Background LCA report of Deskpro

in accordance with ISO 14040:2006, ISO 14044:2006,
ISO 14025:2006, EN 15804:2012+A2:2019
and NPCR - 026 PCR - Part B for Furniture version 2.0



LCA Author: Suraj Shekhar, Sustainability Consultant, KoActs, Pune, India
October 15, 2023

Contents

1. Introduction 1
1.1 Company Description 1
1.2 Office Furniture 2
1.2 Commissioner and Practitioner of the LCA study 3
1.3 Requirements and Standards 3
1.4 Life Cycle Assessment 3
1.5 Scope 4
2. Goal and scope 5
2.1 Functional unit 6
2.2 Reference flow 6
2.3 Material composition 6
2.4 Designed and Market life 7
2.5 Cut-off rules 9
2.6 Geographical Coverage 9
2.7 Allocation 10
2.8 Product Specification 10
2.9 System Boundary and Manufacturing Processes Details 10
3. Process Description: 12
3.1 Raw Material Acquisition: 13
3.2 Parts Manufacturing: 14
3.3 Material Packaging: 14
4. Data Quality, Life Cycle inventory and Data Quality Assessment: 15
5. Life Cycle Impact Assessment Methodology 16
5.1 Environmental Impacts of a product 18
6. Results of Deskpro 19
7. Results Interpretation 22
8. References 24

Test Report
afc
FURNITURE SOLUTIONS

List of Tables

Table 1: Major Materials and their weight % 6
Table 2 Modules declared, geographical scope, share of specific data (in GWP-GHG indicator) and data variation 12
Table 3 Data Quality assessment 15
Table 4 The studied Life Cycle Impact Category Details as per EN 15804 + A2 Method V1.02 17
Table 5 Results of 1m2 of area covered by AFC India ltd.'s Deskpro; Method: EN15804 + A2 Method V1.02 20

List of Figures

Figure 1 LCA Framework 4
Figure 2 Process flow diagram 13

afc
FURNITURE SOLUTIONS

1. Introduction

1.1 Company Description

AFC is a 15 years young organisation that conceptualises, designs, manufactures, and delivers modular furniture solutions across the country.

The brand started its operations in 2008 and has been setting milestones with its multiple initiatives. At a time when the concept of green manufacturing and sustainability was just picking up, AFC set up its own manufacturing unit in Noida with pan-India service capability, and regulatory certifications and compliances for green manufacturing in 2010. By 2019, AFC launched a new manufacturing setup with a 2.5 lakh sq. ft. area with machines imported from Germany and Italy. Here are a few factors that make it a robust organization:

- Enormous scale to manufacture upwards of 15,000 workstations and 12,000 seating solutions in a month on average.
- An in-house R&D team that comes up with new designs and products to transform businesses with the help of 400+ employees.
- A diverse product portfolio that consists of workstations, tables, storages, educational furniture, and seating solutions.

Keeping innovation at heart, AFC has always been at the forefront of being a sustainable brand. Its expertise in green and sustainable manufacturing practices, following all the necessary regulatory compliance, is what sets it apart from others in the industry. AFC is also actively participating in environment-centric activities.

AFC has always managed to maximize employee happiness and productivity alongside organizational performance. Hence, recently it has been recognized as one of the 'Most Preferred Workplaces in Manufacturing 2022-23'.

During the pandemic period, it emerged as an organization working for the frontliners across industries and sectors. Being a major supplier for the majority of the country's private banks, AFC had its workforce work round-the-clock during the tough times of COVID-19.



Since its inception in 2008, the intent of the brand has always been to provide the best delivery timelines. Commenting on the great journey till now, Manoj Tomar, Founder and MD, AFC Furniture Solutions said,

> *"We have come a long way from where we started, and it's just the beginning of the marathon; there is a long path to be covered for us to emerge as pioneers in providing the best value and solutions. Immensely thankful for this wonderful journey, we are set for the surprises and challenges the path ahead has in store for us."*

1.2 Office Furniture

The office furniture industry in India has seen significant growth in recent years due to the country's rapid economic development and the expansion of the corporate

sector. Office desks are essential components of workspaces, playing a crucial role in enhancing productivity and providing comfort for office workers. In this context, manufacturers in the Indian office furniture market, ranging from large-scale to small-scale enterprises, employ diverse materials, production processes, and design approaches to meet the varying needs and budgets of businesses.

Moreover, there is an increasing emphasis on sustainable practices and environmental considerations within the industry, with manufacturers recognizing the value of conducting Life Cycle Assessments (LCAs) to evaluate the environmental impact of office desks throughout their entire life cycle. LCAs enable manufacturers to identify opportunities for improvement, minimizing energy consumption, greenhouse gas emissions, water usage, and waste generation. The Indian government has also introduced initiatives to encourage sustainability in manufacturing, including the office furniture sector, through incentives, the promotion of renewable materials, and responsible disposal practices.

1.2 Commissioner and Practitioner of the LCA study

This LCA study is commissioned by AFC furniture solutions and prepared by Mr. Suraj Shekhar, Sustainability Consultant, KoActs, Pune, India. This LCA study has been carried out for getting EPD for 'Deskpro' office desk.

1.3 Requirements and Standards

This study is conducted in accordance with ISO 14040:2021, ISO 14044:2021, ISO 14025:2006, EN 15804:2012+A2:2019 and NPCR - 026 PCR - Part B for Furniture version 2.0.

