Guidance for Measuring Greenhouse Gas Emissions for Purchased Goods and Services for the Apparel and Footwear Industry

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Fashion for Climate

Sustainable Apparel Coalition

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1. Guidance Context and Objectives

As of March 2023, over 300 apparel and footwear companies had either set or committed to set science-based climate change targets (SBTs) via the Science Based Targets initiative (SBTi).[1] For any company setting an SBT, the foundation of their target is an inventory of greenhouse gas (GHG) emissions across scopes 1, 2, and 3. For companies operating in the apparel and footwear sector - especially brands and retailers - scope 3 emissions are generally the vast majority of total emissions, and purchased goods and services (PG&S, category 1 under the Greenhouse Gas Protocol Value Chain (Scope 3) Standard) is the vast majority of scope 3. To illustrate:

- In FY21, Nike's scope 1 emissions were 0.4% of total emissions; scope 2 were 0.7%, and scope 3 were 98.9%. PG&S emissions were 88.5% of scope 3 emissions.
- In FY21, Decathlon's scope 1 emissions were 0.3% of total emissions; scope 2 were 0.4%, and scope 3 were 99%. Emissions from raw material extraction and product manufacturing were 73% of total company emissions.
- In FY20, Fast Retailing's scope 1 emissions were 0.11% of total emissions; scope 2 were 2.94%; and scope 3 were 97%. PG&S emissions were 86% of total emissions.
- In FY21, Lenzing's scope 1 emissions were 31% of total emissions, scope 2 were 15%, and scope 3 were 53%.

Given the significance of PG&S emissions, it is critical that companies use consistent and robust methods for calculating these emissions.

While the GHG Protocol has published technical guidance for calculating PG&S emissions and other scope 3 categories, the instructions for computing PG&S emissions are generic and not specific to the apparel and footwear sector. The purpose of this guidance document is to provide apparel and footwear sector-specific guidance for calculating PG&S emissions so that:

- There is greater consistency in how apparel and footwear companies develop their PG&S inventories
- Companies can overcome common challenges faced by the sector, for example the need to use a combination of primary and secondary data (more on this below)
- Companies starting the process of measuring PG&S emissions can do so more efficiently and in line with industry practice - which in turn should result in more companies measuring emissions and setting targets
- Over time, with more consistent inventories, the apparel and footwear sector will be able to more accurately gauge its progress towards the GHG reductions needed to stay aligned with SBTs

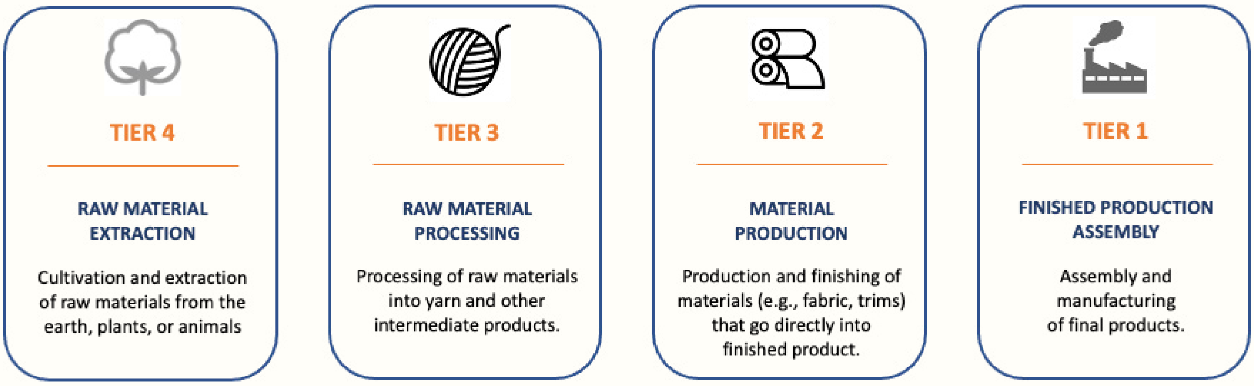
While this document references approaches for reducing GHG emissions in the apparel and footwear sector, its focus is on calculating PG&S emissions. There are other resources that go into detail on reducing GHG emissions and into topics mentioned below such as insetting and renewable energy certificates.

A Note on the Audience for the Guidance

For apparel and footwear brands and retailers, PG&S emissions result from all of the value chain activities that go into making finished products, from raw materials to fabric development to product manufacturing (see Figure 1 below). The PG&S emissions of brands and retailers are the scope 1 and 2 emissions of upstream suppliers, for example the electricity required to spin fiber into yarn results in the PG&S emissions of a brand and the scope 2 emissions of the company spinning the yarn.

[1] Based on a download from the Science Based Targets initiative website on March 22,2023

Figure 1: Overview of PG&S Activities from the Perspective of Brands and Retailers



Source: Adapted from Roadmap to Net Zero (World Resources Institute and Apparel Impact Institute)

Given the magnitude of PG&S for brands and retailers, the language in this document is generally tailored for them. However, the guidance can be used by finished goods manufacturers, textile manufacturers, and other "upstream" companies to measure their PG&S emissions. For example, a finished goods manufacturer purchases fabric and other components to produce garments, and thus would use the same approach as described below. Due to the nature of scope 3 GHG accounting, there is overlapping accountability for PG&S emissions based on GHG accounting principles, and so a brand and a finished goods manufacturer (tier 1) should, in theory, have the same PG&S emissions for the activities upstream of the manufacturer (tier 2 to 4) for the products made for that brand. There is also shared accountability for reducing those emissions – that is, a brand should work to reduce its PG&S emissions (scope 3) which are the scope 1 and 2 emissions of its suppliers.

Box 1: Challenges in measuring PG&S emissions

Given the nature of the apparel and footwear industry, there are a number of common challenges for measuring PG&S emissions, for example:

- **Incomplete access to primary data:** Very few, if any apparel and footwear companies have access to primary data for all of their upstream activities (tiers 1 to 4). A brand's knowledge of specific suppliers and thus visibility into actual impact data generally declines as one goes upstream – most brands know their finished goods factories, but fewer know their textile mills, spinners, cotton farms, and so on. Thus, companies must rely on a mix of primary or secondary data, which has various implications (described below).
- **Lack of access to GHG emissions factors:** Relatedly, companies often lack easy access to emissions factors for elements such as grid electricity and fuels, as well as for materials. Thus, a company might know the electricity usage for a given manufacturing facility, but it may not have the actual GHG emissions factor for the electricity used by the facility.
- **Allocating manufacturing emissions by brand customer:** Most manufacturers make products for multiple brand or retailer customers, and are usually not able to measure emissions at the brand level. Thus, brands must make assumptions to estimate the portion of their emissions that come from a given supplier.

Below, this document describes how companies are addressing these challenges.

