Life Cycle Assessment

of Cibes A5000 and Kalea A4 Primo

Title: Life Cycle Assessment of Cibes A5000 and Kalea A4 Primo
Date: 24/03/2022
Ordered by: Cibes Lift Group AB
Report number: 942
Name of database: Ecoinvent 3.8
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Ordered by: *Cibes Lift*
Cibes is a brand owned by Cibes Lift Group AB, Europe's leading manufacturer of space-saving, modular lifts known for its Swedish quality and design. The products are customized for both public and private markets. Sales, installation, and service are provided through the company's global network of subsidiaries and partners. Cibes, with its head office in Gävle, Sweden, has more than 1000 employees, a partner network in more than 70 countries and subsidiaries in about 20 countries.

Issued by: Miljögiraff AB
Miljögiraff is an environmental consultant specialising in Life Cycle Assessment and Ecodesign. We believe that a combination of analysis and creativity is necessary to meet today's challenges. Therefore, we provide Life Cycle Assessment to evaluate environmental aspects and design methods to develop sustainable solutions.

We create measurability in environmental work based on a life cycle perspective on ecological aspects. The LCA methodology establishes the basis for modelling complex systems of aspects with a credible assessment of potential environmental effects.

Miljögiraff is part of a global network of experts in sustainability metrics, piloted by PRé Sustainability.

Abbreviations and expressions

Clarification of expressions and abbreviations used in the report

CO_2 eq – Carbon dioxide equivalents
EPD – Environmental Product Declaration
GWP – Global Warming Potential
ISO – International Organization for Standardisation
IPCC – Intergovernmental Panel on Climate Change
LCA – Life Cycle Assessment
LCI – Life Cycle Inventory Analysis
LCIA – Life Cycle Impact Assessment
PCR - Product Category Rules
RER – The European region
RoW – Rest of the world
GLO – Global
APOS – Allocation at the point of substitution (system model in ecoinvent)
Cut-off – Allocation cut off by classification (system model in ecoinvent)

Environmental aspect - An activity that might contribute to an environmental effect, for example, "electricity usage".

Environmental effect - An outcome that might influence the environment negatively (Environmental impact), for example, "Acidification", "Eutrophication" or "Climate change".

Environmental impact - The damage to a safeguarding object (i.e., human health, ecosystems, health, and natural resources).

Life Cycle Inventory (LCI) data – Inventory of input and output flows for a product system

Abstract

Cibes Lift Group is a Swedish manufacturer of low-speed, screw driven platform lifts for use in public and private settings.

The study's goal was to find metrics for the environmental impact of Cibes lift A5000 and Kalea A4 Primo from a life cycle perspective. The report describes the results in a transparent and reproducible way according to the standard. The results are interpreted, followed by recommendations for mitigating the environmental impact. The purpose was product development and environmental communication in the form of an Environmental Product Declaration (EPD), and the intended audience of this report is thus both internal and external.

Miljögiraff has made a cradle-to-grave attributional LCA of the A5000 and Kalea A4 Primo lifts, which are installed in low-rise residential, commercial of public buildings. The lifts have a compact design and can be customised to fit in almost any space, enabling travel between two to six floors. The shaft is prefabricated which makes for an easy installation. Further specifications can be found in Table 7 in section 4.1. The LCA has been made according to the product category rules for construction products (PCR 2019:14) and the sub-PCR for lifts (c-008) in the international EPD system. Results are presented per functional unit ("transportation of a load over a distance, expressed as one tonne transported vertically over one kilometre, (i.e. 1 tonne*kilometre or tkm)") as well as over the whole lifetime of the lift (25 years).

The environmental impacts have been calculated at midpoint and endpoint according to the environmental footprint 3.0 and IPCC methodologies, respectively (see detailed results in section 5.1). Overall, most of the environmental impact can be attributed to the production of materials and components (module A1) as well as electricity consumption in the use phase (module B6). The environmental impact of the raw materials is dominated by resource use of minerals and metals and by climate impacts. The use-phase electricity consumption was calculated to be 4,83 MWh of electricity consumed over the lift's lifetime, RSL = 25 years. The majority (ca 85%) of this comes from stand-by energy use. The environmental impact of this electricity consumption is dominated by fossil resource use and climate impacts.

Miljögiraff suggests that Cibes can reduce environmental impacts, for instance, by ecodesign for using less material in the product or using more recycled materials, or by reusing and recycling the product and its components. Furthermore, the electricity consumption in use phase can be mitigated by improved energy efficiency, particularly of the standby-energy consumption, or by influencing customers to use clean energy to power their Cibes lift.

1 Introduction

This report presents the total environmental footprint for the A5000 lift, produced by Cibes Lift Group AB from a life cycle perspective following the ISO 14040 standard. The report also represents Kalea A4 Primo, which is an identical product but sold under a different brand name.

The LCA approach harmonises with the Product Environmental Footprint Category Rules published on 12 February 2019. The methodology used follows the General program instructions for the International EPD System (EPD International, 2021b), PCR 2019:14 version 1.11 and c-PCR-008 (EPD International, 2021a). These are in line with the international standards for LCA that apply to this context: EN15804:2012+A2:2019 (CEN, 2019), ISO 14025 (ISO, 2006a), ISO 14040 (ISO, 2006b), and 14044 (ISO, 2006c).

The purpose of using the LCA method is to understand the environmental impact from a holistic perspective, which enables the most effective opportunities to mitigate adverse effects and avoid burden shifting from one part of the lifecycle to another. A secondary purpose of the report is to act as a foundation for the publication of an EPD, to be used for external marketing purposes.

1.1 Reading guide to the report

Readers of this report can choose different parts to read, depending on their time availability:

- 5 minutes
  - Section 7 gives the briefest summary of the most relevant conclusions and recommendations.
- 10 minutes
  - Section 6 gives some more nuance/depth, including interpretation and sensitivity analysis that underpins the conclusions
- 20 minutes
  - Section 5 presents detailed results and flowcharts/diagrams for the different impact categories
- >30 minutes
  - For in-depth detail and transparent documentation on the modelling of each part of the life cycle, see section 4 (“Life Cycle Inventory”)
  - For information about methodology, scope and functional unit, see sections 2 (“Life Cycle Assessment”) and section 3 (“Goal and Scope”)

1.2 General description of the product and its context

The Cibes A5000 and Kalea A4 Primo lifts are screw-driven platform lifts for use in private and public environments. The lift has a compact design and can be customised to fit in almost any space, enabling travel between two to six floors. The shaft is prefabricated which makes for an easy installation.

1.3 General description of the subject

The industrial and natural systems depend on a stable Earth system. Steffen et al. (Steffen, W., K. Richardson, J. Rockström, S.E. Cornell, 2015) describe nine processes that determine the resilience and stability of the Earth system, such as climate change, water use, and land use. Crossing these boundaries increases the risk of abrupt and irreversible environmental change, while staying within the boundaries represents a safe operating space for a sustainable society, see Figure 1.

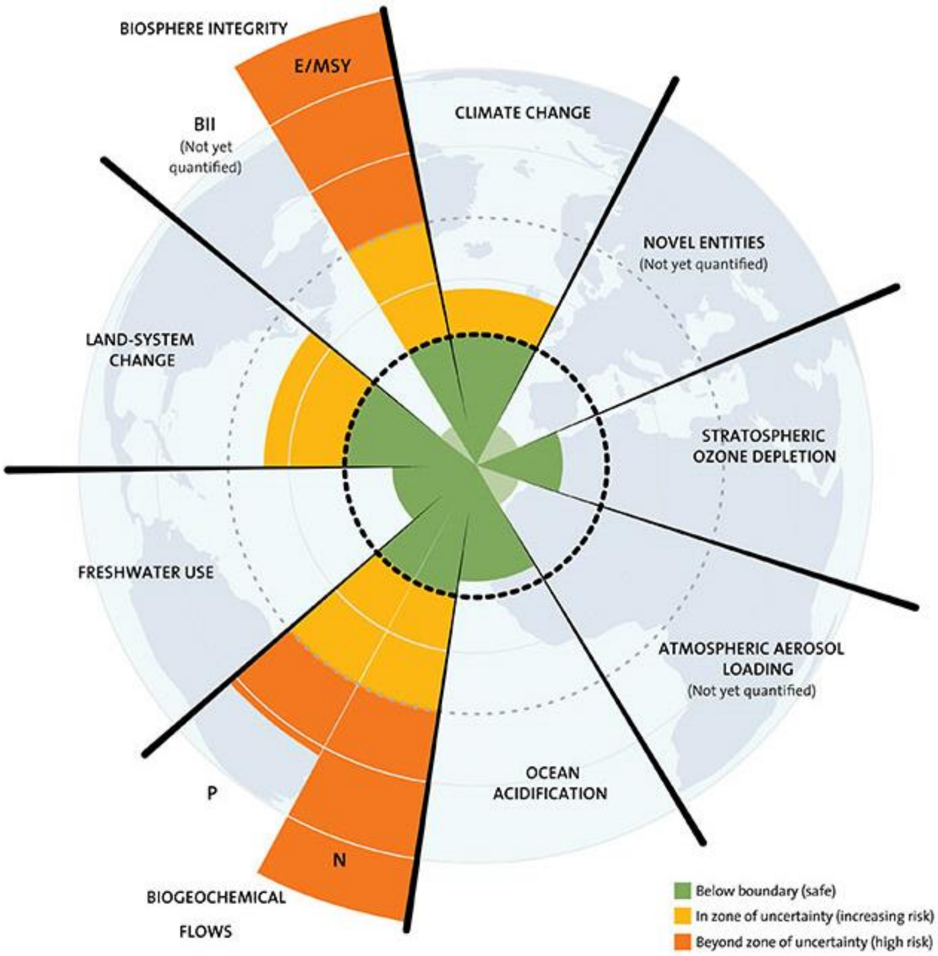

Figure 1: Estimates of how the control variables for the planetary boundaries have changed since 1950, where the green area represents a safe operating space. From J. Lokrantz/Azote based on Steffen et al. 2015.