The inventory for the LCA study is based on the period of June 2023 to June 2024 production figures from Greater Noida plant of AFC. This LCA was modelled with SimaPro LCA v9.5 software with Ecoinvent v3.9 database.

1.4 Life Cycle Assessment

The basic idea of life cycle assessment is to reveal all environmental impacts a certain product generates throughout its entire lifetime. Thus, life cycle assessment describes all processes from raw material extraction to produce the product to its end-of-life treatments like recycling, incineration, landfill, etc. When all inputs and outputs to and from a product system are analysed, the impacts to the environment caused by this product can be calculated. Life cycle assessment analyses a variety of different types of environmental impacts, such as carbon footprint,

eutrophication, acidification, resource depletion, damage to ecosystems, damage to human health, etc.

The procedure to execute LCA is organised in four phases as shown in fig 1.

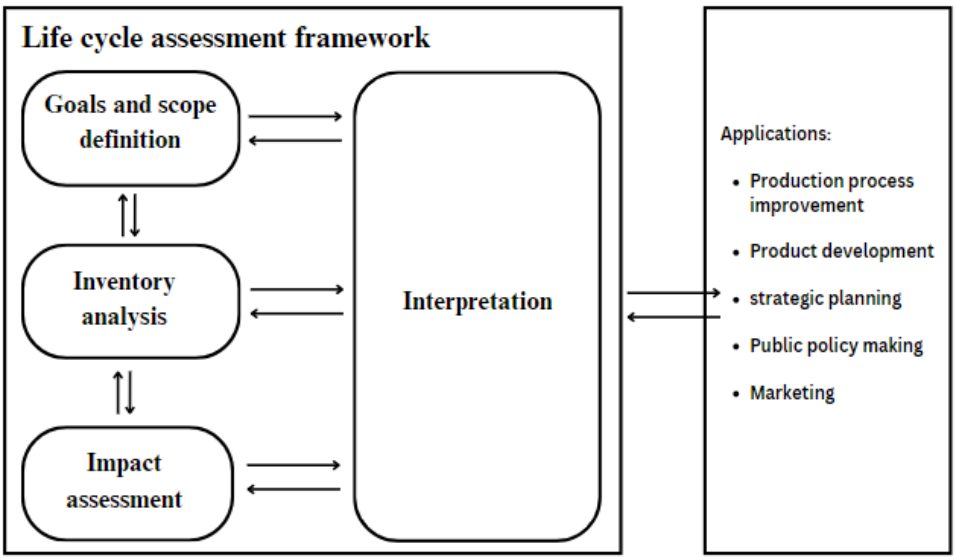


Figure 1 LCA Framework

Goal and scope definition serves to define the purpose and extent of the study, and it contains a description of the system studied. An important issue is the functional unit of a product or service delivered.

The second phase, inventory analysis, consists of data collection and analysis. Data on the environmental interventions (emissions, land use, resource use, noise etc.) connected to each process in the life cycle is collected, often guided by a process flow diagram. This data processing is not always straightforward. For processes that produce more than one output, decisions are required about how to allocate the environmental burdens to each output.

The third phase, impact assessment calculations, serves to evaluate the significance of the environmental interventions contained in a life cycle inventory. In practice, an inventory will contain a long list of emissions and resource uses. The purpose is to determine the relative importance of each of these inventory items and to aggregate interventions to a small set of indicators, or even to a single indicator. This is done in order to identify those processes which contribute most to the overall impact, or to compare products.

LCA can be seen as an iterative process where interpretations may lead to an adjustment of the goal and scope or further investigations of the inventory and associated impacts.

2. Goal and scope

The primary purpose of this LCA study is to find out total environmental impacts due to manufacturing of one Deskpro with modules C1–C4 and module D (A1–A3 + C + D) to be awarded Environmental Product Declarations (EPDs) certified by The International EPD System through third-party verification.

The results of present LCA study conforming to this BIFMA PCR for Office Furniture Workspace Products, UNCPC 3814 shall be, at a minimum, used to identify the potential environmental impacts of each life cycle phase of the product, or enable product improvement over the full life cycle of the product, and shall be presented in such a way as to be relevant to the public or for internal company use.

Any EPD comparisons derived from the use of this BIFMA PCR for Office Furniture Workspace Products, UNCPC 3814 must be conducted in respect to ISO 14025/14040/14044 and EN 15804.

The intended audience of this LCA study are business owners, sustainability consultants etc. However, this study should not be used for comparative assertions as LCA results tend to change due to differences in LCA methodology, assumptions and data quality.

2.1 Functional unit

As per PCR the functional unit is - the production of one unit of the declared product provided and maintained for an estimated service life (ESL) for the product declared. Estimated service life of the product as per PCR is 15 years. Deskpro has a designed service life of 10 years.

2.2 Reference flow

The reference flow shall be the amount of product needed to satisfy the above functional unit. In order to satisfy the functional unit, many different parts are required like Particle board, Aluminium alloy, CR tubes etc. Which are assembled later in the assembly stage.

The size of one Deskpro is 1600mm X 600 mm.

2.3 Material composition

Overall, the following material composition is noted.

Table 1: Major Materials and their weight %

S.no	Material	Approximate weight%
01	Particle board	25
02	MDF	9
03	Aluminium	13
04	CR tube	14
05	CRCA sheets	35
06	GI steel sheets	4
07	Packaging	1

2.4 Designed and Market life Test Report

Deskpro table was tested according to BIFMA 5.5:2021: Desk and Table Products standards by TUV Pvt. Ltd.

Test Report- Hardline

TÜVRheinland®
Precisely Right.