2. Process for Developing the Guidance

In partnership with the UN Climate Change-convened Fashion Industry Charter for Climate Action (Fashion Charter), the Sustainable Apparel Coalition (SAC) led the development of this guidance with the support of an external consultant with experience in the fashion sector, GHG accounting, and SBTs. In developing the initial draft, the SAC received input from over a dozen individuals representing brands, manufacturers, consultancies, and other industry stakeholders. The SAC shared the draft with these individuals for feedback, and incorporated this feedback into this version.

3. General Approaches to Measuring PG&S Emissions

As described in the GHG Protocol scope 3 technical guidance, there are several approaches for calculating PG&S emissions for companies across sectors:

- **Supplier specific:** product-level GHG inventory data for goods and services, for example the actual emissions resulting from the production of a pair of jeans. This is often referred to as primary data. Companies can access supplier-specific directly from suppliers (e.g., via surveys or other reporting tools) or via dedicated reporting platforms or software.
- **Average data:** estimated emissions for goods and services based on industry average emissions data (and not the actual emissions from a product). This is often referred to as secondary or life-cycle inventory data. Examples of average data sets include ecoinvent and the Higg Materials Sustainability Index (MSI).
- **Spend based:** estimated emissions for goods and services based on the economic value of goods and services purchased. For example, a company would measure the amount of a material it uses in its products and then multiply that amount by an emissions factor (i.e., kg per $ USD). This is the approach that underlies the Scope 3 Evaluator from Quantis and the GHG Protocol. Companies often use this approach to estimate emissions from service providers such as accountants and lawyers.
- **Hybrid:** a combination of the above approaches - many apparel and footwear companies use a combination of supplier-specific and average data.

Ideally, apparel and footwear companies would have access to supplier-specific (primary) data for all tiers in the supply chain. This should be the industry's collective ambition. However, given the nature of the industry, this is not currently possible - and it will take many years and significant changes in the dynamics of the sector (e.g., greater visibility into the origin of materials and products) in order to make primary data the norm. Thus, companies will continue to use a combination of the above approaches to estimate their emissions.

Box 2: A complex value chain

The apparel and footwear value chain is complex and far reaching. To illustrate:

- Adidas sources from over 440 tier 1 factories and subcontractors and 180 wet processing facilities.
- Fast Retailing sources from nearly 600 tier 1 factories and over 90 fabric mills.
- H&M sources from nearly 1,200 tier 1 factories and nearly 400 tier 2 mills.
- There are over 16,000 cotton farms in the United States alone.

Source: Data from public information compiled from company websites in August 2022. Cotton farmer data from Roadmap to Net Zero report.

This guidance document is focused on supplier-specific and average data for constructing PG&S GHG inventories as these approaches are more precise than the spend-based approach, and better position companies to measure progress over time (despite limitations which are described below). Tools based on the spend-based model such as the Scope 3 Evaluator can be useful for companies to do an initial screening of scope 3 emissions, from which they can focus their attention on hot spots of emissions such as PG&S and then aim to gather primary data for these areas. However, year-over-year tracking of a company's GHG emissions against an SBT should not rely on spend-based models, due to the inherent limitations of such models.

Box 3: A note on scope 3 screening

According to the requirements of the SBTi, companies setting SBTs must include a scope 3 component to their targets if scope 3 emissions are 40% or more of total emissions (scopes 1, 2 and 3). If this threshold is met, companies must include a minimum of two-thirds of scope 3 emissions in their scope targets.[2] As noted above, scope 3 emissions will well exceed 40% of total emissions for most apparel and footwear brands and retailers, and PG&S emissions will exceed two-thirds of scope 3.

For companies just getting started on taking stock of their emissions, tools such as the Scope 3 Evaluator can be useful for conducting an initial screen to evaluate scope 3 emissions, as well as the distribution of emissions across the 15 scope 3 categories.[3]

Apparel and footwear companies can make the reasonable assumption that they will need to set a scope 3 target and measure their scope 3 emissions. This guidance document provides details on estimating PG&S emissions (category 1), while the GHG Protocol scope 3 technical calculation guidance is useful for measuring the other 14 categories which are less industry-specific. For example, emissions for business travel and employee commuting will generally be measured in the same way for companies across sectors.

[2] These requirements apply to near-term targets under the SBTi (no further than 10 years). For long term targets, companies must include at least 90% of scope 3 emissions.

[3] For a full description of scope 3 categories, see the GHG Protocol's Corporate Value Chain (Scope 3) Accounting and Reporting Standard

Box 4: Measuring FLAG Emissions

In September 2022, the SBTi launched the Forest, Land, and Agriculture Science Based Target Setting Guidance (FLAG) for companies in land-intensive sectors to set science-based targets that include land-based emission reductions and removals. While the apparel sector is not listed as a sector that is required to set FLAG targets, companies must set a FLAG target if they have FLAG-related emissions totaling 20% or more of the company's overall emissions across scopes 1, 2, and 3.

FLAG emissions come in two categories: land use change (e.g., deforestation) and land management (e.g., enteric emissions, fertilizer production). Some data sets may already account for some of these emissions, for example emissions from farm equipment and fertilizer production are included in emissions factors for cotton.

The need to set a FLAG target will vary based on a company's material usage, for example companies that are heavily reliant on leather or cotton may need to set such a target. In general, companies will use the approaches presented below in section 4 to measure these emissions.

For more information on FLAG emissions and targets, see the SBTi website.

4. Measuring PG&S Emissions for the Apparel and Footwear Sector

In this section, we provide industry-specific guidance on calculating GHG emissions per the supplier-specific and average methods described in the GHG Protocol Scope 3 technical calculation guidance. Typically, companies use a combination of supplier-specific and average methods since they do not have full visibility into the emissions across their entire supply chains.

In general, companies should strive to use as much primary data as possible in developing their GHG inventories, and engage suppliers to gather such data. That said, the GHG Protocol writes the following about the difference between data specificity and accuracy:

"Even though the supplier-specific and hybrid methods are more specific to the individual supplier than the average-data and spend-based methods, they may not produce results that are a more accurate reflection of the product's contribution to the reporting company's scope 3 emissions. In fact, data collected from a supplier may actually be less accurate than industry-average data for a particular product. Accuracy derives from the granularity of the emissions data, the reliability of the supplier's data sources, and which, if any, allocation techniques were used. The need to allocate the supplier's emissions to the specific products it sells to the company can add a considerable degree of uncertainty, depending on the allocation methods used."[4]

Approach 1: Supplier Specific

Applicability of this approach

When a brand can meet all three conditions below:

- Identify the facility[5] at which its products and materials are manufactured.
- Identify which manufacturing processes (e.g., tier 2 textile wet processing, tier 4 farming/extractive processes) took place at that facility.
- Access the facility's GHG emissions inventory estimate for the brand's share of total facility

[4] Technical Guidance for Calculating Scope 3 Emissions, Supplement to the Corporate Value Chain (Scope 3) Accounting & Reporting Standard

[5] We use "facility" throughout this document for simplicity, but data will also come from various entities across the value chain - farms, ranches, etc.

production.

How to calculate emissions

A brand will need to identify the facility used in its supply chain for a given reporting period and obtain the facility's scope 1 and 2 GHG emissions data.

