WWF | HSBC

Climate Solutions Partnership

Guidebook on

GHG INVENTORIES FOR TEXTILE & DYEING SECTOR

CONTENTS

List of figures and tables

Abbreviations

AR6	Sixth Assessment Report of IPCC, 2021
CAT	Category
CDM	Clean Development Mechanism
CO_2e	CO_2 equivalent
CPTPP	The Comprehensive and Progressive Agreement for Trans-Pacific Partnership
ENERTEAM	Energy Conservation Research and Development Center
EU	European Union
EVFTA	European Union–Vietnam Free Trade Agreement
EVN	Vietnam Electricity
FABRIC	Promoting Sustainability in the Textile and Garment Industry in Asia
FDI	Foreign direct investment
GHG Protocol	Greenhouse Gas Protocol
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GWP	Global warming potential
IPCC	Intergovernmental Panel on Climate Change
GHG	Greenhouse Gas
US EPA	United States Environmental Protection Agency
WWF	World Wide Fund for Nature
WRI	World Resources Institute
WBCSD	World Business Council for Sustainable Development

Glossary

Base year	A historic datum (a specific year or an average over multiple years) against which a company's emissions are tracked over time.
Base year emissions	GHG emissions in the base year.
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.
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.
Clean Development Mechanism (CDM)	A mechanism established by Article 12 of the Kyoto Protocol for project-based emission reduction activities in developing countries. The CDM is designed to meet two main objectives: to address the sustainability needs of the developing (country and to increase the opportunities available to developed (Annex 1 Parties) to meet their GHG reduction commitments. The CDM allows for the creation, acquisition, and transfer of Certified Emission Reductions (CERs) from climate change mitigation projects undertaken in non-Annex 1 countries.
Certified Emission Reductions (CERs)	A unit of emission reduction generated by a CDM project. CERs are tradable commodities that can be used by Annex 1 countries to meet their commitments under the Kyoto Protocol.
Consolidation	Combination of GHG emissions data from separate operations that form part of one company or group of companies
CO_2 equivalent (CO_2e)	The universal unit of measurement to indicate the global warming potential (GWP) of each greenhouse gas, expressed in terms of the GWP of one unit of carbon dioxide. It is used to evaluate releasing (or avoided releasing) of different greenhouse gases against a common factor.
Direct GHG emissions	Emissions from sources that are owned or controlled by the reporting company.
Emission factor	A factor allowing GHG emissions to be estimated from a unit of available activity data.
Activity data	GHG activity data is a quantitative measure of the activity leading to GHG emissions or GHG removals.
Greenhouse gases - GHG	Gases that contribute to global warming by absorbing infrared radiation. The GHG Protocol and Kyoto Protocol include seven gases: carbon dioxide (CO_2); Methane (CH_4); Nitrous oxide (N_2O); Hydrofluorocarbon (HFCs); Perfluorocarbons (PFCs); Sulphur hexafluoride (SF_6); and Nitrogen trifluoride (NF_3).
Organic Growth	is the growth rate that a company can achieve by increasing production and sales revenue through internal processes.

01

INTRODUCTION

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Textile and garment production is one of Vietnam's key export industries. It is essential to the economy's growth, accounting for 12 - 16% of Vietnam's total export turnover (ranked 2nd after the Telephone and electronic components industries). The accumulated FDI in the textile and garment industry as of May 18, 2022, has a registered capital of about US$31 billion with 2,787 valid projects.[1] Vietnam is currently participating in new-generation free trade agreements (CPTPP and EVFTA) with the rule of origin "from yarn onwards" in CPTPP and "from fabric onwards" in EVFTA. To take advantage of tax incentives brought by the agreements, Vietnam should increase the localization of fiber and fabric raw materials.

The global fashion industry's greenhouse gas emissions are a significant cause of climate change. European international commitments and legal requirements, including the German Enterprise Appraisal Law increase pressure on brands and multinational companies to identify, prevent, reduce, and take responsibility for environmental and social risks over the entire supply chain. It is against this background that numerous fashion brands and textile manufacturers have set their climate and environmental goals.[2]

The Law on Environmental Protection 2020 and the Government's Decree No. 06/2022/NĐ-CP dated January 7, 2022, on mitigation of greenhouse gas emissions and protection of the ozone layer, have issued regulations related to the mitigation of greenhouse gas emissions. Specifically, on January 18, 2022 in Decision No. 01/2022/QĐ-TTg, the Prime Minister issued a list of sectors and facilities that must carry out a greenhouse gas inventory. Accordingly, more than 500 companies in the textile and dyeing industry are now responsible for providing operational data before March 31, 2023, according to the Ministry of Industry and Trade, and organize the implementation of a GHG inventory every two years from 2024 onwards and send it to the People's Committee of the province before March 31, 2025.

Based on the above-mentioned context, this guidebook aims to support the textile and dyeing industry to comply with legal regulations, understand their role in climate change, and know how to calculate and reduce their greenhouse gases. This guidebook is a product of the Project "An energy transition for a 1.5-degree world: Acceleration Process in Asia". The project is part of the Climate Solutions Partnership, funded by HSBC and implemented by WWF-Vietnam and the World Resources Institute (WRI) through the Clean Energy Investment Accelerator (CEIA) with the cooperation of the Tay Ninh Department of Industry and Trade and Vietnam Chamber of Commerce and Industry (VCCI).[3]

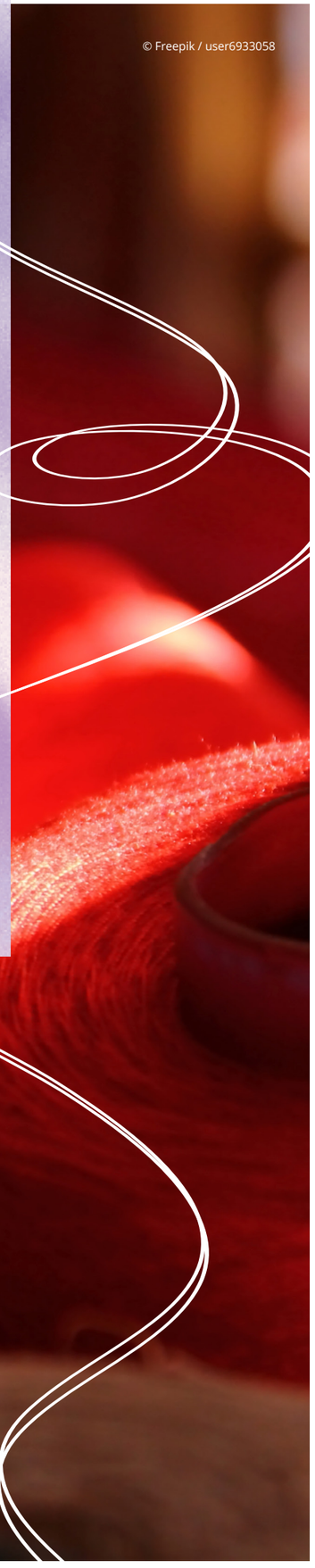
The guidebook is compiled based on documents, tools, and technical guidelines developed by the GHG Protocol (established by The World Resources Institute), the World Business Council for Sustainable Development, ISO "Greenhouse gas and climate change management and related activities sub-committee (ISO TC 207/SC 7), Promoting Sustainability in the Textile and Garment Industry in Asia (FABRIC) project by GIZ, workshop documents and technical comments of other organizations.

[1] Improving the efficiency of corporate governance in the textile and garment industry in the new scene, https://moit.gov.vn/tin-tuc/phat-trien-cong-nghiep/nang-cao-hieu-qua-quan-tri-doanh-nghiep-det-may-trong-boi-canh-moi.htm

[2] Greening of the textile and garment industry, https://congthuong.vn/xanh-hoa-nganh-det-may-173070-173070.html

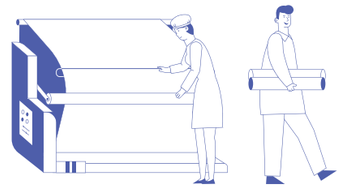
[3] WWF, HSBC, and WRI mark a groundbreaking partnership to advance climate solutions with global impact, https://vietnam.panda.org/en/?372756/WWF-HSBC-WRI-hoi-thao-khoi-dong-du-an-Tay-Ninh

02



BASIC PRINCIPLES FOR ACCOUNTING AND REPORTING GHG EMISSIONS

GHG accounting and reporting principles are developed and published in the Greenhouse Gas Protocol - A Corporate Accounting and Reporting Standard (WRI/WBCSD, 2004). According to the Greenhouse Gas Protocol, GHG accounting and reporting should be based on the following principles:



Details on each of these principles can be found in **the Greenhouse Gas Protocol - A Corporate Accounting and Reporting Standard** (pg. 8-9).

RELEVANCE	Ensure the GHG inventory appropriately reflects the GHG emissions of the company and serves the decision-making needs of users – both internal and external to the company.
COMPLETENESS	Account for and report on all GHG emission sources and activities within the chosen inventory boundary. Disclose and justify any specific exclusions.
CONSISTENCY	Use consistent methodologies to allow for meaningful comparisons of emissions over time. Transparently document any changes to the data, inventory boundary, methods, or any other relevant factors in the time series.
TRANSPARENCY	Address all relevant issues in a factual and coherent manner, based on a clear audit trail. Disclose any relevant assumptions and make appropriate references to the accounting and calculation methodologies and data sources used.
ACCURACY	Ensure that the quantification of GHG emissions is systematically neither over nor under actual emissions, as far as can be judged, and that uncertainties are reduced as far as practicable. Achieve sufficient accuracy to enable users to make decisions with reasonable assurance as to the integrity of the reported information.

03

SETTING ORGANIZATIONAL BOUNDARIES AND OPERATIONAL BOUNDARIES

Two types of boundaries are described in the GHG emissions inventory, which are organizational boundaries and operational boundaries:

Organizational boundaries are defined as the group of activities or facilities in which an organization exercises operational or financial control or has an equity share[4].

Operational boundaries refer to the range of emissions included within defined organizational boundaries[5].

4 ISO 1064-1:2018, 3.4.7

5 IPIECA, Energy API, OGP (2011). Petroleum industry guidelines for reporting greenhouse gas emissions - Second edition, p3-1

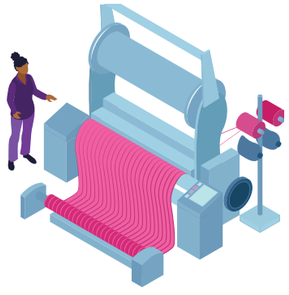
Details on how to define organizational and operational boundaries are presented below.

3.1 SETTING ORGANIZATIONAL BOUNDARIES

Organizational boundaries can be defined by the equity approach or the control approach.

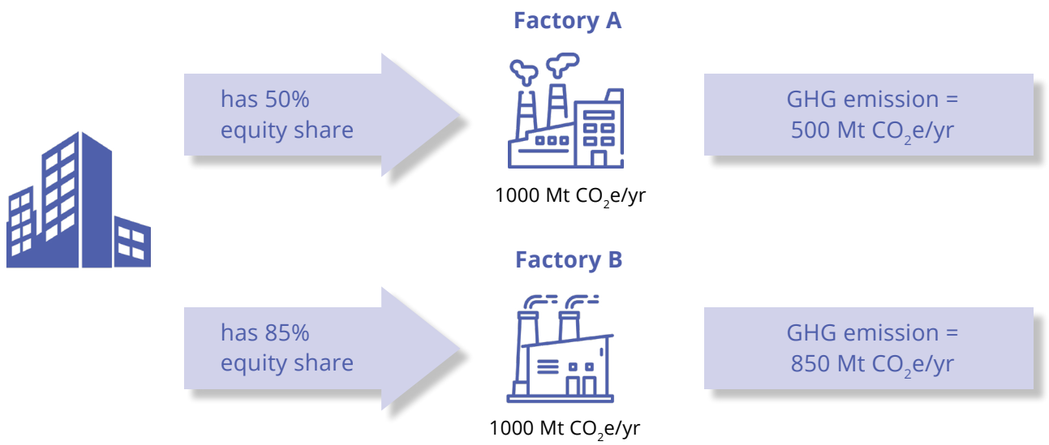
3.1.1 Equity share approach

Under the equity share approach, the amount of GHG emissions from a company's operations is calculated according to its share of equity (i.e., ownership percentage) in the operation. The equity share reflects economic interest, which is the extent of rights a company has to the risks and rewards flowing from an operation. To use this method, the GHG inventory team may need to consult with the company's accounting or legal staff to ensure that the appropriate equity share percentage is applied for each joint operation.



For example: The company holds 50% equity with factory A and 85% equity with factory B. Under the equity approach, the company's consolidated greenhouse gas emissions are calculated as shown in Figure 3.1.

Figure 3.1/ Consolidate GHG emissions reporting under the equity share approach



3.1.2 Control approach

Under the control approach, a company accounts for 100 percent of the GHG emissions from operations over which it has control. It does not account for GHG emissions from operations in which it owns an interest but has no control. Control can be defined as financial or operational control.

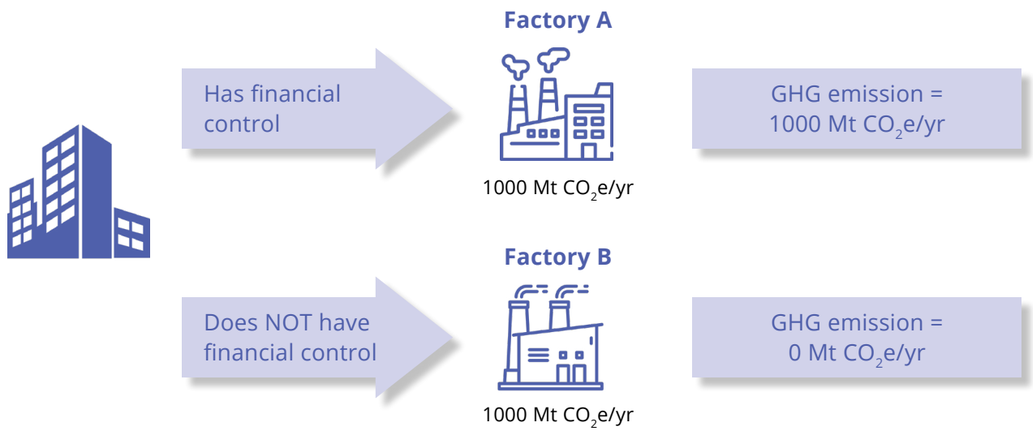
a. Financial control

A company has financial control if it has the ability to direct financial and operating policies with a view to gain economic benefits from its activities. For example, financial control usually exists if the company has the right to the majority of benefits of the operation. Similarly, a company is considered to financially control an operation if it retains the majority of risks and rewards of ownership of the operation's assets.

Under this criterion, a company may have financial control over an operation for GHG accounting purposes even if it has less than a 50 percent interest in that operation such as when an operation is considered as a group company or subsidiary. If this criterion is chosen to determine control, emissions from joint ventures where partners have joint financial control are accounted for based on the equity share approach.

For example: The company holds 50% equity with factory A and 85% equity with factory B. In which, the company has financial control over factory A, without financial control with factory B. According to the financial control approach, the company's consolidated GHG emissions are calculated as shown in Figure 3.2.

Figure 3.2/ Consolidate GHG emissions reporting under financial control



b. Operational control

A company has operational control over an operation if the company (or one of its subsidiaries) has the full authority to introduce and implement operating policies at the operation. This criterion is most commonly used and consistent with current accounting and reporting practices. In the vast majority of cases, if the company or one of its subsidiaries is the operator of a facility, it would be considered to have operational control as it would have the full authority to introduce and implement its operating policies.

Under the operational control approach, 100% of emissions from operations over which it (or one of its subsidiaries) has operational control would be counted.

Note that having operational control does not mean that a company has the authority to make all decisions regarding the organization. For example, large capital investments will likely require the approval of all the partners that have joint financial control. Operational control does mean that a company has the authority to introduce and implement its operating policies.

For example: A company holds 50% equity with factory A and 85% equity with factory B. In which, the company has operational control over factory A, without the operation control with plant B. According to the operational control approach, the company's consolidated GHG emissions are calculated as shown in Figure 3.3.