In LCA, the effect of a product system on the environment and on human health is quantified. These quantifications are divided into different so-called impact categories that represent different types of environmental impact. Note that the division into categories in LCA is done according to a somewhat different logic compared to the planetary boundaries, see Appendix 1.

One of the most important examples of environmental impact is climate change. IPCC (IPCC, 2021) shows that the available space for mitigating radical climate change is ever-shrinking, necessitating decisive action in all parts of society. Figure 2 shows the projected temperature changes due to greenhouse gas emissions in the coming century, in 5 different scenarios where only the most ambitious one results in a temperature increase within 1,5°C.

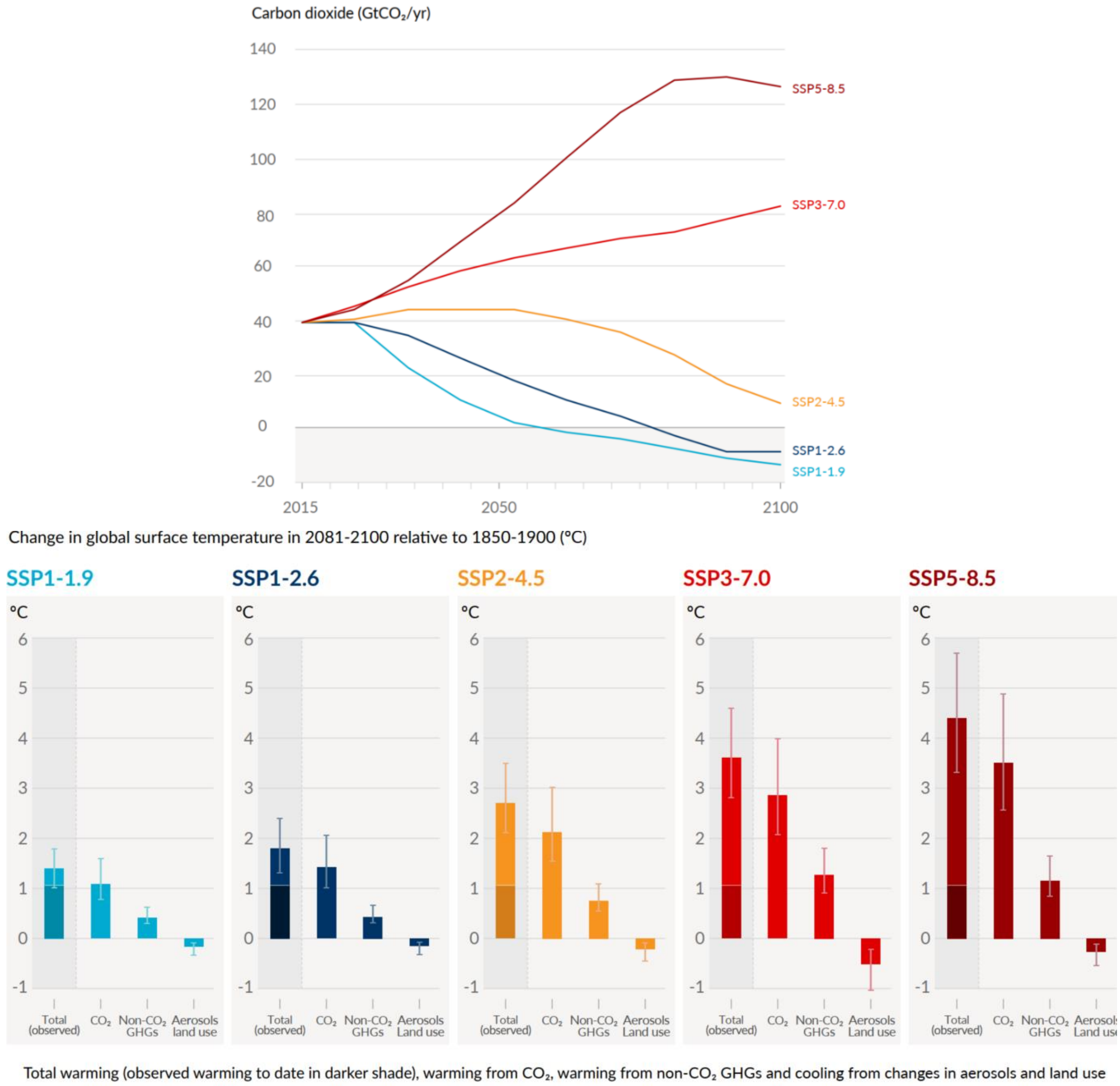

Figure 2: Future annual emissions of CO_2 (top) and contribution to global surface temperature increase from different emissions, with a dominant role of CO_2 emissions (bottom) across five illustrative scenarios (Image from IPCC (IPCC, 2021))

2 Life Cycle Assessment

The importance of potential environmental impacts associated with the manufacturing and use of products is continuously increasing. Therefore, organisations require a system perspective for finding the best environmental strategy for product and business development. The method for this is Life Cycle Assessment (LCA). It provides the backbone for strategy, management, and communication of environmental issues related to products. Actors can then combine different plans to develop products and business models (Wendin & Jakobsson, 2019).

The purpose is sustainable development. From a system perspective on products, the circularity of materials and energy keeps the system perpetual. Therefore, all incoming and outgoing flows of environmental importance throughout a product's life cycle are considered (see Figure 3), and the relevant impacts are measured. When combined in a complete system model, actors can use the LCA to show the environmental impacts per functional unit, allowing for comparison between alternatives.

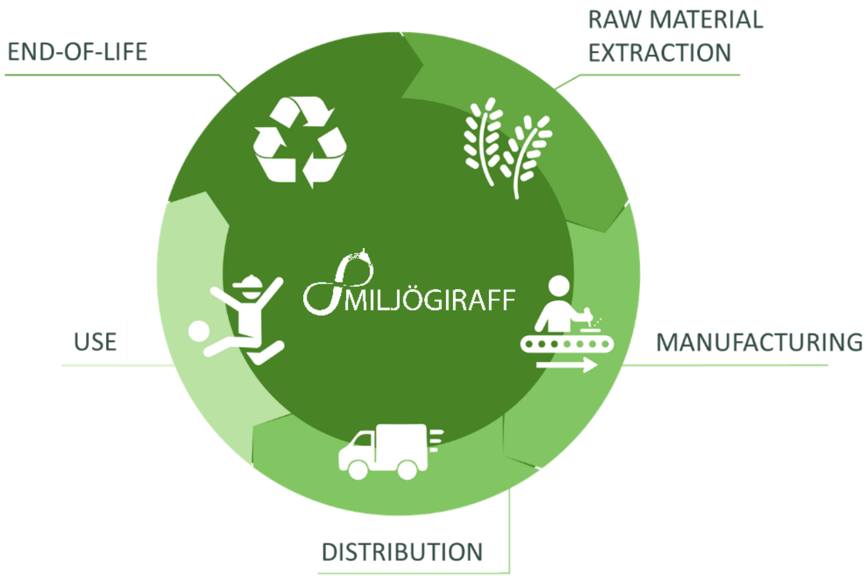

Figure 3: The Life Cycle concept, starting from raw material extraction, manufacturing, and distribution, followed by use and end-of-life.

Miljögiraff combines the confidence and objectiveness of the strong and accepted ISO standard with the scientific and reliable LCI data from ecoinvent and with the world-leading LCA software SimaPro for calculation and modelling (see Figure 4.).

Figure 4: ISO standard combined with reliable data from ecoinvent and the LCA software SimaPro.

Details on the ISO standards can be found in Appendix 5, LCA methodology and ISO 14040.

2.1 Limitations

Practitioners can only achieve the broad scope of analysing the entire life cycle of a product using a holistic approach at the expense of simplifying some aspects. Thus, the following limitations must be taken into account as summarised by Guinée et al. (2002):

- Localised aspects are typically not addressed, and LCA is not a local risk assessment tool
- LCA is typically a steady-state approach rather than a dynamic approach
- LCA does not include market mechanisms or secondary effects on technological development
- Processes are considered linear, both in the economy and the environment, meaning that impact increases linearly with increased production.
- LCA focuses on environmental aspects and excludes social, economic, and other characteristics
- LCA involves several technical assumptions and value choices that are not purely science-based

3 Goal and Scope

3.1 The aim of the study

The study's goal was to quantify the environmental impact of the lifts Cibes A5000 and Kalea A4 Primo, from a life cycle perspective. The report describes the results in a transparent and reproducible way according to the standard. The LCA has been made according to the product category rules for construction products (PCR 2019:14) and the sub-PCR for lifts (c-008) in the international EPD system. The results are interpreted, followed by recommendations for mitigating the environmental impact.