- The facility may provide total facility-level emissions to the brand, and if the latter knows how much production is theirs as a percentage of the total units produced, they can estimate their portion of emissions on a pro-rata basis.
- The facility may also provide the already-allocated emissions directly to the brand.

In the case of simple pro-rata allocation

$$Brand\ Allocated\ Facility\ GHG\ Emissions = (F.S1\&2 + F.NPS3) \times \frac{FVB}{FVT}$$

Where:

- **F.S1&2** = the total facility scope 1 and 2 GHG emissions. It is the total measured scope 1 and scope 2 GHG emissions of the facility during the reporting period[6] in kilograms of carbon dioxide equivalent ($kgCO_2e$)
- **F.NPS3** = the facility estimated "non-product" scope 3 GHG emissions. These are the facility scope 3 emissions that are not otherwise captured in the brand's scope 3 assessment (e.g. upstream manufacturing of chemicals and fuels used in the production process, downstream emissions from facility waste management), in $kgCO_2e$
- **FVB** = Facility production volume purchased by Brand. The volume of facility's production that was purchased by the brand during the reporting period, typically in kilograms or square meters of material produced for tiers 4, 3, and 2 and in units produced in tier 1
- **FVT** = Total facility production volume. The total volume of production by the facility during the reporting period, typically in kilograms or square meters of material[7] produced for tiers 4, 3, and 2 and in units produced in tier 1

Allocating emissions pro rata, on a per unit basis (i.e., total annual emissions from a facility multiplied by the share of production that a customer purchases in that period) has limitations. For example, all products do not go through the exact same processes in a facility, and a customer's emissions may be overstated if their products go through fewer processes (i.e., the per unit average is higher than the likely actual emissions figure). While not ideal, this is likely the most viable calculation approach for most facilities as they typically do not have access to data at a granular level (e.g., energy metering at the process level). More sophisticated allocation methods are also prone to over or under counting of total emissions and should be used carefully.

[6] Per the GHG Protocol Corporate Accounting and Reporting Standard

[7] Since emissions factors are typically based on mass (e.g., kg), volume measures such as square meters will need to be converted to mass to calculate GHG emissions, using the area density of the material (in kg/m^2).

Box 5: Facility non-product scope 3 emissions

Facility scope 3 emissions can be quite significant, in particular:

- Scope 3 category 3: Fuel- and energy-related activities. For example, natural gas combustion generates around 2.3 $kgCO_2e$ per kg of natural gas, but the upstream production and distribution of that natural gas (in China, as an example) is around 0.9 $kgCO_2e$ per kg. Meaning that scope 3 emissions for natural gas combustion are about 28% of the scope 1 emissions.
- Scope 3 category 5: Waste generated in operations. For some processes, like leather pre-tanning for example, the waste generated in operations can be significant and lead to significant scope 3 emissions.
- Scope 3 category 1: Purchased goods and services. This category refers to non-product purchased goods and services, meaning typically the chemicals and reagents used by a factory that would not be otherwise accounted for in the scope 3 calculations of its customer because they do not show up in the Bill of Materials. These typically will include chemicals like dyes, detergent, softeners, and can lead to significant scope 3 emission that may need to be accounted for separately under this approach.

Given their significance, these facility scope 3 emissions should ideally be accounted for, by the facility, and shared with its customers along with its scope 1 and 2 emissions. In practice, few facilities are actually reporting on these and they may need to be estimated using default estimated values. For comparability of emission between approach 1 and approaches 2a and 2b, it is highly recommended to estimate these emissions.

In the case of process level allocation:

$$Brand\ Allocated\ Facility\ GHG\ Emissions$$
$$= (FOH.S1\&2 + FOH.NPS3) \times \frac{FVB}{FVT} + (FP.S1\&2 + FP.NPS3) \times \frac{FPVB}{FPVT}$$

Where:

- **FOH.S1&2** = Facility overhead scope 1 and 2 GHG emissions. The total scope 1 and 2 emissions from facility processes that are shared across all production (e.g., office building heating and cooling) in $kgCO_2e$
- **FOH.NPS3** = Facility estimated overhead "non-product" scope 3 GHG emissions. These are the facility overhead scope 3 emissions that are not otherwise captured in the brand's scope 3 assessment (e.g. upstream manufacturing of fuels used in the office building heating), in $kgCO_2e$
- **FVB** = Facility production volume purchased by Brand. The volume of a facility's production purchased by a brand during the reporting period, typically in kilograms or square meters of material produced for tiers 4, 3, and 2 and in units produced in tier 1
- **FVT** = Total facility production volume. The total volume of production by a facility during the reporting period, typically in kilograms or square meters of material produced for tiers 4, 3, and 2 and in units produced in tier 1
- **FP.S1&2** = Process scope 1 and 2 GHG emissions. The scope 1 and 2 GHG emissions from the facility's processes in question, in $kgCO_2e$
- **FP.NPS3** = Process estimated non product scope 3 GHG emissions. These are the facility scope 3 emissions related to the process, that are not otherwise captured in the brand's scope 3 assessment (e.g. upstream manufacturing of chemicals and fuels used in the production process, downstream emissions from facility waste management), in $kgCO_2e$
- **FPVB** = Facility production volume of process purchased by brand. The volume of the facility's process that was purchased by the brand during the reporting period, typically in kilograms or square meters of material produced for tiers 4, 3, and 2 and in units produced in tier 1

- **FPVT** = Total facility production volume for that process. The total volume of production for that process by the facility during the reporting period, typically in kilograms or square meters of material produced for tiers 4, 3, and 2 and in units produced in tier 1

Where appropriate, emissions may otherwise be allocated using approach 2a below to compromise between using facility actuals and potentially over or under counting where a facility has many unused processes.

Facility emissions shall include at a minimum all facility scope 1 and 2 GHG emissions (if relevant, both market-based and location-based shall be reported), as calculated per the GHG Protocol.

Box 6: Tools for collecting supplier-specific data

Companies may use different approaches and tools for gathering supplier-specific data. For example, some companies use Enablon to gather data directly from select manufacturers, while other companies use the Higg FEM or the ZDHC Resource Efficiency Module to gather data. This document does not recommend any one tool - companies should use the tool that best allows them to efficiently gather robust data.

How to deal with similar suppliers for which the brand does not have primary data

When a brand has sufficient and representative supplier data in a given value chain tier, it may decide to use such data to extrapolate to total emissions of that tier, rather than using average data as described in Approach 2 below. While there is no definitive threshold for "sufficient and representative," a reasonable level would be that at least 50% of a brand's total production volume in a given tier comes from specific suppliers. There are limitations to this approach, for example the facilities representing 50% of production might be better performing from a GHG perspective. If this was the case, then the total inventory would be lower than it was in actuality.