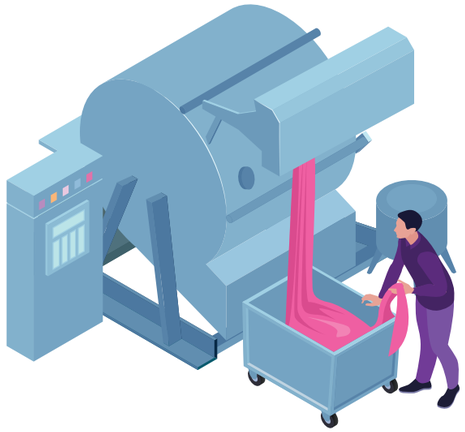
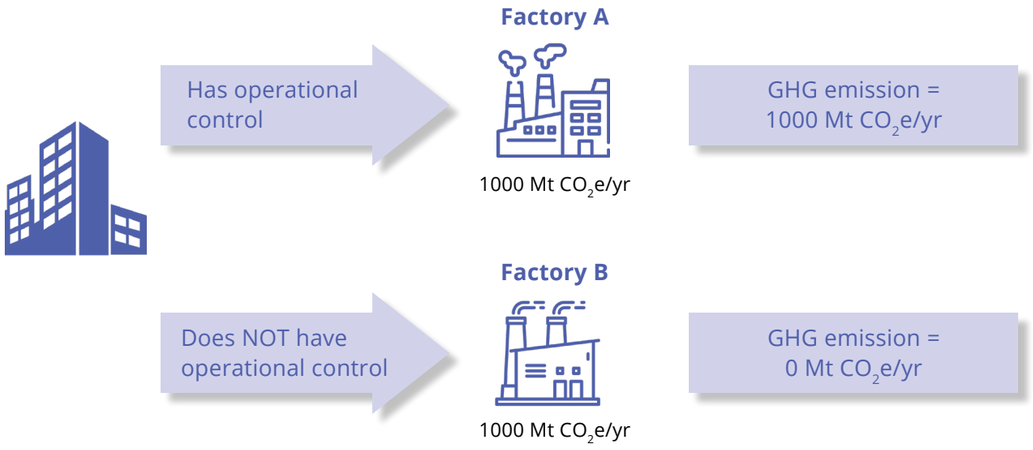


Figure 3.3/ Consolidate GHG emissions reporting under operational control



SETTING OPERATIONAL BOUNDARIES 3.2

Operational boundaries define a company's direct and indirect emission ranges. Operational boundaries (Scope 1, Scope 2 and Scope 3) are determined after first establishing a company's organizational boundaries. The selected operational boundary should be applied uniformly to identify and classify direct and indirect emissions at each activity level.

3.2.1 Scope 1: Direct GHG emissions

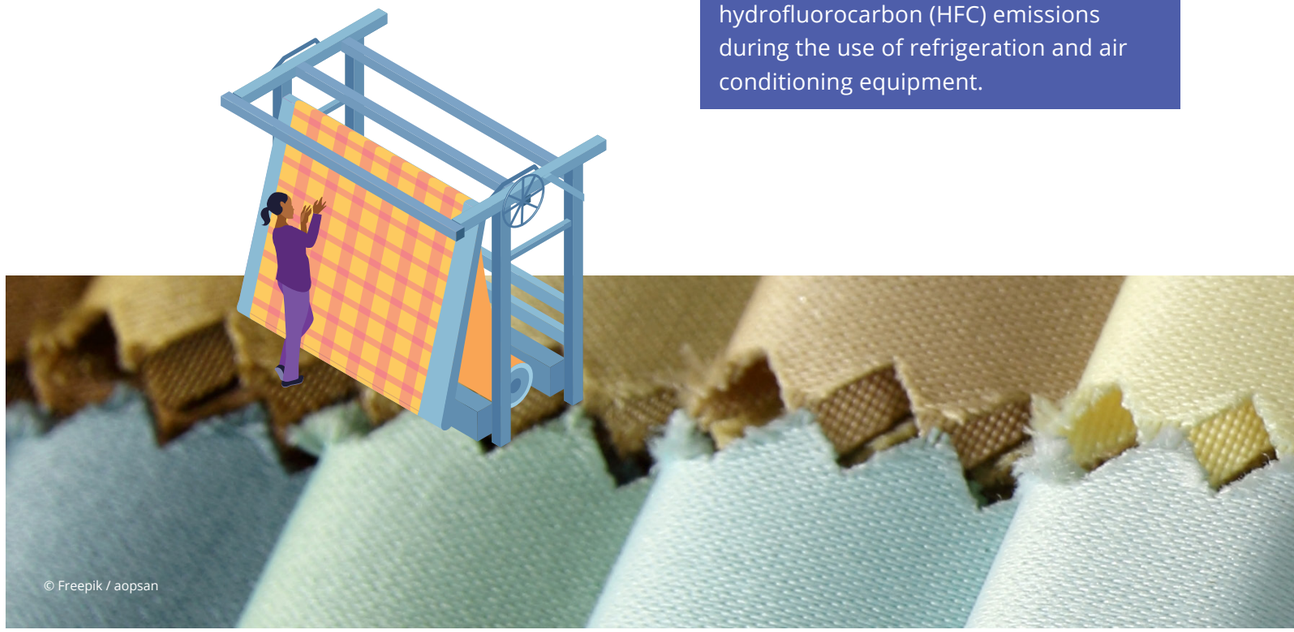
Companies report GHG emissions that they directly emit as Scope 1. Direct GHG emissions are principally the result of the following types of activities undertaken by the company:

Combustion of fuels in stationary sources (e.g., boilers, furnaces, turbines) to generate electricity, heat, or steam.

Combusion of fuels from owned/ controlled mobile sources (e.g., trucks, cars, forklift), used to transport materials, products, waste, and employees.

Emissions creating by physical or chemical processing (e.g., cement, aluminum, adipic acid, ammonia manufacture, and waste treatment).

Fugitive emissions: Emissions resulting from intentional or unintentional releases (e.g., equipment leaks from joints, seals, packing, and gaskets; methane (CH4) escaping from landfills; hydrofluorocarbon (HFC) emissions during the use of refrigeration and air conditioning equipment.



3.2.2 Scope 2: Indirect GHG emissions

Scope 2 emissions are a special category of indirect emissions that refer solely to the emissions associated with purchased electricity, steam, and heat. For many companies, purchased electricity represents one of the largest sources of GHG emissions and the most significant opportunity to reduce these emissions. Accounting for Scope 2 emissions is required by all major GHG inventory standards and allows companies to better compare different energy sources, such as between gas and petroleum-run machines (scope 1) and their electric (scope 2) counterparts.

Companies can reduce their Scope 2 emissions through two main tactics: 1) use less electricity and 2) use electricity with lower emissions factors, e.g., source renewable electricity instead of coal-fired electricity. The former can be achieved by investing in energy-efficient technologies and energy conservation. The latter can be achieved by installing on-site renewables, or by purchasing electricity through a green energy market (in places where such markets exist). Emerging green energy markets can provide opportunities for companies to switch to less GHG intensive sources of electricity, without having to install renewables capacity directly on their land.

3.2.3 Scope 3: Other indirect GHG emissions

While accounting for Scope 3 emissions remains optional for most companies, it provides an opportunity to understand the bigger picture of a company's GHG emissions along its value chain. At present, standardization across Scope 3 disclosures remains poor, so Scope 3 may not lend itself well to comparisons across companies. This section provides an indicative list of Scope 3 categories and includes case studies on some of the categories.

Scope 3 emissions of one company are essentially the scope 1 emissions or another company. This means that depending on the organizational boundary used, there can be variance on whether an emission is considered Scope 1 or 3. To determine if an activity falls within Scope 1 or Scope 3, the company should refer to the selected consolidation approach (equity or control) used in setting its organizational boundaries.

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Some activities in Scope 3 are listed below:

Extraction and production of purchased materials and fuels.

Transport-related activities

- ★ Transportation of purchased materials or goods
- ★ Transportation of purchased fuels
- ★ Employee business travel
- ★ Employees commuting
- ★ Transportation of sold products
- ★ Transportation of waste

Electricity-related activities not included in Scope 2

- ★ Extraction, production, and transportation of fuels consumed in the generation of electricity (either purchased or own generated by the reporting company)
- ★ Purchase of electricity that is sold to an end user (reported by eletricity company)
- ★ Generation of electricity that is consumed in a T&D system (reported by end-user)

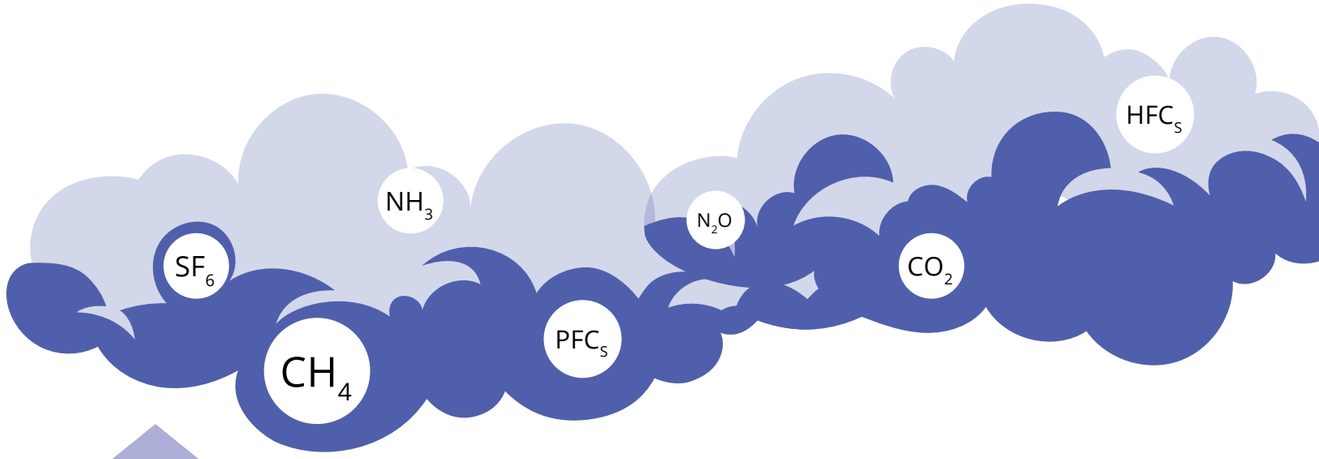
Leased assets, franchises, and outsourced activities—emissions from such contractual arrangements are only classified as Scope 3 if the selected consolidation approach (equity or control) does not apply to them. Clarification on the classification of leased assets should be obtained from the company accountant.

Use of sold products and services.

Waste treatment

- ★ 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 cycle.

The scopes and sources of emissions are summarized as shown below:



SCOPE 1
Direct

Energy/Heat Generation at Company Facilities

Company Vehicles

Fugitive Emissions

SCOPE 2
Indirect

Purchased Electricity, Steam, Heat & Cooling

SCOPE 3
Indirect

Leased Facilities

Employee Commuting

Business Travel

Purchased Goods/ Services

Capital Goods

Transport & Distribution

Fuel/Energy Related

Operational Waste

SCOPE 3
Indirect

Transport & Distribution

Processing of Sold Products

Use of sold Products

End of Life for Products

Leased Facilities

Franchises

Investments

UPSTREAM ACTIVITIES

DOWNSTREAM ACTIVITIES

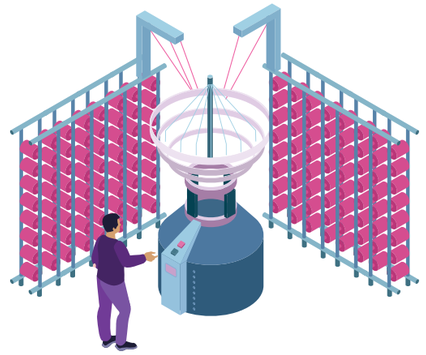
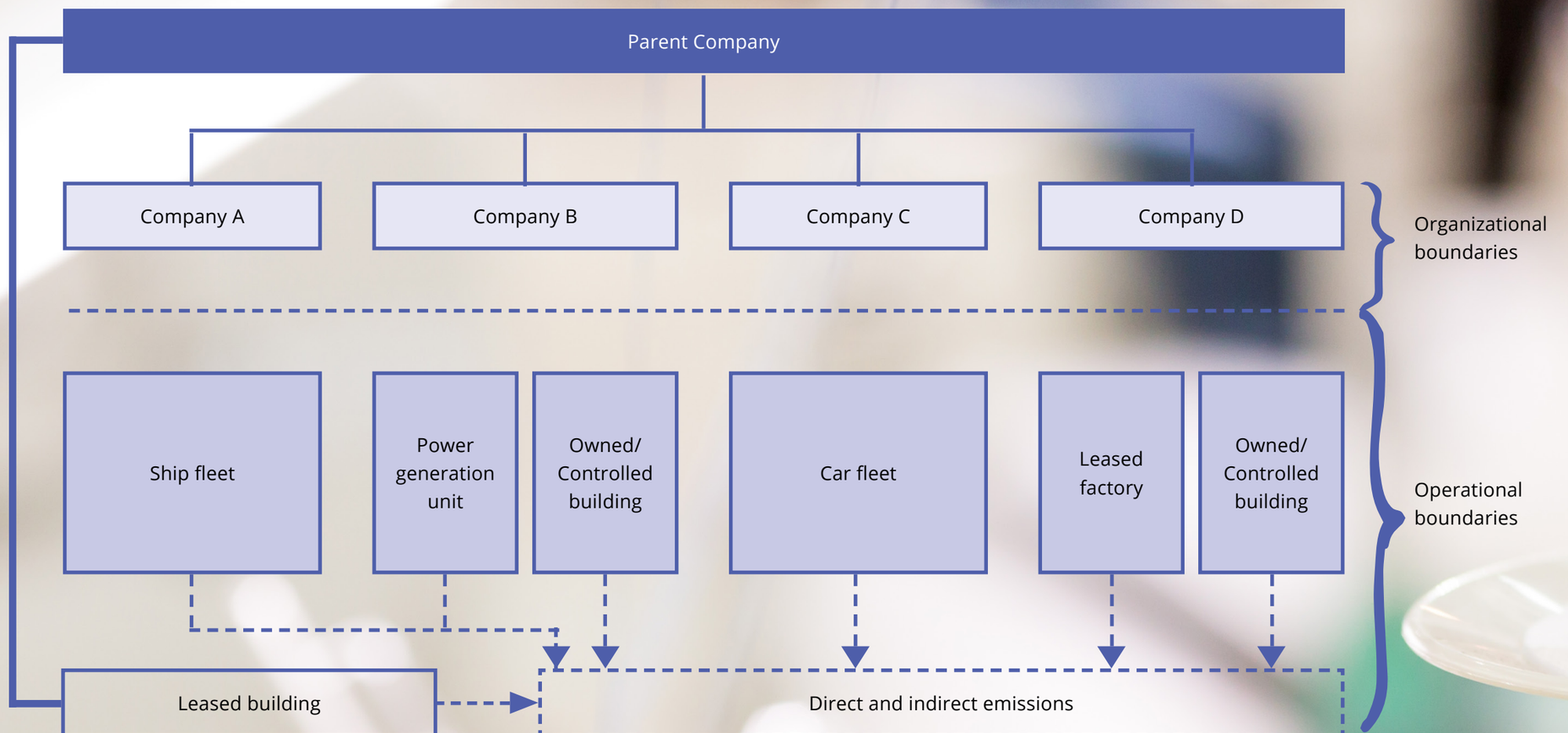