Prüfbericht-Nr.: *Test Report No.:*	**IN23F05H 001**	**Auftrags-Nr.:** *Order No.:*	146828367 Seite 1 von 3 *Page 1 of 3*
Kunden-Referenz-Nr.: *Client Reference No.:*	TRF dated on 29.08.2023	**Auftragsdatum:** *Order date:*	07.09.2023
Auftraggeber: *Client:*	AFC SYSTEM PRIVATE LIMITED,33, ECOTECH 12, WEST GREATER NOIDA, UTTAR PRADESH - 201310		
Prüfgegenstand: *Test item:*	**Deskpro, desk and tables workstation cluster**		
Bezeichnung / Typ-Nr.: *Identification / Type*	Style No./SKU No. : **Deskpro, desk and tables workstation cluster**		
Auftrags: *Order:*	PO No.: Not Provided		
Prüfgrundlage: *Test specification*	**BIFMA 5.5:2021: Desk and Table Products**		

Wareneingangsdatum: *Date of receipt:*	24-08-2023
Prüfmuster-Nr.: *Test sample No.:*	A003557205-001
Prüfzeitraum: *Testing period:*	25/08/2023 - 05/09/2023
Ort der Prüfung: *Place of testing:*	27/B, 2nd Cross, Electronic City, Phase 1, Bangalore- 560 100,
Prüflaboratorium: *Testing laboratory:*	TÜV Rheinland (India) Pvt. Ltd
Prüfergebnis*: *Test result*:*	**Pass**



geprüft von / *tested by:*

Datum *Date*	Name / Stellung *Name / Position*	Unterschrift *Signature*
07.09.2023	Sachin shivraj /Test Engineer	

kontrolliert von / *reviewed by:*

Datum *Date*	Name / Stellung *Name / Position*	Unterschrift *Signature*
07.09.2023	Yogisha Gowda/ Asst Manager	

Sonstiges / *Other:* **Buyer name:**Not provided ,Country of origin:India,Country of destination:Not Provided , Material: **Pre-laminated particle board, CRCA sheets and tubes, aluminium profiles.** ,Color Name: Not Provided ,End use of product: Work station, Decision Rule: The laboratory employs simple acceptance rule in making pass or fail decisions on test results with no guard band

Zustand des Prüfgegenstandes bei Anlieferung: *Condition of the test item at delivery:*	Prüfling komplett und beschädigt *Test item complete and undamaged*

* Legende:	1 = sehr gut	2 = gut	3 = befriedigend	4 = ausreichend	5 = mangelhaft
	P(ass) = entspricht o.g. Prüfgrundlage(n)		F(ail) = entspricht nicht o.g. Prüfgrundlage(n)	N/A = nicht anwendbar	N/T = nicht getestet
Legend:	*1 = very good*	*2 = good*	*3 = satisfactory*	*4 = sufficient*	*5 = poor*
	P(ass) = passed a.m. test specification(s)		*F(ail) = failed a.m. test specification(s)*	*N/A = not applicable*	*N/T = not tested*

Dieser Prüfbericht bezieht sich nur auf das o.g. Prüfmuster und darf ohne Genehmigung der Prüfstelle nicht auszugsweise vervielfältigt werden. Dieser Bericht berechtigt nicht zur Verwendung eines Prüfzeichens.
This test report only relates to the a. m. test sample. Without permission of the test center this test report is not permitted to be duplicated in extracts. This test report does not entitle to carry any test mark.

Overall Dimensions:
Height: 1050mm Width: 24000mm Depth: 1200mm Total Work surface(A): 2.88m2

Category: I(H> 610mm and A>0.46m2)

FL = Functional load; PL = Proof load; EE = Extendible element; C = Concentrated; D = Distributed

Clause	Test Item	Parameter / Observation	Observation	Result
3.2	Manufacturer's Instructions	When a manufacturer provides specific instructions and/or product safety labels, these instructions shall be followed prior to testing unless otherwise specified by the test procedures herein. Mid-test adjustments to the unit, such as retightening fasteners, are not permitted unless otherwise specified by the test procedures herein.	Not provided	NA
3.7	Pretest Inspection	Before beginning the testing, visually inspect the unit thoroughly. Record any defects so that they are not assumed to have been caused by the tests.	No defect is observed	P
5	**Unit Strength Tests**			
5.2	Concentrated Functional Load Test	☒ L > 1829 mm or ganged units > 2.6 m: 2 x CFL x 914mm Time: 60min	No loss of serviceability at 182kg	P
5.8	Benching Systems – Distributed Functional Load and Stability Test	DFL as Table 1 / 60 min. ☒ Primary surface depth ≥ 406 mm, DPL center line is 178 mm from edge ☒ If two-sided unit, DFL to 1 side only for stability test, then DFL to both 2 sides / 60 min.	No tip over at 153kg No loss of serviceability at 153kg	P
5.9	Benching Systems – Distributed Proof Load Test	DPL as Table 1 / 15 min. ☒ Primary surface depth ≥ 406 mm, DPL center line is 178 mm from edge	No loss of serviceability at 232kg	P
6	**Top Load Ease Cycle Test**	H ≤ 965 mm . ☒ Primary surface depth ≥ 457 mm, edge of the loading bag/disk within 25 mm from the edge of the surface at the center of the largest unsupported span. ø406 mm / 91 kg / 10,000 cycles	No Loss of serviceability	P

TÜVRheinland®
Precisely Right.