In this case, a company could use an average of GHG emissions per unit of output (e.g., units produced, or kilograms of material produced) over recent years to represent the emissions from the production not covered by the supplier-specific data per the following formula:

$$Avg\ facility\ GHG\ intensity = \frac{Supplier\ specific\ total\ GHG\ Emissions}{Supplier\ specific\ total\ production\ volume}$$

$$Extrapolated\ GHG\ emissions = Other\ facilities'total\ production \times Avg\ facility\ GHG\ intensity$$

This emissions intensity figure would be applied to the production of other facilities attributable to the brand.

Where:

- **Average facility GHG intensity** is typically in kgCO_2e per kg or square meters of material produced for tiers 4, 3 and 2, and in kgCO_2e per unit produced in tier 1
- **Supplier specific total GHG emissions** = the total GHG emissions of those facilities within a given tier that have provided supplier specific data, in kgCO_2e
- **Supplier specific total production volume** = the total production of that same pool of facilities, in kilograms or square meters of material produced for tiers 4, 3, and 2 and in units produced in tier 1

Note that year-over-year progress made in facilities with supplier-specific data may not be representative of progress in other facilities. Suppliers providing primary data to their brand customers tend to be more advanced and better performing in terms of GHG emissions. As such, it is likely overly optimistic to extrapolate emissions from this higher performing subset of facilities to the entire supply chain. It is therefore recommended that emissions intensity (kgCO_2e/unit of production) calculated from this extrapolation approach be kept constant (equal to the baseline[8] emissions intensity, i.e., "historical") throughout the reporting period, in order to avoid overextending the impact of progress made in facilities with supplier-specific data.

Other considerations

The topic of renewable energy certificates (RECs), also known as energy attribution certificates (EACs), is increasingly under scrutiny.[9] To simplify a complex issue, the main concern raised by stakeholders is that RECs may not result in additional renewable energy being generated. This paper is not intended to address the pros and cons of RECs. However, if a manufacturer purchases high quality RECs that effectively help increase renewable energy supply, then it can adjust its GHG emissions factor accordingly via the market-based accounting method under the GHG protocol.[10] Brands that purchase products from that facility will then be able to use the lower emissions factor. The same is true for purchases of renewable energy via virtual purchase power agreements (vPPAs). Organizations such as World Resources Institute have written papers about high quality RECs.

If a factory subcontracts portions of production to other entities - a common occurrence in the apparel supply chain - there may be undercounting of a brand's scope 3 emissions. Particular care should be taken to accurately map the actual volumes and specific processes happening at each facility to address this risk. The primary factory should strive to measure the resulting GHG emissions from outsourced activities.

Box 7: A note about insetting

According to the SBTi, carbon insetting describes "mitigation projects that are wholly contained within a scope 3 supply chain boundary of a company, a project partially within their scope 3 supply chain boundary, and a project adjacent to a supply chain boundary." Examples of insetting projects could include a brand investing to replace a coal-fired boiler in a textile mill for a lower GHG emission alternative, or a brand investing in the cattle portion of the value chain (tier 4) to reduce emissions resulting from livestock.

Insetting is a complex topic that various organizations have been working on for several years. While high-quality insets may play a role in decarbonizing the apparel and footwear sector, this guidance document does not make any recommendations about insetting. The SBTi continues to deliberate on how to treat insets, and offers the following:

"Regarding insetting, further work is required to standardize the definition of insetting projects and to develop a clear accounting methodology. For these reasons, the SBTi will assess insetting projects on a case-by-case basis during the validation process and may not approve their use."

Approach 2: Average Data

For emissions that cannot be specifically tied to a given facility in their entirety, a brand can use one of the following calculation approaches.

[8] Companies will generally track their progress against an emissions reduction target, which should include a baseline year, and a target year. Baseline emissions intensity here refers to the emissions intensity in the baseline year of the target period.

[9] See for example this article in Nature

[10] Note that this facility would need to report scope 2 emissions via both the market-based and location-based approaches under the GHG Protocol.

Approach 2a: Facility-adjusted process data

Applicability of this approach

For emissions sources where the brand can meet the following requirements:

- Identify the facility at which manufacturing of its products and materials took place.
- Identify which manufacturing processes (e.g., tier 2 textile wet processing, tier 4 farming/extractive processes) took place at that facility.
- Have access to information about that facility's energy sources (electricity, thermal energy, or both).
- Have an emissions factor calculation model[11] to estimate the GHG emissions of those specific manufacturing processes, given the facility's energy sources.

This approach requires less specific data from the facility, as it does not require the facility's scope 1 and 2 GHG emissions inventory calculations, nor figuring out a brand's share of the facility's production to allocate emissions. This makes Approach 2a especially valuable in simplifying the potential errors in GHG emissions reporting and allocations, while recognizing some set of country specific grid factors, fuel switching efforts or renewable energy installations (or purchases) from the facility.

How to calculate emissions

Emissions are calculated using the following formula:

$$GHG\ emissions = AD \times (PTI \times FTEF + PEI \times FEEF)$$

Where:

- **AD** = Activity data. It is the kilograms or square meters of gross[12] material manufactured for tiers 4, 3 and 2, or units produced for Tier 1
- **PTI** = Process thermal intensity. It is the thermal energy intensity of the process found in the calculation model (i.e., a disaggregated LCA dataset), typically in MJ/kg or MJ/unit[13]
- **FTEF** = Facility specific thermal emissions factor. This represents the facility's specific thermal energy GHG emissions factor (based on the facility's fuel mix), in $kgCO_2e/MJ$
- **PEI** = Process electric energy intensity. The electric energy intensity of the process found in the disaggregated LCA dataset, in kWh/kg or kWh/unit
- **FEEF** = Facility electricity grid emissions factor. The facility's specific electric energy GHG emissions factor (based on the facility's country grid mix, or specific electricity sources), in $kgCO_2e/kWh$

If a production facility can be identified but information about that facility's energy sources and usage is not available, replacing the applicable LCA's grid GHG emission factor with a country-specific factor may lead to more accurate baselines. The default thermal energy LCA thermal intensity factor can still be used per this approach.

Other considerations

Using country-specific grid factors on their own will have little use for tracking any change over time besides large-scale shifts in sourcing from country to country. So, although it may be desirable for baselining, it is unlikely to be sufficient for tracking against targets.

When the production facility and thermal energy usage for a specific process is known, this method can

[11] In technical terms, the calculation model is a partially disaggregated LCA model, which allows the footprint calculation of the process based on specific energy mix input data.

[12] "Gross" material use is inclusive of loss rates happening at each stage of the value chain, as opposed to "net" material weight which is the material that actually ends up in the product itself.

[13] MJ = megajoule

reflect the energy sourcing decisions of the facility while avoiding concerns associated with using total facility emissions. For example, where only a subset of processes are used within a vertically-integrated facility, using the total facility's per unit emissions may be misleading.

While this method does reduce inaccuracy introduced by averaging over a facility's entire reported data, it does not reflect energy efficiency within the facility since those numbers are still provided by the LCA - unless the LCA model specifically allows for it using facility-level energy intensity in addition to energy mix.

Approach 2b. Simple average process data

Applicability of this approach

For emissions originating from sources where a brand does not have traceability to the exact facility where the process happened, or does not have access to any information about the facility. Note that this is how most companies currently calculate GHG emissions from raw materials.