Figure 3.4/ An overview of the scope and sources of emissions in a value chain

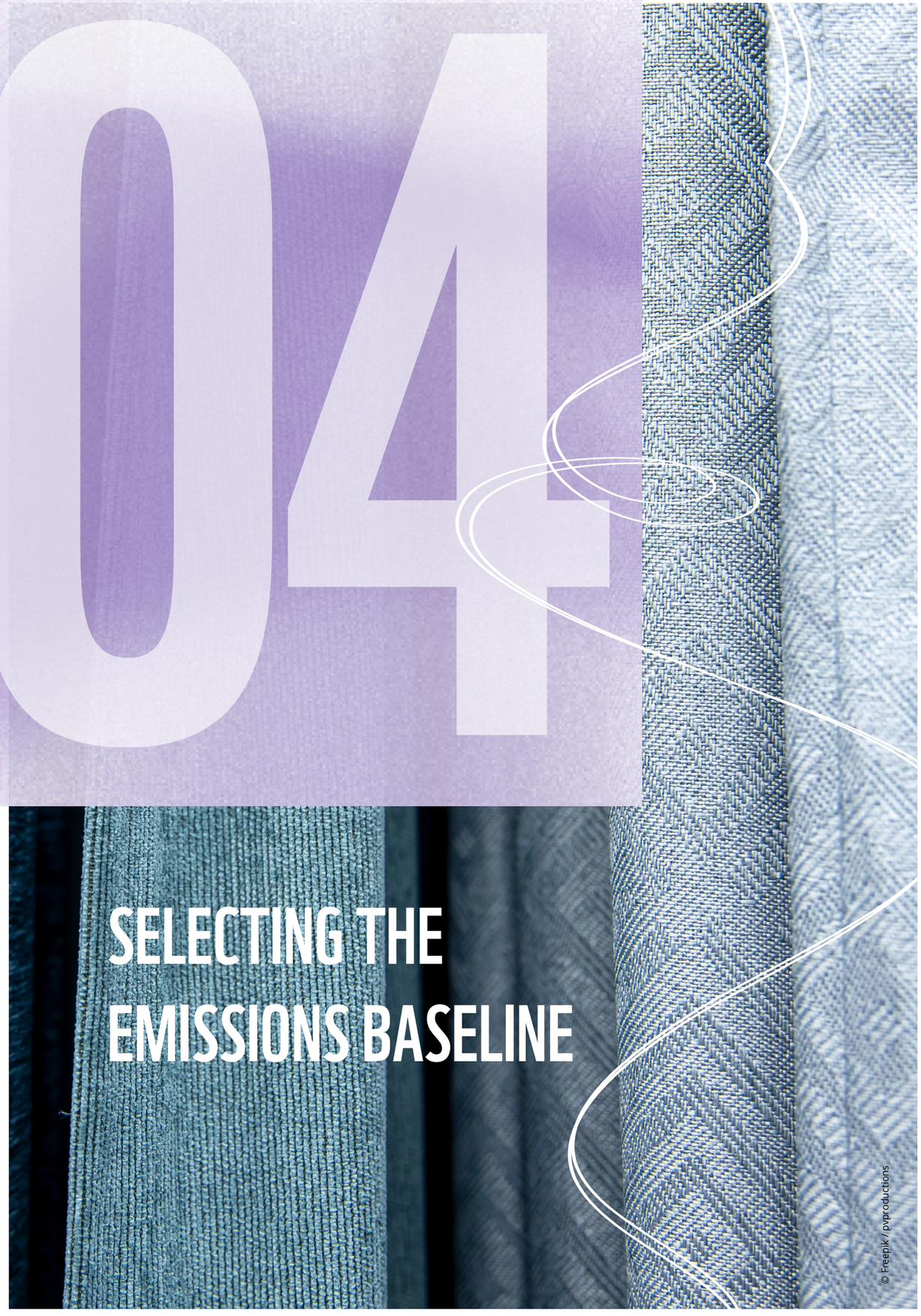
Figure 3.5 illustrates the relationship between organizational and operational boundaries. After determining which companies belong to the parent company (organizational boundaries), the company must also determine which greenhouse gases from those companies should be included in the inventory (operational boundaries).

Figure 3.5/ Organizational and Operational boundaries



04

SELECTING THE EMISSIONS BASELINE



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SELECT THE BASE YEAR 4.1

The baseline refers to the emissions in a single year, known as the base year. In addition to the baseline, estimating the business-as-usual (BAU) emissions, a scenario that predicts the level of greenhouse gas emissions if there are no greenhouse gas reduction projects or activities, enables companies to demonstrate improvements or reductions. Normally, targets are set based on baseline emissions (For example: reduce 50% of emissions by 2030 compared to a 2021 baseline).

When selecting a base year, we need to pay attention to:

Verifiable data on emissions of Scope 1 and 2, (and Scope 3, if being includied within the company's GHG inventory) must be sourced. You should select the most recent year for which data is available.

The base year should represent a typical GHG profile of a company (i.e., don't use a baseline year where emissions were unusually high or low). A representative 2-3 year average GHG emissions footprint may be more appropriate for companies with high emissions variance.

The base year is a 12 month period in which the company is in a stable operation (i.e., without fluctuations such as divestments, mergers and acquisitions).

While data to calculate the base year would ideally cover at least 12 months to reflect emission changes over different seasons, it can also be extrapolated from shorter timeframes (e.g., 3 or 6 months).[6]

To have a reliable goal, we need to define the goal emissions calculated based on the emissions of the base year. For textile and fashion industries, the common approach is to set a base year with a fixed goal.

Determining the base year is really important at the first stage to be able to then create an achievable, measurable goal, and to satisfy the requirements and commitments from brands and associations.

[6] Guidance on how to measure and report your greenhouse gas emissions – DEFRA (Page 26-27)

4.2 CALCULATE THE EMISSIONS OF THE BASE YEAR

Alterations to a company's structure, such as through acquisitions, divestments, and mergers, frequently lead to substantial shifts in its emission patterns. As a result, comparing emissions across different time periods becomes challenging.

4.2.1 Recalculate base year emissions after structural changes

Structural changes such as acquisitions or divestments require the transfer of emissions from one company to another. When structural changes occur mid-year, base year and current year emissions should be recalculated for the entire year, rather than just for the remainder of the reporting period after the structural change has occurred. This avoids having to recalculate base year emissions again in the following year. If it is not possible to recalculate in the year of the structural change (for expample due to missing data after to an acquisition), recalculation can be performed in the following year.

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Changes in calculation methodology or improvements in data accuracy:[8]

A baseline may need to be updated if a company changes the ways it estimates emissions. To illustrate, a company might have estimated its Scope 2 emissions by employing a national emissions factor for electricity generation. In subsequent years, the company acquires more precise emission factors tailored to the utilities it employs, for present and past years. Should the alteration yield significant differences in emissions, the company should recalculate its baseline.

At times, it may not be feasible to apply the more accurate data to all prior years, or historical data points might be absent for new calculation methods. In such cases, the company can resort to backcasting to estimate these data points. Alternatively, the change in data source might simply be acknowledged. This acknowledgment should be included in each report to ensure transparency. Neglecting this information could lead new report users, particularly those two or three years after the change, to misconstrue the company's performance.

It is important to note that any changes to emission factors or activity data that reflect real shifts in emissions—such as changes in fuel type or technological advancements—do not trigger a recalculation.

05

IDENTIFYING THE EMISSION SOURCE AND CALCULATE THE GHG EMISSIONS

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Once inventory boundaries have been established, companies typically calculate greenhouse gas emissions in steps developed by the GHG Protocol as follows:

1. **Identify the GHG emission sources**
2. **Select the GHG emission calculation approach**
3. **Collect the activity data and select the emission factor**
4. **Apply emission calculation tool**
5. **Calculate total GHG emissions of the whole company**

5.1 IDENTIFY THE GHG EMISSION SOURCES

Companies have processes, products or services that generate direct and/or indirect emissions from one or more types of emission sources as described in **Section 3.2**.

All emission sources should be fully considered and identified before calculating a company's greenhouse gas emissions. According to the GHG Protocol Cooperate Standard, emission sources are classified as follows:

5.1.1 Scope 1: Stationary combustion sources

Stationary combustion sources and used fuels:

STATIONARY COMBUSTION SOURCES	COMMONLY USED FUELS
Boiler	Coal, fuel oil, LPG, natural gas, biomass fuel
Thermal oil boiler	Coal, fuel oil, diesel, biomass fuel
Heating equipment in production process	LPG, CNG
Generators, fire fighting pumps	Diesel Oil, Gasoline

Figure 5.1/ Coal-fired boiler in textile factory

Figure 5.2/ Gas-burned singeing at textile factory

Figure 5.3/ Backup generator

Figure 5.4/ Firefighting pumps

5.1.2 Scope 1: Mobile combustion sources

Scope 1 mobile emission sources refer to a variety of company-owned or operated vehicles, motors, and equipment that generate GHG emissions through the combustion of various fuels while moving from one location to another. These include vehicles used on roads to transport employees, distribution trucks, and non-road vehicles used to transport goods, engines and equipment.

If the company does not own nor have direct operational control over the vehicle or equipment, these sources of emissions will be reported under Scope 3, not Scope 1.

Mobile combustion source and used fuels:

COMMONLY MOBILE COMBUSTION SOURCE		COMMONLY USED FUELS
On-Road Vehicles	Company-owned transport vehicles	Gasoline, diesel
	The leased tranport vehicle is directly operated by the company	Gasoline, diesel
Non-Road Vehicles	Forklift trucks and other vehicles	Gasoline, diesel

Figure 5.5/ Gasoline vehicles owned by the company

Figure 5.6/ Diesel forklift trucks at textile dyeing factory

5.1.3 Scope 1: Fugitive emissions

Fugitive emissions from refrigeration and air-conditioning systems result from leaks and maintenance throughout the life of the equipment and from disposal at the end of its life. Refrigerant gas leaks are a small but significant source of GHG emissions due to their high GWP values.

In addtion, other sources of fugitive emissions include the treatment and discharge of industrial and sanitary wastewater and firefighting activitives.

Common fugitive emisson sources:

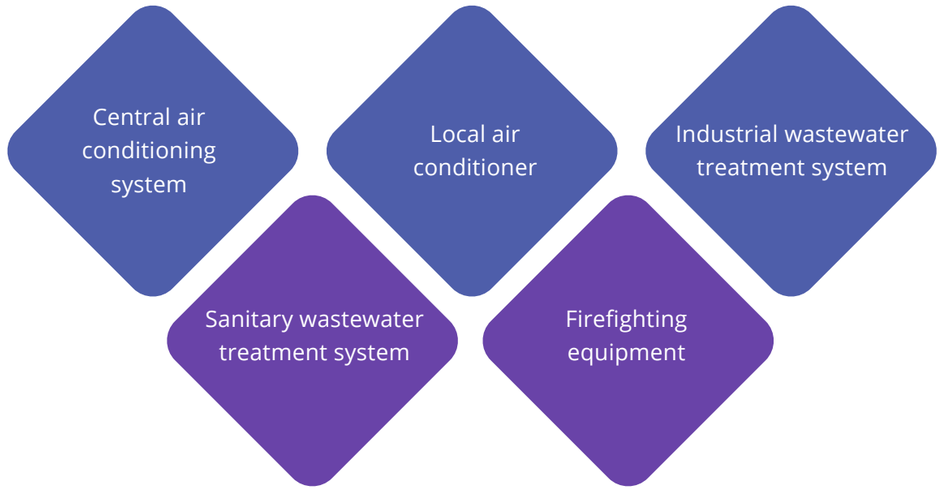


Figure 5.7/ Air conditioner using refrigerant R22 at factory

Figure 5.8/ Biological treatment stage of wastewater treatment plant

5.1.2 Scope 2: Emissions from purchasing energy

GHG emissions from this scope of activitives: purchasing electricity, heat or steam which are owned or controlled by an external organization.

Figure 5.9/ Electricity meter records purchased electricity data

Figure 5.10/ Steam meter records purchased steam data

For example:

Garment Company A is located in Vietnam and produces clothes for a fashion brand C. To manufacture clothes, Garment Company A needs raw materials such as cotton fabric purchased from Textile Dyeing Company B.

Textile Dyeing Company B → Garment Company A → Fashion Brand C

The following are typical GHG emission sources of the above 03 companies. Depending on the actual activity and operation of each company, the emission sources may change.

For Garment Company A:

★ Scope 1: Emissons from the use of biomass for boilers, thermal oil boiler for generators and refrigerant leaks for air conditioners.

★ Scope 2: Emissions associated with using grid electricity for lighting, air-conditioning, and the operation of machinery in the cutting and sewing stages.

★ Scope 3: Emissions from transportation of raw fabrics from Textile Dyeing Company B to Garment Company A by the transportation service company, business trips made to meet and negotiate with Brand C Fashion, and the transportation of the final products from Company A to the store owned by Fashion Brand C.

For Textile Dyeing Company B:

★ Scope 1: Emissions from the use of LPG gas stoves for the company's canteen and the use of diesel for trucks owned and operated by the company.

★ Scope 2: Emissions from using grid electricity to operate machinery and equipment in fabric preparation, weaving, dyeing, finishing, and steam used for dyeing.

★ Scope 3: Emissions of third-party trucks carrying dyed fabrics from Company B to Garment Company A, and emissions from growing raw materials (cotton) on the farm that are purchased by Company B.

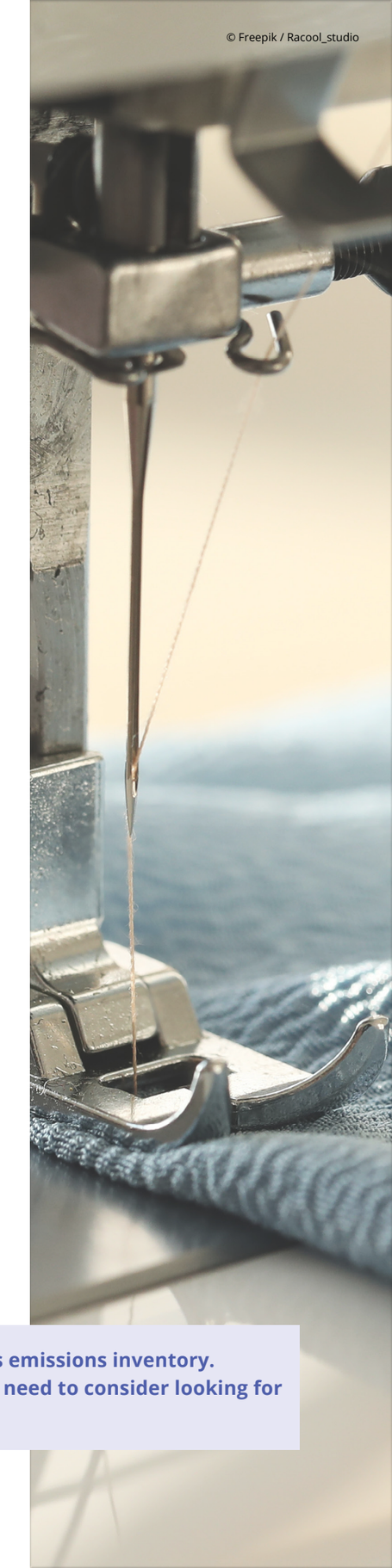
For Fashion Brand C:

★ Scope 1: Fugitive emissions from leaking air conditioners used in brand-owned stores and business trips in company-owned vehicles.

★ Scope 2: Emissions associated with purchased electricity.

★ Scope 3: Emissions from garments purchased from Garment Company A, delivery of products from the store to consumers, and from product use and waste consumer abandonment, etc.

Emissions from all scopes count towards an organization's emissions inventory. If organizations want to reduce their GHG emissions, they need to consider looking for mitigation opportunities across all three scopes.