Test Report- Hardline

ANLAGE zum Prüfbericht-Nr.:
Test Report No.: IN23F05H 001

Seite 3 von 3
Page 3 of 3

FL = Functional load; PL = Proof load; EE = Extendible element; C = Concentrated; D = Distributed

Clause	Test Item	Parameter / Observation	Observation	Result
8	**Leg Strength Test**	**8.3 Leg Strength Test –** FLA = 445 N FLB = 222 N PLA = 668 N PLB = 334 N	No Loss of serviceability	P

*** Key:**	P	Pass	F	Fail	NA	Not Applicable
	NC	Not Conducted as per client request	NT	Not Test	DATA	Record data only

NOTE: P = PASS THE REQUIREMENT F = FAIL THE REQUIREMENT NA= NOT APPLICABLE
PL=PROOF LOAD FL=FUNCTIONAL LOAD NT=NOT TESTED

Remark: 1) Testing has been Conducted as per Applicant Request.
2) Sample not drawn by TUV Rheinland India Pvt. Ltd.

..END OF REPORT..

2.5 Cut-off rules

A minimum of 95% of the total mass, energy, and environmental relevance for the system has been considered.

Efforts, however, have been made to include all flows in the modelling.

2.6 Geographical Coverage

The geographical coverage of the study is India. Recent aggregated data from 2023-24 have been collected from AFC plants in India to model this LCA study.

2.7 Allocation

When a process has more than one output, the environmental burdens are allocated to different outputs. Wherever necessary, allocation based on mass has been used in this study.

2.8 Product [Deskpro] Specification

Deskpro is a highly efficient and well-organized workstation system designed to seamlessly fit into any environment. Its flexible design elements offer multiple solutions, creating spaces that encourage communication and teamwork. With its sleek and adaptable structure, Deskpro enables users to easily collaborate and be productive. It seamlessly integrates into various settings, making it an ideal choice for modern workspaces. Deskpro's functional and visually appealing design ensures it meets the diverse needs of professionals, enhancing productivity and improving the overall work experience.



The size of one Deskpro is 1600mm X 600 mm. It has estimated service life of 10 years. The product is marketed all over the world. Major market share is in India.

2.9 System Boundary and Manufacturing Processes Details

The system boundary taken for the LCA study is according to EN 15804 Section 5.2. As per the above clause EPD system boundary A1-D will be used if the following three conditions are valid:

The aggregation of the modules A1, A2, A3, A4, A5, B1, B2, B3, B4, B5, B6, C1, C2. C3, and C4 is allowed by EN 15804:2012+A2:2019.

- **Product stage**
    - A1: Raw Material Supply
        - Extraction and processing of raw materials (Mineral gypsum, additives, and others).
        - Generation of electricity and heat from primary energy resources.
    - A2: Transportation
        - External transportation to the core processes and internal transport.
    - A3: Manufacturing
        - Manufacturing of the finished parts of Deskpro.
        - Production of ancillary materials or pre-products.

- **Construction/installation stage**
    - A4: Transportation
        - Transportation of finished product to the customer.
    - A5: Installation
        - Final assembly and installation of Deskpro at final consumer site.

afc
FURNITURE SOLUTIONS

- **Use stage**
    - B1: Use
        - After the assembly of parts into Deskpro, the use stage begins.
    - B2: Maintenance
        - Includes maintenance, e.g., energy and water use in cleaning, and recommended repainting during the service life.
    - B3: Repair
        - Repairs includes, if any, repairs during the service life.
    - B4: Replacement
        - Replacement, if any, recommended during service life.
    - B5: Refurbishment
        - Refurbishment, if relevant.
    - B6: Operational energy use
        - Operational energy use, if relevant during service life.
    - B7: Operational water use
        - Operational water use, if relevant during service life.

- **End of life**

- C1: Demolition
  - Includes the demolition of furniture.
- C2: Transportation
  - Includes the transport of the furniture to final waste treatment.
- C3: Reuse, recovery and/or recycling
  - Includes all activities regarding reuse, recovery and/or recycling after transportation of furniture.
- C4: Disposal
  - Includes disposal, i.e., waste handling that does not give a useful product. For example, after incineration of Particleboard or Fiberboard, the ashes are sent to the final landfilling sites.

Modules declared, geographical scope, share of specific data (in GWP-GHG indicator) and data variation:

Table 2 Modules declared, geographical scope, share of specific data (in GWP-GHG indicator) and data variation

	Product stage		Construction process stage			Use stage							End of life stage					Resource recovery stage
	Raw material supply	Transport	Manufacturing	Transport	Construction installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction demolition	Transport	Waste processing	Disposal		Recycling potential
Module	**A1**	**A2**	**A3**	**A4**	**A5**	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**C1**	**C2**	**C3**	**C4**		**D**
Modules declared	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**		**X**
Geography	**IN**	**IN**	**IN**	**IN**	**IN**	**IN**	**IN**	**IN**	**IN**	**IN**	**IN**	**IN**	**IN**	**IN**	**IN**	**IN**		**IN**
Variation – sites	**Not relevant**																	

X: Declared, ND: Not declared

3. Process Description:

The production of an office desk involves a series of intricate processes, encompassing the acquisition of raw materials and subsequent manufacturing of individual components. This comprehensive description outlines the key steps involved in the life cycle of an office desk, from raw material acquisition to material packaging.

Process flow chart is shown below. The complete description of manufacturing is also given.