The purpose was product development and environmental communication in the form of an Environmental Product Declaration (EPD).

The intended audience of this report is both internal and external.

3.2 Scope of the Study

3.2.1 Name and Function of the Product/System

The scope of an LCA shall clearly specify the functions (performance characteristics) of the system being studied. In this study, the system studied was the life cycle of Cibes A5000 lift (from cradle to grave) and its function is to transport load between the floors of a building. The lift comes in different sizes (2-6 floors), and for this report, an average 2-floor version was modelled, which weighs ca 1110 kg (including packaging).

3.2.2 The Functional Unit and reference flow

The LCA results shall be presented per functional unit (f.u.) and the f.u. shall be consistent with the goal and scope of the study. One of the primary purposes of a functional unit is to provide a reference to which the input and output data are normalised.

The function of a lift is the transportation of persons and/or freight. For this study, in accordance with the PCR, the functional unit was thus defined to be the transportation of a load over a distance, expressed as one tonne transported vertically over one kilometre, (i.e. 1 tonne*kilometre or tkm).

The results were presented both per f.u. and over the whole lifetime of the lift.

3.2.3 System Boundary

The system boundary determines which modules and activities are included within the LCA. Figure 5 shows all the life cycle stages included in an LCA, divided into modules A-D.
The selection of the system boundary shall be consistent with the goal of the study. The practitioner chooses a system boundary to include all contributing processes for the system while facilitating the modelling and analysis of the system. Therefore, there may be reasons to exclude activities that contribute insignificantly to the environmental effects (so-called "cut-off"). However, the omission of life cycle stages, processes, inputs, or outputs is permitted if it does not significantly change the study's overall conclusions. The practitioner clearly states any decision to skip life cycle stages, processes, inputs, or outputs and must explain the reasons and implications for their exclusion.

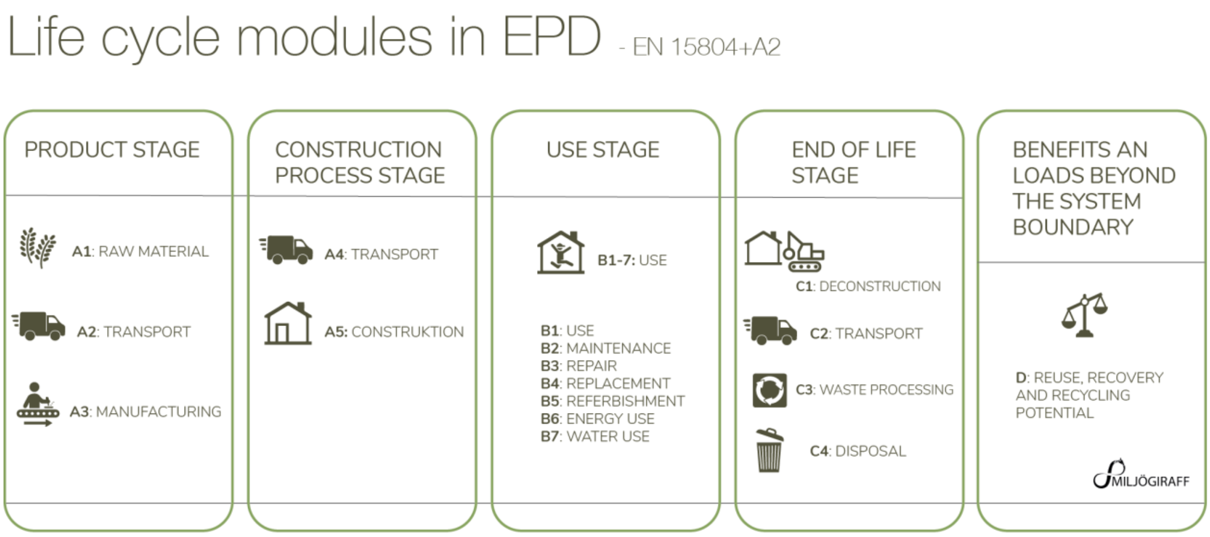

Figure 5: General summary of the modules included in an LCA, based on EN 15804.

This study goes from cradle to grave, and includes the D-module as well. That means that all processes needed for raw material extraction, manufacturing, transport, usage, and end-of-life are included in the study, as well as a calculation of the benefits from recycling. Figure 6 shows an overview of the model.

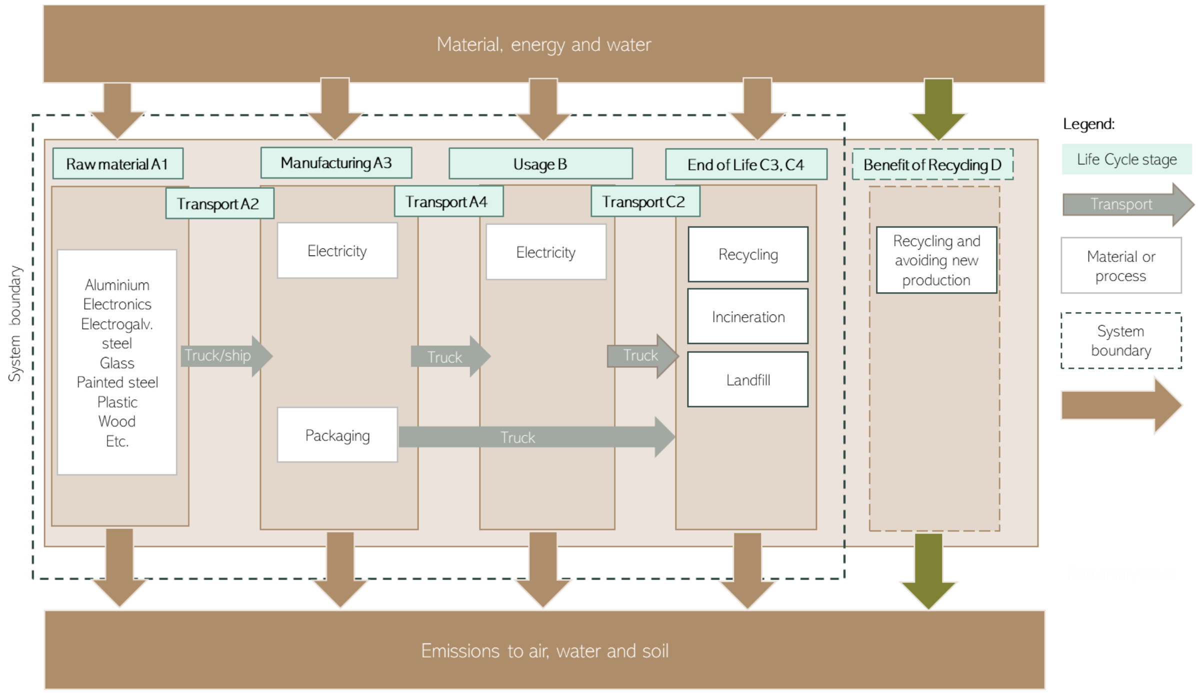

Figure 6: System boundaries for the model of the product system.

In this LCA, boundaries with other systems, and the allocation of environmental burdens between them, are based on the recommendations of the international EPD system[1], which are also in line with the requirements and guidelines of the ISO14040/14044 standards. Following these recommendations, the Polluter Pays (PP) allocation method is applied (see Figure 7). For allocation of

[1] EPD (Environmental Product Declarations) by EPD International®

environmental burdens when incinerating waste, all processes in the waste treatment phase, including emissions from the incineration, are allocated to the life cycle in which the waste is generated. Subsequent procedures for refining energy or materials to be used as input in a following/receiving process are allocated to the next life cycle.

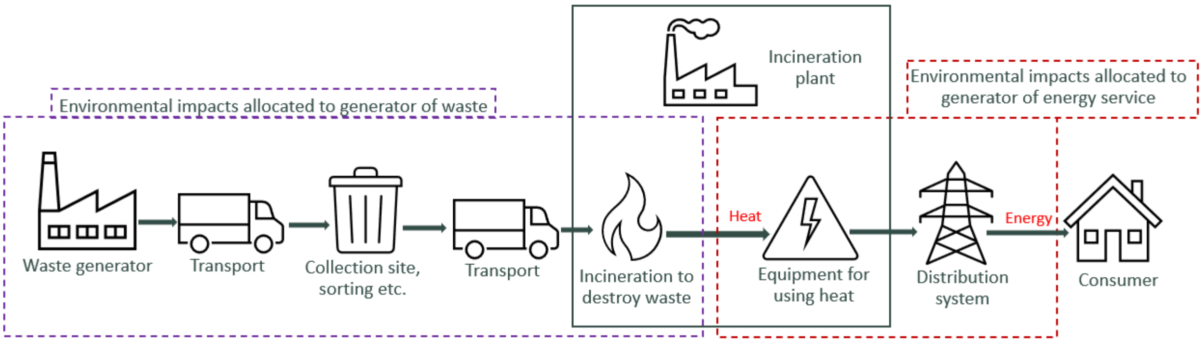

Figure 7: Allocation of environmental impacts between two life cycles according to the PP allocation method. Here in regards to incineration of waste and resulting energy products.