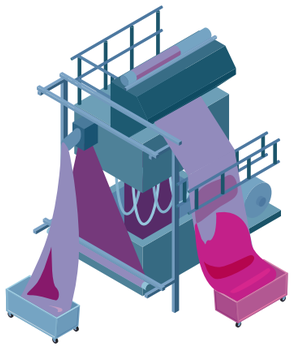


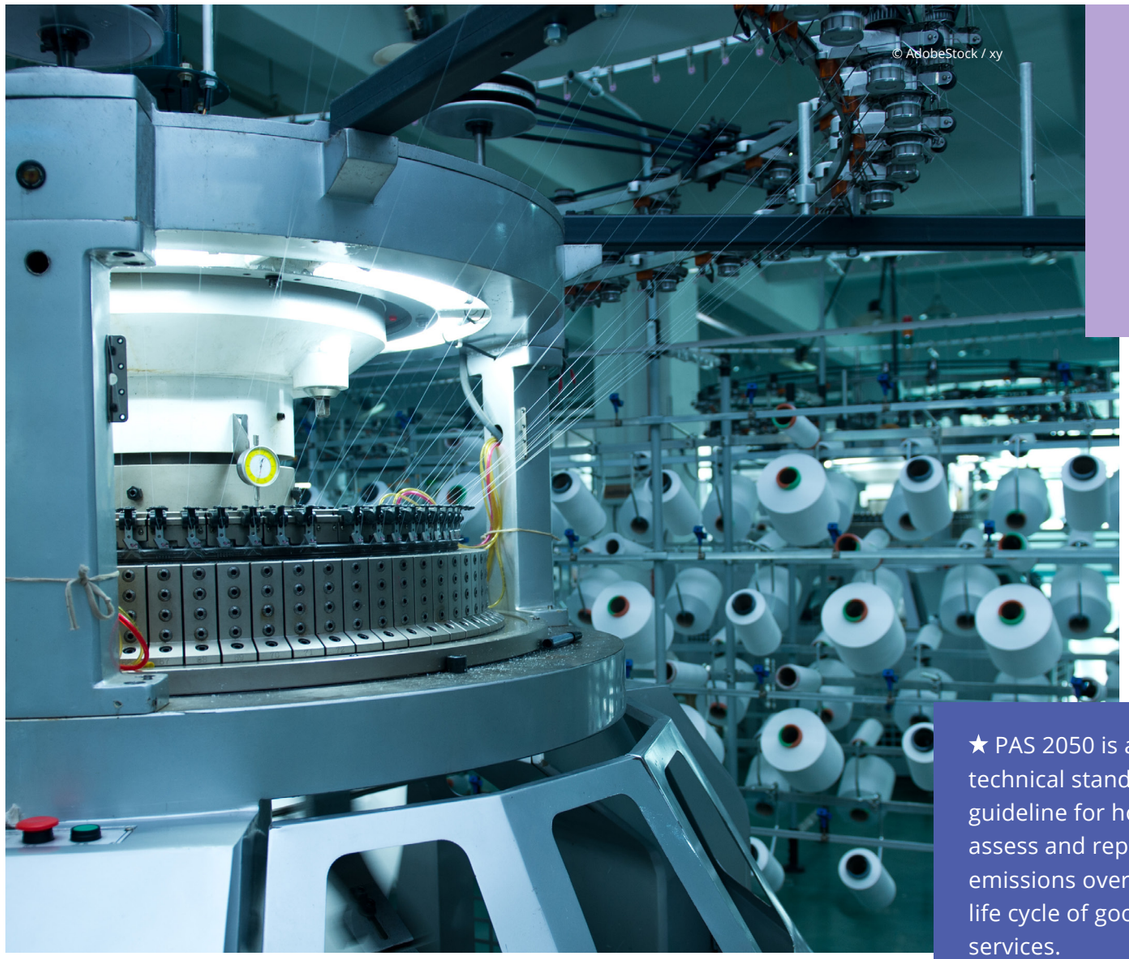
5.2 SELECT THE GHG EMISSION CALCULATION APPROACH

Below describes common methods and approaches to measure and calculate GHG emissions at the enterprise level. These methods are derived from the following corporate standards:

ISO 14064-1:2018 Greenhouse gases – Part 1: Specifications and guidelines for calculating and reporting greenhouse gas emissions and removals at the organizational level

The Greenhouse Gas Protocol – A Corporate Accounting and Reporting Standard: An organization-level GHG inventory and reporting standard





While beyond the scope of this document, there are also approaches to calculating GHGs at the product level, as follows:

★ Product Lifecycle Accounting and Reporting Standard (according to GHG Protocol Product Standard): The Product Lifecycle Inventory and Reporting Standard can be used to capture the full life cycle of emissions of a product.

★ ISO 14040/44: These two ISO standards deal with product carbon footprint audits. ISO 14040 describes the principles and framework for life cycle assessment (LCA). ISO 14044 specifies requirements and provides guidelines for product life cycle assessments.

★ PAS 2050 is a technical standard and guideline for how to assess and report GHG emissions over the life cycle of goods and services.

This document focuses on the organizational level (Scope 1 and 2) GHG reporting based on the guidance from The Greenhouse Gas Protocol – A Corporate Accounting and Reporting Standard. This approach has been adopted by the Higg Facility Environment Module (Higg FEM) assessment tool.

5.3 COLLECT THE ACTIVITY DATA AND SELECT THE EMISSION FACTOR

A GHG inventory is the process by which a business measures its total direct and indirect GHG emissions from its operations in CO_2 equivalent (CO_2e). Once an emission source has been identified, the company continues to collect activity data for each emission source over a specific period (usually a year) and selects an appropriate corresponding emission factor.

5.3.1. Activity data

Activity data is a quantitative measure of how an activity creates or eliminates GHG emissions. Commonly-used activity data (and measurable units) include:

Grid electricity (kWh, MWh)

Coal used in boiler (kg, tonne)

Gasoline/diesel for cars, trucks, generators (liters)

Refrigerants: HEC-32(R32), HFC-410a (R410A) (kg)

LPG (kg, m^3)

Biomass fuel: firewood, ricehusk pellet, ricehusk briquette, etc. (kg, tonne)

Activity data can be collected through different sources and methods such as invoices, purchase records, and meter readings (electricity, steam). If the data cannot be compiled through the above methods, the company can estimate consumption based on equipment capacity and usage time with the principle of aiming for as much accuracy as possible. The company should describe data collection methods in detail to ensure the accuracy and reliability of the data.

Figure 5.11/ Invoice

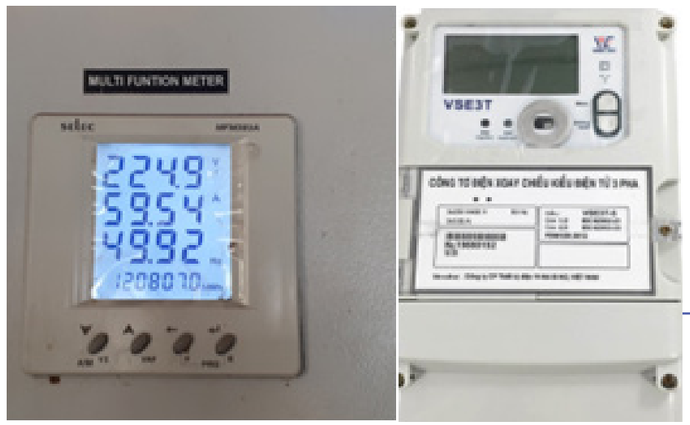


Figure 5.12/ Continuous measuring device

Figure 5.13/ Estimate through device parameter

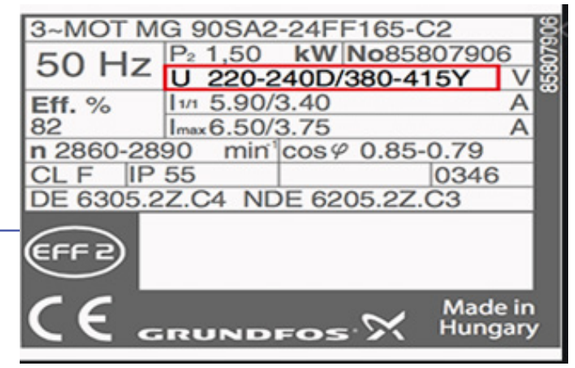


Figure 5.14/ Instantaneous values measuring device

5.3.1.1 Stationary combustion

Activity data collection requirements:

The necessary activity data for this calculation includes the fuel consumption for each stationary combustion source and the fuel characteristics of each fuel type used.

Fuel Consumption: *Collect data on the amount of fuel consumed for combustion purposes. Two calculation methods are outlined below.*

- *On-site measurement:* Measure the mass or volume flow rate of fuel at the inlet point of one or multiple combustion devices. This data can be collected using measuring equipment such as scales or flow meters.
- *Procurement records:* The mass or volume of fuel entering the company. This data can be based on fuel invoices, procurement records, or data directly provided by energy suppliers.

Fuel Characteristics: *Determine emission factor data based on the characteristics of the fuel burned at each identified source. The most common approach for textile dyeing industry businesses is to use the actual calorific value of the fuel or default calorific values.*

- *Actual Calorific Value of Fuel:* The calorific value of a fuel is a measure of the amount of heat released during the combustion process. This information can often be found on procurement records that include details of the purchased fuel types and the results of fuel characteristic analysis conducted by fuel suppliers.
- *Default Calorific Values:* If obtaining specific data for the fuel used is not practical, default calorific values pre-integrated in the provided GHG emission calculation tools in Section 5.4.5 can be applied to calculate emissions.

5.3.1.2 Mobile combustion source

Activity data collection requirements:

The estimation of greenhouse gas emissions from mobile combustion processes can be most easily achieved by collecting data on fuel consumption, travel distance, vehicle characteristics, and fuel properties for each identified source.

The activity data required for calculating emissions from mobile combustion sources includes:

TYPE OF DATA	ACTIVITY DATA
Fuel Consumption	Annual fuel usage in liters or cubic meters for each fuel type (Unit: Liter, m^3)
Transport Distance	Total kilometers traveled annually by each type of transport vehicle
Vehicle Characteristics	Vehicle type and year of production
Fuel Properties	Type of fuel and calorific value of the fuel

5.3.1.3. Fugitive emissions

Activity data collection requirements:
The requirements activity data to calculate fugitive emissions include:

COMMON SOURCES OF FUGITIVE EMISSIONS		ACTIVITY DATA
Water chiller and air conditioning systems	The company performs in-house maintenance for water chiller and air conditioning equipment.	The annual quantity of each type of refrigerant purchased and used by the company (unit: kg). Detailed inventory of water chiller and air conditioning equipment, including currently in use, newly installed, replaced, and disposed of equipment.
	The company engages contractors for the maintenance of water chiller and air conditioning equipment.	The quantity of each refrigerant type used by the contractor for equipment maintenance at the company on an annual basis (unit: kg). Detailed inventory of water chiller and air conditioning equipment, including equipment currently in use, newly installed equipment, and equipment replaced and disposed of.
Wastewater treatment system	Industrial wastewater	Quantity of industrial wastewater generated per year (unit: m3) and average COD concentration per year (unit: mg/m^3)
	Domestic wastewater	Quantity of domestic wastewater generated (unit: m^3), average BOD (Biochemical Oxygen Demand) concentration per year (unit: mg/m^3), and average total Nitrogen concentration per year (unit: mg/m^3).
Fire protection and fire fighting equipment	Fire extinguisher CO_2	The quantity and types of CO_2 fire extinguishers currently in use at the company. Additional CO_2 refilling provided by external service providers (unit: kg)

5.3.1.4. Emissions from purchased energy

Activity data collection requirements:
The common emission sources and the corresponding activity data to be collected are as follows:

COMMON EMISSION SOURCES	ACTIVITY DATA
Purchased Electricity	The annual purchased electricity quantity for each different power source should be collected. The units of measurement for this data are typically MWh or kWh.
Purchased Steam	The quantity of purchased steam should be collected, and the units of measurement can be in kg, metric tons, or m3. Additionally, the steam pressure should also be recorded, and the units of measurement for steam pressure can be in Bar, Atmosphere (Atm), or Megapascal (MPa). In cases where the company can collect data on fuel consumption and fuel characteristics for steam production from the steam supplier, similar data collection methods as for fixed combustion sources should be applied.
Purchased Heat	Annual puchased energy for each heat source (unit: MJ, kWh, mmBtu)

5.3.2. Emission factor

GHG emission factor is the coefficient of correlation between GHG activity data and GHG emissions.

Emission coefficients can be selected from different sources, but to ensure accuracy it is best to select one that comes from a reputable source.

In Vietnam, when calculating emissions from purchased electricity, the emission factor can be referenced from the value announced by the Climate Change Department under the Ministry of Natural Resources and Environment. Vietnam's electricity grid emission factor 2020 is 0.7221 tCO_2e/MWh. The emission factor of Vietnam's power grid is updated annually. For grid emission factors of other countries, you can refer to the results published by IGES here.

Other reputable emission factor databases are listed below:
- Emission factors according to the List of emission factors for greenhouse gas inventory published under Decision No.2626/QĐ-BTNMT dated October 10, 2022 by the Ministry of Natural Resources and Environment;
- UK DEFRA Emission Factors,
- Emission factors published by the United States Environmental Protection Agency (US EPA),
- Emission factors published by the UK Government,
- Emission factors according to the IPCC Intergovernmental Panel on Climate Change Guidelines,
- Higg Facility Environment Module (Higg FEM).

To see emission factors from above sources, see Appendix 5.

5.4 CALCULATE THE GREENHOUSE GAS EMISSIONS

Once emission coefficients and GHG activity data are collected, the general formula for calculating GHG emissions is as follows:

ACTIVITY DATA	x	EMISSION FACTOR	=	CO_2 EMISSIONS

5.4.1. Calculating stationary combustion emissions (Scope 1)

The formula for calculating emissions from stationary sources:

Calculate the CO_2, CH_4, N_2O emissions: Calculate the CO_2, CH_4, N_2O emissions from the fuel source by to the formula:

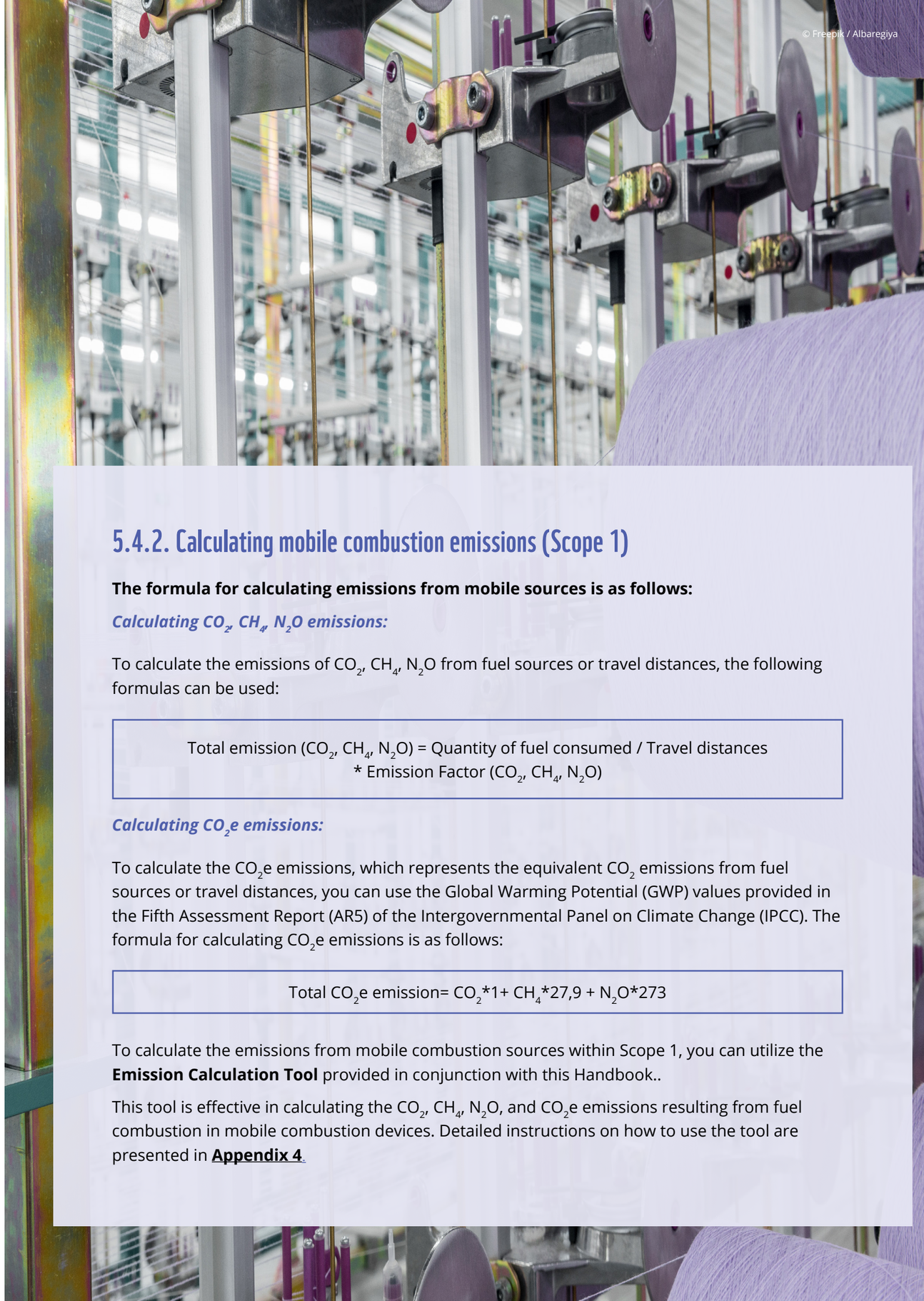
Total emission (CO_2, CH_4, N_2O) = Fuel Consumption
* Emission factor (CO_2, CH_4, N_2O)

CO_2e emissions: Calculate the CO_2 equivalent emissions from fuel sources according to the global warming factor (GWP- Sixth Assessment Report (AR6) by to the formula:

Total CO_2e emission = CO_2*1+ CH_4*27.9 + N_2O*273

Calculate emissions from Scope 1 stationary combustion sources using the **GHG Emissions Calculator** developed with this Guidebook.

