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Canada

METHODOLOGY FOR QUANTIFICATION OF GREENHOUSE GAS EMISSIONS FOR THE OFFICE FURNITURE PROCUREMENT CATEGORY

PUBLIC SERVICES AND PROCUREMENT CANADA

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Executive Summary

WSP Canada Inc. (WSP) was retained by Public Services and Procurement Canada (PSPC) to develop an innovative science-based methodology to measure greenhouse gas (GHG) emissions for office furniture. The work was conducted as part of PSPC's Low Carbon Procurement Project (LCPP), which is funded by the Greening Government fund and aligned with the Greening Government Strategy that was developed to meet the Government of Canada's (GoC's) target to achieve net zero emissions by 2050.

The LCPP is a PSPC initiative aimed at measuring and reducing the carbon footprint (CFP) of the GoC's procurement activities. The methodology for quantifying the product carbon footprint (CFP) for PSPC's office furniture procurement (the CFP methodology) was designed to align with the guidelines and requirements of ISO 14067 Carbon Footprint of Products as well as with the PCRs developed by the Business and Institutional Furniture Manufacturers Association (BIFMA). A functional unit specific to each product sub-category was selected as the basis for the CFP methodology calculations. The CFP methodology includes two paths. The first is a simplified path (Path A) for products with pre-existing environmental product declarations (EPDs). A second path (Path B) was developed to directly calculate the CFP of products without pre-existing EPDs based on detailed product-specific input data provided by suppliers. For Path B, the following input data are required for each office furniture life cycle: material acquisition and pre-processing, product manufacturing, distribution and use, and product end of life. In order to ease the burden of the CFP methodology on suppliers, input data for non-core processes (that is, processes outside of the operational control of the product manufacturers) were made optional where possible. Background data for optional data inputs were aligned with the recommendations for data sources provided in the office furniture PCRs developed by BIFMA.

The CFP tool applies the methodology to calculate the CFP of purchased office furniture products.

This document is an abridged version of a report written and submitted by WSP to PSPC in fulfilment of a contract for the LCPP.

List of Acronyms

Acronym	Description
BIFMA	Business and Institutional Furniture Manufacturers Association; primary industry association for office furniture manufacturers in North America
CFP	carbon footprint; application of a life cycle assessment (LCA) for a single impact category, global warming potential (GWP) as described in ISO 14067
CO_2e	carbon dioxide equivalent; emissions of various greenhouse gases (GHGs) reported as equivalent emissions of carbon dioxide only
EEIO	environmentally extended input–output
EPD	environmental product declaration
FU	functional unit; quantified description of a product system, used as the reference point for product data in a life cycle assessment (LCA)
GGS	Greening Government Strategy
GHG	greenhouse gas
GoC	Government of Canada
GWP	global warming potential; atmospheric heat absorbed by an individual greenhouse gas (GHG) relative to carbon dioxide
IPCC	Intergovernmental Panel on Climate Change
ISO	International Organization for Standardization; organization that publishes standards for life cycle analysis
LCA	life cycle assessment; methodology for assessing one or more environmental impacts of a product, service, or process from all activities within the defined system boundary as described in ISO 14040 and ISO 14044
LCIA	life cycle impact assessment
LCPP	Low Carbon Procurement Project; project to reduce emissions from procurement for the Government of Canada (GoC)
PCR	product category rule; standards that define the rules and requirements for conducting life cycle assessments (LCAs) of a product and reporting the results through an EPD
PSPC	Public Services and Procurement Canada; Government of Canada (GoC) department responsible for internal servicing and administration for the government
UNCPC	United Nations Central Products Classification
USEPA	United States Environmental Protection Agency
WSP	WSP Canada Inc.; consultant retained by Public Services and Procurement Canada (PSPC) to develop a science-based methodology to measure greenhouse gas (GHG) emissions for office furniture procured

Glossary of Terms

TERM	DEFINITION
GENERAL GREENHOUSE GAS TERMS	
biogenic emissions	CO_2 emissions related to the natural carbon cycle as well as those resulting from the combustion, harvest, combustion, digestion, fermentation, decomposition, or processing of biologically based materials (EPA, 2017)
GHG Protocol	Establishes comprehensive global standardized frameworks to measure and manage greenhouse gas (GHG) emissions from private and public sector operations, value chains, and mitigation actions (World Resources Institute, 2004)
global warming potential (GWP)	The index used to translate the level of emissions of various greenhouse gases into a common measure in order to compare the relative radiative forcing of different gases without directly calculating the changes in atmospheric concentrations (EPA, 2021)
greenhouse gas (GHG) emissions	The atmospheric gases responsible for causing global warming and climate change. The major GHGs are carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) (EPA, 2022)
Scope 1 emissions	Direct emissions for an organization from owned or controlled sources (World Resources Institute, 2004)
Scope 2 emissions	Indirect emissions for an organization from the generation of purchased energy (World Resources Institute, 2004)
Scope 3 emissions	All indirect emissions (not included in Scope 2) that occur in the value chain of a reporting company, including both upstream and downstream emissions (World Resources Institute, 2004)
sustainability	Involves ensuring the persistence of natural and human systems, implying the continuous functioning of ecosystems, conservation of high biodiversity, recycling of natural resources and, in the human sector, successful application of justice and equity (IPCC, 2019)
sustainable development	Development that meets the needs of the present without compromising the ability of future generations to meet their own needs (WCED 1987) and balances social, economic, and environmental concerns (IPCC, 2019)
LIFE CYCLE ASSESSMENT TERMS	
life cycle assessment (LCA)	Compilation and evaluation of the inputs, outputs, and potential environmental impacts of a product system throughout its life cycle (ISO, 2006a)
product category rule (PCR)	Allow for review and comparison of different environmental product attributes among products in a defined category (NSF, 2022)

environmental product declaration (EPD)	Independently verified and registered document that communicates transparent and comparable information about the life cycle environmental impact of products in a credible way (EPD International, 2022)
carbon footprint	Total greenhouse gases (GHGs) emitted by an individual, event, organization, service, place, or product expressed as carbon dioxide equivalent (CO_2e) over the life cycle (Carbon Trust, 2022)
product system	Collection of unit processes with elementary and product flows, performing one or more defined functions, and which models the life cycle of a product (ISO, 2006a)
functional unit	Quantified performance of a product system for use as a reference unit (ISO, 2006a)
system boundary	Defines the unit processes to be included in the system (ISO, 2006a)
cradle-to-grave	Environmental aspects and potential environmental impacts throughout a product's life cycle from raw material acquisition through production, use, end-of-life treatment, recycling, and final disposal (ISO, 2006a)
cradle-to-gate	An assessment of a partial product life cycle from resource extraction (cradle) to the factory gate (that is, before it is transported to the consumer) (ISO, 2006a)
gate-to-gate	A partial life cycle assessment (LCA) looking at only one value-added process in the entire production chain (Jimenez-Gonzalez et al., 2000)
gate-to-grave	Assessment that covers all life cycle phases that follow the manufacturing process (Cooney et al., 2013)
cut-off criteria	Specification of the amount of material or energy flow or the level of environmental significance associated with unit processes or product system to be excluded from a study (ISO, 2006a)
allocation	Partitioning the input or output flows of a process or a product system between the product system under study and one or more other product systems (ISO, 2006a)
life cycle	Interlinked and consecutive stages of a product system, from acquisition of raw materials, design, production, transportation/delivery, use, end-of-life treatment, and final disposal (ISO, 2006a)
life cycle impact assessment (LCIA)	Phase of a life cycle assessment (LCA) aimed at understanding and evaluating the magnitude and significance of the potential environmental impacts for a product system throughout the life cycle of the product (ISO, 2006a)
impact assessment method	The methods used for life cycle impact assessment (LCIA) that establish the relationship between each stage of the life cycle inventory and the corresponding environmental impacts (ISO, 2006a)
unit process	Smallest element considered in the life cycle inventory analysis for which input and output data are quantified (ISO, 2006a)

end of life	Impacts include demolition and processing of waste or recyclable materials (ISO, 2006a)
primary data	Data collected or measured directly by a company (for example, raw material, energy [electricity, natural gas], wastes [emissions as well as solid waste], and inputs for a particular process or product) (Guinee, 2002)
secondary data	Data collected through publications, open literature, software, life cycle assessment (LCA) libraries, etc. (Guinee, 2002)
FURNITURE TERMS	
surface furniture products	Furniture that primarily provides a flat area on which to conduct work such as reading and writing or use equipment such as a computer (for example, desks or tables) (Steelcase, 2022)
storage products	Provides basic physical enclosure to containerize collections and make it possible to contain multiple items within a room or structure (Stashc, 2022)
workspace products	Furniture for workspaces includes interconnecting panels and freestanding systems, freestanding height-adjustable desks and tables, filing and storage solutions, and freestanding casegoods or desks (Office Interiors, 2022)
workstation	Broad category that includes all furnishings, such as seating, tables, and cabinets, needed and implemented in a given work area to promote organization, safety, and productivity in industrial, commercial, and domestic occupational environments (Workbench manufacturers, 2022)
seating products	Products with single or multiple seat units, arena folding chairs, and standard folding chairs (BIFMA, 2019)
PROCUREMENT TERMS	
supplier	An entity that supplies goods and services to another organization (Accounting Tools, 2022)
manufacturer	A person or company that produces finished goods from raw materials by using various tools, equipment, and processes and sells the goods (CFI, 2022)
reuse	Any operation by which products or components that are not waste are used again for the same purpose or a new application (Eurostat, 2019)
remanufacturing / refurbishment	The rebuilding of a product to specifications of the original manufactured product using a combination of reused, repaired, and new parts (Johnson and McCarthy, 2014)

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1. Introduction

WSP Canada Inc. (WSP) was retained by Public Services and Procurement Canada (PSPC) to develop a science-based methodology to quantify the carbon footprint (CFP) of office furniture products procured by PSPC. This work was completed as part of PSPC's Low Carbon Procurement Project (LCPP) funded by the Greening Government fund and is aligned with the Greening Government Strategy (GGS), which was developed to meet the Government of Canada's (GoC's) target to achieve net zero emissions by 2050. Specifically, the GGS commits that the government will "aid the transition to a net-zero, circular economy through green procurement that includes life-cycle assessment principles" (Government of Canada, 2020).

The LCPP aims to measure and reduce the CFP of the GoC's procurement activities. The goal of the LCPP is to develop an innovative, science-based methodology to measure the CFP of high-impact goods and services and support the transition towards net-zero for the GoC and its suppliers.

This document is an abridged version of a report written and submitted by WSP to PSPC in fulfilment of a contract for the LCPP.

1.1. Project overview

The primary objective of this project was to develop a methodology that could be used to measure and track the greenhouse gas (GHG) emissions of office furniture products procured by PSPC. The CFP methodology was developed based on best practices for the application of life cycle assessment (LCA) in the office furniture market. LCA is a methodology for assessing one or more environmental impacts of a product, service, or process from all activities within the defined system boundary. The system boundary of an LCA can consist of all parts of the life cycle from raw material acquisition to production, use, and end-of-life treatment to final disposal (cradle-to-grave) and/or reuse (cradle-to-cradle). A CFP is a limited LCA that measures a product, service, or process for a single impact factor, climate change, through the quantification of the GHG emissions in the system boundary (ISO, 2013).

2. Office furniture market review

A market review was undertaken to assess the availability of data for the CFP methodology development and assess the readiness of the office furniture market for participation in the CFP methodology. The application of LCA in the furniture market was assessed through a review of technical standards such as product category rules (PCRs), GHG emissions disclosures by furniture manufacturers, and available environmental product declarations (EPDs) for office furniture products. In addition, five years of historical spend data for PSPC's office furniture purchases were analyzed in order to identify applicable sub-categories of office furniture for the CFP methodology. The findings of the market review are summarized in this section.