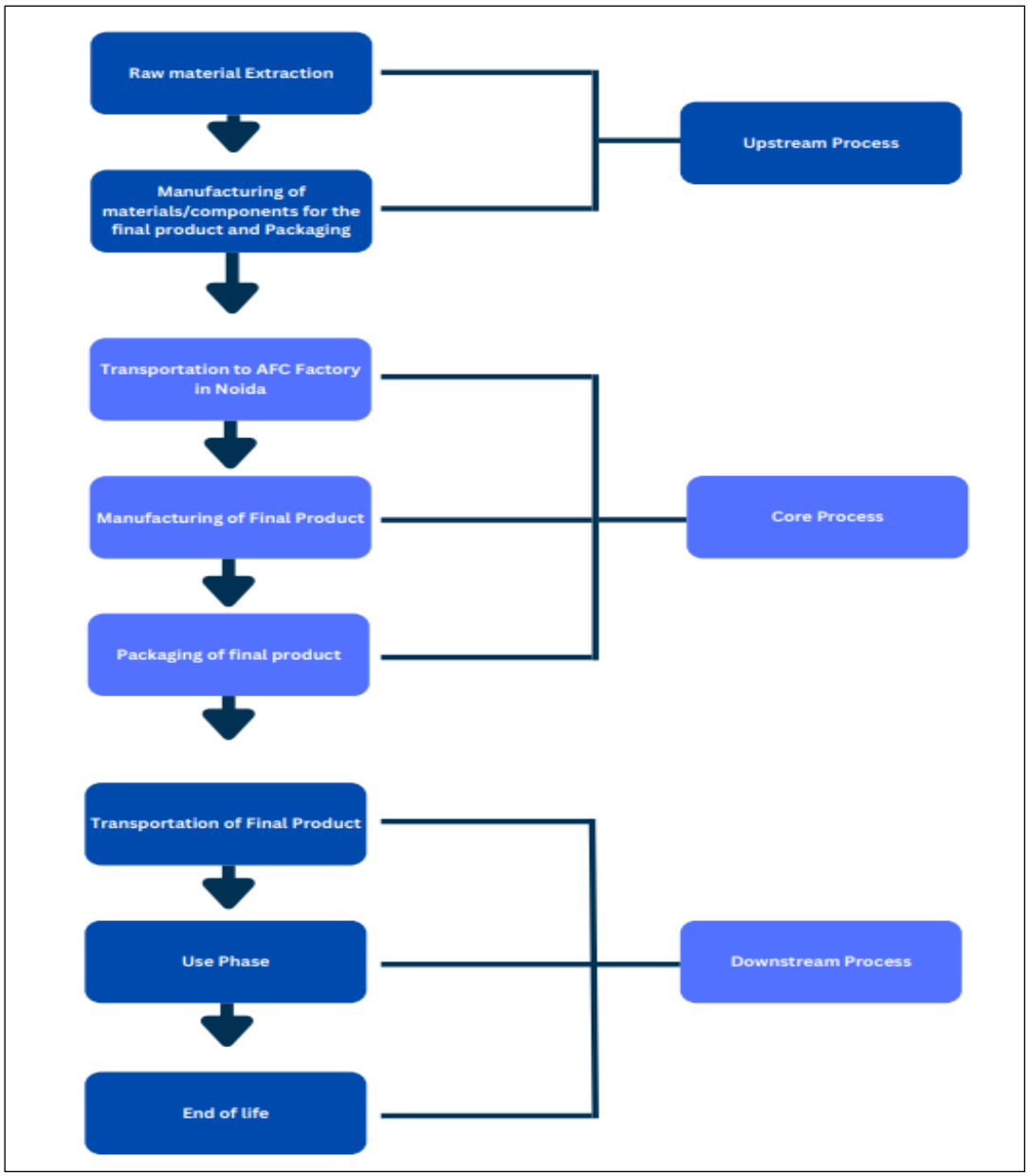


Figure 2 Process flow diagram

3.1 Raw Material Acquisition:

The office desk is an amalgamation of multiple parts made from diverse materials. These materials include Aluminium alloy, Particleboard, and Medium-Density Fiberboard (MDF). Sourced from various suppliers, these raw materials are transported to the manufacturing unit of AFC furniture solutions for further processing. The acquisition phase involves coordinating the logistics and transportation of the raw materials from their respective plant sites to the manufacturing facility.

3.2 Parts Manufacturing:

Upon arrival at the manufacturing unit, the raw materials undergo specific manufacturing processes tailored to their unique characteristics and intended use. Particleboard, for example, is utilized in the production of the Worktop and Modesty panels. The Particleboard is first directed to the Saw, where it is meticulously trimmed to the required dimensions. Subsequently, it undergoes edge lipping, a process that imparts a finished appearance to the edges, and is then forwarded to the Skipper, where precise holes are drilled to complete the Worktop component.

In the case of Aluminium items, the material is initially cut to the desired dimensions using specialized cutting equipment. Following the cutting stage, the Aluminium parts undergo die punching, a process that shapes them according to the required specifications. To provide durability and an aesthetically pleasing finish, a powder coating process is then employed, adding a protective layer and enhancing the visual appeal of the Aluminium components.

Metal sheets, such as Galvanized Iron (GI) sheets, form an integral part of the desk's structure. The manufacturing process for these sheets involves uploading the design onto a laser cutting machine, which meticulously cuts the sheet to conform to the required specifications. Subsequently, the cut sheets are skillfully welded using techniques such as Metal Inert Gas (MIG) welding and Spot welding to achieve the desired shape and structural integrity. The final steps in the manufacturing process include grinding for surface refinement and powder coating to provide a protective finish, ensuring longevity and resistance to wear and tear.

