on climate change, which can improve health and boost economies [27].

In order to limit the excessive concentration of greenhouse gases, the sources of these gases must be identified, in order to reduce them and also know which of these gases have the greatest impact on the climate.

Carbon Footprint

The amount of carbon dioxide in the atmosphere is currently around 412 parts per million and rising. In 2019, humans released 36.44 billion tons of carbon dioxide into the atmosphere [24]. Methane is a potent greenhouse gas with a global warming potential 28-34 times higher than carbon dioxide over a 100-year time horizon [24, 28]. To compare the warming effect of methane, they are often converted to carbon dioxide equivalents. This conversion is done by multiplying the mass of emissions of a particular greenhouse gas by its equivalent carbon dioxide emissions [24]

The concept of a carbon footprint first appeared in the BBC Plant Foods magazine in 1999. It is the amount of carbon dioxide emissions associated with all the activities of a person or other entity, such as a building or a product. The concept of carbon footprint also includes emissions of other greenhouse gases, such as methane, nitrous oxide, or CFCs [2]. Greenhouse gases are often expressed as carbon dioxide in their carbon footprint because carbon dioxide is the most prevalent greenhouse gas. It is the most important greenhouse gas on Earth, as it absorbs and radiates heat, and is the main driver of climate change resulting from human activity [6]. When calculating a carbon footprint, emissions of other greenhouse gases, such as methane and nitrous oxide, are converted to carbon dioxide equivalents using their respective global warming potentials. This allows a standardized measurement of the impact of different greenhouse gases on global warming, expressed in carbon dioxide equivalents [3]. Carbon footprint is usually expressed as a measure of weight, such as tons of CO2 or CO2 equivalent per year [22]. This concept gained popularity in 2003 when an oil and gas company launched an advertising campaign encouraging people to calculate their personal carbon footprint using the company's calculator [5].

Calculating your carbon footprint is important to understand its impact on the environment and air pollution. The carbon footprint, which measures the amount of carbon dioxide and other greenhouse gases emitted by human activities, is a critical tool for assessing and managing air pollution and climate change. By measuring emissions associated with various activities, products or services, individuals, companies and governments can identify opportunities to reduce their environmental impact and contribute to improving air quality. In addition, calculating the carbon footprint helps raise awareness about the environmental consequences of everyday actions and supports the development of strategies to mitigate air pollution and its harmful effects on the environment and public health [2, 30].

GHG Protocol

The Greenhouse Gas Protocol is an international standard for holding companies accountable and reporting greenhouse gas emissions. It was created by the World Resources Institute and the World Business Council for Sustainable Development to help countries and companies calculate, report and mitigate emissions. It provides accounting and reporting standards, industry guidance, accounting tools, and training to businesses, as well as local and national governments. The Greenhouse Gas Protocol is widely used by companies, with 92% of companies using it directly or indirectly. It also provides standards and tools to help countries and cities track their progress toward achieving climate goals. The Protocol classifies greenhouse gases into three scopes: Scope 1, Scope 2, and Scope 3, based on the source of emissions as shown in Figure 1 [21].

Scope 1 emissions: These are direct emissions from owned or controlled sources. This includes emissions from company-owned or controlled vehicles, company-owned or controlled facilities, and company-owned or controlled industrial processes.

Scope 2 emissions: These are indirect emissions resulting from purchased energy generation. This includes emissions associated with producing purchased electricity and steam, heat and cooling consumed by the reporting company.

Scope 3 emissions: These are all indirect emissions (not included in Scope 2), including upstream and downstream emissions. This includes emissions from sources such as business travel, employee transportation, transportation and distribution, waste disposal, and purchased goods and services.