2.1. Office furniture sub-categories

The first objective of the literature and market review was to identify the relevant office furniture sub-categories for which the CFP methodology may be developed. Product sub-categories are classified through their United Nations Central Products Classification (UNCPC) code, an international taxonomy of goods and services. The UNCPC is a 5-level hierarchy that classifies products by section, division, group, class, and sub-class. In this report, a product sub-category refers to a specific class or sub-class of products within the UNCPC group of office furniture. An initial review of the five previous fiscal years of PSPC office furniture spend data was conducted to identify the office furniture sub-categories purchased by PSPC.

Availability of data for the identified sub-categories was validated through a review of office furniture PCRs. Based on the analysis, it was determined that the CFP methodology should be developed for three office furniture sub-categories. These sub-categories and the applicable PSPC products in each sub-category, determined from PSPC's workspace and office seating technical specifications, are provided in Table 2–1.

Table 2–1: Public Services and Procurement Canada product categories for each office furniture sub-category

UNCPC product code	General products	Applicable PSPC product categories based on technical specifications
3814	Office workspace, panelling solutions, benching, desking open plan, etc.	• 1.1 A – Interconnecting panels • 1.2.1 – Fixed height work surfaces • 1.2.3 – Meeting tables • 2 – Freestanding height adjustable work surfaces • 4.1 – Fixed height work surfaces • 4.2 – Meeting tables • 6.1 – Tables and credenzas except 6.1.4 (credenzas)
3811	Seats with metal frames, seats with wooden frames, other seats	• Rotary chair • Stools • Side chair • Large-occupant seating
3812	Bookcases, lateral files, file cabinets, bins, cabinets, etc.	• 3 – Metal filing and storage cabinets • 4.3 – Wood veneer storage products • 1.4 – Storage products • 6.1.4 – Credenzas (credenzas, hutches and overhead storage, pedestals, 2-drawer lateral file cabinets, personal storage towers, wardrobes and bookcases)

UNCPC = United Nations Central Products Classification; PSPC = Public Services and Procurement Canada.

The CFP methodology was developed for each of the three sub-categories listed in Table 2–1. While the methodology allows for the CFP calculation of all products within the different sub-categories listed in Table 2–1, use of the CFP methodology's results for comparative purposes is limited to products with equivalent functionality. For example, seating products may consist of rotary chairs or stools, which have different functionalities; therefore, the CFP of these two products should not be compared. Only the CFPs of functionally equivalent rotary chair products may be compared. Similarly, the CFP of a storage product such as a bookcase may not be comparable with that of a personal storage tower as the products have different functions.

2.2. Product category rules

An EPD is a third-party verified report of a product's environmental impacts as calculated through an LCA and published by a manufacturer or other supplier of the product. An EPD is defined under ISO 14025 as a Type III declaration that "quantifies environmental information on the life cycle of a product to enable comparisons between products fulfilling the same function" (ISO, 2006c). EPDs provide an accessible and consistent format through which consumers can access and understand the environmental impacts of products they purchase. EPDs are typically developed and published in accordance with a set of rules known as PCRs. PCRs are standards that define the rules and requirements for publishing an EPD for a particular product or product sub-category. PCRs provide a consistent methodology by which the environmental impacts of products within a particular industry may be evaluated and are developed in accordance with ISO 14025.

A review of available PCRs for office furniture was conducted to evaluate how LCA principles are currently applied in the office furniture market. Five PCRs, listed in Table 2–2, were identified for the office furniture sub-categories identified through PSPC's spend data, and the LCA methodology followed in each PCR was reviewed. The PCRs reviewed were developed by the Business and Institutional Furniture Manufacturers Association (BIFMA), the Norwegian EPD foundation, and EPD International. Each PCR was reviewed in detail and assessed for suitability to PSPC's needs.

Table 2–2: List of available product category rules for office furniture evaluated in study

PCR name	UNCPC product code	Products
BIFMA PCR for office furniture workspace products (2020a)	3814	Office workspace, panelling solutions, benching, desking open plan, etc.
BIFMA PCR for seating (2020b)	3811	Seats with metal frames, seats with wooden frames, other seats
BIFMA PCR for storage (2018)	3812	Bookcases, lateral files, file cabinets, bins, cabinets, etc.
International EPD – PCR for seating (2009)	3811	All types of seats: benches, bridge chairs, folding chairs, garden chairs, upholstered chairs, sofas, stools, armchairs, etc.
International EPD – PCR for furniture, except seats and mattresses (2012)	3812-3813-3814	Furniture except seating and mattresses

Norge PCR 026 Part B for furniture 18101 (2018)	3811-3812-3813-3814-3815	All types of furniture for domestic, non-domestic, educational, and professional use, for users of all ages

PCR = product category rule; UNCPC = United Nations Central Products Classification; BIFMA = Business and Institutional Furniture Manufacturers Association; EPD = environmental product declaration.

Each of the PCRs listed in Table 2–2 was reviewed. The scope of the LCA was reviewed through the following items:

- functional unit (FU)
- service life
- cut-off rules
- end-of-life allocation and remanufacturing
- impact categories and life cycle impact assessment (LCIA) methods
- data sources
- treatment of biogenic carbon

A summary of this analysis is provided in Table 2–3, which outlines the criteria evaluated and the findings of the review. Decisions regarding each criterion, including how they were applied in the product category, are also summarized in Table 2–3.

Table 2–3: Summary of life cycle assessment methodology application in office furniture product category rules

LCA Criteria	Definition	Findings
FU	An FU is defined in ISO 14044 (2006b) as the quantified performance of a product system for use as a reference unit. FU consistency is essential in order to compare impact results of products of the same category and function.	FUs were not consistent across PCRs. PCRs published by BIFMA specified FUs according to product function (for example, units in volume for storage products or area for surface products), while other PCRs specified more general FUs based on finished product (for example, number of chairs). It was determined that FUs based on product function are the most appropriate for the LCPP's goals and will ensure the CFP methodology is fairly applied in the evaluation of products purchased by PSPC. The FUs specified in the BIFMA PCRs were determined to be appropriate for the CFP methodology.
Service life	A product's total life in use from the point of sale to the point of disposal and/or reuse by second user.	Across the PCRs reviewed, service lives varied between 10 or 15 years. It was determined that the CFP methodology should align with the BIFMA PCR time boundaries of 10 years as this is consistent with PSPC's technical requirements for office furniture products. As such, in the CFP methodology, if a product service life is more than 10 years, the entire impact needs to be allocated to the 10-year reference period. If a

		product's service life is less than 10 years, the product impact should be increased fractionally to cover a 10-year period.
Cut-off criteria	Cut-off rules are defined in ISO 14044 (2006b) as a specification of the amount of material or energy flow or the level of environmental significance associated with unit processes or product system to be excluded from a study. They specify activities within the system boundary that may be excluded provided they meet a specified threshold.	Cut-off criteria in PCRs developed by International EPD are based on contribution of processes to total environmental impacts reported, whereas BIFMA and Norge PCRs are typically based on elementary flows. BIFMA and Norge PCRs' cut-off criteria are thus applied upstream of LCIA, while those used by International EPD are applied after the LCIA is completed. The CFP methodology aligns with the BIFMA PCRs, whereby any mass and energy flows within the product boundary that consist of less than 1%, may be omitted where justified and documented. Cumulative omitted mass or energy flows shall not exceed 5%. These cut-off rules were selected for ease of application as they do not require computation of LCIA results to validate whether cut-off criteria are met.
End-of-life allocation	ISO14044 (2006b) defines allocation as partitioning the input or output flows of a process or a product system between the product system under study and one or more other product systems. End-of-life allocation rules specify how to model the treatment, recycling, and reuse of product materials at the end of their life.	Most PCRs reviewed recommended the use of the recycled content method and the polluter pays principle, for which the generator of waste should carry the full environment impact up to the exit gate of the waste treatment facility. Under this method, manufacturers who use recycled materials do not account for impacts associated with the initial production of the material. Based on this review, the CFP methodology uses the recycled content method for end-of-life allocation.
Impact categories and LCIA methodologies	Impact categories represent environmental issues of concern to which life cycle inventory analysis results may be assigned. Impacts are quantified through different impact indicators and by using different assessment methods.	Many impact categories and assessment methods exist in the office furniture PCRs and include but are not limited to acidification potential, photochemical ozone creation potential, eutrophication potential, ozone depletion, land use, etc. For PSPC's office furniture CFP methodology, GWP, measured in CO_2e over a time period of 100 years, is assessed. GWP results in the CFP methodology are based on the GWP values without climate-carbon feedbacks published in the Fifth Assessment Report (AR5) by the IPCC. GWP results based on AR5 are assessed through the IPCC (2013) LCIA.
Data sources	Required data sources for each PCR are distinguished between primary data, which refers to	Data requirements for primary and secondary data are aligned across PCRs. Primary data are required in all reviewed PCRs for gate-to-gate

	specific activity data from the activity site, and secondary data, which typically refers to data from other sources such as national statistics, the literature, and/or LCA databases.	(core) processes of the EPD developers. Estimation procedures, generic data, and in some cases proxy data can be used for most cradle-to-gate (upstream) and gate-to-cradle (downstream) processes. In some PCRs, specific allocation rules or estimation procedures are defined when primary data gaps exist for gate-to-gate activities. No consistent approach for the type of secondary data was identified. Based on the review of PCRs, it was determined that data inputs for gate-to-gate processes would be mandatory in the CFP methodology. For other processes, optional data inputs would be allowed; background data sources recommended in the BIFMA PCRs would be used in the CFP methodology where possible. The list of mandatory vs. optional primary data is provided in Appendix A.
Treatment of biogenic CO_2	Biogenic CO_2 is CO_2 released as a result of the combustion or decomposition of organic material. Examples include carbon dioxide released during the combustion of wood and biogas generated by decomposition.	A differentiation between emissions from biogenic and non-biogenic (fossil) carbon is often made in LCAs since they do not represent equivalent GWP. All reviewed PCRs require biogenic emissions to be reported separately from the GWP impact category. At this time, the CFP methodology does not quantify releases of biogenic CO_2.

LCA = life cycle assessment; CFP = carbon footprint; FU = functional unit; BIFMA = Business and Institutional Furniture Manufacturers Association; PCR = product category rule; LCPP = Low Carbon Procurement Project; PSPC = Public Services and Procurement Canada; GWP = global warming potential; CO_2e = carbon dioxide equivalent; LCIA = life cycle impact assessment; EPD = environmental product declaration.

In general, based on the findings of the methodology review, it was determined that PCRs developed by BIFMA followed LCA methodologies that were consistent with the goals of the LCPP. Additionally, these PCRs were commonly used by PSPC's office furniture suppliers for EPDs. As such, the CFP methodology applied consistent quantification approaches as those followed in the BIFMA PCRs for each criterion listed in Table 2–3.

2.3. Review of office furniture manufacturers

In order to ensure the CFP methodology would be accessible for PSPC's furniture suppliers and consistent with data available in the office furniture market, a review of environmental disclosures by furniture manufacturers was also conducted. Office furniture manufacturers from which PSPC has historically purchased products were identified through the analysis of PSPC's spend data. Manufacturers were reviewed for disclosure of public GHG emissions and other environmental impacts, participation in sustainability certifications, as well as publication of EPDs. The results of this review are summarized in this section.

Participation in numerous independent product certifications, including but not limited to EPDs, is common practice in the office furniture market. Publication of EPDs is based mostly on the three PCRs developed by BIFMA. Publication of EPDs was common for the office furniture manufacturers, where 60% of the 10 manufactures reviewed had published EPDs. EPDs published by office furniture manufacturers under the PCRs were reviewed to understand the range of GHG emissions of office furniture products.