CRCA pipes, essential for providing structural support to the office desk, undergo a series of manufacturing steps. These pipes are initially cut to the desired size and shape, and if necessary, notching is performed using dedicated notching machines. To facilitate joint formation, holes are drilled in the pipes, allowing for the riveting process. MIG welding and/or Spot-welding techniques are employed to create permanent joints in the CRCA pipes, ensuring structural stability and strength. The manufacturing process concludes with a thorough quality check to verify compliance with company standards, ensuring that only components of the highest quality proceed to the next stage.

3.3 Material Packaging:

Once all the parts have successfully undergone the manufacturing processes, they are subjected to a rigorous quality check. This assessment ensures that the components meet the necessary standards in terms of functionality, aesthetics, and durability. Upon passing the quality assessment, the components are carefully

packaged using materials such as Corrugated ply rolls and Bubble wrap. These packaging materials provide adequate protection during transportation and storage, safeguarding the components from potential damage or deterioration.

4. Data Quality, Life Cycle inventory and Data Quality Assessment:

Life Cycle Data is the most important aspect of accuracy of LCA results. It forms the backbone of every LCA study. Efforts have been made to model LCA on data collected from plant and its suppliers.

According to EN 15804:2012+A2:2019/AC:2021 specific data was used for module A3 (Processes the manufacturer has influence over) and was gathered from the Manufacturing Plant. Primary or Specific data includes actual product weights, amounts of raw materials used, product content, energy consumption, etc. are collected from AFC furniture solutions The collected data from AFC furniture solutions and its suppliers are accurate, complete and represent the manufacturing process based on latest technology. The collected data are recent data collected during September 2023 to October 2023.

afc
FURNITURE SOLUTIONS

Table 3 Data Quality assessment

Process	Time Period	Geography	Technology	Data Source
Particle board	2023	India	Modern technology	Primary data & Ecoinvent
MDF	2023	India	Modern technology	Primary data & Ecoinvent
Aluminium	2023	India	Modern technology	Primary data & Ecoinvent
CR tube	2023	India	Modern technology	Primary data & Ecoinvent
CRCA sheets	2023	India	Modern technology	Primary data & Ecoinvent

GI steel sheets	2023	India	Modern technology	Primary data & Ecoinvent

Electricity is supplied 100% from the grid.

According to PCR 2019:14 Construction products (EN 15804:2012+A2.2019/AC:2021) Version 1.2.5 – section 5.3.5 If the bought electricity used in module A3 accounts for more than 30% of the total electricity use in modules A1 to A3, the energy sources behind the electricity grid in module A3 shall be documented. Thus, grid electricity mix are presented below in figures.

Input	Percentage
Electricity, medium voltage {IN-Eastern grid}| market for electricity, medium voltage | Cut-off, U	28
Electricity, medium voltage {IN-North-eastern grid}| market for electricity, medium voltage | Cut-off, U	2
Electricity, medium voltage {IN-Northern grid}| market for electricity, medium voltage | Cut-off, U	48
Electricity, medium voltage {IN-Southern grid}| market for electricity, medium voltage | Cut-off, U	8
Electricity, medium voltage {IN-Western grid}| market for electricity, medium voltage | Cut-off, U	14

Electricity data was taken from Ecoinvent v3.9

afc FURNITURE SOLUTIONS

5. Life Cycle Impact Assessment Methodology

To identify and evaluate the amount and significance of the potential environmental impacts arising from the LCI, the inputs and outputs are assigned to impact categories.

EN 15804 + A2 Method V1.02 will be used in this study as LCIA methodology.

The EN 15804 standard covers Environmental Product Declarations (EPDs) of Construction Products.

- Depletion of abiotic resources: Two impact categories: Abiotic depletion (elements, ultimate reserves) and abiotic depletion (fossil fuels). Abiotic depletion (elements, ultimate reserves) is related to extraction of minerals due to inputs in the system. The Abiotic Depletion Factor (ADF) is determined for each extraction of minerals (kg antimony equivalents per kg extraction) based on concentration reserves and rate of de-accumulation. Abiotic depletion of fossil fuels is related to the Lower Heating Value (LHV) expressed

in MJ per kg of m3 fossil fuel. The reason for taking the LHV is that fossil fuels are fully substitutable.

- Global warming: The characterization model as developed by the Intergovernmental Panel on Climate Change (IPCC) is selected for development of characterization factors. Factors are expressed as Global Warming Potential for time horizon 100 years (GWP100), in kg carbon dioxide equivalent per kg emission.
- Ozone layer depletion (steady state): The characterization model is developed by the World Meteorological Organization (WMO) and defines ozone depletion potential of different gases (kg CFC-11 equivalent per kg emission).
- Toxicity: Human toxicity (HTP inf), Freshwater aquatic Eco toxicity (FAETP inf), Marine aquatic ecotoxicology (MAETP inf) and Terrestrial Eco toxicity (TETP inf) are considered.
- Photochemical oxidation (high NOx): The model is developed by Jenkin & Hayman and Derwent and defines photochemical oxidation expressed in kg ethylene equivalents per kg emission.
- Acidification (incl. fate, average Europe total, A&B): Acidification potential expressed in kg SO2 equivalents per kg emission. Model is developed by Huijbregts.
- Eutrophication (fate not included): Eutrophication potential developed by Heijungs et al and expressed in kg PO4 equivalents per kg emission.