This tool is effective in calculating CO_2, CH_4, N_2O and CO_2e emissions due to fuel combustion in stationary combustion equipment. Instructions for using the tool are detailed in **Appendix 4**.



5.4.2. Calculating mobile combustion emissions (Scope 1)

The formula for calculating emissions from mobile sources is as follows:

Calculating CO_2, CH_4, N_2O emissions:

To calculate the emissions of CO_2, CH_4, N_2O from fuel sources or travel distances, the following formulas can be used:

Total emission (CO_2, CH_4, N_2O) = Quantity of fuel consumed / Travel distances
* Emission Factor (CO_2, CH_4, N_2O)

Calculating CO_2e emissions:

To calculate the CO_2e emissions, which represents the equivalent CO_2 emissions from fuel sources or travel distances, you can use the Global Warming Potential (GWP) values provided in the Fifth Assessment Report (AR5) of the Intergovernmental Panel on Climate Change (IPCC). The formula for calculating CO_2e emissions is as follows:

Total CO_2e emission= CO_2*1+ CH_4*27,9 + N_2O*273

To calculate the emissions from mobile combustion sources within Scope 1, you can utilize the **Emission Calculation Tool** provided in conjunction with this Handbook..

This tool is effective in calculating the CO_2, CH_4, N_2O, and CO_2e emissions resulting from fuel combustion in mobile combustion devices. Detailed instructions on how to use the tool are presented in **Appendix 4**.

5.4.3. Calculating Fugitive Emissions from Refrigerants (Scope 1)

The formula for calculating emissions from fugitive source:

Calculate the CO_2e emissions from the quantity of refrigerant refilled in refrigeration/air conditioning equipment according to the following formula:

Total CO_2e emissions = Refrigerant refilled * GWP Factor-100 (AR6)

To calculate the emissions from fugitive emission sources within Scope 1, you can utilize the **Emission Calculation Tool** provided in conjunction with this Handbook. Detailed instructions on how to use the tool are presented in **Appendix 4.**

5.4.4. Calculating Purchased Energy Emissions (Scope 2)

The formula for calculating emissions from purchased energy:

Calculate the purchased electricity emissions: Calculate the equivalent CO_2 emission according to the formula:

CO_2e of purchased electricity emissions = Electricity used * Vietnam grid emission factors

Calculate the other purchased energy emissions (excluded purchased electricity): Calculate the CO_2, CH_4, N_2O emission according to the formula:

Other purchased energy (CO_2, CH_4, N_2O) emissions= Energy used
* Emission factor (CO_2, CH_4, N_2O)
CO_2e of other purchased energy emissions = CO_2*1+ CH_4*27.9 + N_2O*273

Calculate the total purchased energy emissions: Calculate the CO_2e emission from the purchased source according to the formula:

Total CO_2e of purchased energy emissions = CO_2e of purchased electricity emissions
+ CO_2e of other purchased energy emissions

Examples of GHG emission calculations for the emission sources listed above are presented in **Appendix 1.**

5.4.5 GHG emission calculation tools

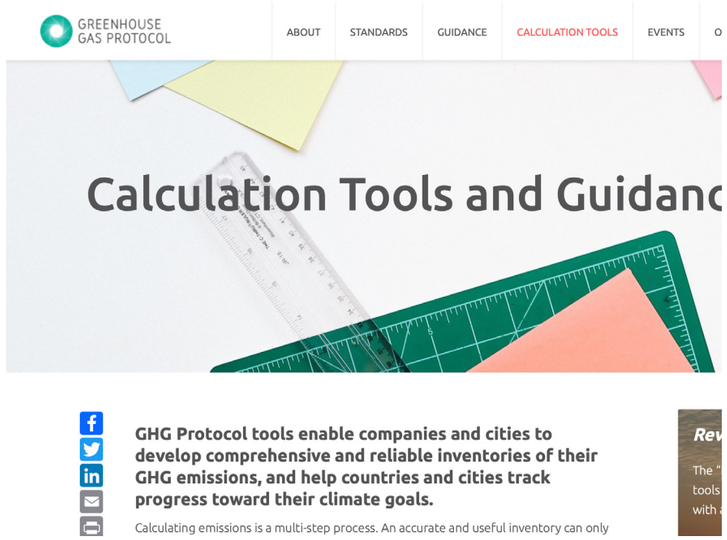
There are calculation tools developed from organizations such as:

US Environmental Protection Agency - US EPA: The EPA Simplified GHG Emissions Calculator is designed as a simplified calculator to help low-emissions organizations estimate and report their annual greenhouse gas emissions. The excel tool will identify direct and indirect emissions from all sources at a company when inputting annual operational data.

Figure 5.15/ US EPA's GHG Emission Calculation Tool

GHG Protocol: GHG Protocol tools enable companies to develop comprehensive and standardized inventories of GHG emissions and track progress toward climate targets.

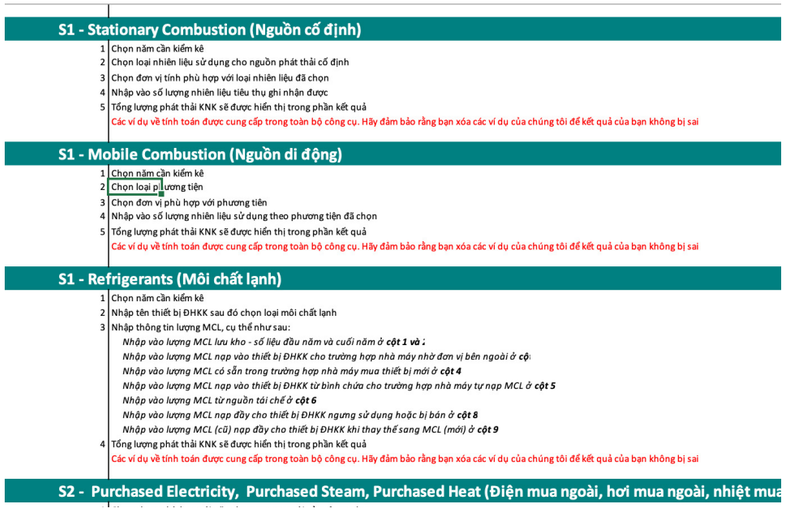
Figure 5.16/ GHG Emission Calculation Tool of GHG Protocol



United Nations Framework Convention on Climate Change – UNFCCC: UNFCCC has developed a free and up-to-date GHG calculation tool to provide the community with a method for calculating GHG emissions. Link to download the UNFCCC GHG emission calculation tool can be found here.

Calculation tool developed along with this Guidebook: Based on the GHG Protocol calculation tool, a calculation tool in Vietnamese language was developed specifically to support textile companies. The illustrating figure of the emission calculation tool is shown as follows:

Figure 5.17/ GHG emission calculation tool developed along with this Guidebook

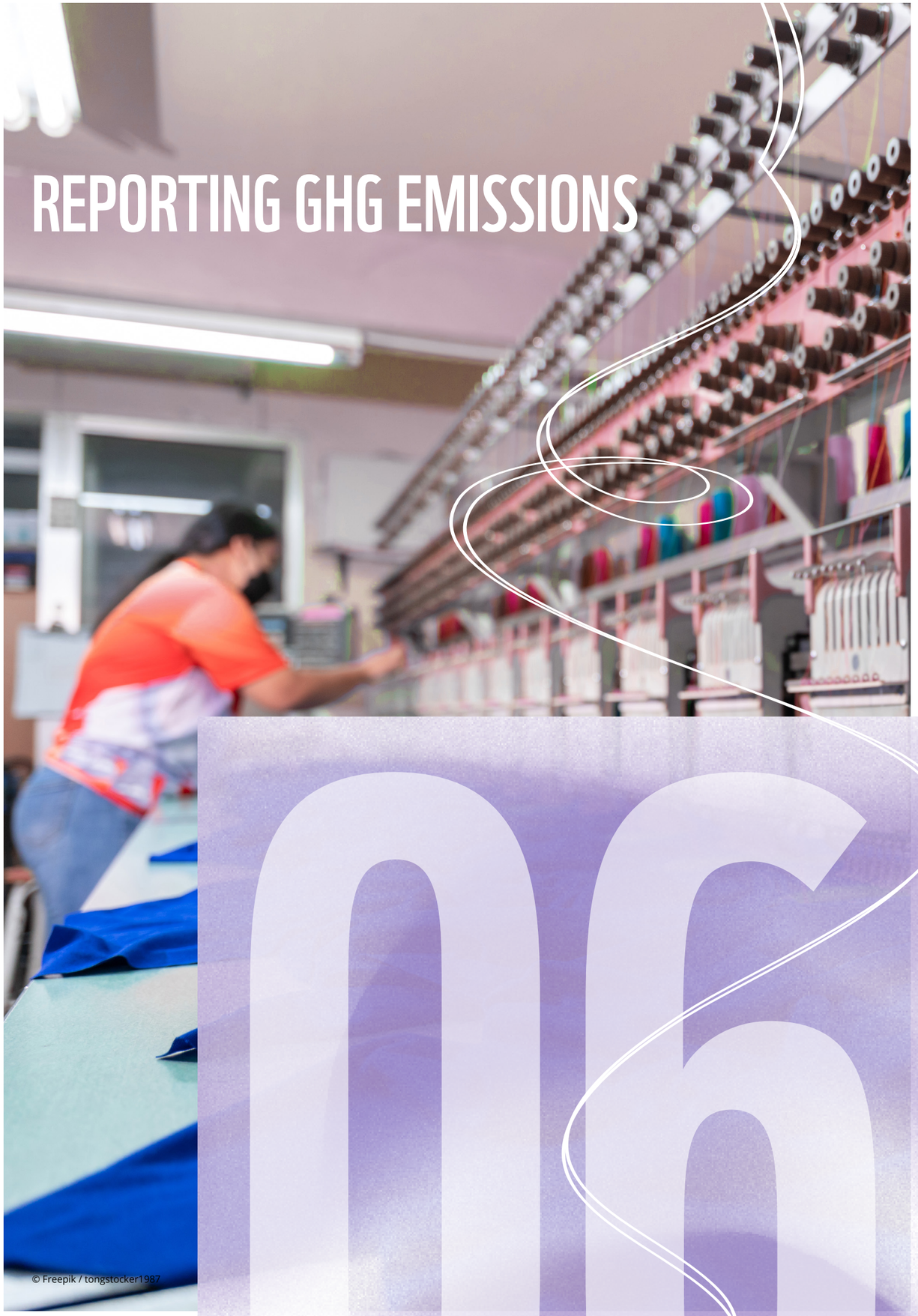


Within the scope of this guidebook, this developed GHG emission calculation tool is recommended. Link to this tool can be found here.

See detailed description and instructions on how to use the tool in the Appendix 4.

REPORTING GHG EMISSIONS

06



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OVERVIEW 6.1

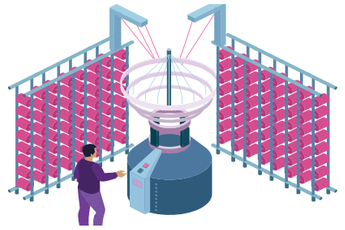
A credible GHG emissions report presents relevant information that is complete, consistent, accurate and transparent.[8] At a minimum, the GHG Protocol Corporate Standard requires that it must include a company's Scope 1 and Scope 2 emissions.

The GHG implementation team, in consultation with higher management, should agree upon the following:[9]

- ★ How the report will fit into the greater context of the organization's GHG policies, strategies or programs
- ★ The intended use and user intent of the GHG inventory
- ★ Overall and specific responsibility for preparing and publishing reports
- ★ Reporting frequency
- ★ Report structure and format
- ★ Data and information included in the report

It takes time to develop a complete corporate inventory of GHG emissions, and it is well accepted that GHG inventories will improve with time as knowledge, experience, and best practices evolve over time. With this in mind, it's important that a GHG report:

- ★ Be based on the best data available at the time of publication, while being transparent about its limitations
- ★ Communicate any material discrepancies identified in previous years
- ★ Include the company's gross emissions for its chosen inventory boundary separate from and independent of any emissions trades in which it might engage (e.g., carbon offsets)



Include the company's gross emissions for its chosen inventory boundary separate from and independent of any emissions trades in which it might engage (e.g., carbon offsets).

[8] The Greenhouse Gas Protocol – A Corporate Accounting and Reporting Standard
[9] ISO 14064-1: 2018, page 14

6.2 CONTENT & STRUCTURE OF GHG INVENTORY REPORT

The organization may consider presenting the GHG inventory report with the following content and structure:

*The GHG inventory report template is detailed in **Appendix 2**.*

01 General information

Description of the reporting organization, purpose of the report, and reporting period.

02 Organizational and operational boundaries

Explain which business entities and activities are being included (and excluded) within your GHG inventory.

03 Base year

Define the base year (or mean of years) that you are using as a reference from which emission reduction targets (e.g., 30% reduction by 2030) are being benchmarked.

04 Methodology

Describe and explain the standards and methods used to prepare the GHG inventory report.

05 Calculation of GHG emissions and removals

This chapter includes quantified results by each category (e.g., Scope 1 transport emissions, Scope 2 electricity emissions), describes the activity data used, references and/or explains emission factors, uncertainty and imprecision effects on results, and an action plan to reduce uncertainty for future inventories.

06 Carbon offset

Report on any carbon offsetting activities (if any) during the reporting period.

07 Proposed action plans

List any emission reduction targets and strategies (e.g., install 100kW of solar capacity; upgrade to motion sensor lights, improve insulation) that are planned for the upcoming years. Plans should include a timeline, be measurable, and be suitable to achieve the aims of the reduction targets.

07

ACTION PLAN FOR GHG EMISSIONS REDUCTION

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OBJECTIVES OF GHG EMISSIONS REDUCTION

7.1

Due to the urgency of the climate crisis and increasing scrutiny facing the textile and fashion industries, brands are setting objectives to reduce their emissions. These objectives often include Scope 3 emissions, which mainly come from purchased goods and services.

There are different types of objectives that brands are setting, depending on what terms resonate with the team and their stakeholders. Three commonly noted objectives are Carbon Neutrality, Net-zero emissions, and Science-based Targets.

Carbon Neutrality
Simply put, carbon neutral refers to when the amount of CO_2e emitted into the atmosphere from a company is equal to the amount of CO_2e removed or avoided (through actions like planting or protecting forests).

Science-based Targets
Science-based targets provide companies with a defined path to reduce emissions at a rate consistent with (or better than) the Paris Agreement goals (i.e., limiting global warming to 2°C, or 1.5°C, above pre-industrial levels). There are more than 4000 businesses across sectors (including fashion and textile) applying GHG emissions reduction measures in accordance with the Science Based Targets initiative. By March 2023, more than 295 fashion brands and companies have committed to the Science-Based Goals initiative, with 113 fashion brands having approved their science-based objectives.[10]

Net-zero emissions
The term net-zero emissions signifies a greater effort to reduce at-source emissions and greater inclusion of Scope 3 emissions in GHG inventory accounting. While definitions alter, the main point of difference between “carbon neutral” and “net zero” is that net-zero requires abatement of your emissions – through actions like efficiency, electrification, renewables, and other means. Offsets are only acceptable as a last resort for the hardest-to-abate emissions. A net-zero commitment should also include efforts to remove emissions across the value chain (Scope 3), rather than just direct (Scope 1 and 2) emissions.

[10] https://sciencebasedtargets.org/companies-taking-action#dashboard, last visited in March 2023.

7.2 GHG EMISSIONS REDUCTION PLAN

GHG emissions reduction plans for factories are prepared based on features including operating scope, capacity, existing technology, production and facility business plans.

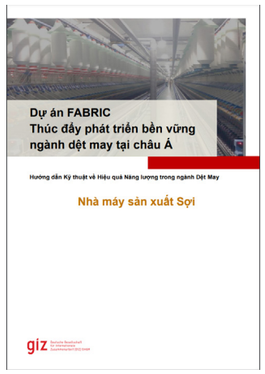
Measures to reduce emissions can include using energy economically and efficiently, replacing fossil-fueled energy with renewable energy, and reclaiming refrigerant / using refrigerants with a lower GWP.