While raw material production and product manufacturing are the most significant life cycle stages for GHG emissions, the contribution of each stage to overall GHG emissions can range significantly due to the material composition of the products, differences in the LCA methodology applied, and the data sources used for impact quantification.

The review of the North American office furniture market showed significant participation by manufacturers in Scope 1 and 2 GHG emissions disclosures. Scope 3 emissions, which represent emissions in the value chain of the manufacturers, were publicly disclosed by only one of the reviewed manufacturers. This is a significant finding as the review of EPDs described above showed that the largest contribution for an office furniture product CFP typically occur in the raw materials extraction and production stage. Emissions for this stage would be reported under Scope 3 for office furniture manufacturers. This suggests that manufacturers likely do not have primary data to quantify upstream and downstream GHG emissions of their products. As discussed in Table 2–3, based on this finding and the review of PCRs, it was determined that data inputs would only be mandatory for gate-to-gate processes in the CFP methodology.

Requirements under the CFP methodology for products with and without EPDs are detailed in Appendix A.

2.4. Summary of key findings

The purpose of the literature review and market analysis was to assess the availability of data for CFP methodology development, evaluate the rules and assumptions for LCAs across office furniture PCRs, and determine current practices across the office furniture industry. This information was used to inform CFP methodology development and ensure it aligns with the literature and market best practices. Table 2–4 summarizes the key findings from the literature and market review.

Table 2–4: Application of findings from market review in carbon footprint methodology

Criteria	Application in CFP methodology
Office furniture sub-categories	The following sub-categories were identified: • seating • workspaces • storage
System boundaries	The system boundaries cover cradle to grave, including four life cycle stages: material acquisition and pre-processing, product manufacturing, distribution and use, and product end of life.
FU	The FUs are based on product function as specified under the BIFMA PCRs were selected for use in the CFP methodology.
Service life	The CFP methodology uses a 10-year service life for all products. If a product service life is more than 10 years, the entire impact needs to be allocated to the 10-year reference period. If a product's service life is less than 10 years, the product impact should be increased fractionally to cover a 10-year period.
Cut-off criteria	Any mass and energy flows within the product boundary that consist of less than 1% may be omitted where justified and documented. Cumulative omitted mass or energy flows shall not exceed 5%.
End-of-life allocation	Allocation for recycling follows the recycled content method (or cut-off) in accordance with ISO 14044 allocation procedures for reuse and

	recycling. As such, recycling facility activities and their emissions fall outside the system boundaries as well as the benefits from the reintegration of recovered materials into the downstream economy. All other waste transportation and treatment activities (landfilling, incineration, etc.) and their emissions are accounted for in the CFP methodology.
Impact categories and impact assessment methods	The CFP methodology requires the quantification of the 100-year GWP without climate-carbon feedbacks, in CO_2e, using the IPCC (2013) LCIA.
Data sources	Primary data requirements are aligned with rules of other PCRs. Mandatory and optional primary data sources are identified in the CFP methodology. Optional secondary data sources are also identified and used in the CFP methodology. EPDs published under the BIFMA PCRs should be leveraged as much as possible to avoid undue burden on manufacturers. As detailed in Section 3.2., the CFP methodology allows furniture manufacturers to use results from EPDs where possible.
Treatment of biogenic carbon	Not quantified within the CFP methodology.

CFP = carbon footprint; FU = functional unit; BIFMA = Business and Institutional Furniture Manufacturers Association; PCR = product category rule; GWP = global warming potential; CO_2e = carbon dioxide equivalent; LCIA = life cycle impact assessment; EPD = environmental product declaration.

3. Carbon footprint methodology

This section details the complete methodology for quantifying the CFP for PSPC's office furniture procurement (the CFP methodology). The CFP methodology was developed to align with the guidelines and requirements under the ISO 14044 LCA, ISO 14067 CFP of Products, and PCRs developed by BIFMA.

3.1. Scope of the carbon footprint methodology

The CFP methodology for office furniture products purchased by PSPC was developed based on the findings of the market review. As noted in Section 2.3, the CFP methodology was determined in two paths: Path A for products with pre-existing EPDs and Path B for products without EPDs. Figure 3–1 provides an overview of the CFP methodology.

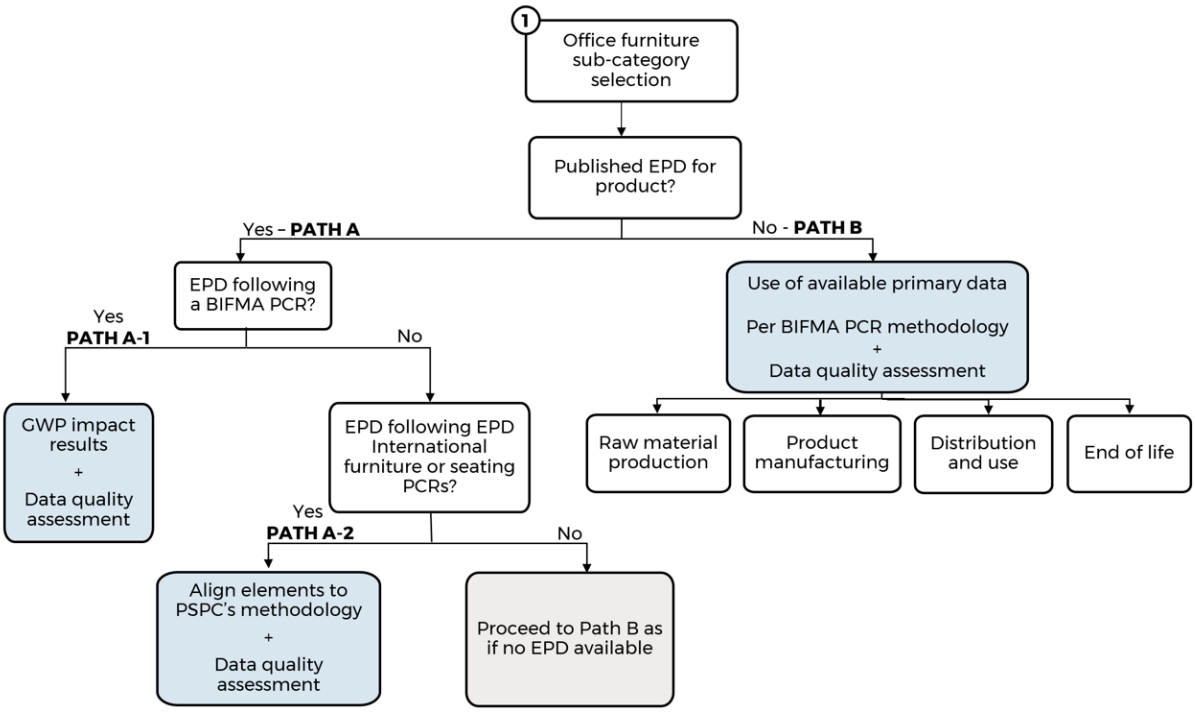

Figure 3–1: Overview of the office furniture carbon footprint methodology

Based on the findings of the market review, an appropriate LCA scope was determined to quantify the CFP of office furniture products purchased by CFP. The scope of the LCA applied in the CFP methodology is detailed in the following sub-sections.

3.1.1. System boundary

A system boundary is defined in ISO 14044 (2006b) as a set of criteria specifying which unit processes are part of a product system. They define the activities and processes to be included in and excluded from the LCA model. The PCRs reviewed as part of the literature review typically prescribed a consistent system boundary that included all cradle-to-grave (or cradle-to-cradle) activities for office furniture production from raw materials extraction to end-of-life management. The system boundaries of each of the office furniture sub-categories subject to the CFP methodology are shown in Figure 3–2.

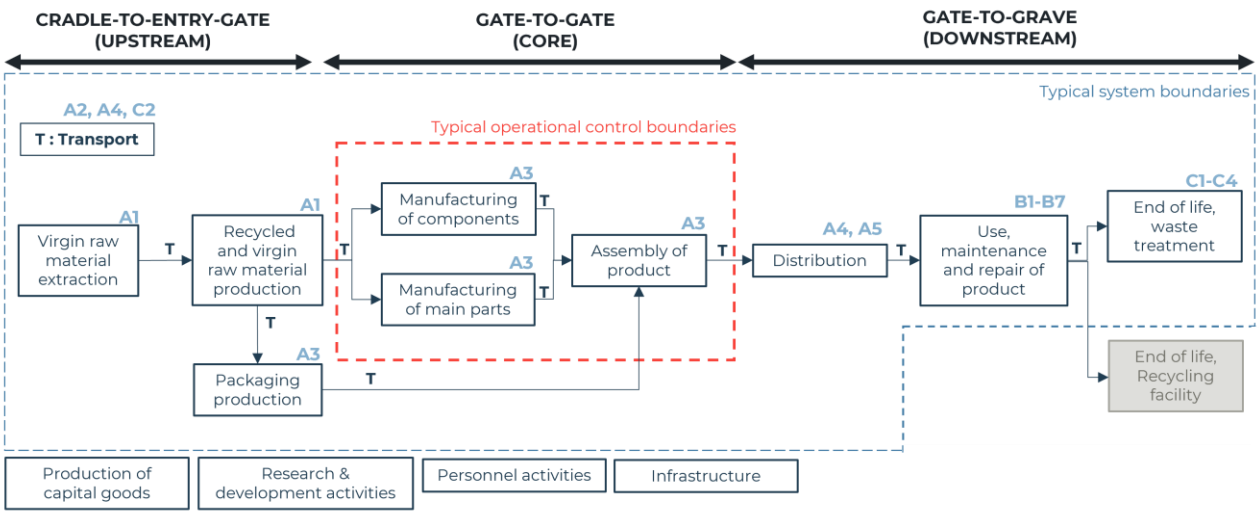

Figure 3–2: System boundaries of office furniture products

Ultimately, the system boundaries defined in the CFP methodology include all cradle-to-grave activities. While Figure 3–2 outlines three steps of the systems boundaries for office furniture products, the CFP methodology used four stages – material acquisition and pre-processing (cradle-to-entry gate); product manufacturing (gate-to-gate); distribution and use (A4, A5, and B1 to B7 of gate-to-grave); and end of life (C1 to C4 of gate-to-grave). These are explained in more detail in Section 5.

- **Cradle-to-entry-gate** activities, or upstream activities, include the extraction, acquisition, and production of raw materials required for the finished product and its packaging as well as transport and energy use within these processes. The phase ends at the entry gate of the furniture manufacturing plant(s) under the control of the manufacturer.
- **Gate-to-gate** activities, or core activities, include manufacturing and assembly of the furniture, typically representing activities under operational control of the manufacturer, as well as transport and energy used to obtain the final product. The BIFMA PCRs include packaging in the core activities instead of the upstream activities. The phase ends at the end-gate of the plant(s), when the finished product is ready to be distributed and used.
- **Gate-to-grave** processes, or downstream activities, typically encompass distribution, use, and maintenance activities as well as end-of-life management. The end-of-life activities within the system boundaries include collection of end-of-life products and packages as well as waste management activities such as incineration, landfilling, or composting. Allocation for recycling follows the recycled content method as detailed in the BIFMA PCRs and is in accordance with the ISO 14044 allocation procedures for reuse and recycling. The boundaries presented in this section are consistent with the vast majority of the BIFMA PCRs as well as with the majority of the activities found in the EPD International PCRs, as determined through the market review.

3.1.2. Functional unit

An FU specific to each furniture sub-category is used as a basis for calculation of the CFP. Table 3–1 presents the three FUs selected, each following the corresponding BIFMA PCR.