In the case of recycling, environmental burdens are accounted for outside of the generating life cycle. They have thus been allocated to the subsequent life cycle, which uses the recycled materials as input.

Avoided materials due to recycling are typically not considered in the main scenario, per the International EPD system's recommendation of the Polluter Pays Principle. In other words, only if the generating life cycle uses recycled material as input material will it account for the benefits of recycling.

However, avoided materials from recycling are in this report presented as separate environmental impacts and benefits, represented by the D-module, as recommended by EN15804.

3.2.4 Excluded parts and "cut-off"

The system model chosen in this report is the cut-off method where loads caused by a product are assigned only that product. The omission of life cycle stages, processes, inputs, or outputs is permitted if it does not significantly change the study's overall conclusions (Baumann & Tillman, 2004).

It is common to scan for the most critical factors (a "cut off" of 95% is a minimum) rather than being unnecessarily thorough. In general, LCA focuses on the essential flows, while the flows that can be considered negligible are excluded. By setting cut-off criteria, a specific and lower limit is defined for the order of the flows to be included. Flows below the limit can be assumed to have a negligible impact and are thus excluded from the study. For example, cut-off criteria can be determined for inflows concerning mass, energy, or outflows, e.g., waste.

In general, to ensure that all relevant environmental impacts were represented in the study, the following cut-off criteria were used:

Mass—If the flow was less than 1% of the cumulative mass of all the inputs and outputs of the LCI model, it was excluded, provided its environmental relevance was not a concern.
Energy—If the flow was less than 1% of the cumulative energy of all the inputs and outputs of the LCI model, it was excluded, provided its environmental relevance was not a concern.
Environmental relevance—If the flow met the above criteria for exclusion yet was thought to have a potentially significant environmental impact. It was evaluated with proxies identified by chemical and

material experts within Miljögiraff. If the proxy for an excluded material significantly contributed to the overall LCIA, more information was collected and evaluated in the system.

The sum of the neglected material flows did not exceed 5% of mass or 1% of energy.

In addition to cut-off of material- and energy flows, also entire life cycle stages can be excluded if they are deemed to be of low relevance or do not cause any negative environmental effects. An overview of processes that are included or excluded is presented in Table 1.

Table 1: Overview of aspects that are included or excluded.

Included	Excluded
Production of the components	Production of capital goods for manufacturing (machines and facilities)
Transport of components to manufacturing.	Transport to site for components weighing less than ca 10 kg
Electricity for manufacturing	Transport of products to retail and disposal.
Electricity consumption (user)	Disposal

3.2.5 Allocation procedure

The study shall identify the processes shared with other product systems and deal with them according to the stepwise procedure presented below. For this report, no allocations were made in specific data, but the procedure may still be relevant to understand:

- **Step 1**: Wherever possible, the allocation should be avoided by dividing the unit process into two or more sub-processes and collecting the input and output data related to these sub-processes or expanding the product system to include the additional functions related to the co-products.
- **Step 2**: Where allocation cannot be avoided, the inputs and outputs of the system should be partitioned between its different products or functions in a way that reflects the underlying physical relationships between them; i.e., they should reflect how the inputs and outputs are changed by quantitative changes in the products or functions delivered by the system.
- **Step 3**: Where physical relationship alone cannot be established or used as the basis for allocation, the inputs should be allocated between the products and functions in a way that reflects other relationships between them. For example, input and output data might be allocated between co-products in proportion to the economic value of the products.

When other allocations are used, it is expressed if it may be significant to the results. Allocation of waste is described in ISO 14044 section 4.3.4.3.3 (ISO, 2006c) and uses the method Allocation cut-off by classification in accordance with EPD guidelines (EPD International, 2021b).

3.2.6 Method of Life Cycle Impact Assessment (LCIA)

The LCIA methods are chosen to give a comprehensive and multifaceted picture of the environmental effects of the product's life cycle. In total, 19 different environmental effect categories will be used to provide different perspectives on the environmental burden.

The life cycle impact assessment (LCIA) was made with the LCA software SimaPro[2]. This software includes databases with generic LCI data (e.g., ecoinvent) and several readymade LCIA-methods. All these are well recognised scientific methods. The methods, impact categories, and indicators to be used are listed below. The methodology is further described in chapter 5.

The **Environmental Footprint 3.0 method** is the most recently updated and comprehensive method best adapted to all the environmental effects recommended by the PCR. Furthermore, Environmental Footprint 3.0 is especially harmonised with the demands from EN 15804:2012+A2:2019. More information about the impact assessment method can be found in Appendix 1.

For the single-issue climate change, the method **IPCC 2013 GWP 100 years** is used because it is the most established method that best describes climate change potential for gases contributing to the greenhouse effect. The category indicator is Global Warming Potential (GWP).

Another single-issue is Water Depletion, for which the **AWARE 1.01 method** (Boulay et al., 2018) is used. It is a method for regionalised assessment of a water scarcity footprint of a given region, depending on the region's available remaining water after satisfying the demand of ecosystems and human activities (Boulay et al., 2018).

The **CML method** is the reference for impact categories used in the international EPD system (EPD International, 2021b). It has two different sub-methods, CML 2001 baseline[3] and CML-IA non-baseline, to handle variations in different PCRs. The version is version 4.7 (Aug 2016).

For external communication, Environmental Product Declaration (EPD) is recommended. The General Program Instructions (EPD International, 2021b) and the Product Category Rules of EPDs are the primary basis for choosing which environmental effect categories to include. The methods used to calculate them are summarised below in Table 2-Table 6. The life cycle impact assessment (LCIA) was made with the LCA software SimaPro 9.3[4], developed by PRé Consultants. It is the world's leading LCA software chosen by industry, research institutes and consultants in more than 80 countries. SimaPro is a powerful tool for calculations of complex product systems and in-depth comparisons of life cycles with documentation that conform to the ISO 14000 standard. This software includes databases with generic LCI data (e.g. ecoinvent[5]) and several readymade LCIA-methods. The impact categories, category indicators and characterisation models used are determined by the demands stated in ISO 14040 (ISO, 2006b).

Table 2: Impact categories, indicators and methods used in the study. Construction products EN 15804:2012+A2:2019.

Impact category	Abbreviation	Category indicator	Method
Climate Change-total	GWP total	kg CO_2 equivalents	CML 2001 baseline version 4.7 (IPCC 2013 GWP 100)
Climate Change-fossil	GWP fossil	kg CO_2 equivalents	CML 2001 baseline version 4.7 (IPCC 2013 GWP 100)

[2] SimaPro Version 9.3 described at support.simapro.com

[3] CML-IA Characterisation Factors - Leiden University (universiteitleiden.nl)

[4] SimaPro Version 9.3 described at support.simapro.com.

[5] Ecoinvent 3.8, ecoinvent

Climate Change-biogenic[6]	GWP biogenic	kg CO_2 equivalents	CML 2001 baseline version 4.7 (IPCC 2013 GWP 100)
Climate Change-land use and land use change	GWP luluc	kg CO_2 equivalents	CML 2001 baseline version 4.7 (IPCC 2013 GWP 100)
Ozone-depleting gases	ODP20	CFC 11-equivalents	CML 2001 baseline version 4.7
Acidification potential (fate not included)')	AP	mol H+ eq	EF 3.0 based on ReCiPe 2008
Eutrophication aquatic freshwater	EP	kg P equivalents / kg	EF 3.0 based on ReCiPe 2008
Eutrophication aquatic marine	EP	kg N equivalents / kg	EF 3.0 based on ReCiPe 2008
Eutrophication aquatic terrestrial	EP	mol N equivalents / kg	EF 3.0 based on ReCiPe 2008
Photochemical ozone creation potential	POCP	kg NMVOC eq./ kg	EF 3.0 based on ReCiPe 2008
Abiotic resource depletion, elements	ADPe	kg Sb eq / kg	EF 3.0 based on ReCiPe 2008
Abiotic resource depletion, fossil fuels	ADPf	MJ	EF 3.0 based on ReCiPe 2008
Water Depletion	WD	m3	AWARE 1.01

Table 3: Additional environmental impact indicators and methods used in the study. SS-EN 15804:2012+A2:2019 (E).