Factories can refer to the Technical Guidebooks on Energy Efficiency in the Textile Industry under the GIZ FABRIC project product "Promoting Sustainability in the Textile and Garment Industry in Asia" issued in 2022. This is the useful reference for energy managers in identifying potential energy efficiency opportunities, as well as assessing on-site applicability. Information of the Guidebooks is listed below:

Guidebook of Energy Efficiency Best Practices for Yarn Mills, see details of the Guidebook here. (Vietnamese Language)

Guidebook of Energy Efficiency Best Practices for Textile Dyeing Mills, see details of the Guidebook here. (Vietnamese Language)

Guidebook of Energy Efficiency Best Practices for Garment Factory, see details of the Guidebook here. (Vietnamese Language)



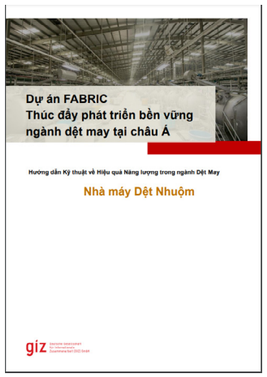


Figure 7.1/ Guidebooks of Energy Efficiency Best Practices (GIZ FARBIC, 2022)

In addition, the Adidas guidebook (Environmental Good Practice Guide & Toolkit of Adidas 2019, download here) includes a list of measures, along with expected emission reductions when these measures are put into practice. Details are in the following table:

Table 7.1/ Energy efficiency measures

CATEGORY	MEASURE	ELECTRICITY CONSUMPTION SAVINGS	PAYBACK PERIOD
General operations	Turn off machines at the end of the day and when not in use (either manually or automatically)		0–3 months
	Set up auto turn-off system for optimizing HVAC system	1–5% of factory's electricity consumption	0–3 months
	Adjust working hour schedule for workshop area to maximize production line utilization		Immediate
Lighting	Replace fluorescent lights with LEDs	20–40% of lighting electricity consumption	15-30 months
	Manually turn off lights when not in use	1–5% of factory's electricity consumption	Immediate
	Install motion sensors to optimize on/off time for lights		<12 months
	Install additional light switches for better zoning control		
	Eliminate double-layer lights		Immediate
	Lower the lighting fixtures height level		4-6 months
Steam system	Regular steam trap check/repair routine	1–5% of steam consumption	0-3 months
	Regular steam leakage check/repair routine		
Steam end use	Fit the steam traps to irons	Up to 20% of steam consumption	Less than half a year

CATEGORY	MEASURE	ELECTRICITY CONSUMPTION SAVINGS	PAYBACK PERIOD
Thermal energy	Introduce program of regular thermal imaging checks	1–5% of factory's energy consumption	0-3 months
	Proper insulation for thermal systems (e.g. pipes, valves and flanges)	1–4% of steam consumption	6-12 months
	Stenter exhaust heat recovery for air preheating	5–10% of heat supply	18-24 months
	Dryer control enhancement	5–10% of drying process's energy consumption	12-24 months
Air-conditioner	Install temperature/humidity control using HVAC system	5–10% of factory's electricity consumption	More than 12 months
Variable speed drive (VSD) retro-fitting	Install VSD for cooling tower fan	10–30% of factory's electricity consumption	12-24 months
	Install VSD and modulating valve for air handling unit		
	Install VSD for chilled water pumps	15–30% of water pump's energy consumption	
	Install VSD for condenser water pumps		
	Install VSD for air compressors	10–35% of air compressors' energy consumption	15-30 months
Piping	Install steam trap on condensate pipe to limit flow of steam for ironing process	10–20% of steam consumption	6-12 months
Motors	Replace low efficiency motors with high efficiency motors	5–10% of motor's energy consumption	24-36 months
	Replace induction and hydraulic motors with servo motors	50–70% of sewing/ cutting machine's energy consumption	

Once emissions reduction measures in the factory have been defined, the next step should be to put them into an action plan.

Typically, an action plan includes the following information:

- Description of the proposed emissions reduction measures;
- A draft analysis prepared by assigned personnel (e.g., using in-plant experts or outsourced consultants);
- Estimate of the amount of emissions reduced;
- Whether the implementation offers co-benefits, such as improved product quality/ quantity, system reliability, and staff health/satisfaction.
- Estimate cost savings in order of energy savings;
- Approval of leaders for implementation;
- Whether support can be requested from factory staff or requires outsourced experts; and
- Financial support sources needed to maintain implementation of measures.

Details of the Emissions Reduction Opportunity Identification Form and the Action Plan Form can be found in Appendix 3.

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APPENDIX

08

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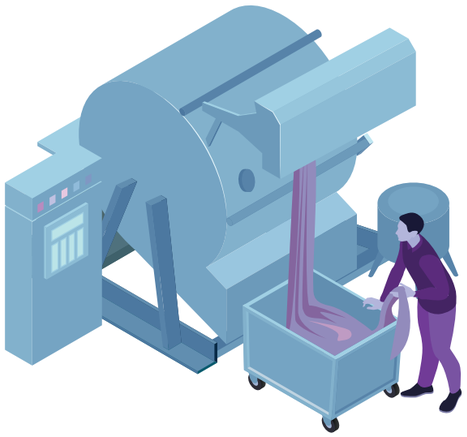
APPENDIX 1. EXAMPLES OF GHG EMISSION CALCULATIONS 8.1

Scope 1

Stationary combustion source emissions

Calculate the GHG emissions from stationary fuel combustion equipment, i.e., emissions from burning fuel to power to generators, boilers, and stationary equipment in the facility.

Figure 8.1/ Boiler using LPG



Example: calculate the GHG emissions from using boilers for production at a garment company. Records showed that the boilers used 4,908 kg LPG over 2022.

The steps to calculate GHG emissions in the unit of CO_2e are as follows:

Refer to the GHG emissions factor of LPG according to EPA source (or can use other sources such as IPCC, UK, etc.)

LPG (Stationary source)	CO_2 ($kgCO_2$/mmBtu)	CH_4 (gCH_4/mmBtu)	N_2O (gN_2O/mmBtu)
Emissions factor	61.71	3	0.6

Convert the unit of fuel used

LPG (mmBtu) = 4,908 kg*0.51798431 gal/kg*0.09200 mmBtu/gal = 233,888 mmBtu

(Look up the conversion factor mmBtu/gal in column "Heat Content (HHV)" of table 1 "Emission Factors for Greenhouse Gas Inventories, US EPA)

Calculate emissions of CO_2, CH_4, N_2O

Emissions of CO_2 =	Emissions of CH_4 =	Emissions of N_2O =
233.888 mmBtu*61.71 kg CO_2/ mmBtu = 14.433 kg CO_2 = 14.4 tCO_2	233.888 mmBtu*3 g CH_4/ mmBtu = 701.664 g CH_4 = 0.00070167 tCH_4	233.888 mmBtu*0.6 g N_2O/ mmBtu = 140.330 g N_2O = 0.00014033 tN_2O

Calculate emissions of CO_2e

Emissions of CO_2e = Emissions of CO_2*1+ Emissions of CH_4*27.9 + Emissions of N_2O*273

Emissions of CO_2e = 13.2 tCO_2*1+ 0.00070167 tCH_4*27.9 + 0.00014033 tN_2O*273 = 14.46 tCO_2e

So, the amount of GHG emissions from using the LPG boilers over the year is 14.46 tonnes of CO_2e/year.

Scope 1
Mobile combustion source emissions

Calculate the GHG emissions from mobile fuel combustion equipment, i.e., emissions from burning fuel to provide power for forklifts, freight cars, employee shuttles, and mobile equipment used by the company.

Figure 8.2/ Forklift using diesel

For example: calculate the GHG emissions from using forklifts at a garment company. The forklifts consume 7,800 liters/year of diesel. The steps to calculate GHG emissions in the unit of CO_2e are as follows:

Refer to the GHG emissions factor of diesel according to EPA source (or can use other sources such as IPCC, UK, etc.)

Diesel (Mobile source)	CO_2 ($kgCO_2$/gal)	CH_4 ($kgCH_4$/mmBtu)	N_2O (kgN_2O/mmBtu)
Emissions factor	10.21	0.00057	0.00026

Convert the unit of fuel used

Diesel (gal) = 7,800 liters / 3.785 liters/gal= 2,060 gal

(Conversion factor: 1 gal (US) = 3.785 liters)

Calculate the emissions of CO_2, CH_4, N_2O

Emissions of (CO_2, CH_4, N_2O) = Energy used * Emissions factor of (CO_2, CH_4, N_2O)

Emissions of CO_2 = 2,060 gal *10.21 $kgCO_2$/gal = 21,032 $kgCO_2$ = 21.032 tCO_2

Emissions of CH_4 = 2,060 gal*0.00057 $kgCH_4$/gal = 1.174 $kgCH_4$ = 0.001174 tCH_4

Emissions of N_2O = 2,060 gal*0.00026 kgN_2O/gal = 0.536 kgN_2O = 0.000536 tN_2O

Calculate emissions of CO_2e

Emissions of CO_2e = Emissions of CO_2*1+ Emissions of CH_4*27.9 + Emissions of N_2O*273

Emissions of CO_2e = 21.032 tCO_2 *1+ 0.001174 tCH_4 *27.9 + 0.000536 tN_2O *273 = 21.21 tCO_2e

So, the amount of GHG emissions emitted from using 7,800L of diesel for the forklift is 21.21 tonnes of CO_2e/year.

Distributed source emissions (Scope 1)

Calculate the GHG emissions from equipment using refrigerants that may leak, resulting in GHG emissions. Equipment includes air conditioners, chillers, medium or large commercial refrigerators, using refrigerants such as R32, R410A, R22.

Figure 8.3/ Air conditioner at the factory using R32

For example: calculate the GHG emissions from using air conditioners at a garment company. Records from the maintenance department show that the additional refrigerant charge in 2022 is 20 kg R32. The steps to calculate GHG emissions in the unit of CO_2e are as follows:

Look up GWP factor of refrigerant R32 according to IPCC source - Fifth Assessment Report (version AR6)[11].

GWP-100 Factor	AR6
R32	771

Calculate CO_2e emissions:

CO_2e = Amount of refrigerants used * GWP-100 Factor (AR6)

Emissions of CO_2e = 20 kg R32 * 771 = 15,420 $kgCO_2e$ = 15.42 tonnes of CO_2e

So, the amount of GHG emissions from using air conditioners at the garment company are 15.42 tonnes of CO_2e/year.

[11] Source: https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_Chapter07_SM.pdf

Scope 2
Emissions from purchased electricity

The calculation of emissions from grid electricity depends on where the factory is located (location-based method). In Vietnam, the national grid emissions factor is announced and updated annually by the Department of Climate Change - Ministry of Natural Resources and Environment.

Figure 8.4/ Factory purchases grid electricity for use

For example: calculate the GHG emissions from purchasing electricity from EVN at a garment company in Vietnam. The amount of electricity purchased is 3,000,000 kWh (or 3,000 MWh) over one year. The steps to calculate GHG emissions in the unit of CO_2e are as follows:

Look up the electricity grid emission factor in Vietnam according to the source of the Department of Climate Change – Ministry of Natural Resources and Environment[12].

Purchased electricity	Tonnes CO2e/MWh
Electricity grid emissions factor in 2021	0.7221

Calculate emissions of CO_2e:

Emissions of CO_2e of purchased electricity = Electricity used (MWh) * Emissions factor

Emissions of CO_2e =
3,000 MWh * 0.7221 $kgCO_2e$/MWh = 2,166.3 tCO_2e

So, the amount of GHG emissions from using purchased grid electricity is 2,166.3 tonnes of CO_2e/year

[12] Source: http://dcc.gov.vn/van-ban-phap-luat/1101/He-so-phat-thai-luoi-dien-Viet-Nam-2021.html

APPENDIX 2. GHG INVENTORY REPORT FORM 8.2

BÁO CÁO KIỂM KÊ KHÍ NHÀ KÍNH
CÔNG TY ...
NĂM ..... [NĂM KIỂM KÊ]

LOGO CÔNG TY

MỤC LỤC

8.3 APPENDIX 3. EMISSIONS REDUCTION ACTION PLAN FORM

Emissions Reduction Opportunity Identification Form

NHẬN DIỆN CƠ HỘI GIẢM PHÁT THẢI

Tên cơ sở	
Địa chỉ	
Người thực hiện	
Ngày cập nhật	

Xem tiêu chí ưu tiên bên dưới	*Đưa ra bất kỳ giải pháp giảm phát thải nào được cho là cần thiết, có thể chọn các giải pháp từ mục tài liệu đọc của modun 5.1 và modun 5.2*	*Ước tính tùy thuộc nguồn năng lượng hoặc nhiên liệu mà công ty sử dụng. Có thể tham khảo báo cáo kiểm toán năng lượng, tài liệu đọc của modun 5.1 và 5.2*				*Ước tính chi phí đầu tư*	*Chi phí đầu tư/Chi phí tiết kiệm*	*Lượng giảm phát thải tính toán theo ước tính tiết kiệm*				*Chọn Yes cho giải pháp đưa vào kế hoạch hành động*	*Chọn năm thực hiện dự kiến*
STT	**Tên giải pháp giảm phát thải**	**Tiết kiệm**				**Đầu tư (triệu VNĐ)**	**Thời gian hoàn vốn (năm)**	**Lượng giảm phát thải KNK**				**Giải pháp được chọn**	**Năm thực hiện dự kiến**
		Tiết kiệm điện năng (kWh/năm)	**Tiết kiệm nhiên liệu ... (.../năm)**	**Tiết kiệm nhiên liệu ... (.../năm)**	**Tiết kiệm chi phí (triệu VNĐ/năm)**			**Phạm vi 1 (tCO2e/năm)**	**Phạm vi 2 (tCO2e/năm)**	**Tổng cộng (tCO2e/năm)**	**%**	**Yes/No**	
Ưu tiên 1													
1												Yes	
2												No	
3													
4													
Ưu tiên 2													
1													
2													
3													
4													
Ưu tiên 3													
1													
2													
3													
4													
	Tổng	**0**	**0**	**0**	**0**	**0**		**0**	**0**	**0**			

Loại mục tiêu	...
Năm cơ sở	Năm ...
Phát thải cơ sở Phạm vi 1 (tCO2e)	...
Phát thải cơ sở Phạm vi 2 (tCO2e)	...
Tổng phát thải cơ sở Phạm vi 1 và 2	...
Tổng phát thải cơ sở Phạm vi 1 & 2 (tCO2e)	
Năm mục tiêu	Năm ...
Mục tiêu giảm %	...%

Bảng 10: Tiêu chí phân loại ưu tiên

Phân loại giải pháp tiết kiệm	Chi phí đầu tư
Ưu tiên 1	Thời gian hoàn vốn *Ngay lập tức đến 12 tháng (1 năm)*; chi phí đầu tư thấp/không tốn phí; ít gián đoạn hoạt động của nhà máy, thường liên quan đến thực tiễn quản lý cơ sở chung.
Ưu tiên 2	Thời gian hoàn vốn trên *12 tháng (1 năm) lên đến 24 tháng (2 năm)*, chi phí đầu tư trung bình; có thể gây ra một số gián đoạn trong hoạt động của nhà máy khi triển khai.
Ưu tiên 3	Thời gian hoàn vốn từ trên *24 tháng (2 năm)*, chi phí đầu tư tương đối cao; có gián đoạn đáng kể trong hoạt động của nhà máy hoặc cần phải dừng để triển khai lắp đặt.