Table 3–1: Functional units for each office furniture sub-category in the carbon footprint methodology

Sub-category	Reference Units	FU	Maximum service life
Workspace products	Square metres (m^2)	1 m^2 of floorspace (including all components from floor	Up to 10 years

		to ceiling), maintained for 10 years	
Seating products	Number of seats	1 unit of seating to seat 1 individual, maintained for 10 years	Up to 10 years
Storage products	Cubic metres (m^3)	0.15 m^3 for general storage, maintained for 10 years; 0.25 m^3 for static storage, maintained for 10 years	Up to 10 years

FU = functional unit.

The workspace product FU, per the BIFMA PCR for Office Furniture Workspace Products, "includes all the office workspace product materials that extend from the floor to the ceiling" (2020a, p.12). Modelling of the entire office workspace product (for example, a group of four cubicles including worksurfaces, panels, and storing area) is likely necessary. The CFP results for the entire product must then be normalized to the 1 m^2 FU, knowing the total floorspace the product occupies. The same calculation method can be applied for storage products, where the entire storage product must be modelled but the impact results are normalized to the FU using the total storage volume of the product.

A maximum service life of 10 years is selected for all three sub-categories, as required under PSPC's technical requirements. A service life of 10 years is also in alignment with the BIFMA PCRs.

3.2. Path A – methodology for products with published environmental product declarations

As noted previously, the CFP methodology was developed in two paths to allow for ease of access. Path A of the CFP methodology allows products with pre-existing EPDs published under a PCR developed by BIFMA or EPD International to use results directly from those EPDs**.** All other products, including products with EPDs published under other PCRs, will follow Path B of the CFP methodology, which will require input data to calculate the CFP results for the product.

3.2.1. Path A-1 – products with published environmental product declarations under Business and Institutional Furniture Manufacturers Association product category rules

For products with an EPD under a BIFMA PCR, the GWP impact results can be provided and applied directly in the CFP methodology as the CFP methodology was developed to be consistent with the BIFMA PCRs. The required input data for these products is provided in Appendix A.

3.2.2. Path A-2 – products with published environmental product declarations under EPD International product category rules

Based on the PCR review, EPD International PCRs for office furniture products use inconsistent FUs and service lives from those applied in the CFP methodology. As such, results of these EPDs can be applied in the CFP methodology; however, they need to be aligned with the service life and FUs required under the CFP methodology. The required input data for these products is provided in Appendix A.

EPD results and other input data provided by users are used to realign the CFP results to the methodology's FU. Two elements of the FUs need to be readjusted: the quantity of product per FU and the temporal dimension of the FU. The calculation for realigning FUs between the EPD International methodology and the methodology is detailed in Equation 1.0.

Equation 1.0 – Functional unit adjustment

$$GWP_{FU} = GWP_{EPD} \times \frac{10}{service\ life} \times \frac{1}{reference\ size} \times \frac{1}{FU}$$

where:

- GWP_{FU} is the CFP of the product under evaluation in the present CFP methodology, per the applicable FU, in kilograms (kg) carbon dioxide equivalent (CO_2e) per FU
- GWP_{EPD} is the declared GWP for a product's FU in an EPD following an EPD International PCR, in $kgCO_2e$
- *service life* is the declared product lifetime in an EPD following an EPD International PCR, in years
    - If the declared product lifetime in the EPD is greater than 10 years, the service life is assumed to be 10 years
    - If the declared product lifetime in the EPD is less than or equal to 10 years, the service = the declared product lifetime in the EPD
- *reference size* is the size of the product in the reference unit of the product sub-category:
    - For workspace products, reference size is the product's total floorspace, in m^2
    - For seating products, reference size is the product's number of seats
    - For storage products, reference size is the product's total storage volume, in m^3
- *FU* is the product's FU, which varies according to the furniture sub-category, as defined in Table 3–1:
    - For workspace products, *FU* is 1 m^2
    - For seating products, *FU* is 1 seat
    - For general storage products, *FU* is 0.15 m^3; for static storage products, *FU* is 0.25m^3

The temporal adjustment depends on the service life of the products in each EPD under an EPD International PCR. The assumed product lifetime (that is, service life) used in the FU of EPDs under International EPD PCRs can vary between EPDs, whereas the CFP methodology and BIFMA PCRs set the FU's service life to a maximum of 10 years.

Therefore, if an EPD under EPD International PCRs states a service life of more than 10 years, the service life will be declared as 10 years in the CFP methodology. If an EPD under EPD International PCRs states a service life of less than 10 years, the same service life will be used in the CFP methodology. However, to meet the FU's temporal dimension of 10 years, more than one product unit will be needed. For example, if an EPD declares a product service life of 5 years, two products will be needed to fill the FU over the required 10-year period. The EPD's GWP impact results will also be adjusted by this factor, in addition to being adjusted by the amount of product per FU.

3.3. Path B – methodology for products without environmental product declarations

Path B of the CFP methodology provides the steps for calculating the CFP of products without published EPDs from BIFMA or EPD International. The following sections detail the required data inputs and recommended data sources by product life cycle stage. The CFP calculations to be performed using the primary data provided from suppliers, background secondary data from third-party sources, and emission factors used in the CFP methodology are also presented. The required input data for these products by life cycle stage is provided in Appendix A.

In the CFP methodology, GWP impacts of the activities shown in Figure 3–2 are quantified in four stages: material acquisition and pre-processing (cradle-to-entry gate); product manufacturing (gate-to-gate); distribution and use (A4, A5, and B1 to B7 of gate-to-grave); and end of life (C1 to C4 of gate-to-grave). The following sections describe the calculation of the CFP for each life cycle stage. All data inputs required in Path B of the CFP methodology are provided in Appendix A.

3.3.1. Material acquisition and preprocessing

The material acquisition stage starts at the extraction of raw materials from the natural environment and includes all raw material processing to its generic form as well as transportation to the manufacturing facility gate. Where the raw materials used in a product or packaging product contain recycled materials, this stage only includes impacts of production from the share of virgin materials as well as any impacts of recycling activities to include recycled content in the final raw material.

This stage includes both primary processing from raw resource (for example, tree) to a bulk or generic form (for example, hardwood) and intermediate processing from a generic resource to the material component form, which is used in the manufacturing of the furniture product or its packaging (for example, particleboard). The stage also includes all transportation to the gate of the office furniture manufacturing facility as well as the waste and scrap created and treated during the raw material production activities.

In the CFP methodology, the total GWP impact for the material acquisition and pre-processing stage is determined as the sum of the GWP impacts from the extraction and production of the raw materials), GWP impacts from transportation of raw materials to the manufacturer's facility, and GWP impacts from end-of-life treatment of scrap produced during the raw material production phase. The total GWP impact for this stage is calculated using Equation 2.0.

Equation 2.0 – Material acquisition and pre-processing global warming potential

$$GWP_{material} = GWP_{raw\ material} + GWP_{material\ transportation}$$

The calculation of the GWP impacts for each term in Equation 2.0 are provided below.

Global warming potential for raw material

The GWP for material includes emissions from all activities involved in material production from raw material extraction to the production of the final input component used in the furniture product or in the product packaging.

The CFP methodology allows suppliers the option to provide data on materials from a supplier produced EPD if available. If a supplier-specific EPD for the material is available, the CFP methodology will use the GWP impacts reported in the EPD for the applicable stages to cover the system boundary of the input material from cradle to the exit gate of the input material production facility prior to being shipped to the furniture manufacturer.

If a supplier-specific EPD is not available, the CFP methodology uses GWP impacts from an LCA database for each input or packaging material. Where possible, location-specific emission factors will be used. However, it is possible that manufacturers may not have information about the source of input materials in furniture products and packaging, particularly if production of the material is distributed across multiple parties and/or locations. In this case, default global average emission factors for the materials will be used. This is consistent with requirements under BIFMA PCRs, which allow for the use of secondary data for activities that are outside of manufacturer's control. The calculation of the GWP for input materials is provided in Equation 2.1.

Equation 2.1 – Global warming potential for raw material

$$GWP_{raw\ material} = \sum_{i=1}^{n} Input\ mass_i \times EF_{,i} + \sum_{j=1}^{m} Packaging\ mass_j \times EF_{,j}$$

where:

- *input mass$_i$* is the mass of input material *i* in the product, in kg, calculated using Equation 2.2
- *EF$_i$* is the emission factor for input material *i* in kgCO_2e per kg of material
- *n* is the total number of input materials in the furniture product for which the CFP is being evaluated
- *packaging material mass$_j$* is the mass of input material *j,* in kg as calculated using Equation 2.3
- *EF$_j$* is the emission factor for packaging material *j,* in kgCO_2e per kg of material
- *m* is the total number of packaging materials used in the packaging of the furniture product for which the CFP is being evaluated

Equation 2.2 – Input material mass

$$Input\ mass_i = product\ mass\ \times composition_i + product\ mass\ \times scrap\ rate$$

where:

- *input mass$_i$* is the mass of input material *i,* in kg, used in the office furniture product for which the CFP is being evaluated
- *product mass* is the total mass of the office furniture product for which the CFP is being evaluated, in kg, and is supplier provided
- *composition$_i$* is the share of the furniture product's total mass from input material *i,* in % and is supplier provided
- *scrap rate* is the average rate of scrap material produced during the manufacturing phase, in %, calculated as the sum of total scrap produced divided by the mass of the product for which the CFP is being evaluated

Equation 2.3 – Packaging material mass

$$Packaging\ material\ mass_j = product\ packaging\ mass\ \times composition_j + product\ packaging\ mass\ \times scrap\ rate$$

where:

- *packaging material mass$_j$* is the mass of packaging material *j* used in the office furniture product for which the CFP is being evaluated, in kg
- *furniture product packaging mass* is the total mass of the final packaging used for the furniture product for which the CFP is being evaluated, in kg
- *composition$_j$* is the share of the office furniture product's total packaging mass attributed to packaging material *j,* in %, and is supplier provided
- *scrap rate* is the average rate of scrap material produced during the manufacturing phase, in %, calculated as the sum of total scrap produced divided by the mass of the packaging materials product for which the CFP is being evaluated

As each material emission factor used in the CFP methodology is sourced from an LCA (either a product-specific EPD or from a generic database), the CFP methodology does not quantify impacts from scrap generated in the raw material production and extraction phase. This is to avoid double counting of impacts as the underlying LCA for these material emission factors already accounts for the impacts of scrap generated in the production of each material.

Global warming potential for material transportation

The GWP for material transportation includes the impacts from transportation of product input and packaging materials from the final pre-processing facility to the office furniture manufacturing facility where it will be used in the furniture product. The calculation of these impacts is provided in Equation 2.4.

Equation 2.4 – Global warming potential for material transportation

$$GWP_{material\ transportation} = \sum_{i=1}^{n+m} \sum_{j=1}^{p} mass\ of\ material_{i,j} \times distance_{i,j} \times transportation\ mode_i\ EF$$

where*:*

- *mass$_i$* is the mass of input or packaging material *i* used in the office furniture product, in kg, as calculated in Equations 2.2 or 2.3, transported using transportation mode *j*
- *distance$_i$* is the distance material *i* will be transported using mode *j* from the final pre-processing facility of to the office furniture manufacturing facility, in km
- *transportation mode$_i$ EF* is the emission factor for transportation mode *j*, in kgCO_2e per km
- *n+m* is the total number of materials (input materials and packaging materials) used in the office furniture product for which the CFP is being evaluated
- *p* is the total number of transportation modes used to transport each material to the office furniture manufacturing facility

3.3.2. Product manufacturing

The product manufacturing stage starts at the entry gate of the facility, that is, where input materials used to manufacture the office furniture products enter the facility. If multiple facilities are part of the manufacturing process, this stage starts at the entry gate of the first facility and includes all the facilities needed to manufacture the product. The stage includes energy consumption for the manufacturing, preparation, and assembly of the final furniture product, typically representing activities under operational control of the manufacturer. It also includes the transport of components between processes or facilities as well as treatment of waste and scrap created during the manufacturing process. The phase ends at the exit-gate of the last facility where the packaged finished product is ready for distribution to the end-user. Since the individual product parts may be manufactured in different facilities, this phase includes any necessary transportation between intermediate facilities.