Impact category	Indicator	Unit	Method
Particulate Matter emissions	Potential incidence of disease due to PM emissions (PM)	Disease incidence	EF 3.0 based on ReCiPe 2008
Ionising radiation, human health	Potential Human exposure efficiency relative to U235 (IRP)	kBq U235 eq.	EF 3.0 based on ReCiPe 2008
Eco-toxicity (freshwater)	Potential Comparative Toxic Unit for ecosystems (ETP-fw)	CTUe	EF 3.0 based on ReCiPe 2008
Human toxicity, cancer effects	Potential Comparative Toxic Unit for humans (HTP-c)	CTUh	EF 3.0 based on ReCiPe 2008
Human toxicity, non-cancer effects	Potential Comparative Toxic Unit for humans (HTP-nc)	CTUh	EF 3.0 based on ReCiPe 2008
Land-use related impacts/Soil quality	Potential soil quality index (SQP)	dimensionless	EF 3.0 based on ReCiPe 2008

[6] Removals of biogenic CO2 into biomass (with the exclusion of biomass of native forests) and transfers from previous product systems shall be characterised in the LCIA as –1 kg CO2 eq./kg CO2 when entering the product system. Emissions of biogenic CO2 from biomass and transfers of biomass into subsequent product systems (with the exclusion of biomass of native forests) shall be characterized as +1 kg CO2 eq./kg CO2 of biogenic carbon, see EN ISO 14067:2018, 6.5.2. (Swedish Standard Institute, 2020)

Table 4: Information on biogenic content.

Biogenic carbon content (1 kg = 44/12 kg CO2)	Unit per FU or DC
Biogenic carbon content in the product	Kg C
Biogenic carbon content in the accompanying packaging	Kg C

Table 5: Resource use to be declared in the study.

Resource	Unit
Use of renewable primary energy excluding primary energy resources used as raw material (PERE)	MJ
Use of renewable primary energy resources used as raw material (PERM)	MJ
Total use of renewable primary energy (PERT)	MJ
Use of non-renewable primary energy excluding primary energy resources used as raw material (PENRE)	MJ
Use of non-renewable primary energy resources used as raw material (PENRM)	MJ
Total use of non-renewable primary energy (PENRT)	MJ
Use of recycled or recycled materials (secondary materials)	Kg
Use of renewable secondary fuels	MJ
Use of non-renewable secondary fuels	MJ
Net use of freshwater	m3

Table 6: Waste materials to be declared in the study.

Rest materials	Unit
Hazardous waste	Kg
Non-hazardous waste	Kg
Radioactive waste, disposed/stored	Kg
Outputs, secondary materials and exported energy	
Material for reuse	Kg
Recycling material	Kg
Material for energy recovery	Kg
Exported energy	MJ

3.2.7 Interpretation

Interpretation of the results is made by identifying the data elements that contribute significantly to each impact category, evaluating the sensitivity of these significant data elements, assessing the completeness and consistency of the study, and drawing conclusions and recommendations based on a clear understanding of how the LCA was conducted, and how the results were developed.

3.2.8 Data requirements

Figure 8 shows the type of data to be collected for each process in the system. The data can be either specific or general, where specific means that all data concerning material, energy and waste are specifically modelled for the conditions at the manufacturing facility and the technology used. Generic data means that material or energy are represented using average LCI data from ecoinvent 3.8.

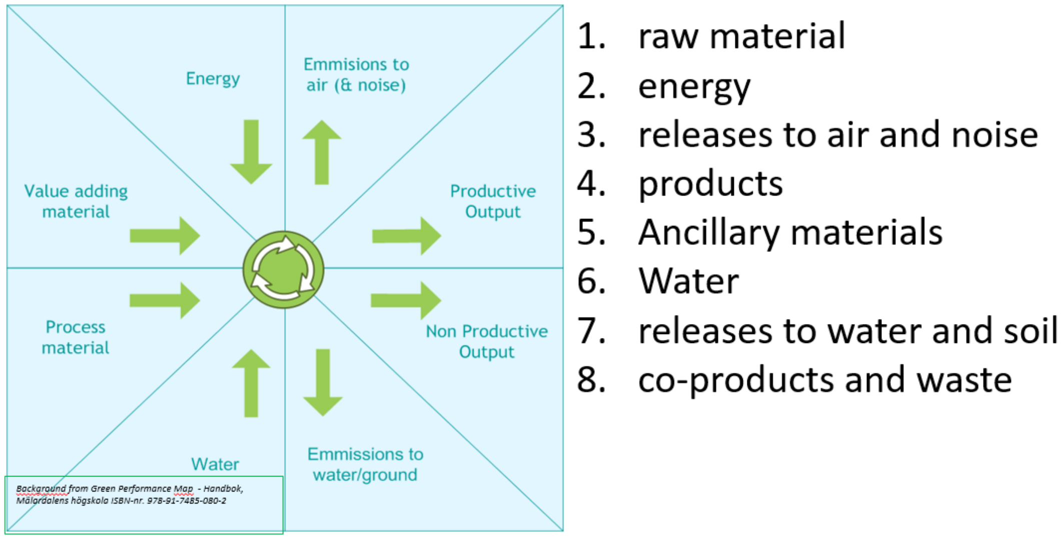

Figure 8: Environmental System Analysis as standard for data to be collected.

The following requirements are used for all the central LCI data. The more peripheral aspects may deviate from the DQI based on the rule for "cut off".

- Time period: 2014 and after
- Geography: The processes included in the data set are well representative for the geography stated in the "location" indicated in the metadata
- Technology: Average technology or BAT[7]
- Representativeness: Average from a specific process
- Multiple output allocation: Physical causality
- Substitution allocation: Not applicable
- Waste treatment allocation: Not applicable
- Cut-off rules: Less than 1% environmental relevance
- System boundary: Second order (material/energy flows including operations)
- The boundary with nature: Agricultural production is part of the production system

The level of depth depends on the availability of inventory data. Using general data from certified organisations, the fidelity and amount of Life Cycle Inventory (LCI) data increase significantly. However, it is crucial to understand that sole producers may differ considerably from general practice and average data.

In this report, a mix of specific and generic data were used. Specific data were collected from several suppliers of materials and components, on their material composition and energy consumption. The remaining raw materials were modelled with generic data, and all raw material models were regionalised depending on the country or geographical region the supplier comes from (see details in section 4.3). Specific data were used for the distances from suppliers to Cibes (A2), but selected generic data were used to represent the actual shipping emissions. The manufacturing stage (A3) was

[7] BAT (Best Available Technology or Best Available Techniques) signifies the latest stage in development of activities, processes and their method of operation which indicate the practical suitability of particular techniques as the basis of emission limit values, linked to environmental regulations, such as the European Industrial Emissions Directive (IED, 2010/75/EU). In determining whether operational methods are BAT, consideration is given to economic feasibility and the availability of techniques to carry out the required function. The BAT concept is closely related to BEP (Best Environmental Practice), which is the best environment-friendly company practice.

represented with specific data, based on Cibes' estimations. For the other life cycle stages, selected generic data were used.

More in detail, different types of data are used throughout the study, depending on the availability and quality of data.

Specific data
1. Environmental Product Declarations (type III)
2. Collected data (web format, site visits and interviews).
3. Reported data (EMS, Internal data systems or spreadsheets)

Selected generic data
1. Close proxy with data on a similar product
2. Statistics
3. Public documents

Generic data
1. Public and verified libraries with LCI data
2. Trade organisations libraries with LCI data
3. Sector-based IO data, national

3.2.9 Assumptions

Assumptions that are general to the entire LCA are:

- choice of energy model: (e.g. regional averages obtained from the Ecoinvent LCI database or according to specific conditions);
- Choice of transport model: (e.g. regional averages from Ecoinvent) or according to specific conditions calculated according to the Network for Transport and the Environment (NTM).
- Transport distances have been based on Google Maps for road transportation and a port routing tool (e.g. Sea Distances or Port World) for sea transports. Possible deviating routes have not been included in the calculations.
- Ecoinvent processes that contain market funds such as "Diesel burned in building machine {GLO} | market for | Cut-off, U" includes generic shipments from producer to end customer. Therefore, these data sets have no further transport.

Specific assumptions are presented in the section for the life cycle inventory, see chapter 4 Life cycle inventory (LCI).

3.2.10 Type of critical review, if any

This LCA report was externally reviewed by Hüdai Kara, Metsims.

4 Life cycle inventory (LCI)

In the inventory analysis, the product system is defined and described. Firstly, the material flows and relevant processes required for the product system are identified. Secondly, environmentally relevant data (i.e. resource inputs, emissions and product outputs) for the system components are collected and their amounts related to the defined functional unit.

The LCA model is parameterised to allow for changes to many parts of the model and allow for scenario analysis. The parameters occur on different levels, from process-specific to project and database (global).

4.1 Product specification

The PCR mandates the inclusion of the information in Table 7, which details some key information about the lift and its performance. In particular, note the parameter “Transportation performance” (TP), which expresses the amount of function (in ton*km) that the lift achieves during its lifetime (see calculation in Table 8 below).

Table 7: Mandatory product specifications, according to the PCR.

Index	Values	Representative values chosen in case of ranges
Type of installation	*New generic lift*	
Commercial name	*A5000 and Kalea A4 Primo*	
Main purpose	*Transport of passengers*	
Type of lift	*Platform lift (electric)*	
Type of drive system	*Screw and nut drive*	
Rated load (fixed or range)	*300-500 kg*	*400 kg*
Rated speed (fixed or range)	*0,15 m/s*	
Number of stops (fixed or range)	*2-6*	*2*
Travelled height (fixed or range)	*1-20 m*	*3,28 m*
Number of operating days per year (fixed or range)	*365 days*	
Applied usage category (UC) according to ISO 25745-2	*1*	*20 trips per day*
Designed Reference Service Life (RSL)	*25 years*	
Transportation performance (TP)	*19,71 tkm*	
Geographic region of intended installation	*Europe*	*The Netherlands*
Additional information		
Recommended application (main market) - Building rise (typical) - Building type	*Low-rise residential / commercial*	
Additional requirements	*NA*	
Standby power requirement	*24 W*	

The total amount of tkm fulfilled by the lift during its lifetime (known as transportation performance, TP) is calculated according to the PCR and ISO 25745-2, see Table 8. The LCA results per functional unit are then obtained by dividing all inputs and outputs by the TP.