Emissions Reduction Action Plan Form (Part 1)

KẾ HOẠCH HÀNH ĐỘNG GIẢM PHÁT THẢI

Tên cơ sở	
Địa chỉ	
Người lập	
Ngày lập	
Người phê duyệt	
Ngày phê duyệt	
Tổng phát thải cơ sở Phạm vi 1 & 2 (tCO2e)	
Năm cơ sở	

	Các giải pháp được chọn sau bước Nhận diện cơ hội giảm phát thải	*- Mô tả cách thực hiện giải pháp giảm phát thải -Xác định về việc có tiết kiệm điện lưới, khí đốt, dầu nhiên liệu hoặc nguồn năng lượng khác hay không - Nhận định về mức độ thực hiện của biện pháp là khó hay dễ*	*Ước tính tùy thuộc nguồn năng lượng hoặc nhiên liệu mà công ty sử dụng. Có thể tham khảo báo cáo kiểm toán năng lượng, tài liệu đọc của modun 5.1 và 5.2*				*Ước tính chi phí đầu tư*	*Thời gian hoàn vốn*	*Lượng giảm phát thải tính toán theo ước tính tiết kiệm*			
	Tên giải pháp giảm phát thải	**Mô tả ngắn gọn các giải pháp**	**Tiết kiệm điện năng (kWh/năm)**	**Tiết kiệm nhiên liệu ... (.../năm)**	**Tiết kiệm nhiên liệu ... (.../năm)**	**Tiết kiệm chi phí (triệu VNĐ/năm)**	**Chi phí đầu tư (triệu VNĐ)**	**Thời gian hoàn vốn (năm)**	**Giảm phát thải Phạm vi 1 tCO2e/năm**	**Giảm phát thải Phạm vi 2 tCO2e/năm**	**Giảm phát thải tổng tCO2e/năm**	**% Giảm phát thải**
Ví dụ	*Thay thế bóng đèn huỳnh quang T5 bằng đèn LED*	*Thay thế 2.000 bóng đèn huỳnh quang T5 bằng đèn LED tiết kiệm điện cho 2 xưởng 01 và 02*	*33600*	*0*	*0*	*71*	*240*	*3,4*	*0*	*27,02*	*27,02*	*2*
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
Tổng												

Emissions Reduction Action Plan Form (Part 2)

KẾ HOẠCH HÀNH ĐỘNG GIẢM PHÁT THẢI

Tên cơ sở	
Địa chỉ	
Người lập	
Ngày lập	
Người phê duyệt	
Ngày phê duyệt	
Tổng phát thải cơ sở Phạm vi 1 & 2 (tCO2e)	
Năm cơ sở	

	Các giải pháp được chọn sau bước Nhận diện cơ hội giảm phát thải	*- Mô tả cách thực hiện giải pháp giảm phát thải -Xác định về việc có tiết kiệm điện lưới, khí đốt, dầu nhiên liệu hoặc nguồn năng lượng khác hay không - Nhận định về mức độ thực hiện của biện pháp là khó hay dễ*	*Vui lòng đưa ra bất kỳ lợi ích bổ sung nào từ việc thực hiện các giải pháp đó*	*Cung cấp thông tin về thời gian/ngày thực hiện*	*Cung cấp thông tin về thời gian/ngày dự kiến hoàn thành*	*Cung cấp thông tin về tình trạng của từng giải pháp, ví dụ tính khả thi theo đánh giá; đã được phê duyệt; đang triển khai...*	*Vui lòng cho biết nhân viên được phân công thực hiện*	*Vui lòng cho biết nhân viên được phân công thực hiện*	*Vui lòng chỉ ra sự cần thiết phải hỗ trợ kỹ thuật nào để phát triển dự án hay không (ví dụ: thuê tư vấn bên ngoài để đánh giá cơ hội, xác định khoản tiết kiệm, xác định thiết bị, v.v.) Ngoài ra, nếu ngân sách bổ sung được yêu cầu (ví dụ: ngân sách bộ phận hiện tại không thể chi trả cho khoản đầu tư) hoặc nếu có hỗ trợ tài chính của bên thứ ba khi thích hợp.*
	Tên giải pháp giảm phát thải	**Mô tả ngắn gọn các giải pháp**	**Các lợi ích bổ sung**	**Ngày thực hiện**	**Ngày hoàn thành dự kiến**	**Tình trạng dự án**	**Phân công thực hiện**	**Phân công giám sát và đánh giá**	**Cần hỗ trợ**
Ví dụ	*Thay thế bóng đèn huỳnh quang T5 bằng đèn LED*	*Thay thế 2.000 bóng đèn huỳnh quang T5 bằng đèn LED tiết kiệm điện cho 2 xưởng 01 và 02*	*Giảm phát sinh rác thải nguy hại*	*01-Nov-22*	*01-Mar-23*	*Đã được phê duyệt, chờ triển khai*	*Tổ trưởng bảo trì*	*Bộ phận tuân thủ*	*Kinh phí bảo trì năm 2022 và 2023*
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
Tổng									

8.4 APPENDIX 4. GHG EMISSIONS CALCULATION TOOL

Using the GHG Protocol as a reference, ENERTEAM developed a calculation tool in Vietnamese to support the creation of GHG inventories for textile companies.

Structure of GHG emissions calculation tool

GHG emissions calculation tool is in Excel file format, including 1 Instruction sheet and 6 calculation sheets for each emissions source, as follows:

Sheet **S1_Stationary Combustion** calculates emissions from stationary fuel combustion sources (Scope 1).

Sheet **S1_Mobile Combustion** calculates emissions from mobile fuel combustion sources (Scope 1).

Sheet **S1_Refrigerants** calculates emissions of refrigerants (Scope 1).

Sheet **S2_Purchased Electricity** calculates emissions of grid electricity (Scope 2).

Sheet **S2_Purchased Steam** calculates emissions of purchased steam (from boilers) purchased outside, (Scope 2).

Sheet **S2_Purchased Heat** calculates emissions of purchased heat from a thermal oil boiler (Scope 2).

Sheet S1_Stationary Combustion

★ Step 1: Select data year
★ Step 2: Select fuel from stationary sources
★ Step 3: Select corresponding units of fuel
★ Step 4: Input the amount of fuel used
★ Step 5: See calculation results

CÔNG CỤ HỖ TRỢ TÍNH TOÁN PHÁT THẢI KHÍ NHÀ KÍNH

PHẠM VI 1 NGUỒN CỐ ĐỊNH (STATIONARY COMBUSTION)

Thuyết minh:
Bao gồm tiêu thụ nhiên liệu tại nhà máy. Quá trình đốt cháy nhiên liệu bằng các loại lò hơi, máy phát điện diesel và các thiết bị khác thải ra khí CO_2, CH_4 và N_2O ra ngoài môi trường.
Dữ liệu yêu cầu để tính toán:
- Loại nhiên liệu
- Đơn vị nhiên liệu (đơn vị thể tích hoặc đơn vị khối lượng hoặc đơn vị nhiệt)
- Lượng nhiên liệu sử dụng
Công thức tính toán: Phát thải GHG của nhiên liệu = Lượng nhiên liệu sử dụng * Hệ số phát thải của nhiên liệu

Chú thích: Nhập/Lựa chọn data; Kết quả tính toán

STT	Năm	Loại nhiên liệu	Đơn vị nhiên liệu	Lượng sử dụng	CO_2 (kg)	CH_4 (kg)	N_2O (kg)	CO_2e (kg)_AR4	CO_2e (kg)_AR5	CO_2e (kg)_AR6
1	2021	LPG	kg	1,000.00	2,940.76	0.14	0.03	2,952.86	2,952.34	2,952.83
2										
3										
4										

Sheet S1_Mobile Combustion

★ Step 1: Select data year
★ Step 2: Select fuel from mobile sources
★ Step 3: Select corresponding units of fuel
★ Step 4: Input the amount of fuel used
★ Step 5: See calculation results

CÔNG CỤ HỖ TRỢ TÍNH TOÁN PHÁT THẢI KHÍ NHÀ KÍNH

PHẠM VI 1 NGUỒN DI ĐỘNG (MOBILE COMBUSTION)

Thuyết minh:
Bao gồm mức tiêu hao nhiên liệu của các phương tiện giao thông do nhà máy sở hữu hoặc cho thuê. Quá trình đốt cháy nhiên liệu trong các phương tiện giao thông (bao gồm ô tô, xe tải, ...) thải ra khí khí CO_2, CH_4 và N_2O ra ngoài môi trường.
Dữ liệu yêu cầu để tính toán:
- Loại nhiên liệu - Loại phương tiện
- Đơn vị nhiên liệu (đơn vị thể tích hoặc đơn vị khối lượng hoặc đơn vị nhiệt)
- Lượng nhiên liệu sử dụng
Công thức tính toán: Phát thải GHG của nhiên liệu = Lượng nhiên liệu sử dụng * Hệ số phát thải của nhiên liệu

Chú thích: Nhập/Lựa chọn data; Kết quả tính toán

STT	Năm	Loại nhiên liệu - Loại phương tiện	Đơn vị nhiên liệu	Lượng sử dụng	CO_2 (kg)	CH_4 (kg)	N_2O (kg)	CO_2e (kg)_AR4	CO_2e (kg)_AR5	CO_2e (kg)_AR6
1		Xe con sử dụng xăng	lít	1,000.00	2,319.43	0.10	0.02	2,328.38	2,327.98	2,319.44
2										
3										
4										

Sheet S1_Refrigerants

★ Step 1: Select data year.

★ Step 2: Input the model name of the air conditioning equipment for which calculations are being made.

★ Step 3: Select type of refrigerant (R32, R40A, or R22).

★ Step 4: Input the amount of refrigerants in use and disuse, as follows:

• Columns 1&2: The amount of refrigerants in stock – data of the beginning and the end of the year.

• Column 3: The amount of refrigerants used to charge depleted air conditioning equipment (for cases where this service is outsourced).

• Column 4: The amount of refrigerant installed within all equipment purchased that year (the value of column 4 is equal to column 7 – the amount of refrigerants used to fully charge the new air conditioning equipment).

• Column 5: The amount of refrigerants used to charge depleted air conditioning equipment (for cases where the company completes refrigerant charging itself rather than outsourcing).

• Column 6: The amount of refrigerants added from recycled sources

• Column 8: The amount of refrigerants charged to air conditioning equipment that were discontinued or sold

• Column 9: The amount of (old) refrigerants fully charged to air conditioning equipment when replacing to (new) refrigerants

★ Step 5: See calculation results

Sheet S2_Purchased Electricity

★ Step 1: Select data year

★ Step 2: Select the energy source needed to be calculated, in this case it's always **purchased electricity**

★ Step 3: Select unit of energy, in this case it's always **kWh**

★ Step 4: Input the amount of purchased electricity

★ Step 5: See calculation results

CÔNG CỤ HỖ TRỢ TÍNH TOÁN PHÁT THẢI KHÍ NHÀ KÍNH

PHẠM VI 1 MÔI CHẤT LẠNH (REFRIGERANTS)

Thuyết minh:

Quá trình sử dụng môi chất lạnh (MCL) trong hệ thống ĐHKK thường phát sinh rò rỉ, gây phát thải ra khí khí CO_2, CH_4 và N_2O ra ngoài môi trường.

Dữ liệu yêu cầu để tính toán:

- Loại MCL
- Lượng MCL lưu kho, mua vào, nạp đầy tương ứng với từng mục đích sử dụng

Công thức tính toán: Phát thải GHG của MCL = Lượng MCL * Hệ số phát thải của MCL

Chú thích: Nhập/Lựa chọn data; Kết quả tính toán

MCL (Môi chất lạnh)

				1	2	3	4	5	6	7	8	9		
	Cột số liệu đầu vào													
STT	Năm	Tên máy lạnh/Model	Tên MCL	Lượng MCL lưu kho_số liệu đầu năm	Lượng MCL lưu kho_số liệu cuối năm	Lượng MCL nạp từ bình chứa	Lượng MCL có sẵn trong thiết bị ĐHKK mới	Lượng MCL được nạp vào thiết bị từ thầu phụ	Lượng MCL từ nguồn tái chế	Lượng MCL nạp đầy cho thiết bị ĐHKK mới	Lượng MCL nạp đầy cho thiết bị ĐHKK ngưng sử dụng/bị bán	Lượng MCL nạp đầy của thiết bị khi thay thế môi chất khác	CO_2e (kg)_AR4	CO_2e (kg)_AR5
1	2021		R22			1.00	1.00			1.00			1,810.00	1,760.00
2														
3														
4														
5														
6														
7														
8														
9														
10														

CÔNG CỤ HỖ TRỢ TÍNH TOÁN PHÁT THẢI KHÍ NHÀ KÍNH

PHẠM VI 2 ĐIỆN MUA NGOÀI (PURCHASED ELECTRICITY)

Thuyết minh:

Điện được mua từ điện lực địa phương. Theo công văn số 1316/BĐKH-TTBVTOD ban hành ngày 31 tháng 12 năm 2021 của Bộ Tài nguyên và Môi trường, kết quả tính toán hệ số phát thải của lưới điện Việt Nam năm 2020 là 0,8041 tấn CO_2e/MWh.

Dữ liệu yêu cầu để tính toán:

- Lượng điện mua vào

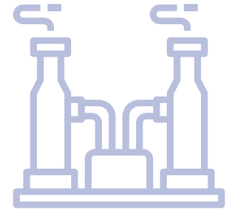
Công thức tính toán: Phát thải GHG của năng lượng = Lượng năng lượng mua vào * Hệ số phát thải của năng lượng

Chú thích: Nhập/Lựa chọn data; Kết quả tính toán

STT	Năm	Năng lượng mua ngoài	Đơn vị năng lượng	Lượng mua vào	CO_2 (kg)	CH_4 (kg)	N_2O (kg)	CO_2e (kg)_AR4	CO_2e (kg)_AR5	CO_2e (kg)_AR6
1	2021	Điện mua ngoài	kWh	19,000,000.00	0.80	-	-	15,277,900.00	15,277,900.00	15,277,900.00
2										
3										
4										

Sheet S2_Purchased Steam

- ★ Step 1: Select data year
- ★ Step 2: Select the energy source needed to be calculated, in this case it's always Steam (Boiler)
- ★ Step 3: Select unit of energy, in this case it's always tonne (tấn)
- ★ Step 4: Input the amount of purchased steam
- ★ Step 5: See calculation results



CÔNG CỤ HỖ TRỢ TÍNH TOÁN PHÁT THẢI KHÍ NHÀ KÍNH

PHẠM VI 2 **HƠI MUA NGOÀI (PURCHASED STEAM)**

Thuyết minh:

Hơi nước được mua từ đơn vị cung cấp năng lượng bên ngoài (quá trình đốt nhiên liệu không diễn ra tại nhà máy). Quá trình đốt cháy nhiên liệu của đơn vị cung cấp năng lượng bên ngoài thải ra khí khí CO_2, CH_4 và N_2O ra ngoài môi trường.

Dữ liệu yêu cầu để tính toán:

- Áp suất hơi và nhiệt độ nước cấp lò hơi
- Lượng hơi mua vào

Công thức tính toán: Phát thải GHG của năng lượng = Lượng năng lượng mua vào * Hệ số phát thải của năng lượng

Chú thích: Nhập/Lựa chọn data

Kết quả tính toán

Chú thích: barA: Áp suất tuyệt đối, bằng áp suất đồng hồ cộng 1

STT	Năm	Năng lượng mua ngoài	Đơn vị năng lượng	Loại nhiên liệu	Áp suất hơi (barA)	Nhiệt độ nước cấp (°C)	Lượng hơi mua vào (tấn)	CO_2 (kg)	CH_4 (kg)	N_2O (kg)	CO_2e (kg)_AR4	CO_2e (kg)_AR5	CO_2e (kg)_AR6
1	2021	Hơi nước (lò hơi)	tấn	Than	7.00	25.00	100.00	29,680.97	3,463.36	503.76	29,917.67	29,911.44	29,921.70
2													
3													
4													

Sheet S2_Purchased Heat

- ★ Step 1: Select data year
- ★ Step 2: Select the energy source needed to be calculated, in this case it's always **Heat (thermal oil boiler)**
- ★ Step 3: Select unit of energy, in this case it's always **Gcal (million kcal)**
- ★ Step 4: Input the amount of purchased heat
- ★ Step 5: See calculation results

CÔNG CỤ HỖ TRỢ TÍNH TOÁN PHÁT THẢI KHÍ NHÀ KÍNH

PHẠM VI 2 **NHIỆT MUA NGOÀI (PURCHASED HEAT)**

Thuyết minh:

Nhiệt từ lò dầu tải nhiệt được mua từ đơn vị cung cấp năng lượng bên ngoài (quá trình đốt nhiên liệu không diễn ra tại nhà máy). Quá trình đốt cháy nhiên liệu của đơn vị cung cấp năng lượng bên ngoài thải ra khí khí CO_2, CH_4 và N_2O ra ngoài môi trường.