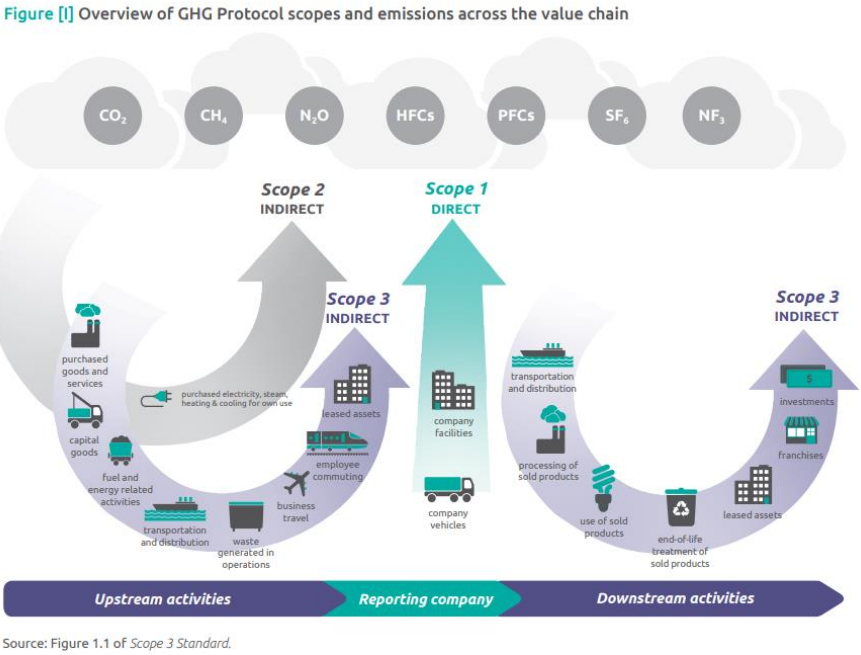

Figure 1: Overview of GHG Protocol scopes and emissions across the value chain [26]

The Greenhouse Gas Protocol depends on several factors and components to calculate the carbon footprint of a company or product. First, it divides the process of calculating emissions into two main steps: setting regulatory limits and setting operational limits. Regulatory limits specify which subsidiaries, franchises, and other entities will be included in the calculation, while operational limits specify which activities and emission sources will be included. Second, for each emission category, the GHG Protocol requires the collection of accurate data on emission sources, such as energy consumption, transportation, and waste management. This data is measured in units of carbon dioxide equivalent. Thirdly, CO2 emissions are calculated by multiplying the business activity by the emissions factor. These factors are derived from specialized databases and methodologies, such as those provided by the IPCC and the US Environmental Protection Agency. Fourth, the Greenhouse Gas Protocol requires verification by an independent third party, This process includes reviewing and confirming the calculations, methodologies, and data used to calculate the carbon footprint. Fifth, the Greenhouse Gas Protocol encourages companies to regularly update and improve their emissions inventory, taking into account new data, methodologies and regulatory requirements [7].

IPCC

The 2006 Intergovernmental Panel on Climate Change (IPCC) guidelines on greenhouse gases provide a technically sound methodological basis for their inventory. These guidelines were developed by the IPCC and aim to ensure transparency and accuracy in the reporting of greenhouse gas emissions by countries [15, 9]. The guidelines consist of five volumes and cover different aspects of developing greenhouse gas inventories, as well as carbon footprint standards [9].

First, defining and classifying activities and sources, this includes identifying and classifying activities and sources of greenhouse gas emissions within the country. Secondly, compiling inventories, as the guidelines provide a step-by-step approach to compiling greenhouse gas inventories, including selection of relevant activities and sources, data collection, and calculation methods. Thirdly, ensuring quality and consistency, as the guidelines emphasize the importance of ensuring data quality and consistency in greenhouse gas inventories. Fourth, reporting and verification, The guidelines specify processes for reporting and verifying greenhouse gas inventories, including the use of standardized formats and methodologies. Fifth: Monitoring and updating, the guidelines encourage countries to update and improve their greenhouse gas inventories on a regular basis, taking into account new data, methodologies and regulatory requirements. The 2006 IPCC guidelines were updated in 2019 to address

specific issues and methodological developments. The item includes The fifth is also cooperation with other organizations, as the Intergovernmental Panel on Climate Change cooperates with other organizations, such as the World Resources Institute, the World Business Council for Sustainable Development, and the International Organization for Standardization ISO, in order to ensure compatibility and consistency in methodologies for calculating the carbon footprint [9].

ISO 14064

It is a series of standards that serve as the basis for calculating the carbon footprint. The series consists of three parts, each of which provides principles and requirements for quantifying, monitoring, reporting, verifying and validating greenhouse gas emissions. The first part focuses on the organizational level, the second part on the project level, and the third part provides guidance on verification, calculation, and reporting [12, 17].

This standard provides a framework for organizations to quantify and report their greenhouse gas emissions at a regulatory level. The standard requires organizations to establish an inventory of greenhouse gases, including limits, scope, and data collection methodology. The inventory must be verified by an independent third party to ensure accuracy and transparency .The second edition of the standard provides guidance on quantifying and reporting reductions or eliminations of greenhouse gas emissions, such as for energy projects. The standard requires organizations to establish project boundaries, define its scope and data collection methodology, and measure and report on the reductions or eliminations of greenhouse gas emissions achieved by the project .The third edition of the standard provides guidance on validating greenhouse gas assertions. The standard requires organizations to create a verification plan including scope, data collection methodology, and verification procedures [12].