Table 8: Calculation of transportation performance (TP), according to ISO 25745-2 and the certification report by Liftinstituut in Appendix 6.

Parameter	How to calculate	Calculation
TP = transportation performance	Average car load (Q_{av}) multiplied by the distance travelled by the lift during the service life (s_{RSL})	0,03 tonnes * 657 km = 19,71 tkm
Q_{av} = average car load	Rated load (in tonnes) multiplied by the corresponding percentage from Table 3 of ISO 25745–2	0,4 tonnes * 0,075 = 0,03 tonnes
s_{RSL} = Distance travelled by the lift during the service life	One-way average travel distance (s_{av}) * number of trips per day (n_d) * number of operating days per year (d_{op}) * Reference Service Life (RSL)	3,6 meters * 20 trips * 365 days * 25 years = 657 km

4.2 Product content declaration

This part describes all the different components, packaging materials and substances of very high concern.

Table 9: Content declaration

Product components	Weight (kg)	Recycled material (wt%)		Renewable material (wt%)
		Pre-consumer	Post-consumer	
Painted steel	668,3	2,6 %	0	0
Electrogalvanized steel	97,7	0	0	0
Aluminium	77,5	0	1,1 %	0
Electronics	59,8	0	0	0
Glass	44,0	0	0	0
Plastic	18,3	0	0	0
Door stopper	2,64	0	0	0
Glue/tape	2,33	0	0	0
Zink	0,81	0	0	0
Oil	0,71	0	0	0
Brass	0,54	0	0	0
Total	972,6	1,8%	0,1%	0 %
Packaging materials				
Packaging	137,4	0	0	88,8 %

Dangerous substances from the candidate list of SVHC for Authorisation	EC No.	CAS No.	Weight-% per functional or declared unit
Lead	231-100-4	7439-92-1	0,13 wt% per total lift weight

SVHC and the Candidate List of SVHC are available via the European Chemicals Agency[8].

[8] Candidate List of substances of very high concern for Authorisation - ECHA (europa.eu)

4.3 Raw material (A1 + A2)

The following section describes all the different raw materials needed for the manufacturing of Cibes A5000 lift. The section is divided into seven subsections (4.3.1 - 4.3.7), each corresponding to a different material, ordered according to their weight contribution, as in Table 9. Transportation data for the A2 module are presented in each respective table. It was modelled for all components weighing more than ca 10 kg, while the rest was either cut off or included in generic market processes in the Ecoinvent database.

4.3.1 Painted steel components

The painted steel components are summarised in Table 10.

Table 10: Painted steel components and their transport to the production site

Component (article number)	Weight (kg)	Described in section	Origin	Transport type	Transport distance (km)	Comment
Steel sheets (251829-VIT PLÅT + 251846-VIT-S2 PLÅT + 251849-VIT PLÅT)	310,6	4.3.1.1	Sweden/Finland	Euro 6 truck	320	148,99 + 89,92 + 71,65 = 311 kg. Specific data
Other steel (coloured)	91,3	4.3.1.1	Sweden/Finland	Euro 6 truck	320	Sum of all steel components (coloured) not specifically modelled. Proxy data
Lifting sheet (253660-S2)	132,0	4.3.1.2	Lithuania	Sea freight + Euro 6 truck	589 + 293	Generic data
Frame (6120-HV-S2)	74,8	4.3.1.3	Sweden	Euro 6 truck	45	37,4*2 = 74,8 kg. Generic data
Door (251911-8X20)	44,5	4.3.1.3	Sweden	Euro 6 truck	45	2*22,27 = 44,54 kg. Generic data
Upper screw attachment (237182)	15,1	4.3.1.4	Lithuania	Sea freight + Euro 6 truck	589 + 293	Generic data

4.3.1.1 Steel sheets and other steel (coloured)

The steel sheets (251829-VIT PLÅT + 251846-VIT-S2 PLÅT + 251849-VIT PLÅT) are made by painted steel and are produced by SSAB, who provided an EPD that acted as a black box in the model for Cibes lift. The EPD represents "metal coated steel sheets and coils" produced in Finland and is published in the international EPD system (SSAB, 2020).

The share of steel that was not part of the specific components listed in Table 10 was grouped into one category dubbed "other steel (coloured)". It was modelled in the same way as the steel sheets, assuming a similar type of steel as an approximation.

4.3.1.2 Lifting sheets

The lifting sheets (253660-S2) were modelled according to Table 11 (using the EPD described in section 4.3.1.1).

Table 11: Modelling details for 1kg of lifting sheets.

	Database process used	Database	Amount	Comment
Materials	Metal coated steel sheets and coils_Steel sheet_SSAB_FI (EPD)	EPD	0,9755 kg	Same EPD as described in section 4.3.1.1. The weight is 1 kg minus the weight of the coating layer (according to the input of coating powder to the powder coat ecoinvent process).
	Powder coat, steel {RER}| powder coating, steel | Cut-off, U	Ecoinvent 3.8	0,2544 m2	Using 0,254 m2/kg to convert from 1 kg of steel to m2 of powder coating needed for SSAB steel components in Cibes elevator
Processing	Energy and auxilliary inputs, metal working factory {RER}| market for energy and auxilliary inputs, metal working factory | Cut-off, U	Ecoinvent 3.8	0,9755 kg	Proxy for forming of the steel. Subtracting the weight of the coating layer (according to the input of coating powder to the powder coat ecoinvent process.
	Energy and auxilliary inputs, metal working factory {RER}| market for energy and auxilliary inputs, metal working factory | Cut-off, U	Ecoinvent 3.8	1 kg	Data representing further processing (laser, bending, welding)

4.3.1.3 Frame and door

The frame (6120-HV-S2) and the door (251911-8X20) were modelled in the same simplified way, using the SSAB steel from section 4.3.1.1 with an added powder coating and some generic further processing, see Table 12.

Table 12: Modelling details for 1kg of frame as well as 1 kg of door

	Database process used	Database	Amount	Comment
Materials	Metal coated steel sheets and coils_Steel sheet_SSAB_FI (EPD)	EPD	0,9755 kg	Same EPD as described in section 4.3.1.1. The weight is 1 kg minus the weight of the coating layer (according to the input of coating powder to the powder coat ecoinvent process).
	Powder coat, steel {RER}| powder coating, steel | Cut-off, U	Ecoinvent 3.8	0,2544 m2	Using 0,254 m2/kg to convert from 1 kg of steel to m2 of powder coating needed for SSAB steel components in Cibes elevator
Processing	Energy and auxilliary inputs, metal working factory {RER}| market for energy and auxilliary inputs, metal working factory | Cut-off, U	Ecoinvent 3.8	0,9755 kg	Proxy for forming of the steel. Subtracting the weight of the coating layer (according to the input of coating powder to the powder coat ecoinvent process.

4.3.1.4 *Upper screw attachment*

The upper screw attachment (237182) was modelled according to Table 13 (using the EPD described in section 4.3.1.1).

Table 13: Modelling details for 1kg of upper screw attachment.

	Database process used	Database	Amount	Comment
Materials	Metal coated steel sheets and coils_Steel sheet_SSAB_FI (EPD)	EPD	0,9755 kg	Same EPD as described in section 4.3.1.1. The weight is 1 kg minus the weight of the coating layer (according to the input of coating powder to the powder coat ecoinvent process).
	Powder coat, steel {RER}| powder coating, steel | Cut-off, U	Ecoinvent 3.8	0,2544 m2	Using 0,254 m2/kg to convert from 1 kg of steel to m2 of powder coating needed for SSAB steel components in Cibes elevator
Processing	Energy and auxilliary inputs, metal working factory {RER}| market for energy and auxilliary inputs, metal working factory | Cut-off, U	Ecoinvent 3.8	0,9755 kg	Proxy for forming of the steel. Subtracting the weight of the coating layer (according to the input of coating powder to the powder coat ecoinvent process.
	Energy and auxilliary inputs, metal working factory {RER}| market for energy and auxilliary inputs, metal working factory | Cut-off, U	Ecoinvent 3.8	1 kg	Data representing further processing (cutting, laser, welding, painting)

4.3.2 Electrogalvanized and other steel components

The electrogalvanized (and other) steel components are summarised in Table 14.

Table 14: Raw materials and transport to the production site

Component (article number)	Weight (kg)	Described in section	Origin	Transport type	Transport distance (km)	Comment
Lifting screw (253750)	34	4.3.2.1	France	Euro 6 truck	2270	2*17= 34 kg. Specific data.
Crossbar (250622)	20,26	4.3.2.2	Sweden	Euro 6 truck	162	4*5,065 = 20,26 kg. Generic data.
Bottom frame (253577-S2)	14,9	4.3.2.3	Ukraine	Euro 6 truck	2500	Generic data.
Ceiling (side) (239816-S2)	10,41	4.3.2.4	Sweden	Euro 6 truck	162	4*2,602 = 10,41 kg. Generic data.
Other steel (electrogalvanized)	18,14	4.3.2.5	Sweden	Euro 6 truck	162	Sum of all other galvanized steel components (electrogalvanized) not specifically modelled.