How to calculate emissions

Emissions are calculated using the following formula:

$$GHG\ emissions = AD \times PEF$$

Where:

- **AD** = Activity data. It is typically the kilograms or square meters of gross material manufactured for tiers 4, 3 and 2, or units produced for Tier 1.
- **PEF** = Process emission factor. It is the GHG emissions per unit of Activity Data (e.g., $kgCO_2e$ / kg or square meters of material in tiers 4, 3 and 2, or $kgCO_2e$ / unit produced in tier 1). This is a fixed value for the manufacturing process (i.e., not dependent on facility level information) and must be sourced from an appropriate data source (e.g., ecoinvent, Higg MSI, WALDB). Ideally, a company would use emissions factors from one data source to avoid differences in boundaries and methodological differences across datasets.

Other considerations

Simple average process data may be sufficient for baseline estimations but is likely to capture more information about product mix than sustainability related business decisions when compared over time, for that reason it should only be used where necessary and in areas of the supply chain with little available information.

Box 8: Accounting for Inter-tier Transportation Emissions

PG&S emissions should include the transportation-related emissions that result from moving intermediate products between tiers in the value chain, for example cotton bales to a spinner or fabric to a finished goods factory. In an ideal scenario, every entity in the supply chain upstream of a company would track upstream (category 4) and downstream (category 9) transportation and distribution emissions, and these would be allocated to the company. In practice, such data is incredibly challenging to obtain. As an alternative, some secondary data sets have default values for inter-tier transportation emissions. For example, the MSI makes a standard standard assumption of 200 kilometers by large truck, users can update this data if they have actual information. Companies should evaluate whether their chosen data source includes similar default emissions data.

Table 1: Summary of GHG emissions calculation approaches

Approach	Common Use Case	Pros	Cons
1. Supplier Specific	Tier 1, some brands have extended use into tier 2.	Most complete representation of actual facility performance, tracking both energy efficiency and energy sources.	Resource intensive and error prone: requires tracing manufacturing to individual facilities and accurately tracking and allocating GHG emissions. Harder to mesh with other approaches to calculate full PG&S footprint.
2a. Average Data – Facility adjusted process data	Tiers 1 and 2; in some cases brands are using for tier 3.	Provides ability to reflect renewable energy or fuel switching efforts in the supply chain. Easy to consolidate with other average data.	Requires tracing facilities and obtaining energy source data from them.
2b. Average Data – Simple average process data	Most commonly used for tiers 3 and 4; some brands use for tier 2.	Easier to implement, requires less information about the supply chain.	Only reflects volume growth and material / process switching (provides no information on energy efficiency or renewable energy use in the supply chain).

Disclosing the Calculation Approach

While not a requirement from the GHG Protocol and SBTi, it is recommended that apparel and footwear companies disclose the calculation approach taken (supplier specific, facility adjusted process data, simple average process data) for each tier in their value chains. This will help bring greater consistency and transparency into apparel and footwear sector emissions calculations.

Box 9: Accounting for non-product related emissions

Section 4 describes how companies can calculate emissions that are product-related, for example turning cotton fiber into yarn or assembling a shoe. Such emissions are generally the vast majority of companies' PG&S emissions. However, there are non-product sources of PG&S emissions, for example information technology hardware, furniture and fixtures in retail and office environments, and professional services (e.g., accounting, legal). If a company is able to calculate emissions from these non-product sources using one of the above approaches, that is recommended. However, it is more likely that companies will use a spend-based approach to estimate emissions for these sources.

5.1 Brand Case Study

Below, we illustrate how a hypothetical brand (Brand A) compiles their PG&S emissions using a hypothetical set of products in order to satisfy two separate use cases over two reporting years. Through the case study, we describe the decisions, calculations, and interpretations that the brand makes through the process. By following Brand A over two years, we can demonstrate the impact of updates through the process.

Use Cases

1. Overall scope 3 reporting

Brand A is in the process of setting a SBT. It knows that it needs to baseline its scope 3 emissions, including PG&S, and set up a reliable process for updating and reporting on its progress against its target. This use case does not require a high degree of granularity - certainly not at the product level - but is simple, intuitive, and repeatable.

2. Target setting and intervention tracking

At the same time, Brand A is trying to identify hot spots in their PG&S emissions in order to set internal targets for its product and sourcing teams. In particular, it wants to understand how interventions to produce more sustainable products will impact progress against its SBT. Because product goals will include individual products, it is important for Brand A to be able to measure its PG&S emissions at the product level even if it does not benefit the company's external reporting.

Brand A considered separating its product goals from its PG&S emissions inventory to simplify the process, but ultimately decided that it was important to be able to quantify the impact of its sustainable product initiatives on their SBT and reasoned that the only way to do that that was to tie the two use cases to the same data and reporting.

The Starting Point for Brands: Bills of Materials

A good starting point for calculating the gross mass of raw materials used is analyzing the bills of materials (BOMs)[14] for all products manufactured for the company. This can be a daunting exercise, even for companies with robust information technology systems. In brief, a company can use BOMs to measure the mass of all materials used in products - cotton, polyester, metal for zippers and buttons, and so on. For some materials, BOMs might list the amount used (e.g., yard of fabric), and for others the unit (e.g., one zipper). Companies can use this information to estimate the total mass of every material in finished products, from which they can extrapolate upstream to estimate the mass of raw material needed to produce those materials. If a company does not have access to BOM data, or that data is incomplete, it can take other approaches, for example using purchase orders or aggregated data from product lifecycle management (PLM) systems or from their material sourcing management system.

For simplicity and illustrative purposes, the BOMs in this case study use simple proxy materials and omit packaging, trim, and other components.[15] Individual components that are often tracked separately have been combined. In practice, companies should strive to include such omitted materials that are significant, for example if they represent greater than 1% of the mass of the total product.[16]

[14] A list of all of the materials and other parts (commonly also called trims) that are used in a product, along with their quantity

[15] While measuring emissions for these items can be challenging, companies should attempt to do so.

[16] This threshold is illustrative and is derived from the GHG Protocol Product Life Cycle Accounting and Reporting Standard (page 42).

In the example below, Brand A sells four products: sandals, cotton t-shirts with conventional cotton, cotton t-shirts with recycled content, and sneakers. Brand A tracks its material usage in terms of both "net" (the material that ends up in the final product) and "gross", an estimate of the amount of material required to manufacture a product at a tier 1 facility. Brand A has reasonable trust in its gross material usage figures, and elects to use these figures for its emissions inventory rather than other methods.[17]

Brand A's costing breakdowns (CBDs) have sufficient information for it to create an accurate list of tier 1 processes for its products. However, because the brand has a close relationship with its tier 1 suppliers except for their sandals, which are licensed, and tier 1 process level data is not considered necessary for internal target setting, tier 1 processes were only compiled and used for sandals since the facility actual emissions are available for all other products.