The standard specification for this ISO standard relies on several sources and tools to calculate the carbon footprint, including the corporate standard for the Greenhouse Gas Protocol [17].

ISO 14067

ISO 14067 is a standard within a family of environmental standards that focuses on measuring the carbon footprint of products. It helps manufacturers and producers calculate and report the carbon footprint of their products, considering the life cycle assessment of these products. It is applicable to CFP studies, the results of which provide the basis for different applications. This standard addresses only a single impact category: climate change. Carbon offsetting and communication of CFP or partial CFP information are outside the scope of this standard.The standard aims to help organizations understand and measure the environmental impact of their products and support their efforts to address climate change and promote sustainability [1].

European Investment Bank

The European Investment Bank (EIB) has developed the EIB Project Carbon Footprint Methodologies, which are used to calculate the carbon footprint of the investment projects financed by the bank. These methodologies enable the quantification and reporting of the carbon footprint of a product in line with international standards as the Intergovernmental Panel on Climate Change, ISO 14064 and the Greenhouse Gas Protocol [10].

These methodologies cover different sectors such as forests, ports, airports, land use change, wastewater treatment facilities, etc. The European Union Ecolabel has also developed a toolkit for measuring the carbon footprint, suitable for various products and services [16].

The carbon footprints are published on the project's Environmental and Social Data Sheet and are also aggregated annually as part of the EIB's Carbon Footprint Exercise. The EIB's carbon footprinting work is mainstreamed into its operations and re-

mains under regular review, with the bank working closely with other financial institutions and stakeholders in this area [13].

Environmental Protection Agency for Carbon Footprint

The EPA does not have a specific standard for calculating a carbon footprint. However, the EPA provides valuable information about the sources of greenhouse gas emissions and their impact on the environment. EPA emissions data help companies, governments, and other entities understand the environmental impacts of their emissions and take appropriate measures to reduce them [11].

Clean development mechanism

It is a flexible mechanism introduced in the Kyoto Protocol that allows developed countries to achieve their greenhouse gas emission targets by investing in projects that reduce emissions or eliminate greenhouse gases in developing countries [14,29].

The Clean Development Mechanism allows developing countries to obtain certified emission reduction credits for every ton of carbon dioxide equivalent they prevent from being released into the atmosphere [3]. These credits can be traded, sold, and used by industrialized countries to achieve part of the emission reduction targets under the Kyoto Protocol [25, 29].

The Clean Development Mechanism plays an important role in reducing the carbon footprint by promoting sustainable development and facilitating the implementation of emission reduction projects in developing countries, thus contributing to global efforts to combat climate change [25, 18].

Conclusion

Calculating one's carbon footprint is imperative for comprehending one's ecological influence and aiding in the battle against climate change. Through the evaluation of our carbon footprint, we can discern specific areas where emissions can be diminished, including energy usage, transportation, and dietary preferences. This practice enables us to formulate a robust environmental strategy and play a role in curbing greenhouse gas emissions. Moreover, it serves as a catalyst to motivate others to partake in this endeavor, emphasizing the significance of emission reduction and fostering environmental awareness. By comprehending one's carbon footprint, individuals are empowered to take action to mitigate their environmental impact and contribute to global endeavors to combat climate change. Furthermore, this knowledge facilitates the making of informed decisions regarding one's lifestyle and consumption habits, ultimately leading to more sustainable choices.

Protocols, guidelines and standards play distinct roles in carbon footprint calculations as protocols, such as the Greenhouse Gas Protocol, provide clear structures for carbon footprint calculations. For example, the Greenhouse Gas Protocol provides comprehensive standards for private and public entities to calculate their carbon footprint. While guidelines, such as those found in the ISO 14064 standard, define the principles and requirements for measuring, monitoring, reporting, verifying and validating greenhouse gas emissions.

The Greenhouse Gas Protocol and the ISO 14064 standard collaborate with the Intergovernmental Panel on Climate Change in calculating the carbon footprint by providing internationally recognized guidelines and standards for greenhouse gas accounting and reporting. The Greenhouse Gas Protocol provides standards consistent with IPCC methodologies and guidelines for accounting for greenhouse gases. In addition, ISO 14064 focuses on GHG projects or project-based activities designed to reduce emissions or enhance removals, further contributing to the harmonization of GHG accounting and reporting. By adhering to these internationally recognized guidelines and standards, organizations can accurately calculate their carbon footprint, enabling informed decisions and effective climate action.

Ethical Approval

This article agrees with the general ethical framework

Consent to Participate

The authors have no objection to Participate this article

Consent to Publish

The authors have no objection to publishing the article

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Hamada and Bassma participated in writing all parts

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