Dữ liệu yêu cầu để tính toán:

- Lượng nhiệt mua vào

Công thức tính toán: Phát thải GHG của năng lượng = Lượng năng lượng mua vào * Hệ số phát thải của năng lượng

Chú thích: Nhập/Lựa chọn data

Kết quả tính toán

STT	Năm	Năng lượng mua ngoài	Đơn vị năng lượng	Loại nhiên liệu	Lượng mua vào (GCal)	CO_2 (kg)	CH_4 (kg)	N_2O (kg)	CO_2e (kg)_AR4	CO_2e (kg)_AR5	CO_2e (kg)_AR6
1		Nhiệt (lò dầu tải nhiệt)	GCal	Than	10,000,000.00	4,673,046,386.25	545,279,625.00	79,313,400.00	4,710,313,770.08	4,709,332,266.75	4,710,948,277.28
2											
3											
4											

8.6 APPENDIX 5. GHG EMISSIONS FACTORS

Decision No. 2626/QD-BTNMT dated 10/10/2022 of the Minister of Natural Resources and Environment announcing the list of emission coefficients serving the GHG inventory. See details at https://monre.gov.vn/VanBan/Pages/ChiTietVanBanChiDao.aspx?pID=2787

BỘ TÀI NGUYÊN VÀ MÔI TRƯỜNG

Số: 2626 /QĐ-BTNMT

CỘNG HÒA XÃ HỘI CHỦ NGHĨA VIỆT NAM
Độc lập - Tự do - Hạnh phúc

Hà Nội, ngày 10 tháng 10 năm 2022

QUYẾT ĐỊNH
Công bố danh mục hệ số phát thải phục vụ kiểm kê khí nhà kính

BỘ TRƯỞNG BỘ TÀI NGUYÊN VÀ MÔI TRƯỜNG

Căn cứ Luật Bảo vệ môi trường ngày 17 tháng 11 năm 2020;

Căn cứ Nghị định số 36/2017/NĐ-CP ngày 04 tháng 4 năm 2017 của Chính phủ quy định chức năng, nhiệm vụ, quyền hạn và cơ cấu tổ chức của Bộ Tài nguyên và Môi trường;

Căn cứ Nghị định số 06/2022/NĐ-CP ngày 07 tháng 01 năm 2022 của Chính phủ quy định giảm nhẹ phát thải khí nhà kính và bảo vệ tầng ô-dôn;

Theo đề nghị của Cục trưởng Cục Biến đổi khí hậu,

QUYẾT ĐỊNH:

Điều 1. Công bố danh mục hệ số phát thải phục vụ kiểm kê khí nhà kính, bao gồm:

1. Danh mục hệ số phát thải phục vụ kiểm kê khí nhà kính lĩnh vực năng lượng tại Phụ lục I;

2. Danh mục hệ số phát thải phục vụ kiểm kê khí nhà kính lĩnh vực các quá trình công nghiệp và sử dụng sản phẩm tại Phụ lục II;

3. Danh mục hệ số phát thải phục vụ kiểm kê khí nhà kính lĩnh vực nông nghiệp, lâm nghiệp và sử dụng đất tại Phụ lục III;

4. Danh mục hệ số phát thải phục vụ kiểm kê khí nhà kính lĩnh vực chất thải tại Phụ lục IV.

Emission coefficient of Vietnam's electricity grid is published annually by the Department of Climate Change under the Ministry of Natural Resources and Environment. Details of emission factors of Vietnam's electricity grid in recent years are listed as follows:

Table 8.1/ Emission coefficients of Vietnam's electricity grid

Year	Value tCO_2/MWh	Sources
2019	0.8458	http://www.dcc.gov.vn/van-ban-phap-luat/1066/He-so-phat-thai-luoi-dien-Viet-Nam-2019.html
2020	0.8041	http://dcc.gov.vn/van-ban-phap-luat/1082/He-so-phat-thai-luoi-dien-Viet-Nam-2020.html
2021	0.7221	http://dcc.gov.vn/van-ban-phap-luat/1101/He-so-phat-thai-luoi-dien-Viet-Nam-2021.html

Emission factors announced by United States Environmental Protection Agency. See details at the link https://www.epa.gov/climateleadership/ghg-emission-factors-hub

Emission Factors for Greenhouse Gas Inventories

Last Modified: 1 April 2022

Red text indicates an update from the 2021 version of this document.

Typically, greenhouse gas emissions are reported in units of carbon dioxide equivalent (CO_2e). Gases are converted to CO_2e by multiplying by their global warming potential (GWP). The emission factors listed in this document have not been converted to CO_2e. To do so, multiply the emissions by the corresponding GWP listed in the table below.

Gas	100-Year GWP
CH_4	25
N_2O	298

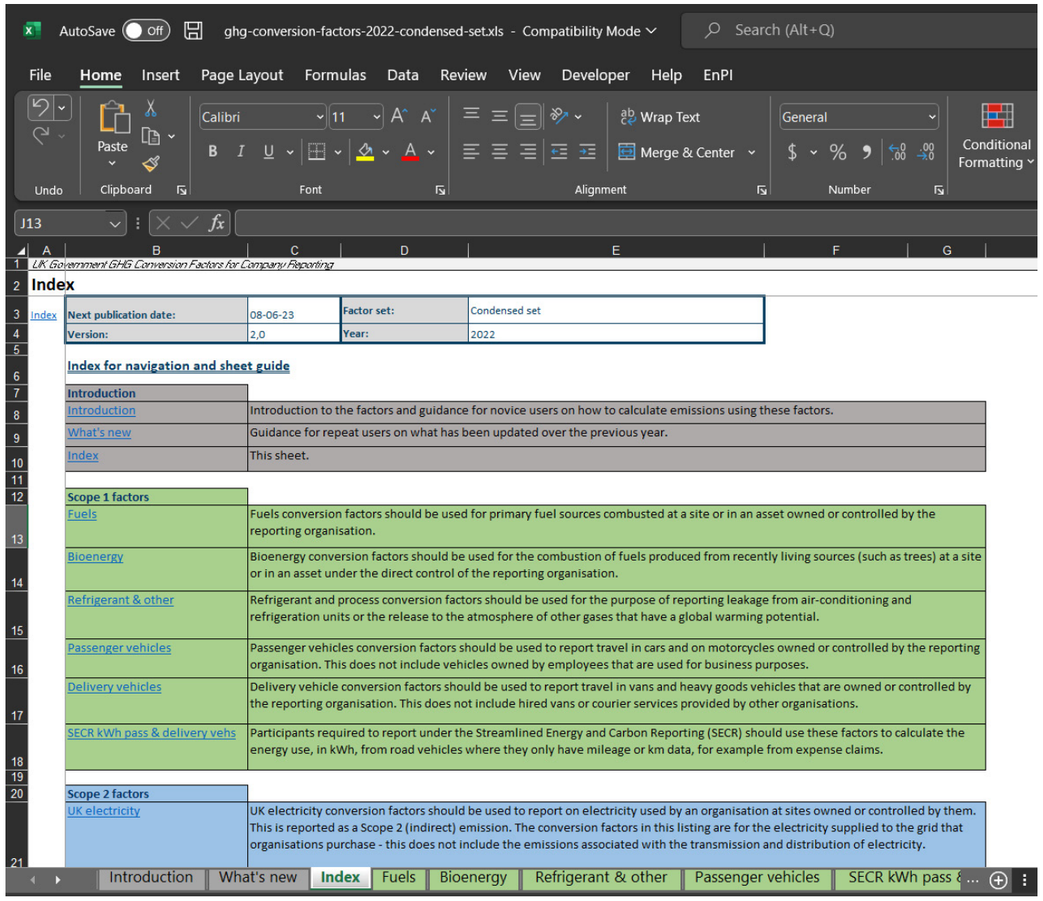
Source: Intergovernmental Panel on Climate Change (IPCC), Fourth Assessment Report (AR4), 2007. See the source note to Table 11 for further explanation.

Table 1 Stationary Combustion

Fuel Type	Heat Content (HHV) mmBtu per short ton	CO_2 Factor kg CO_2 per mmBtu	CH_4 Factor g CH_4 per mmBtu	N_2O Factor g N_2O per mmBtu	CO_2 Factor kg CO_2 per short ton	CH_4 Factor g CH_4 per short ton	N_2O Factor g N_2O per short ton
Coal and Coke							
Anthracite Coal	25.09	103.69	11	1.6	2,602	276	40
Bituminous Coal	24.93	93.28	11	1.6	2,325	274	40
Sub-bituminous Coal	17.25	97.17	11	1.6	1,676	190	28
Lignite Coal	14.21	97.72	11	1.6	1,389	156	23
Mixed (Commercial Sector)	21.39	94.27	11	1.6	2,016	235	34
Mixed (Electric Power Sector)	19.73	95.52	11	1.6	1,885	217	32
Mixed (Industrial Coking)	26.28	93.90	11	1.6	2,468	289	42
Mixed (Industrial Sector)	22.35	94.67	11	1.6	2,116	246	36
Coal Coke	24.80	113.67	11	1.6	2,819	273	40
Other Fuels - Solid							
Municipal Solid Waste	9.95	90.70	32	4.2	902	318	42
Petroleum Coke (Solid)	30.00	102.41	32	4.2	3,072	960	126
Plastics	38.00	75.00	32	4.2	2,850	1,216	160
Tires	28.00	85.97	32	4.2	2,407	896	118
Biomass Fuels - Solid							
Agricultural Byproducts	8.25	118.17	32	4.2	975	264	35
Peat	8.00	111.84	32	4.2	895	256	34
Solid Byproducts	10.39	105.51	32	4.2	1,096	332	44
Wood and Wood Residuals	17.48	93.80	7.2	3.6	1,640	126	63

Fuel Type	Heat Content (HHV) mmBtu per short ton	CO_2 Factor kg CO_2 per mmBtu	CH_4 Factor g CH_4 per mmBtu	N_2O Factor g N_2O per mmBtu
Coal and Coke				
Anthracite Coal	25.09	103.69	11	1.6
Bituminous Coal	24.93	93.28	11	1.6
Sub-bituminous Coal	17.25	97.17	11	1.6
Lignite Coal	14.21	97.72	11	1.6
Mixed (Commercial Sector)	21.39	94.27	11	1.6
Mixed (Electric Power Sector)	19.73	95.52	11	1.6
Mixed (Industrial Coking)	26.28	93.90	11	1.6
Mixed (Industrial Sector)	22.35	94.67	11	1.6
Coal Coke	24.80	113.67	11	1.6

Emissions factor announced by United Kingdom government. See details at the link https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2022



Emission factors according to Guidelines of the Intergovernmental Panel on Climate Change (IPCC). See details at the link https://www.ipcc.ch/reports/. Including Guidelines in 2006 (https://www.ipcc.ch/report/2006-ipcc-guidelines-for-national-greenhouse-gas-inventories/) and the update in 2019 (https://www.ipcc.ch/report/2019-refinement-to-the-2006-ipcc-guidelines-for-national-greenhouse-gas-inventories/). Details of emission factors according to IPCC Guidelines are presented in the tables below:

Table 8.2/ Stationary combustion sources

Stationary combustion source	Unit	$kgCO_2e$ / TJ	Source
Gasoline	$kgCO_2e$	69,739	IPCC 2006 guideline - Volume 2 - Chapter 2. Stationary combustion - table 2.3
Diesel	$kgCO_2e$	74,539	IPCC 2006 guideline - Volume 2 - Chapter 2. Stationary combustion - table 2.3
fuel oil	$kgCO_2e$	77,839	IPCC 2006 guideline - Volume 2 - Chapter 2. Stationary combustion - table 2.3
CNG	$kgCO_2e$	56,399	IPCC 2006 guideline - Volume 2 - Chapter 2. Stationary combustion - table 2.3
LPG	$kgCO_2e$	63,399	IPCC 2006 guideline - Volume 2 - Chapter 2. Stationary combustion - table 2.3
Biodiesel	$kgCO_2e$	71,043	IPCC 2006 guideline - Volume 2 - Chapter 2. Stationary combustion - table 2.3

Table 8.3/ Mobile combustion sources

Mobile combustion source	Unit	$kgCO_2e$ / TJ	Nguồn
Gasoline	$kgCO_2e$	71,072	IPCC 2006 guideline - Volume 2 - Chapter 3. Mobile combustion - table 3.2.1 & 3.2.2
DO	$kgCO_2e$	75,243	IPCC 2006 guideline - Volume 2 - Chapter 3. Mobile combustion - table 3.2.1 & 3.2.2
CNG	$kgCO_2e$	59,471	IPCC 2006 guideline - Volume 2 - Chapter 3. Mobile combustion - table 3.2.1 & 3.2.2
LPG	$kgCO_2e$	64,889	IPCC 2006 guideline - Volume 2 - Chapter 3. Mobile combustion - table 3.2.1 & 3.2.2

Table 8.4/ Global warming potential (GWP) values relative to CO_2

Industrial designation or common name	Chemical formula	GWP-100		
		IPCC AR4	IPCC AR5	IPCC AR6
Carbon dioxide	CO_2	1	1	1
Methane	CH_4	25	28	27.9
Nitrous oxide	N_2O	298	265	273
Chlorodifluoromethan (HCFC-22)	$CHClF_2$	1,810	1,760	1,960
Trifluoromethane (HFC-23)	CHF_3	14,800	12,400	14,600
Difluoromethane (HFC-32)	CH_2F_2	675	677	771
Methyl Fluoride (HFC-41)	CH_3F	-	116	135
Pentafluoroethane (HFC-125)	CHF_2CF_3	3,500	3,170	3,740
1,1,2,2-Tetrafluoroethane (HFC-134)	CHF_2CHF_2	-	1,120	1,260
1,1,1,2-Tetrafluoroethane (HFC-134a)	CH_2FCF_3	1,430	1,300	1,530
1,1,2-Trifluoroethane (HFC-143)	CH_2FCHF_2	-	328	364
1,1,1-trifluoroethane (HFC-143a)	CH_3CF_3	4,470	4,800	5,810
1,2-Difluoroethane (HFC-152)	CH_2FCH_2F	-	16	21.5
1,1-Difluoroethane (HFC-152a)	CH_3CHF_2	124	138	164
Ethyl fluoride (HFC-161)	CH_3CH_2F	-	4	4.84
1,1,1,2,3,3,3-Heptafluoropropane (HFC-227ea)	CF_3CHFCF_3	3,220	3,350	3,600
1,1,1,2,2,3-Hexafluoropropane (HFC-236cb)	$CH_2FCF_2CF_3$	-	1,210	1,350
1, 1, 1, 2, 3, 3-hexafluoropropane (HFC-236ea)	CHF_2CHFCF_3	-	1,330	1,500
1,1,1,3,3,3-Hexafluoropropane (HFC-236fa)	$CF_3CH_2CF_3$	9,810	8,060	8,690
1,1,2,2,3-pentafluoropropane (HFC-245ca)	$CH_2FCF_2CHF_2$	-	716	787
1,1,1,3,3-Pentafluoropropane (HFC-245fa)	$CHF_2CH_2CF_3$	1,030	858	962
1,1,1,2,3,4,4,5,5,5-Decafluoropentane (HFC-43-10mee)	$CF_3CHFCHFCF_2CF_3$	1,640	1,650	1,600
1-Chloro-1,1-difluoroethane (HCFC-142b)	CH_3CClF_2	2,310	1,980	2,300
Sulfur hexafluoride	SF_6	22,800	23,500	24,300
Nitrogen trifluoride	NF_3	17,200	16,100	17,400
Perfluoromethane (PFC-14)	CF_4	7,390	6,630	7,380
Perfluoroethane (PFC-116)	C_2F_6	12,200	11,100	12,400
Perfluoropropane (PFC-218)	C_3F_8	8,830	8,900	9,290
Perfluorocyclobutane (PFC-C-318)	$c\text{-}C_4F_8$	10,300	9,540	10,200
Perfluorobutane (PFC-31-10)	$n\text{-}C_4F_{10}$	8,860	9,200	10,000

Sources:
Fourth Assessment Report (IPCC AR4): https://www.ipcc.ch/site/assets/uploads/2018/02/ar4-wg1-chapter2-1.pdf
Fifth Assessment Report (IPCC AR5): https://www.ipcc.ch/pdf/assessment-report/ar5/wg1/WG1AR5_Chapter08_FINAL.pdf
Sixth Assessment Report (IPCC AR6): https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_Chapter07_SM.pdf

The Higg Facility Environmental Module (Higg FEM) with most up to date emissions factors. See details at the link https://marketing-cdn.higg.com/guides/reslib/FEM-GHG-Emission-Factors_FEM-2021.xlsx

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