In the CFP methodology, the total GWP impact for the manufacturing stage is determined as the sum of the GWP impacts from the production of the product, GWP impacts from third-party transportation of intermediary products between facilities, and GWP impacts from end-of-life treatment of scrap generated during the manufacturing phase. The total GWP impact for this stage is calculated using Equation 3.0.

Equation 3.0 – Manufacturing global warming potential

$$GWP_{manufacturing\ total} = GWP_{manufacturing} + GWP_{intermediary\ transportation} + GWP_{manufcacturing\ scrap}$$

The GWP impact calculations for each term in Equation 3.0 are provided below.

Global warming potential for manufacturing

The manufacturing GWP includes the GWP impacts of all product activities controlled by the manufacturer, such as energy consumption at manufacturing facilities and transportation of products between intermediary facilities.

It was determined that the CFP methodology should use reported GHG emissions from corporate GHG inventories instead of calculating GHG emissions for the manufacturing stage through primary data. This simplifies the CFP methodology for suppliers as it ensures all applicable manufacturing activities for a product are included in the manufacturing stage without intensive primary data collection as part of the CFP methodology. This is a required data input for the methodology, and GHG emissions from the manufacturing stage that fall within the system boundary of the CFP methodology would be reported in a corporate GHG inventory as follows:

- Scope 1, which includes direct emissions for an organization from owned or controlled sources. Emissions reported under this scope would include all activities that occur at office furniture manufacturing facilities such as fuel combustion for facility equipment, fugitive emissions from refrigeration or air conditioning equipment, and transportation of components between facilities in owned or operated vehicles.

- Scope 2, which includes indirect sources from generation of purchased energy. Emissions reported under this scope would include GHG emissions from the generation of purchased electricity, steam, and chilled water.
- Scope 3, category 3, which includes upstream emissions from the extraction and production of fuels consumed by the reporting company or used in the generation of electricity as well as transmission and distribution losses from purchased electricity. Based on the market review, it was determined that few suppliers currently report Scope 3 GHG emissions. As such, this is currently an optional input for data collection purposes only in the CFP methodology and is not used in the calculation of the product CFP.

The Greenhouse Gas Protocol (GHG Protocol), developed by the World Resources Institute and the World Business Council for Sustainable Development, is a globally accepted GHG accounting standard. The GHG Protocol sets the standards to account for and disclose GHG emissions. While the CFP methodology asks whether manufacturer emissions were quantified in accordance with the GHG Protocol, it is not currently a requirement of the CFP methodology. The CFP methodology will require GHG emissions for the most recent reporting year available, and data must be no older than five years, which is consistent with BIFMA's requirements for the temporal representativeness of primary data. In the CFP methodology, manufacturer-reported GHG emissions are currently not required to be third-party verified.

As corporate GHG inventories report total emissions for a company, the total emissions must be allocated to an individual office furniture product. The BIFMA PCRs specify mass-based allocation or economic allocation when allocation is required (with mass-based allocation being the preferred method). Mass-based allocation assigns a portion of total inputs or outputs (such as total corporate GHG emissions) to an individual product based on the share of the product's mass to the total mass of all products produced by a facility or company. For furniture products, mass-based allocation can be complex to calculate as manufacturing facilities may produce multiple product types that do not have comparable mass (for example, desks and chairs) and for which collecting production numbers might be complex. Economic allocation serves the same function, but portions total inputs or outputs based on the product's contribution to total sales revenue.

As there are limitations with both allocation methods and each may be appropriate under different circumstances, the CFP methodology allows for the use of either allocation method to allocate the total Scope 1 and 2 emissions of the supplier to the individual product, in alignment with the BIFMA PCRs. The calculation of the manufacturing GWP is provided for each allocation method in Equations 3.1 and 3.2

Equation 3.1 – Manufacturing global warming potential – mass allocation

$$GWP_{manufacturing} = \frac{Manufacturer\ Scope\ 1 + Manufacturer\ Scope\ 2}{Total\ Manufactured\ Mass} \times Product\ Mass\ \div 1000$$

where*:*

- *manufacturer emissions* are the Scope 1 and 2GHG emissions of the manufacturer, in tCO_2e
- *total manufactured mass* is the total mass of products manufactured by the company, in kg, for the data period for which GHG emissions are reported
- *product mass* is the mass of the product, in kg, for the data period for which emissions are reported

Equation 3.2 – Manufacturing global warming potential – economic allocation

$$GWP_{manufacturing} = \frac{Manufacturer\ Scope\ 1 + Manufacturer\ Scope\ 2}{Total\ Sales\ Revenue} \times Product\ sale\ price\ \div 1000$$

where*:*

- *manufacturer emissions* are the Scope 1 and 2 GHG emissions of the manufacturer, in tCO_2e
- *total sales revenue* is the total sales revenue, in US dollars, for the data period for which GHG emissions are reported

- *product sale price* is the average sale price of the product, in US dollars, for the data period for which emissions are reported

Global warming potential for manufacturing scrap

Emissions from scrap material created during the manufacturing phase and disposed off site will not be included in the manufacturing GWP as they occur outside the operational control of the manufacturers and are not included in Scope 1 and 2 corporate GHG inventories. These impacts are accounted for in the CFP methodology based on average rates of scrap production and waste treatment methods, per the BIFMA PCRs. Equation 3.3 provides the calculation of GWP impacts from waste treatment of manufacturing scrap.

If the rates of scrap production and waste treatment methods are not provided by suppliers, the default values from the BIFMA PCRs are used as inputs for Equation 3.3. The CFP methodology uses waste treatment emission factors from the United States Environmental Protection Agency's (USEPA's) Emission Factors for GHG Inventories. The USEPA's waste treatment emission factors include emissions from transportation to the waste treatment facility. As such, these emissions are not calculated separately. The USEPA's waste treatment emission factors are applied for all manufacturers regardless of manufacturing facility location. This is to ensure consistency with the calculation of waste treatment impacts from the end-of-life stage, which would only occur near GoC offices.

Equation 3.3 – Manufacturing scrap global warming potential

$$GWP_{manufcacturing\ scrap} = \sum_{i=1}^{n} product\ mass \times scrap\ rate \times waste\ treatment_i\ rate\ \times waste\ treatment_i\ EF$$

where*:*

- *scrap rate* is the average rate of scrap production during product manufacturing, in %; if primary data are not available a default value is specified in the CFP methodology
- *waste treatment$_i$ rate* is the share of manufacturing scrap that is treated by treatment method *i,* in %
- *waste treatment$_i$ EF* is the emission factor for waste treatment method *i,*, in $kgCO_2e$ per kg scrap

Global warming potential for intermediary transportation

Some furniture product manufacturing may be assembled in stages with component parts produced and assembled at multiple facilities. In these cases, the GWP impacts from the transportation of intermediary products between facilities are within the gate-to-gate boundaries. If intermediary transportation is completed by manufacturer-owned or -operated vehicles, emissions from this activity are included in the total Scope 1 emissions reported by the manufacturer and used in the calculation of the production GWP. However, if intermediary transportation is completed by a third-party, the emissions from this activity will need to be calculated separately. GHG emissions for this activity are calculated using the average transportation distance between intermediary facilities, average mass of intermediary product, and typical mode of transportation, as provided by the manufacturer.

Equation 3.4 – Intermediary transportation global warming potential

$$GWP_{intermediary\ transportation} = component\ mass \times distance\ \times transportation\ mode\ EF$$

where:

- *component mass* is the average mass of all intermediary product components shipped between manufacturing facilities
- *distance* is the average distance of third-party transportation of intermediary product components
- *transportation mode EF* is the emission factor for the transportation mode used for the transportation of intermediary products, in $kgCO_2e$ per km

3.3.3. Distribution and use

The distribution and use stage begins with the packaged office furniture product leaving the gate of the manufacturer's facility for shipment to the end-user and ends when the product is ready for disposal, recycling, or reuse. The distribution stage includes all legs of transportation needed to reach the end-user, including distribution centres and retail locations. The use stage includes installation of the product, normal use, repair, and maintenance during the service life of the product. In the CFP methodology, the end-user represents a typical customer. While this methodology only applies to furniture purchased for the GoC, the PSPC project team determined that due to lack of data about actual product use, the CFP methodology should calculate impacts based on typical end-users not specific to PSPC's use.

Most of the products included in the scope of this CFP methodology do not consume energy or generate emissions during their use. Some products may consume energy (such as electric sit-stand desks); however, emissions from the use phase are excluded from the scope of the CFP methodology. In addition, the use of tools and products for the installation, repair, or maintenance of the product are excluded from the data inputs required. These materials and energy flows do not represent a significant portion of the life cycle inventory, nor do they represent a significant portion of the life cycle impacts as observed among the EPDs reviewed as part of the literature and market review phase. These exclusions are in accordance with the cut-off rules found in the BIFMA PCRs, which state "any mass and energy flow within the product boundary, which consists of less than 1%, may be omitted."

In the present CFP methodology, the total GWP impacts for the distribution and use stage are determined as the sum of the GWP impacts from each mode of transportation used for downstream shipping of final products to a typical end-user. The total GWP impact for this stage is calculated using Equation 4.0.

Equation 4.0 – Distribution global warming potential

$$GWP_{distribution} = \sum_{i=1}^{n} product\ mass \times distance_i \times transportation\ mode_i\ EF$$

where*:*

- *mass of final product* is the mass of the final furniture product for which a CFP is being calculated*,* in kg
- *average distance$_i$* is the average distance from the manufacturer's facility to end-user completed by transportation mode *i,* in km
- *transportation mode$_i$ EF* is the emission factor for the transportation mode *i* used in transportation of products to end-users, in kgCO_2e per km
- *n* is the total number of transportation modes used in transportation of final products to end-users

3.3.4. End of life

The end-of-life stage starts when the product is ready for disposal, recycling, or reuse and ends when the product is disposed of by landfilling, incineration, or another method or diverted to be recycled, refurbished, or reused. The stage also includes the collection of the product and transportation to the treatment facility.

The product end-of-life stage also includes the collection and end-of-life treatment of the product's packaging.

Allocation for recycling is required to follow the recycled content method (or cut-off), as detailed in the BIFMA PCRs and in accordance with the ISO 14044 allocation procedures for reuse and recycling. Recycling facility activities associated with the product end-of-life stage and their emissions fall outside the system boundaries as well as the benefits from the reintegration of recovered materials into the downstream economy. Other waste transportation and treatment activities (landfilling, incineration, etc.) and their emissions must be accounted for.

In the present CFP methodology, the total GWP impacts for the end-of-life stage are determined as the sum of the GWP impacts from the waste treatment of each material in the final product. As specified by BIFMA, waste treatment methods are determined by first calculating the amount of material that is recycled, which is the product of material that can be disassembled from the final product and recycling rate of the material. Disassembly refers to the ability to remove individual materials from a finished product at the end of the product's life. For examples, materials which can be unscrewed may be considered able to be disassembled compared to materials which are glued or soldered and are generally not considered able to be disassembled. After the recycled quantity is determined, remaining materials are to be landfilled, composted, or incinerated. The share of materials for each are based on the following data hierarchy:

- PSPC's end-of-life data for furniture products
- default values from secondary data.