Sandals

BOM

Material	Gross Use (grams)
Polyester	100
EVA	280
Cotton	60

Production Processes

Process
Stitching
Die Cutting
Cementing/Gluing
Chilling/Cooling
Deep Well Pressing
Delasting
Priming

Tee Generic

BOM

Material	Gross Use (grams)
Cotton	360

Tee with Recycled Content

BOM

Material	Gross Use (grams)
Recycled Cotton	170
Cotton	190

[17] For example, material purchase orders is another method, as reported by the T2 suppliers, for gross materials usage. But because those numbers typically cannot be reliably broken down to individual product styles, they cannot support the internal target setting use case.

Sneakers

BOM

Material	Gross Use (grams)
Rubber	250
EVA	200
TPU	70
Polyester	140

Year One Production

Product	Production (units)
Sandals (Licensed)	5,000
Tee Generic	15,000
Tee Recycled Content	0
Sneakers	2,000

Year One Emissions Inventory

In order to calculate its PG&S emissions inventory, Brand A first calculated its entire inventory using approach 2b – simple average process data. Although it intended to replace certain parts of the data with other methods, the brand reasoned that the exercise would give it a reasonable basis against which to compare its further calculations. Brand A believed it would be instructive to compare its more specific values with the simple average process data in order to both validate that its math was in the same range and see how its more specific emissions inventory compared to global averages.

Brand A did this by looking up the GHG emission factor (EF) for each of the materials used in its products and the finished goods emissions factors for its products (using LCA databases such as those listed in section 7). Brand A compiled data at the process level, and has the ability to swap in actual data from its own suppliers in the future. For this case study, the numbers are presented by tier rather than process, and emission factors are not actual and used for illustrative purposes only.

Material	Tier 2 EF ($kgCO_2e$ / kg)	Tier 3 EF ($kgCO_2e$ / kg)	Tier 4 EF ($kgCO_2e$ / kg)
Polyester	1	2	4
EVA	1	1	4
Cotton	2	1	2
TPU	1	1	4
Rubber	2	1	2
Recycled Cotton	2	1	1

Product	Tier 1 EF ($kgCO_2e$ / unit)
Sandals (Licensed)	2.5
Tee Generic	0.6
Tee Recycled Content	0.6
Sneakers	5.7

By multiplying product count by the finished good emissions factor and summing the product of each material and the respective material tier emissions factor, Brand A was able to create an inventory of emissions for each product across tiers.

Product	Tier 1 $kgCO_2e$	Tier 2 $kgCO_2e$	Tier 3 $kgCO_2e$	Tier 4 $kgCO_2e$	Total $kgCO_2e$
Sandals (Licensed)	12,500	2,500	2,700	8,200	25,900
Tee Generic	9,000	10,800	5,400	10,800	36,000
Tee Recycled Content	0	0	0	0	0
Sneakers	11,400	1,820	1,600	5,560	20,380
Total CO_2e	**32,900**	**15,120**	**9,700**	**24,560**	**82,280**

Total emissions by tier and product using approach 2b simple average process data

Brand A knows that the emissions of tier 1 facilities could be attributed to its orders for every product except for the sandals, therefore it planned to replace the approach 2b numbers for the other three products using supplier specific data (approach 1). The brand knows the energy usage of several of its tier 2 suppliers for its tee generic product, but understands that those facilities have many more processes used for products other than its tees. Thus, the brand elected to use facility-adjusted process data in order to capture the work of the facility to reduce its carbon footprint without capturing unused processes.

In order to replace tier 1 data with supplier-specific data, Brand A replaced tee generic and sneakers tier 1 $kgCO_2e$ with the per unit emissions of its tier 1 facilities, multiplied by the unit volume of those products.

Product	Facility	Facility Volume (units)	Facility Emissions ($kgCO_2e$)	Brand Facility Volume (units)	Brand Share	Brand Emissions ($kgCO_2e$)
Sneakers	Facility A	25,000	125,000	500	2.00%	2,500
Sneakers	Facility B	80,000	432,000	1,500	1.88%	8,100
Tee Generic	Facility C	42,000	16,800	2,000	4.76%	800
Tee Generic	Facility D	150,000	70,500	6,000	4.00%	2,820
Tee Generic	Facility E	28,000	10,920	4,000	14.29%	1,560
Tee Generic	Facility F	140,000	86,800	3,000	2.14%	1,860

In order to replace the tier 2 footprint of tee generic, Brand A took the actual thermal and electric emission factors reported by the facility (through a reporting tool such as Enablon or Higg FEM) for its tier 2 facility and multiplied the tier 2 process thermal and electricity energy intensity by those emissions factors, and finally the unit volume for tee generic. In order to get process energy intensity numbers disaggregated between electric and thermal energy, Brand A used a LCA database (e.g., Sphera's GaBi).

Product	Tier 1 kgCO_2e	Tier 2 kgCO_2e	Tier 3 kgCO_2e	Tier 4 kgCO_2e	Total kgCO_2e
Sandals (Licensed)	12,500	2,500	2,700	8,200	25,900
Tee Generic	7,040	7,200	5,400	10,800	30,440
Tee Recycled Content	0	0	0	0	0
Sneakers	10,600	1,820	1,600	5,560	19,580
Total	**30,140**	**11,520**	**9,700**	**24,560**	**75,920**

Total Emissions by tier and product after replacing values using approaches 1 (Tier 1) and 2a (Tier 2)

Year One Analysis

After creating its PG&S emissions inventory, Brand A identified that it wanted to reduce the footprint of its generic tee. Brand A focused on increasing the use of renewable energy sources across their tier 1 facilities and creating a new tee with recycled cotton to reduce tier 4 emissions.

Year Two Production

Product	Year 1 Production (units)	Year 2 Production (units)
Sandals (Licensed)	5,000	5,000
Tee Generic	15,000	10,000
Tee Recycled Content	0	5,000
Sneakers	2,000	2,000

Year Two Emissions Inventory

Brand A followed the same process in their second year as in year one – calculating a total emissions inventory using only approach 2b.

Product	Tier 1 kgCO_2e	Tier 2 kgCO_2e	Tier 3 kgCO_2e	Tier 4 kgCO_2e
Sandals (Licensed)	12,500	2,500	2,700	8,200
Tee Generic	6,000	7,200	3,600	7,200
Tee Recycled Content	3,000	3,600	1,800	2,750
Sneakers	11,400	1,820	1,600	5,560

Total Emissions by tier and product using approach 2b simple average process data

Brand A then layered in tier 1 and 2 actual data as before, but could not apply tier 2 actuals to tee generic as the supplier of the blended cotton was new and thus emissions data was unavailable.