Table 4 The studied Life Cycle Impact Category Details as per EN 15804 + A2 Method V1.02

EN15804: Core Environmental Impact Indicators	Units
Acidification	mol H+ eq.
Climate change - biogenic	kg CO_2 eq.
Climate change - fossil	kg CO_2 eq.
Climate change - land use and land use change	kg CO_2 eq.
Climate change – total	kg CO_2 eq.
Depletion of abiotic resources - minerals and metals	kg Sb eq.
Depletion of abiotic resources - fossil fuels	MJ, net calorific value
Eutrophication aquatic freshwater	kg Peq.
Eutrophication aquatic marine	kg N eq.
Eutrophication terrestrial	mol N eq.
Ozone Depletion	kg CFC 11 eq.
Photochemical ozone formation	kg NMVOC eq.
Water use	m3 world eq. deprived
Mandatory indicators Resources (EN15804, 7.2.4.2)	**Units**

Total use of non-renewable primary energy resources (primary energy and primary energy resources used as raw materials)	MJ, net calorific value
Use of non-renewable primary energy resources used as raw materials	MJ, net calorific Value
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials	MJ, net calorific value
Total use of renewable primary energy resources (primary energy and primary energy resources used as raw materials)	MJ, net calorific value
Use of renewable primary energy resources used as raw materials	MJ, net calorific value
Use of renewable primary energy excluding renewable primary energy resources used as raw materials	MJ, net calorific value
Net use of fresh water	m^3
Use of secondary material	Kg
Use of non-renewable secondary fuels	MJ, net calorific value
Use of renewable secondary fuels	MJ, net calorific value
Waste (EN15804, 7.2.4.3)	**Units**
Hazardous waste disposed	Kg
Non-hazardous waste disposed	Kg
Radioactive waste disposed	Kg
Output flows (EN15804, 7.2.4.4)	**Units**
Components for re-use	Kg
Exported energy	MJ
Materials for energy recovery	Kg
Materials for recycling	Kg

5.1 Environmental Impacts of a product

Environmental indicators, disclaimers and other requirements in Section 7.2.3 (for environmental impacts based on the LCIA) and Section 7.2.4 (for resource use, waste, etc.) of EN 15804:2012+A2:2019 have been calculated.

As per rule 4.6.1 of EN 15804:2012+A2:2019 results for Deskpro as part of a product assortment have been presented. As shown in the material composition table below for Deskpro composition.

6. Results of Deskpro

The following table shows the environmental impact of one unit of AFC made Deskpro.

Table 5 Results of 1 Deskpro; Method: EN15804 + A2 Method V1.02

Core Environmental impact per Deskpro of weight 53.2 kg																
Impact category	Unit	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C 1	C 2	C3	C 4	D
Global Warming Potential - fossil fuels	kg CO2 eq	158.91	6.11	0.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.31	5.17	0.00	-27.63
Global Warming Potential - Biogenic	kg CO2 eq	-43.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.00	0.06
Global Warming Potential- LU & LU change	kg CO2 eq	0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	-0.01
Global Warming Potential - Total	kg CO2 eq	115.43	6.11	0.94	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.31	5.30	0.00	-27.58
Depletion Potential ODP	kg CFC11 eq	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Acidification Potential AP	mol H+ eq	0.89	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	-0.11
Eutrophication Potential- freshwater	kg P eq	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.01
Eutrophication Potential - marine	kg N eq	0.04	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	-0.03
Eutrophication Potential - terrestrial	mol N eq	2.21	0.29	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.07	0.00	-0.27
Photochemical ozone creation Potential	kg NMVOC eq	0.67	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	-0.13
Abiotic depletion potential - non fossil	kg Sb eq	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Abiotic depletion potential fossil fuels	MJ	2486.49	41.59	9.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.08	54.65	0.00	-272.7
Water user deprivation potential	m3 W eq. Dep	23564.18	0.08	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.17	0.00	-221.2
Global Warming Potential - (GWP-GHG)	kg CO2 eq	85.64	6.10	0.94	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.31	4.97	0.00	-27.36

Additonal Environmental impact per Deskpro, weight 53.2 kg																
Impact category	Unit	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C 1	C 2	C3	C 4	D
Particulate matter emissions (PM)	disease inc.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ionising radiation Human Health (IRP)	kBq U-235 eq	3.88	0.27	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.39	0.00	-0.71
Ecotoxicity, freshwater	CTUe	4646.12	10.90	3.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.55	387.73	0.00	-136.76
Human toxicity, cancer effect	CTUh	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Human toxicity, non-cancer effects	CTUh	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Land use related impacts	dimensionles	3042.17	0.46	2.35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	49.45	0.00	-74.36
Resource Use per Deskpro, weight 53.2 kg																
Impact category	Unit	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C 1	C 2	C3	C 4	D
Use of renewable primary energy carrier	MJ	764.36	0.11	0.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	7.07	0.00	-10.89
Use of renewable primary energy raw mtls	MJ	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total use of renewable primary energy	MJ	764.36	0.11	0.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	7.07	0.00	-10.89
Use of non-renewable prim energy carrier	MJ	526.67	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Use of non-ren. prim enrergy as raw mtls	MJ	1622.42	44.22	9.47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.21	59.69	0.00	-286.6
Total of non-ren. primary energy sources	MJ	2149.09	44.22	9.47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.21	59.69	0.00	-286.6
Use of Secondary Material	Kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Use of renewable Secondary fuels	MJ	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Use of non-renewable secondary fuels	MJ	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Net Use of Freshwater	m3	565.48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.00	-5.16