4.3.2.1 Lifting screw

The lifting screw (253750) is the screw that is driven by the drive package to lift the platform. The model is built on specific data from the supplier.

Table 15: Modelling details for 1 kg of lifting screw

	Database process used	Database	Amount	Comment
Materials	Steel, low-alloyed, hot rolled {RER}| production | Cut-off, U	Ecoinvent 3.8	1,006 kg	Secondary steel (according to Ecoinvent documentation)
	Lubricating oil {RER}| market for lubricating oil | Cut-off, U	Ecoinvent 3.8	0,0014 kg	Consumable. Proxy for Rolling oil, Anti-corrosive oil and Machining lubricant
	Sawnwood, board, softwood, dried (u=10%), planed {Europe without Switzerland}| market for sawnwood, board, softwood, dried (u=10%), planed | Cut-off, U	Ecoinvent 3.8	0,000109 m3	Packaging. Density 464,64 kg per m3 (Ecoinvent documentation)
Processing	Electricity, medium voltage {FR}| market for | Cut-off, U	Ecoinvent 3.8	0,465 kWh	Based on a full year of production, with all their customers (not only Cibes)

	Transport, freight, lorry 16-32 metric ton, euro6 {RER}| market for transport, freight, lorry 16-32 metric ton, EURO6 | Cut-off, U	Ecoinvent 3.8	15,09 kgkm	15 km distance from sub-supplier

4.3.2.2 *Crossbar*

The crossbar (250622) was modelled generically including a simplified representation of the production of the crossbar.

Table 16: Modelling details for 1 kg of crossbar

	Database process used	Database	Amount	Comment
Materials	Steel electrogalvanized steel/EU	Industry data 2.0	1 kg	Assumption to use electrogalvanised rather than hot-dip galvanised
Processing	Section bar rolling, steel {RER}| processing | Cut-off, U	Ecoinvent 3.8	1 kg	Proxy for forming of the steel into its final shape

4.3.2.3 *Bottom frame*

The bottom frame (253577-S2) was modelled generically including a simplified representation of the production of the frame.

Table 17: Modelling details for 1 kg of bottom frame

	Database process used	Database	Amount	Comment
Materials	Steel electrogalvanized steel/EU	Industry data 2.0	1 kg	
Processing	Energy and auxilliary inputs, metal working factory {RER}| market for energy and auxilliary inputs, metal working factory | Cut-off, U	Ecoinvent 3.8	1 kg	Proxy for "punching and bending"

4.3.2.4 *Ceiling (side)*

The ceiling (side) (239816-S2) was modelled generically including a simplified representation of the production process.

Table 18: Modelling details for 1 kg of ceiling (side)

	Database process used	Database	Amount	Comment

Materials	Steel, low-alloyed, hot rolled {GLO}| market for | Cut-off, U	Ecoinvent 3.8	1 kg	Approximation for untreated steel
Processing	Energy and auxilliary inputs, metal working factory {RER}| market for energy and auxilliary inputs, metal working factory | Cut-off, U	Ecoinvent 3.8	1 kg	

4.3.2.5 Other steel (electrogalvanized)

The share of electrogalvanized steel that was not part of the specific components listed in Table 14 was grouped into one category dubbed "other steel (electrogalvanized)". It was modelled in a simplified way, by using the process "Steel electrogalvanized steel/EU", from the database Industry data 2.0.

4.3.3 Aluminium components

The aluminium components are summarised in Table 19.

Table 19: Raw materials and transport to the production site

Component (article number)	Weight (kg)	Described in section	Origin	Transport type	Transport distance (km)	Comment
Guide profile (239941)	46	4.3.3.1	Sweden	Euro 6 truck	508	4*11,5 = 46 kg. Generic data.
Aluminium profile for glass (251916-2000/251917-800)	16	4.3.3.2	Sweden	Euro 6 truck	500	4*2,86 + 4,56 = 16 kg. Generic data.
Other aluminium	15,46	4.3.3.2	Sweden	Euro 6 truck	508	Sum of all aluminium components not specifically modelled. Approximated with the same generic model as the guide profile

4.3.3.1 Guide profile

The guide profile (239941) provides tracks directing the movement of the platform. It was modelled with generic data, except for the 1,9% of post-consumer recycled material which was modelled with an input of aluminium scrap.

Table 20: Modelling details for 1 kg of guide profile

	Database process used	Database	Amount	Comment
Materials	Aluminium, primary, ingot {IAI Area, EU27 & EFTA}| market for | Cut-off, U	Ecoinvent 3.8	0,981 kg	Proxy due to lack of info
	Aluminium scrap, post-consumer {GLO}| aluminium scrap, post-consumer, Recycled Content cut-off | Cut-off, U	Ecoinvent 3.8	0,019 kg	1,9% recycled from post-consumer waste
Processing	Impact extrusion of aluminium, 3 strokes {GLO}| market for | Cut-off, U	Ecoinvent 3.8	1 kg	Proxy due to lack of info

4.3.3.2 Aluminium profile for glass and other aluminium

The aluminium profile (251916-2000/251917-800) surrounding the glass boards was modelled generically as in Table 21. All other aluminium was modelled in the same way.

Table 21: Modelling details for 1 kg of aluminium profile for glass (as well as other aluminium)

	Database process used	Database	Amount	Comment
Materials	Aluminium, primary, ingot {IAI Area, EU27 & EFTA}| market for | Cut-off, U	Ecoinvent 3.8	1 kg	Proxy due to lack of info
Processing	Impact extrusion of aluminium, 3 strokes {GLO}| market for | Cut-off, U	Ecoinvent 3.8	1 kg	Proxy due to lack of info

4.3.4 Electronics

The electronic components are summarised in Table 22.

Table 22: Raw materials and transport to the production site

Component (article number)	Weight (kg)	Described in section	Origin	Transport type	Transport distance (km)	Comment
Electric motors (1042-OBROMS/3017)	23,12	4.3.4.1	Sweden	Euro 6 truck	162	Combined weight of all motors (17,26 + 3,79 + 1.07 = 23,12 kg). Generic data.
Drive package (254560)	21,85	4.3.4.2	Cut off (<5 km)			Specific data.
Cables (TW20-6)	11,71	4.3.4.3	Cut off (low weight)			The largest cable was modelled (per kg) and is here used to represent all cables in the elevator. Specific data.
Battery (3016)	1,335	4.3.4.4	China	Sea freight + Euro 6 truck	20434 + 698	Specific data.
Circuit board with aluminium profile	0,41	4.3.4.5	Cut off (low weight)			Sum of all circuit boards, where the model for one board (CILOW) is used to represent all circuit boards. Specific data.

4.3.4.1 Electric motors

The motors included in the lift were a 2,2 kW brakeless motor (1042-OBROMS), weighing 17,26 kg, and an emergency descent motor (3017), weighing 3,79 kg. A solenoid (3192), 1,07 kg, was included in this model as well, as an approximation.

Due to a lack of specific data, the electric motors were modelled generically, using the process “Electric motor, vehicle {RER}| production | Cut-off, U” in the Ecoinvent 3.8 database as an approximation for all three motors.

4.3.4.2 Drive package

The drive package, including brakes (254560) is what drives the lift screw and moves the lift platform. It was modelled based on specific data from the supplier, see Table 23 and Table 24. The model assumes a rate of production waste of 17% for all input materials except for the bronze, for which the production waste is remelted and fed back into production (i.e. 0% production waste).