The total GWP impacts for this stage are calculated using Equation 5.0.

Equation 5.0 – End-of-life global warming potential

$$GWP_{end\ of\ life} = \sum_{i=1}^{m}\sum_{j=1}^{n} material_{ij} \times waste\ treatment_j\ EF$$

where*:*

- *material*$_i$ is the mass of the material *i* treated by waste treatment method *j* at end of life, in kg, as calculated in Equations 5.1 and 5.2
- *waste treatment*$_j$ *EF* is the emission factor of treatment method *i,* in kgCO_2e per kg waste material
- *n* is the total number of waste treatment methods for each material in the product
- *m* is the total number of materials (product and packaging) in the product

As manufacturers have direct control over the end-of life impact of the scrap materials, Equation 5.0, is only applicable to the mass of materials used in the final product or packaging. End-of-life impacts for quantity of scrap material produced during the manufacturing phase are calculated separately in Equation 3.3.

Equation 5.1 – Recycled material at end of life

$$Recycled_i = Disassembly_i \times Recycling\ rate_i\ \times (material\ mass_i - (product\ mass\ \times scrap\ rate))$$

where*:*

- *disassembly*$_i$ is the ability of material *i* to be disassembled from the final product for recycling as provided by the supplier and is either 0 (cannot be disassembled) or 1 (can be disassembled)
- *recycling rate*$_i$ is the share of material *i* that can be recycled and is supplier provided or based on background data, in %
- *material mass*$_i$ is the mass of product or packaging material *i*, as calculated in Equations 2.2 and 2.3 with the scrap material removed as GWP impacts from scrap are quantified separate in Equation 3.3

Equation 5.2 – Other end-of-life waste treatment

$$Waste_{i,j} = [(material\ mass_i - (product\ mass\ \times scrap\ rate)) -\ recycled_i]\ \times waste\ treatment_j$$

where*:*

- *material mass*$_i$ is the mass of product or packaging material *i*, in kg, as calculated in Equations 2.2 and 2.3, with the scrap material removed as GWP impacts from scrap are quantified separate in Equation 3.3
- *recycled*$_i$ is the mass of input material recycled, in %, as calculated in Equation 5.1

- *waste treatment*$_j$ is the share of input material *i* treated by waste treatment method *j*, in %

3.3.5. Total carbon footprint for Path B

The product GWP impact under Path B of the CFP methodology is calculated as the sum of the GWP impacts from each life cycle stage divided by the key parameter to obtain the CFP per FU, as shown in Equation 6.0. As a maximum service life of 10 years is selected for all three sub-categories, as required under PSPC's technical requirements for office furniture products, only products with a service life of 10 years or more are accepted in this version of the CFP methodology.

EPDs published under BIFMA PCRs are valid for a 5-year period.

Equation 6.0 – Path B global warming potential impacts

$$GWP_{FU} = \left(GWP_{material} + GWP_{manufacturing\ total} + GWP_{distribution} + GWP_{end-of-life}\right) \times \left(\frac{1}{reference\ size}\right) \times FU$$

where*:*

- GWP_{FU} is the total CFP of the product being evaluated per the applicable FU, in $kgCO_2e$ per FU
- $GWP_{material}$ is the product CFP from the materials extraction and pre-processing stage, as calculated in Equation 2.0
- $GWP_{manufacturing\ total}$ is the product CFP from the manufacturing stage, as calculated in Equation 3.0
- $GWP_{distribution}$ is the product CFP from the distribution and use stage, as calculated in Equation 4.0
- $GWP_{end\text{-}of\text{-}life}$ is the product CFP from the end-of-life stage, as calculated in Equation 5.0
- *reference size* is the size of the product in the reference unit of the product sub-category:
  - For workspace products, reference size is the product's total floorspace, in m^2
  - For seating products, reference size is the product's number of seats
  - For storage products, reference size is the product's total storage volume, in m^3
- *FU* is the functional unit for the product's office furniture sub-category, as listed in Table 3–1

3.4. Sources for input data

Each input data required for the CFP methodology has been classified as optional or mandatory. Mandatory data are primary data required from suppliers to follow the CFP methodology. The developed CFP methodology provides clear instructions on the mandatory input data in order to ease the data input process.

To reduce undue burden on suppliers from the implementation of the CFP methodology, effort was made to reduce the mandatory input data requirements while ensuring consistency with the BIFMA PCRs. Input data that manufacturers may not be able to provide have been listed as optional in the CFP methodology with the default assumptions or data sources specified in the BIFMA PCRs used as applicable. Default data using the sources specified below are included within the CFP methodology to ensure manufacturers that are unable to provide optional information are not excluded from participation in PSPC's procurement process.

Table 3–2 lists the default assumptions and sources for the optional data input categories used in the CFP methodology when supplier-specific information is not available.

Table 3–2: Secondary data sources and assumptions recommended for optional data input

Optional data input	Assumption / data source	Source
Raw material acquisition		
Location of material extraction and processing facilities	For all input and packaging materials with unknown sources, emission factors for global averages will be used.	Regional and global datasets from Ecoinvent Database, v.3.9.1
Upstream transportation modes and distance to manufacturing facility	Use of default distances per material type provided in the BIFMA PCRs.	Table 1 of the BIFMA PCR (2020a)
Product manufacturing		
Scrap waste generation rate per product in the manufacturing facility	30% scrap rate, if scrap rate from primary data is unknown.	Section 4.2 of the BIFMA PCR (2020a)
Typical waste management method(s) for scrap waste	When scrap waste treatment is not known, default rates of 80% landfilling and 20% incineration are used based on the default assumptions specified in the BIFMA PCRs.	Section 4.2 of the BIFMA PCR (2020a)
Product end of life		
Typical waste management method for each waste and scrap materials from product and packaging	Recycling rates will be based on the USEPA's *Advancing Sustainable Materials Management: Facts and Figures Fact Sheet* (USEPA 2018), as recommended in the BIFMA PCRs. When end-of-life treatment for a product is not known, default rates of 80% landfilling and 20% incineration are used based on the default assumptions specified in the BIFMA PCRs.	Section 4.4 of the BIFMA PCR (2020a)

BIFMA = Business and Institutional Furniture Manufacturers Association; PCR = product category rule; USEPA = United States Environmental Protection Agency.

3.5. Data sources for emissions factors

Sources for the emissions factors needed to calculate the CFP for Path B of the CFP methodology are listed in Table 3–3. These emission factors are found in the background of the CFP methodology and linked to the input data to calculate the CFP of the products. North American emission factors are used for all end-of-life activities since the majority of end-of-life impacts occur in North America at the products' end of life. The choice of these North American emissions factors also allows for consistency in the boundaries of the emissions factors that are incorporated into the CFP methodology, since the USEPA emission factors include both waste transportation and treatment.

As stated in Section 7.2 of the BIFMA PCRs on data quality, *"information from databases may be regarded as secondary data, if they fulfill one or more of the following requirements:*

a) Representative of the geographical area, that is, data from the same country, or from areas with the same energy supply mix;

b) Technological equivalence;

c) Boundaries towards nature; and

d) Boundaries towards technical systems shall be of best equivalence.

If secondary data are not available, use of a specific proxy is allowed. The user shall document and justify the decision to use the specified proxy." (BIFMA 2020a)

As noted, only of the requirements described above must be met in order to achieve the data quality requirements for secondary data. The data sources proposed in Table 3–3 are regionalized databases, allowing for the selection of geographically representative data and specific to the technology used for furniture production. Where regional datasets may not be used, global databases are recommended; however, they provide options for several technologies for a product or service, allowing for the selection of technologically representative data. As such, the emission factors included in the CFP methodology were chosen to meet BIFMA's secondary data quality requirements presented above.

It is important to note that the ecoinvent database requires a license to be used. An appropriate license was acquired by PSPC during the development of the tool. However, this license does not allow PSPC to share the emission factors extracted from ecoinvent and to share calculations results based on ecoinvent data in an automated way.

Table 3–3: Recommended emission factors sources per data type and activity location

Data type	Location	Preferred data source
Raw materials production	Location-specific datasets, if available Global datasets, if location-specific datasets are not available	Ecoinvent Database, v.3.9.1, IPCC, most recent version available (Wernet et al. 2016)
Transportation	All locations	Emission Factors for Greenhouse Gas Inventories, USEPA (2021b)
End-of-life treatment of product, packaging, and production scrap waste	All locations	Emission Factors for Greenhouse Gas Inventories, USEPA (2021b) **include waste collection and transportation*

IPCC = Intergovernmental Panel on Climate Change; USEPA = United States Environmental Protection Agency.

3.6. Global warming potentials

Results in the CFP methodology are quantified using GWPs without climate-carbon feedback from AR5, published by the Intergovernmental Panel on Climate Change (IPCC). The use of AR5 GWPs is consistent with the IPCC (2013) LCIA used in the CFP methodology. AR5 GWPs are also recommended under the GHG Protocol. These GWPs are not consistent with the GWPs used by the USEPA in the calculation of emission factors. As such, emission factors from the USEPA, which are only available in CO_2e (such as waste treatment) and used in the CFP methodology, are inconsistent with the other GWP impacts. A time horizon of 100 years is used in the CFP methodology, as required in the BIFMA PCRs. The GWPs for a time horizon of 100 years for CO_2, CH_4, and N_2O are presented in Table 3–4. GWP values for SF_6, HFCs, and PFCs are available in the IPCC AR5 report (IPCC 2013).

Table 3–4: Intergovernmental Panel on Climate Change AR5 global warming potential values

Greenhouse gas	CO_2	CH_4	N_2O
AR5 global warming potential	1	28	265

3.7. Data quality assessment

A data quality assessment is also conducted as part of the CFP methodology. The data quality assessment will be used to better understand suppliers' data availability as well as to incentivize primary data collection. For products with EPDs, the data quality assessment can be used to assess the quality of the data used in the EPD relative to the corresponding PCR requirements. This assessment allows for the collection of information on data quality, comparison of the data quality between both paths of the CFP methodology, and provides options for future improvements to the CFP methodology.

The input data are evaluated according to the five data quality indicators in the ISO14044 standard, as described in Table 3–5.

Table 3–5: Data quality indicators specified by ISO 14044 (2006b)

Data quality indicators	Description
Reliability	The degree to which the sources, data collection methods, and verification procedures used to obtain the data are dependable.
Completeness	The degree to which the data are statistically representative of the relevant activity. Completeness depends on many factors including the percentage of sites for which data are used out of the total number of relevant sites, coverage of seasonal and other fluctuations in data, etc. as a percentage of flow that is measured or estimated.
Temporal representativeness	Age of data and the minimum length of time over which data should be collected.
Geographical correlation	Geographical area from which data for unit processes should be collected to satisfy the goal of the study.
Technological representativeness	The degree to which the data reflects the specific technology or technology mix.

In the initial implementation phase of the CFP methodology, it is recommended that the data quality assessment be used as a supplementary source of information only. This will allow for better understanding of suppliers' data availability and use.

After the initial phase, the data quality assessment may be used as a limiting criterion in the application of the CFP methodology. For example, the use of a minimum data quality threshold can limit the uncertainty of results and allows for better comparability of CFPs.

3.8. Uncertainty in results

Three common types of uncertainty are used in the evaluation of LCA studies: model uncertainty, scenario uncertainty, and parameter uncertainty (Huijbregts et al., 2003).

Model uncertainty refers to the use of simplified models and unit processes to represent real-life phenomena and systems. Model uncertainty is an inherent part of LCA application and includes

uncertainty from the impact assessment models, GHG emissions models, as well as additional models that may be used in place of direct measurement for the calculation of inputs or outputs for the LCA.