Output flows and waste categories per Deskpro, weight 53.2 kg																
Impact category	Unit	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C 1	C 2	C3	C 4	D
Hazardous waste disposed	kg	0.15	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00
Non-Hazardous waste disposed	kg	37.29	0.01	0.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	26.88	0.00	-5.07
Radioactive waste disposed	Kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Components for reuse	Kg	193.44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Materials for recycling	Kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Materials for energy recovery	Kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Exported Electrical Energy	MJ	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Exported thermal Energy	MJ	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

afc
FURNITURE SOLUTIONS

7. Results Interpretation

The comparison between different stages reveals that the A1-A3 stages, encompassing raw material supply, transportation, and manufacturing, have the most significant contribution across all categories. These stages alone account for nearly 40% of climate change impact and over 40% of acidification and eutrophication impacts.

Water use is predominantly driven by the product stage (A1-A3), with the remaining impact stemming from other stages such as A4 and packaging. However, the Resource recovery i.e. D stands out as the only phase with negative impacts. This is primarily because a significant portion of Deskpro is recycled, and salvaged parts can be easily reused in other desks, reducing the overall environmental burden.

The use stage has minimal contribution since it requires no energy or material resources, aligning with the negligible impact observed across all impact categories. While the end-of-life phase (C1-C4) has relatively low overall contribution,

it does exhibit noticeable impacts in certain categories, such as "Use of non-renewable primary energy as raw materials" and "Particulate matter emissions," when compared to the use phase.

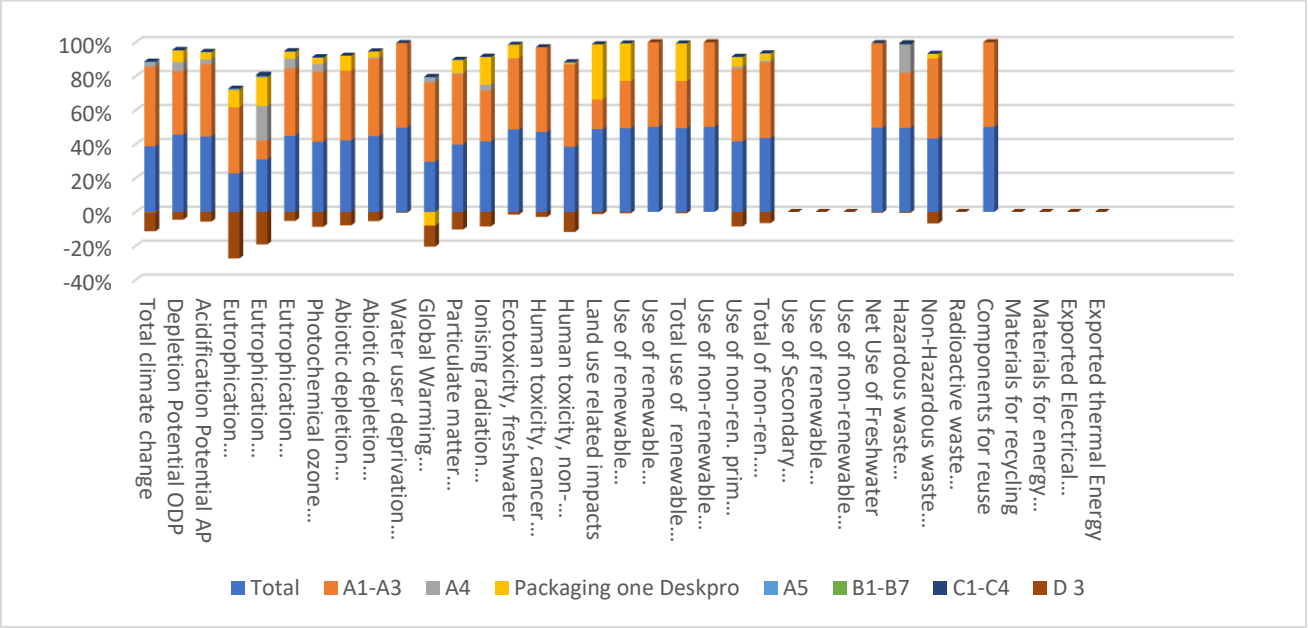


Figure 3 Contribution of each Life cycle phase in each category

8. References

1. ISO 14040: 2006 Environmental management -- Life cycle assessment -- Principles and framework
2. ISO 14044: 2006 Environmental management -- Life cycle assessment -- Requirements and guidelines
3. ISO 14025: 2006 Environmental labels and declarations -- Type III environmental declarations -- Principles and procedures
4. EN 15804:2012+A2:2019 Sustainability of construction works – Environmental product declarations - Core rules for the product category of construction products
5. The International EPD® System / www.environdec.com
6. The International EPD® System / The General Programme Instructions v3.01 / https://www.environdec.com/contentassets/95ee9211a9614f1faa7461ff32cecc91/general-programme-instructions-v3.01.pdf
7. The International EPD® System / PCR 2019:14 Construction products v1.1 (EN 15804:A2) / https://www.environdec.com/PCR/Detail/?Pcr=%2014759
8. Product Environmental Footprint Category Rules Guidance / https://ec.europa.eu/environment/eussd/smgp/pdf/PEFCR_guidance_v6.3.pdf
9. Ecoinvent 3.9.2 / http://www.ecoinvent.org/
10. SimaPro LCA Software / https://simapro.com/

afc FURNITURE SOLUTIONS