Product	Tier 1 kgCO_2e	Tier 2 kg-CO_2e	Tier 3 kg-CO_2e	Tier 4 kg-CO_2e	Total kg-CO_2e
Sandals (Licensed)	12,500	2,500	2,700	8,200	25,900
Tee Generic	4,690	4,800	3,600	7,200	20,290
Tee Recycled Content	2,350	3,600	1,800	2,750	10,500
Sneakers	10,600	1,820	1,600	5,560	19,580
Total	**30,140**	**12,720**	**9,700**	**23,710**	**76,270**

Total Emissions by tier and product using replacing values using approaches 1 and 2a

Year Two Analysis

The introduction of Tee Recycled Content reduced Brand A's total footprint, but the brand was frustrated to need to use method 2b to attribute the tier 2 footprint of the new product. This felt like a step backwards to lose the actual data it had for the generic tee. The brand committed to gather better supply chain data so that it could refine its inventory and take further action to reduce emissions.

A general theme of the Brand A case study is that companies should aim to use the most representative impact data from their chosen data sets: if a company has more specific information about their raw materials, it can use this information to more accurately represent their supply chain than using secondary data. For example, if a company uses 1,000 kg of cotton and it knows that 30% of this is grown in the US (with the other 70% unknown), it could use a US-specific emissions factor (if it exists in their emission factor data source) to calculate that portion of the inventory. While this would be better than using a global average, US data is still average data and not-farm specific.

5.2 Manufacturer Case Study

Below, we illustrate how a hypothetical garment manufacturer (Manufacturer A) compiles their PG&S emissions using a similar hypothetical set of products as Brand A, in order to satisfy one key use case over two reporting years. Manufacturer A owns a "cut & sew" factory, which produces assembled garments from purchased textiles.

Use Case: Overall scope 3 reporting

Manufacturer A is in the process of setting a SBT. It knows that it needs to baseline its scope 3 emissions, including PG&S, and set up a reliable process for updating and reporting on its progress against its target. This use case does not require a high degree of granularity - certainly not at the product level - but is simple, intuitive, and repeatable.

The Starting Point for Manufacturers: Materials Purchased

Manufacturers may not use BOMs, but rather they might receive other documentation detailing the amount of different materials purchased, for example meters of fabric (finished goods factory) or kilograms or bales of cotton (spinner). Manufacturers would take the same approach as outlined below in estimating emissions.

For simplicity and illustrative purposes, the materials in this case study use simple proxy materials and omit packaging, trim, and other components.[18] Individual components that are often tracked separately have been combined. In practice, companies should strive to include such omitted materials that are significant, for example if they represent greater than 1% of the mass of the total product[19].

[18] While measuring emissions for these items can be challenging, companies should attempt to do so.

[19] This threshold is illustrative and is derived from the GHG Protocol Product Life Cycle Accounting and Reporting Standard (page 42).

Also for simplicity and consistency throughout the document, we name here "Tier 2" the textile mill (e.g., textile dyeing and finishing) that supplies Manufacturer A, even though it might be its direct supplier.

In the example below, Manufacturer A produces two products: cotton t-shirts with conventional cotton, and cotton t-shirts with recycled content. Manufacturer A tracks its material usage in terms of both "net" (the material that ends up in the final products) and "gross", the total amount of material purchased and required to manufacture the products at its facilities. Manufacturer A has reasonable trust in its gross material usage figures, and elects to use these figures for its emissions inventory rather than other methods.

Year One Production

Material	Gross Use (kg)
Cotton Textile	5,400
Recycled Cotton Textile	0

Year One Emissions Inventory

In order to calculate its PG&S emissions inventory, Manufacturer A first calculated its entire inventory using approach 2b - simple average process data. Although it intended to replace certain parts of the data with other methods, the manufacturer reasoned that the exercise would give it a reasonable basis against which to compare its further calculations. Manufacturer A believed it would be instructive to compare its more specific values with the simple average process data in order to both validate that its math was in the same range and see how its more specific emissions inventory compared to global averages.

Manufacturer A did this by looking up the GHG emission factor (EF) for each of the materials used in its products (using LCA databases such as those listed in section 7). It compiled data at the process level, and has the ability to swap in actual data from its own suppliers in the future. For this case study, the numbers are presented by tier rather than process, and emission factors are not actual and used for illustrative purposes only.

Material	Tier 2 EF ($kgCO_2e$ / kg)	Tier 3 EF ($kgCO_2e$ / kg)	Tier 4 EF ($kgCO_2e$ / kg)
Cotton	2	1	2
Recycled Cotton	2	1	1

By multiplying material use by the emissions factor, Manufacturer A was able to create an inventory of emissions for each material across tiers.

Material	Tier 2 $kgCO_2e$	Tier 3 $kgCO_2e$	Tier 4 $kgCO_2e$	Total $kgCO_2e$
Cotton Textile	10,800	5,400	10,800	27,000
Recycled Cotton Textile	0	0	0	0
Total CO_2e	**10,800**	**5,400**	**10,800**	**27,000**

Total emissions by tier and product using approach 2b simple average process data

Manufacturer A knows the actual energy usage of several of its textile mill suppliers for its cotton textile, but understands that those facilities have many more processes used for products other than its tees. Thus, the manufacturer elected to use facility-adjusted process data in order to capture the work of the facility to reduce its carbon footprint without capturing unused processes.

In order to replace the default tier 2 footprint of cotton textile, Manufacturer A took the actual thermal and electric emission factors reported by the supplier facility (through a reporting tool such as Enablon or Higg FEM) for its tier 2 facility and multiplied the tier 2 process thermal and electricity energy intensity by those emissions factors, and finally the unit volume for tee generic. In order to get process energy intensity numbers disaggregated between electric and thermal energy, Manufacturer A used a LCA database (e.g., Sphera's GaBi).

Material	Tier 2 kgCO_2e	Tier 3 kgCO_2e	Tier 4 kgCO_2e	Total kgCO_2e
Cotton Textile	7,200	5,400	10,800	23,400
Recycled Cotton Textile	0	0	0	0
Total	**7,200**	**5,400**	**10,800**	**23,400**

Total Emissions by tier and product after replacing values using approach 2a in Tier 2

Year One Analysis

After creating its PG&S emissions inventory, Manufacturer A identified that it wanted to reduce the footprint of its cotton products. Manufacturer A focused on increasing the use of recycled cotton to reduce tier 4 emissions.

Year Two Production

Material	Year 1 Gross Use (kg)	Year 2 Gross Use (kg)
Cotton Textile	5,400	4,550
Recycled Cotton Textile	0	850

Year Two Emissions Inventory

Manufacturer A followed the same process in their second year as in year one – calculating a total emissions inventory using only approach 2b.

Material	Tier 2 kgCO_2e	Tier 3 kgCO_2e	Tier 4 kgCO_2e	Total kgCO_2e
Cotton Textile	9,100	4,550	9,100	22,750
Recycled Cotton Textile	1,700	850	850	3,400
Total	**10,800**	**5,400**	**9,950**	**26,150**

Total emissions by tier and product using approach 2b simple average process data

Manufacturer A then layered in tier 2 actual data as before, but could not apply tier 2 actuals to conventional cotton textile, as the supplier of the organic cotton was new and thus emissions data was unavailable.