Scenario uncertainty refers to uncertainty in methodological choices such as assumptions and allocation, as well as the selection of system boundaries. While there is uncertainty in the scenarios used for the upstream and downstream activities of the product, by aligning the scenarios in the CFP methodology to the BIFMA PCR requirements, scenario uncertainty for comparison across products can be limited. There is greater uncertainty in the product manufacturing stage, as different allocation approaches may be used by different suppliers leading to less comparable results.

Parameter uncertainty refers to the accuracy of values used in the LCA inventory and can be assessed through the evaluation of data quality indicators. Parameter uncertainty is specific to each product's LCA inventory and based on supplier data input. A general uncertainty range for the CFP of all products cannot be determined as uncertainty is inherent to the input data for each specific data input.

The score assigned to each indicator in the data quality assessment proposed can be correlated to LCAs and CFP parameter uncertainty. A good score on the five ISO 14044 data quality indicators can be tied to low parameter uncertainty. As noted in Section 3.7, the use of a minimum data quality threshold may be implemented in future phases of the CFP methodology to reduce or limit the parameter uncertainty.

3.9. Limitations of the methodology

The use of a maximum 10-year service life in the CFP methodology limits the consideration of higher quality products with a longer service life. According to this assumption, if a product can be or is used for more than 10 years, the CFP assessed by the methodology will be overestimated relative to products with a lifespan of 10 years or less. This was discussed with stakeholders and LCA experts who recommended that the service life of 10 years be kept in the CFP methodology as this was the only verifiable service life for office furniture products based on available technical specifications. Stakeholders also noted that the service life generally exceeds the actual useable life of the product as few office furniture products are in use for a full 10-year period. This was validated through discussions with internal GoC stakeholders about the useable life of office furniture products who reported that office furniture products in the GoC are typically not used for the full 10 years.

While the CFP methodology provides options for calculating the CFP of three different sub-categories, use of the CFP methodology's results for comparative purposes is limited to products with equivalent functionality.

As there are currently no third-party verification requirements in Path B of the CFP methodology, it cannot be confirmed whether the reported input data or subsequent CFP calculated using this path is a true representation of the office furniture product. As such, minimum data quality and third-party verification requirements are recommended in future phases of the CFP methodology.

4. Overview of the carbon footprint tool

The CFP tool is a spreadsheet-based tool that measures the CFP of office furniture products based on user input data and background calculations. An overview of the CFP tool is provided in Figure 4–1.

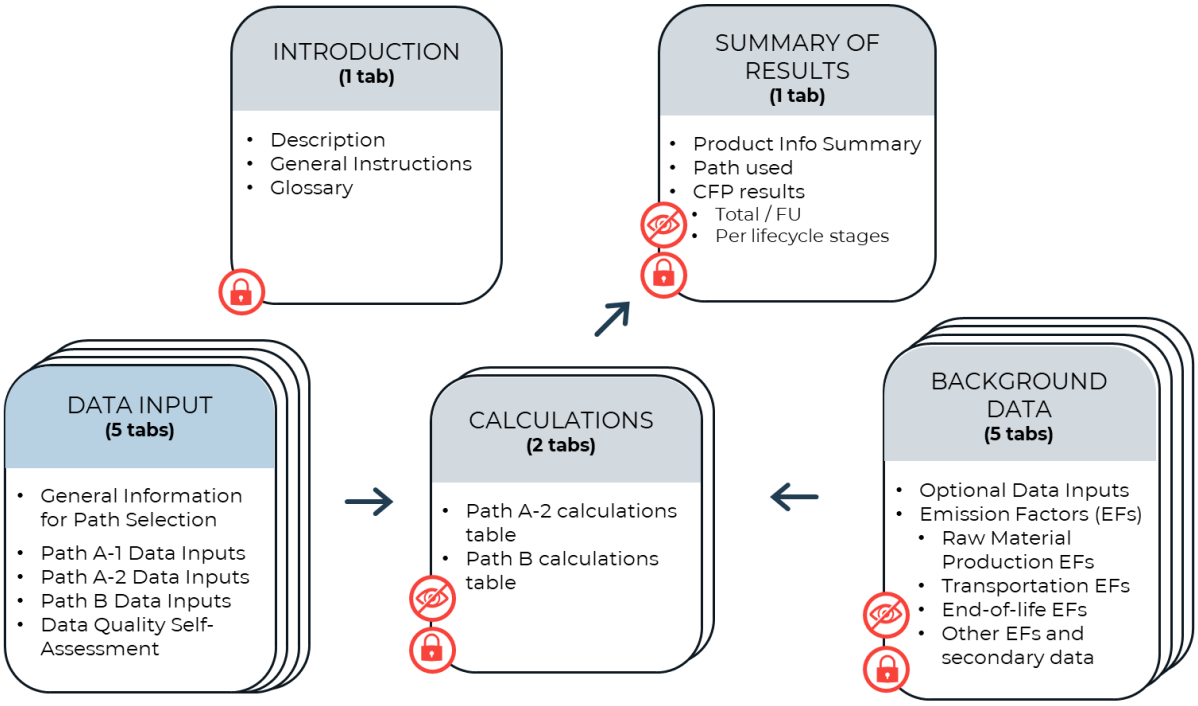

Figure 4–1: Overview of the carbon footprint tool

The CFP tool collects user input data for all mandatory and optional data inputs specified for Path A or Path B of an office furniture product. Default values for optional data inputs from the sources listed in Table 3–2 are included in the background data. The CFP of the office furniture product is calculated following the calculation methodology outlined in Section 3.

5. Conclusion

The development of the CFP methodology for office furniture products showed that there are significant technical and logistical challenges associated with reducing GHG emissions from procurement. The next stage of the CFP methodology will focus on integration of the methodology in PSPC's procurement process. The integration will be led by the LCPP team as well as the office furniture procurement teams within PSPC. The initial stages of implementation will be used to collect data on the CFP of office furniture products purchased by PSPC as well as to evaluate the impacts of the CFP methodology on PSPC's procurement process. Data collected from implementation of the CFP methodology may be used to develop a product baseline as well as product benchmarks. In future phases of implementation, results of the CFP methodology may be used as an evaluation criterion in office furniture procurement decisions. While extensive stakeholder engagement was conducted in the development of the CFP methodology and implementation support tools, it is expected that additional engagement will be necessary following the implementation phase to better understand the impact of the CFP methodology internally as well as on the overall furniture market and to gradually implement proposed updates such as additional requirements around third-party verification.

The CFP methodology presented in this report provide PSPC with an initial step in aligning office furniture procurement with the GGS and supporting the GoC's transition to net-zero. The successful application of the CFP methodology will serve as a proof of concept for the integration of CFP impacts in procurement decision making. As procurement of goods and services contributes to a large share of overall GHG emissions for the GoC, successful integration of the tool provides a significant opportunity for the GoC to fundamentally transition procurement processes and integrate CFP as a primary evaluation criterion.

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Appendices

A. INPUT DATA TABLES

Table A–1 lists the required data inputs for all products under the CFP methodology.

Table A–1: General data inputs required for the carbon footprint methodology

		Input	Description	Units	Input type
1	a	Contract Number	Enter the contract number associated to the product	n/a	Text Mandatory
1	b	Date	Enter the date on which you are completing the CFP Tool.	n/a	Text Mandatory
1	c	Product Name	Enter the name of the products for which you wish to calculate a carbon footprint (CFP). Product name must be entered to begin.	n/a	Text Mandatory
2	a	Manufacturer	Enter the name of the manufacturer for each product.	n/a	Text Mandatory
3	a	Office furniture sub-category	Select the applicable sub-category for each product. The sub-categories are defined in the glossary.	n/a	Dropdown Mandatory
4	a	Product reference unit	This input will be auto-filled based on the sub-category of the product.	n/a	Auto-filled Mandatory
4	b	Product measurement in reference unit (see 4a)	Enter the size of each product in the reference units, for example, number of seats in a chair, capacity in cubic metres of a storage product, or floorspace in square metres of a workspace product.	n/a	Number Mandatory
5	a	Product total mass (excluding packaging)	Enter the total mass of each product, excluding packaging, in kilograms.	kg	Number Mandatory
5	b	Product packaging total mass	Enter the total mass of the packaging for each product only, in kilograms.	kg	Number Mandatory
6		Product service life	If the product meets the BIFMA technical specifications, enter a service life of 10 years. If your product does not have this certification, enter the service life based on other product specifications or testing as available.	years	Number Mandatory

7		Is a valid EPD published and available for the product?	Select yes if there is a third-party verified EPD published for this product. EPD is defined in the glossary.	n/a	Dropdown Mandatory
7	a	PCR under which EPD is published	If an EPD is published, select the PCRs used to develop the EPD from the list. Select “Other” if the applicable PCR is not in the list.	n/a	Dropdown Conditionally mandatory
7	b	If other PCR, please provide the name of the PCR	If the PCR is not listed in question 7a, please enter the name of the PCR.	n/a	Text Conditionally mandatory

CFP = carbon footprint; BIFMA = Business and Institutional Furniture Manufacturers Association; EPD = environmental product declaration; PCR = product category rule.

Table A–2 lists the required data inputs for products with a published EPD developed in accordance with an applicable BIFMA PCR.

Table A–2: Data inputs required for Path A-1

		Input	Description	Units	Input type
8	a	Date of Issue	Enter the date on which the EPD was issued. For use in the CFP tool the EPD must be valid (that is, within the last 5 years).	n/a	Date Mandatory
8	b	End Date of EPD Validity	Enter the date for which the EPD is valid until.	n/a	Date Mandatory
8	c	EPD Number	Enter the reference number for the EPD.	n/a	Text Mandatory
8	d	Office Furniture Sub-Category	This field is auto-filled based on the selection in question 3 on the Inputs - General page. Please edit question 3 on the Inputs - General page if the field is incorrect.	n/a	Auto-filled
8	e	Product reference unit	This field is auto-filled based on the selection in question 3 on the Inputs - General page. Please edit question 3 on the Inputs - General page if the field is incorrect.	n/a	Auto-filled
8	f	BIFMA Storage product type	Select the type of storage product based on the BIFMA PCR definitions for which the EPD is published. Storage products are defined in the glossary.	n/a	Dropdown Mandatory
8	g	EPD Functional Unit	This field is auto-filled based on the selection in question 3 on the Inputs - General page. Please edit question 3 on the Inputs - General page if the field is	-	Auto-filled

			incorrect. For storage products, ensure question 8f is filled.		
9	a	BIFMA EPD Results, GWP Raw Materials	Enter the GWP results from the raw materials life cycle stage as reported in the EPD. This stage includes impacts from all cradle-to-gate activities, that is, from extraction of raw materials to arrival at the furniture manufacturing facility gate.	$kgCO_2e$ per FU	Number Mandatory
9	b	BIFMA EPD Results, GWP Manufacturing	Enter the GWP results from the manufacturing stage as reported in the EPD. This stage includes impacts from all core gate-to-gate activities, that is, from arrival of raw materials to at the furniture manufacturing facility gate to exit of finished products from furniture manufacturing facility gate.	$kgCO_2e$ per FU	Number Mandatory
9	c	BIFMA EPD Results, GWP, Distribution & Use	Enter the GWP results from the distribution & use stage as reported in the EPD. This stage includes impacts from all transportation of finished products to the user and any impacts which occur during the use of the product.	$kgCO_2e$ per FU	Number Mandatory
9	d	BIFMA EPD Results, GWP, End-of-Life	Enter the GWP results from the end-of-life stage as reported in the EPD. This stage includes impacts from any activities after the use of the product from transportation to the waste treatment facility to waste treatment activities and disposal or recycling.	$kgCO_2e$ per FU	Number Mandatory
9	e	BIFMA EPD RESULTS, GWP, total	This field will be auto-calculated as the sum of all life cycle stages. If the sum is incorrect, please correct the results in the life cycle stages in the above fields.	$kgCO_2e$ per FU	Auto-filled

CFP = carbon footprint; BIFMA = Business and Institutional Furniture Manufacturers Association; EPD = environmental product declaration; PCR = product category rule; GWP = global warming potential; CO_2e = carbon dioxide equivalent.

Table A–3 lists the required data inputs for products with a published EPD developed in accordance with an applicable EPD International PCR.

Table A–3: Data inputs for Path A-2

		Input	Description	Units	Inputs type
10	a	Date of Issue	Enter the date on which the EPD was issued. For use in the CFP tool the EPD must be valid (that is, within the last 5 years).	n/a	Date Mandatory
10	b	End Date of EPD Validity	Enter the date for which the EPD is valid until.	n/a	Date Mandatory

10	c	EPD Number	Enter the reference number for the EPD.	n/a	Text Mandatory
10	d	Office Furniture Sub-Category	This field will be auto-filled based on the selection in question 3 on the General Inputs page. Please edit question 3 on the general inputs page if the field is incorrect.	n/a	Auto-filled
10	e	Product reference unit	This field will be auto-filled based on the selection in question 3 on the General Inputs page. Please edit question 3 on the general inputs page if the field is incorrect.	n/a	Auto-filled
11	a	International EPD Results, GWP Raw Materials	Enter the GWP results from the raw materials life cycle stage as reported in the EPD. This stage includes impacts from all cradle-to-gate activities, that is, from extraction of raw materials to arrival at the furniture manufacturing facility gate.	$kgCO_2e$ per product	Number Mandatory
11	b	International EPD Results, GWP Manufacturing	Enter the GWP results from the manufacturing stage as reported in the EPD. This stage includes impacts from all core gate-to-gate activities, that is, from arrival of raw materials to at the furniture manufacturing facility gate to exit of finished products from furniture manufacturing facility gate.	$kgCO_2e$ per product	Number Mandatory
11	c	International EPD Results, GWP Distribution, Use, End-of-Life	Enter the GWP results from the distribution, use and end-of-life stage as reported in the EPD. This stage includes impacts from all transportation of finished products to the user and any impacts which occur during the use of the product.	$kgCO_2e$ per product	Number Mandatory
11	d	International EPD Results, GWP, total	This field will be auto-calculated as the sum of all life cycle stages. If the sum is incorrect, please correct the results in the life cycle stages in the above fields.	$kgCO_2e$ per product	Auto-filled

CFP = carbon footprint; EPD = environmental product declaration; GWP = global warming potential; CO_2e = carbon dioxide equivalent.

Table A–4 lists the required data inputs for the manufacturing stage of products following Path B of the CFP methodology.

Table A–4: Data inputs for the manufacturing stage of Path B products

	Input	Description	Units	Inputs type
Manufacturing GHG Emissions				
12 a	GHG Emissions Reporting Framework	Select whether the GHG Inventory for the manufacturer was developed in alignment with the GHG Protocol or a different guidance.	n/a	Dropdown Mandatory

12	b	Reporting Year	Enter the year for which GHG emissions data is being reported. GHG data should be entered for the most recent year available, and within the last 5 years.	n/a	Year Mandatory
12	c	Total Scope 1 Emissions	Enter the total Scope 1 GHG emissions from the manufacturing company for the reporting year specified. Scope 1 is defined in the glossary.	tCO_2e	Number Mandatory
12	d	Total Scope 2 Emissions	Enter the total Scope 2 GHG emissions from the manufacturing company for the reporting year specified. Scope 2 is defined in the glossary.	tCO_2e	Number Mandatory
12	e	Total Scope 3 Category 3 Emissions - Fuel and Energy related activities	Enter the total Scope 3, Category 3 GHG emissions from the manufacturing company for the reporting year specified. This category is defined in the glossary.	tCO_2e	Number Optional
13	a	Manufacturing location of product	Enter the location of the product's manufacturing facility.		Mandatory
13	b	Reporting Year	This field is auto-filled as data provided below should be for the same reporting year as the year for which GHG emissions are reported.	n/a	Auto-filled
13	c	Mass of all product produced for the reporting year	Enter the mass of all production by the manufacturer in kg, if known. This is used to allocate the total emissions of the manufacturer to the product for which we are calculating the CFP. If this information is not known respond to questions 13d and 13e instead.	kg	Number Conditionally mandatory
13	d	Average product sale price	If mass of products produced above is not known, enter the average sale price of the product during the reporting year.	USD	Number Conditionally mandatory
13	e	Total sales revenue for the reporting year	Enter the total sales revenue for the manufacturer during the reporting year.	USD	Number Conditionally mandatory
Manufacturing scrap waste					
14	a	Is the mass of scrap waste generated per product manufacturing facilities known?	If you know the scrap waste quantity produced during the manufacturing process, select yes, and enter data below. If you don't know, select no. The tool will calculate scrap waste and treatment of scrap based on defaults. Scrap waste is defined in the glossary.	yes/no	Dropdown
14	b	Scrap waste generation rate per kg of final product at manufacturing facilities	Enter the average mass of scrap produced per kg of final product.	kg scrap waste / kg final product	Number

14	c	Are waste treatment and disposal methods for scrap waste at the manufacturing facilities known?	Select yes if you know the waste treatment for scrap waste generated at the manufacturing facilities and enter the % of scrap waste sent to each treatment type in the following questions. Select no if unknown.		
14	d	Share of scrap waste sent to recycling facilities	Enter what percentage of total scrap waste at the manufacturing facility is sent to a recycling facility. Leave blank if unknown and select no for 14c.	%	Number
14	e	Share of scrap waste sent to incineration facilities	Enter what percentage of total scrap waste at the manufacturing facility is incinerated. Enter 0 if none of the scrap waste is sent to an incineration facility.	%	Number
Third-party transportation					
15	a	Do you ship this product between different facilities during the manufacturing process?	If manufacturing of the product occurs in stages at different facilities, do you ship this product between facilities using a third-party transportation service?	yes/no	Dropdown Mandatory
15	b	Typical mode of transportation between intermediary facilities	If intermediary products are shipped between facilities by a third-party, enter the typical mode of transportation used.	n/a	Dropdown Conditionally mandatory
15	c	Average distance of third-party transportation between intermediary facilities	Enter the average distance the intermediary product is transported between intermediary facilities.	km	Number Conditionally mandatory
15	d	Average mass of intermediary products transported between intermediary facilities	Enter the average mass of a typical intermediary product.	kg	Number Conditionally mandatory

GHG = greenhouse gas; CFP = carbon footprint; USD = US dollars.

Table A–5 lists the required data inputs for the distribution stage of products following Path B of the CFP methodology.

Table A–5: Required data inputs for the distribution and use stage of Path B products

		Input	Description	Units	Inputs type
16	a	Typical mode of transportation 1	Select the first mode of transportation used to ship products to end-users.	n/a	Dropdown Mandatory
16	b	Average distance of final product to typical end-user using mode 1	Enter the average distance of the product to the end-user using the above mode of transportation.	km	Number Mandatory

16	c	Typical mode of transportation 2 (if applicable)	If more than 1 mode of transportation is used, select the second mode.	n/a	Dropdown Optional
16	d	Average distance of final product to typical end-user using mode 2	Enter the average distance of the product to the end-user using the above mode of transportation.	km	Number Optional
16	e	Typical mode of transportation 3 (if applicable)	If more than one mode of transportation is used, select the next mode.	n/a	Dropdown Optional
16	f	Average distance of final product to typical end-user using mode 3	Enter the average distance of the product to the end-user using the above mode of transportation.	km	Number Optional

Table A-6 lists the required data inputs for the material stage of products following Path B of the CFP methodology.

Table A–6: Required data inputs for the material stage of Path B products

		Input	Description	Units	Inputs type
17	a	Enter total number of raw materials in product and packaging materials	Enter the total number of raw materials in the product plus the total number of raw materials in the product's packaging to make up at least 95% of the total product + packaging mass. You will have to enter information for the total number of materials entered here.	n/a	Number Mandatory
18	a	**Material type**	Please select the type of material from the list.	n/a	Dropdown Mandatory
18	b	Is this raw material used in the product or its packaging?	Please confirm if this is a product or packaging raw material.	n/a	Dropdown Mandatory
18	c	If material type is Other/unknown in the above list, provide material type	If the material type is not in the list, enter the material type here. For materials not in the tool, you will need to provide your own emission factor.	n/a	Text Conditionally mandatory
18	d	Material Emission Factor (GWP 100 years, AR5)	Leave blank if material type was in dropdown list. Provide the 100-year GWP per kg for raw material extraction and production of the material entered above.	$kgCO_2e$/ kg material	Number Conditionally mandatory
18	e	Emission Factor Source (for example, supplier EPD, LCA database)	Please confirm the data source of the emission factor entered above. Leave blank if not applicable.	n/a	Text Conditionally mandatory
18	f	Material name	Select a specific material from the dropdown list below.	n/a	Dropdown Optional
18	g	% of total product mass OR % of total packaging mass from this material	Enter the % of the total mass of the product OR of the total mass of packaging from this material. For example if this material is 10 kg and the product's total mass is 100 kg, enter 10%.	%	Number Conditionally mandatory
18	h	Location where material is produced	Select the location where the raw material is sourced if known. Leave blank if unknown.	n/a	Dropdown Optional
18	i	Do you have an EPD or supplier-specific emission factor for this material?	If you have an EPD from the supplier of this product with information on the product's GWP, select yes. EPD is defined in the glossary.	n/a	Dropdown Mandatory
18	j	If yes, provide EPD reference number	Provide the reference number of the EPD.	n/a	Text Conditionally mandatory
18	k	If yes, provide results from material EPD:	Enter the 100-year GWP results, excluding biogenic CO_2, from the EPD for the raw material extraction, processing, and production. Make sure to exclude any transportation or end-of-life impacts from the results.	$kgCO_2e$	Number Conditionally mandatory

18	l	Is the distance of this raw material to the furniture manufacturing facility known? *If yes, enter distance by transportation mode below. Enter 0 for non-applicable modes.*	Select yes if you know the distance from the supplier of this raw material to the manufacturing facility for the office furniture product.	yes/no	Dropdown Mandatory
18	m	Truck	If you selected yes above, enter the distance from the raw material supplier to the furniture manufacturing facility by this mode of transportation. Enter 0 if this mode of transportation is not used.	km	Number Conditionally mandatory
18	n	Rail	If you selected yes above, enter the distance from the raw material supplier to the furniture manufacturing facility by this mode of transportation. Enter 0 if this mode of transportation is not used.	km	Number Conditionally mandatory
18	o	Ship	If you selected yes above, enter the distance from the raw material supplier to the furniture manufacturing facility by this mode of transportation. Enter 0 if this mode of transportation is not used.	km	Number Conditionally mandatory
18	p	Aircraft	If you selected yes above, enter the distance from the raw material supplier to the furniture manufacturing facility by this mode of transportation. Enter 0 if this mode of transportation is not used.	km	Number Conditionally mandatory
18	q	Can this material be disassembled from the final product at the end of its life?	Can the furniture product be disassembled at the end of its life to separate this material from the rest of the product?	yes/no	Dropdown Mandatory
18	r	Can this material be recycled at the end of the product life?	Select yes if you know the material can be recycled at the end of the product's life.	yes/no	Dropdown Mandatory

GWP = global warming potential; EPD = environmental product declaration; LCA = life cycle assessment; CO_2e = carbon dioxide equivalent.