Material	Tier 2 $kgCO_2e$	Tier 3 $kgCO_2e$	Tier 4 $kgCO_2e$	Total $kgCO_2e$
Cotton Textile	6,067	4,550	9,100	19,717
Recycled Cotton Textile	1,700	850	850	3,400
Total	**7,767**	**5,400**	**9,950**	**23,117**

Total Emissions by tier and product using replacing values using approach 2a

Year Two Analysis

The introduction of recycled cotton reduced Manufacturer A's total footprint, but the company was frustrated to need to use method 2b to attribute the tier 2 footprint of the new material. This felt like a step backwards to lose the actual data it had for the conventional cotton textile. The company committed to gather better supply chain data so that it could refine its inventory and take further action to reduce emissions.

A general theme of the manufacturer case study is that companies should aim to use the most representative impact data from their chosen data sets: if a company has more specific information about their raw materials, it can use this information to more accurately represent their supply chain than using secondary data. For example, if a company uses 1,000 kg of cotton and it knows that 30% of this is grown in the US (with the other 70% unknown), it could use a US-specific emissions factor (if it exists in their emission factor data source) to calculate that portion of the inventory. While this would be better than using a global average, US data is still average data and not-farm specific.

6. Tracking PG&S Emissions Over Time

According to the IPCC, the world must reduce GHG emissions by roughly half by 2030 and to net zero by no later than 2050. Given this imperative for all sectors, including apparel and footwear, it is critical for companies to track changes in their GHG emissions over time. Many companies measure and report their emissions on an annual basis - which is a requirement of the SBTi.

Ideally, companies would have access to primary data for all of their PG&S activities, as this would allow them to measure actual emissions reductions. However, as described above, companies use secondary data for good portions of their PG&S inventories, and so measuring changes in emissions from year-to-year is less precise.

Each approach to measuring emissions has implications on year over year tracking that companies should consider:

1. Supplier-specific data: if a company bases its emissions calculations on pro-rata allocations (i.e., percentage of emissions based on percentage of total output), it may be over or under counting emissions depending on how well the allocation represents the processes included. For example, if a company primarily sources "basic," lower GHG products from a facility (e.g., t-shirts) but the facility makes more complex, higher GHG products (e.g. jackets), then the company sourcing t-shirts may be overestimating its emissions. Also, switching to lower impact processes within a facility (e.g., from conventional dyeing to low liquor ratio dyeing, within the same Tier 2 facility), will not fully be reflected in the emissions inventory.

2a. Facility-adjusted average data: this method can offer a good compromise between data availability and the ability to represent changes in the supply chain as well as the processes used to make the product. However, it requires solid LCA modeling and data analytics capabilities.

2b. Simple average data: variances in year-over-year emissions will be driven by changes in volume, secondary emissions factors, and any changes in processes or materials. Thus, if the emissions factors and processes and materials remain constant, total emissions will fluctuate with volume (i.e., if a brand makes more products, emissions will increase). Under this approach, a company can estimate the emissions impacts of switching between different materials and processes, but cannot represent the operational improvements made by a given facility, such as switching over to renewable energy sources.

The organizations that own and operate the secondary datasets may take different approaches to refreshing their underlying data. For example, the SAC and Worldly update the emission factors for all individual processes in the MSI on an annual basis. These changes can result in significant changes over time, especially for electricity-heavy processes or where the technology mix changes. For processes such as cotton fiber, where a significant portion of the GHG impacts are due to field emissions, data will not change much on an annual basis unless the life cycle inventory is updated.

Box 10: Recalculating Base Year GHG Emissions

According to the GHG Protocol, companies should develop a base year emissions recalculation policy, and define any "significance threshold" that triggers historic emissions recalculation, for example a 5% difference from the current base year inventory. The need to recalculate base year emissions can be triggered by the following:

- Structural changes in the company that have a significant impact on the company's base year emissions, for example mergers, acquisitions, and divestments or outsourcing and insourcing of emitting activities.
- Changes in calculation methodology or improvements in the accuracy of emission factors or activity data that result in a significant impact on the base year emissions data. This could entail shifting from using average data to supplier-specific data.
- Discovery of significant errors, or a number of cumulative errors, that are collectively significant.

See the GHG Protocol Corporate Accounting and Reporting Standard for more details.

7. Sources of Data for PG&S Emissions

Per the approaches described above, GHG emissions calculations require a large amount of supporting data, from electricity grid emission factors, to process level life cycle assessment models. In this section, we provide guidance on where to find such supporting data.

Electricity grid emission factors

Quality up-to-date electricity grid GHG emission factors can be surprisingly challenging to obtain.

Free sources

- European Commission Joint Research Center: GHG Emission Factors for Electricity Consumption.
  - Scope: EU28
  - Granularity: country level
  - Updated: annually
- Environmental Protection Agency (EPA): Emissions & Generation Resource Integrated Database (eGRID).
  - Scope: USA
  - Granularity: state level
  - Updated: annually
- Institute for Global Environmental Strategies: List of Grid Emission Factors.

- Scope: Non-Annex I Countries from Kyoto Protocol
- Granularity: country level, sub-country level
- Updated: annually
- Note: use Operating Margin (OM) emission factors from the EFfromCountriesOrSB tab

Paid sources

- International Energy Agency (IEA): Annual GHG emission factors for World countries from electricity and heat generation
    - Scope: World
    - Granularity: country level, sometimes sub-country level
    - Updated: annually

Fuel emission factors

Fuel GHG emissions factors can be found in the GHG Protocol Stationary Combustion Tool: Spreadsheet tab -> Select "Manufacturing" in Column C -> Select desired Fuel type and Fuel in Columns D and E -> enter 1 in column H -> the fuel's emission factor in kgCO_2e/unit is in column R.

LCA databases for materials/process emission factors and energy intensity

There are a number of secondary LCA data sets that apparel and footwear companies can use to estimate their PG&S emissions (approach 2a and 2b), for example:

- ecoinvent Database (ecoinvent Association)
- GaBI (Sphera)
- World Apparel and Footwear Life Cycle Assessment Database (Quantis)
- Higg MSI (SAC and Worldly)

This guidance document does not recommend any one data set - companies should use whichever data set best represents their supply chain activities and GHG impacts, while meeting data quality criteria set out in the GHG Protocol.

Life cycle impact assessment data sets such as those above contain data points derived from analyses of materials and processes under boundaries and assumptions specific to certain analyses. For example, the impact data for cotton fiber that is in the ecoinvent Database and the MSI comes from a study conducted by Cotton Incorporated in 2017 which evaluated weighted average production of cotton from China, India, Australia, and the United States. Data for PET from fossil fuels (a precursor to polyester) in GaBI and the MSI comes from thinkstep analysis of PET produced in Europe. Given the time and financial resources required to conduct life cycle analysis of products and processes, a fair amount of data in the above mentioned data sets comes from industry sources. Industries tend to have access to better data given that such data is derived from measurements from companies.

Most, if not all companies use average data to compute portions of their PG&S emissions - particularly tiers 2 to 4. Such data can provide a good estimate of emissions, but it is not the actual data of these companies.

Fashion
for Climate
Fashion Industry Charter for Climate Action