Table 23: Modelling details for 21,852 kg of drive package (including brakes)

	Database process used	Database	Amount	Comment
Materials	Steel hot-dip galvanised coil/EU	Industry data 2.0	0,024603 kg	HGS-5-FZB (Hot-dip galvanized from Ahlsell (likely) (Ahlsell, 2022)
	Steel welded pipe/EU	Industry data 2.0	0,098032 kg	Tube SSEN10305 (Standard for "cold drawn steel tubes" (SIS, 2016)
	Steel, unalloyed {GLO}| market for | Cut-off, U	Ecoinvent 3.8	8,345967 kg	520MW+ (Steel rod ("micro-alloyed"). (TIBNOR, 2022)
	Steel, unalloyed {GLO}| market for | Cut-off, U	Ecoinvent 3.8	7,710084 kg	S235 JRG2 (Unalloyed steel: Standard: (SIS, 2019) Name/designation: (Bofors, 2011)
	Bronze JM5	-	3,357 kg	See Table 24 below. 55% waste is internally recycled and is thus ignored in this model.
	Aluminium, primary, ingot {IAI Area, EU27 & EFTA}| market for | Cut-off, U	Ecoinvent 3.8	0,164648 kg	AW 6082 T6
	Polyoxymethylene (POM)/EU-27	Industry data 2.0	0,01514 kg	POM
	Polyethylene terephthalate, granulate, bottle grade {CH}| polyethylene terephthalate, granulate, bottle grade, recycled to generic market for bottle grade PET granulate | Cut-off, U	Ecoinvent 3.8	0,03028 kg	CB PET-HP (Thermoplastic polyester (Christian Berner, 2022))
	Acrylonitrile-butadiene-styrene copolymer {GLO}| market for | Cut-off, U	Ecoinvent 3.8	0,26695 kg	O-ring + Kilrem + Bälj (damask) + Buntband + Oil cont front, cover
	Polyurethane, rigid foam {RER}| market for polyurethane, rigid foam | Cut-off, U	Ecoinvent 3.8	0,015 kg	Cellfoam Sponge EX 325
	Electromagnet (Electric motors (1042-OBROMS/3017))	-	1,496 kg	Proxy for Electro magnet GCT-80-15W-24/V2050 Semi-stripped. See section 4.3.4.1)
	Electronics, for control units {GLO}| market for | Cut-off, U	Ecoinvent 3.8	0,104 kg	Proxy for Inductive sensor
	Polyvinyl chloride, from suspension process, S-PVC, at plant/RER	Industry data 2.0	0,414 kg	Gränslägeskopplare (kontaktblock) + Attachment plate (Plastic PVC 100 Shore 00017)

Processing	Electricity, medium voltage {SE}| market for | Cut-off, U	Ecoinvent 3.8	11 kWh	1,5 kWh for machines and 9,5 kWh for surface treatment (Estimated from p.57 of (Nordic Galvanizers, 2019)
Production waste	Scrap steel {Europe without Switzerland}| market for scrap steel | Cut-off, U	Ecoinvent 3.8	6,98 kg	17,5% scrap rate (0,01589708+0,004305459+0,017155599+ 4,103+1,460544225+0,028813458+1,349264665)
	Scrap aluminium {Europe without Switzerland}| market for scrap aluminium | Cut-off, U	Ecoinvent 3.8	0,028 kg	17,5% scrap rate
	Waste plastic, mixture {SE}| market for waste plastic, mixture | Cut-off, U	Ecoinvent 3.8	0,008 kg	17,5% scrap rate (0,002649513+0,005299027)

Bronze was modelled in a simplified way, by simply using generic representations for each of the major constituent materials. The material composition used followed the data on the data sheet from (Johnson Metall, 2022).

Table 24: Modelling details for bronze

	Database process used	Database	Amount	Comment
Materials	Copper, cathode {GLO}| market for | Cut-off, U	Ecoinvent 3.8	0,8 kg	78-82%
	Lead {GLO}| market for | Cut-off, U	Ecoinvent 3.8	0,09 kg	8-11%
	Tin {GLO}| market for | Cut-off, U	Ecoinvent 3.8	0,1 kg	9-11%
	Zinc {GLO}| market for | Cut-off, U	Ecoinvent 3.8	0,02 kg	2%

4.3.4.3 Cables

Specific data on material composition for the cables were provided by the supplier, which was complemented by generic data on forming/processing. As an approximation, the largest cable (TW20-6) was modelled and used to represent all cables in the lift, see Table 25.

Table 25: Modelling details for 1,79 kg of the biggest cable (TW20-6), used to represent all cables in the lift.

	Database process used	Database	Amount	Comment
Materials	Copper, cathode {GLO}| market for | Cut-off, U	Ecoinvent 3.8	0,7465 kg	
	Polyvinylchloride, bulk polymerised {RER}| polyvinylchloride production, bulk polymerisation | Cut-off, U	Ecoinvent 3.8	1,044 kg	

	Polyamide (Nylon) 6.6/EU-27	Industry data 2.0	0,0005 kg	
Processing	Wire drawing, copper {GLO}| market for | Cut-off, U	Ecoinvent 3.8	0,7465 kg	
Production waste	Waste polyvinylchloride {Europe without Switzerland}| market group for waste polyvinylchloride | Cut-off, U	Ecoinvent 3.8	0,1	Cut cable ends

4.3.4.4 *Battery*

The battery (3016) was modelled based on specific data from the supplier, see Table 26.

Table 26: Modelling details for 1,335 kg of battery. Production waste is internally recycled and thus ignored in this model.

	Database process used	Database	Amount	Comment
Materials	Lead {RoW}| treatment of scrap acid battery, remelting | Cut-off, U	Ecoinvent 3.8	0,95 kg	
	Glass fibre {RoW}| production | Cut-off, U	Ecoinvent 3.8	0,035 kg	
	Acrylonitrile-butadiene-styrene copolymer {RoW}| production | Cut-off, U	Ecoinvent 3.8	0,1 kg	Reported as 100% recycled, but here modelled conservatively with 0% recycling
	Sulfuric acid {RoW}| production | Cut-off, U	Ecoinvent 3.8	0,25 kg	
	Tap water {RoW}| market for | Cut-off, U	Ecoinvent 3.8	1 kg	
Processing	Transport, freight, lorry 16-32 metric ton, euro6 {RoW}| market for transport, freight, lorry 16-32 metric ton, EURO6 | Cut-off, U	Ecoinvent 3.8	244 kgkm	Transports reported as "Truck", approximated by euro6 truck. Distances: Lead - 40 km Glass fibre - 600 km ABS - 600 km Sulfuric acid - 500 km
	Electricity, medium voltage {CN}| market group for | Cut-off, U	Ecoinvent 3.8	0,15 kWh	

4.3.4.5 *Circuit board with aluminium profile*

All five circuit boards were approximated with the material composition of the largest circuit board (CILOW, 3105). The model was built on specific data from the supplier, see Table 27.

Table 27: Modelling details for 0,17992 kg of circuit board with aluminium profile (CILOW)

	Database process used	Database	Amount	Comment
Materials	Aluminium profile	-	0,0776 kg	The model of aluminium profile from 4.3.3.2 was used as proxy for Profil Alu TS35
	Synthetic rubber {RoW}| production | Cut-off, U	Ecoinvent 3.8	0,00132 kg	0,12 meters of Cell rubber string 6mm (weight 0,011 kg per meter)
	Capacitor, for surface-mounting {GLO}| production | Cut-off, U	Ecoinvent 3.8	0,0001 kg	2 of Ceramic capacitor1206 (weight 0,00001 kg) and 40 of Ceramic capacitor 0603 (weight 0,000002 kg)
	Electric connector, wire clamp {GLO}| production | Cut-off, U	Ecoinvent 3.8	0,0372 kg	5 of Contact 2-pole 3.81 mm (weight 0,001 kg), 4 of Contact 3-pole 3.81 mm (weight 0,00125 kg), 1 of Contact 4-pole 3.81 mm (weight 0,002 kg), 1 of Contact 6-pole 3.81 mm (weight 0,0025 kg), 1 of Contact 8-pole 3.81 mm (weight 0,004 kg), 1 of Relay 2-pole 24V safety (weight 0,0187 kg)
	Diode, glass-, for surface-mounting {GLO}| production | Cut-off, U	Ecoinvent 3.8	0,000294 kg	1 of Diode 4004 (weight 0,00001 kg), 2 of Diode 60V, 2A (weight 0,0001 kg), 21 of Diode SOD323 (weight 0,000004 kg)
	Integrated circuit, logic type {GLO}| production | Cut-off, U	Ecoinvent 3.8	0,000053 kg	1 of IC MCP9700 (weight 0,000004 kg), 1 of IC OP Zero Drift (weight 0,000004 kg), 1 of IC PIC32_695_BGA (weight 0,00002 kg), 1 of IC MCP16331 (weight 0,000006 kg) , 1 of IC Reset 3.3V (weight 0,000003 kg), 2 of IC SOT23 (weight 0,000016 kg)
	Inductor, low value multilayer chip {GLO}| production | Cut-off, U	Ecoinvent 3.8	0,00116 kg	1 of Inductor 15 uH, 500 mA (weight 0,0008 kg), 9 of Inductor 1206
	Light emitting diode {GLO}| production | Cut-off, U	Ecoinvent 3.8	0,000024 kg	8 of LED 0603 (weight 0,000003 kg)
	Silicone product {RoW}| production | Cut-off, U	Ecoinvent 3.8	0,005 kg	Proxy for oscillator (which seems to be made of quartz: 1 of Oscillator 16 MHz Metal can (weight 0,005)
	Polyethylene terephthalate, granulate, amorphous {RER}| production | Cut-off, U	Ecoinvent 3.8	0,02165 kg	Proxy for plastic components: 1 of Overlay PCB Cilow_10 (weight 0,00325 kg), 2 of Plastic TS35Box end (weight 0,0092 kg, from "0.0046 kg ==> 2 X 0.0046 = 0.0092 kg")

	Printed wiring board, for surface mounting, Pb free surface {GLO}| production | Cut-off, U	Ecoinvent 3.8	0,007822 m2	1 of Printed Circuit Board (PCB) FR4 epoxy (weight 0,0255 kg, which equals 0,00782 m2, using the density of 3,26 kg per m2 from the ecoinvent documentation)
	Resistor, surface-mounted {GLO}| production | Cut-off, U	Ecoinvent 3.8	0,001172 kg	92 of Resistor 0603 (weight 0,000002 kg), 19 of Resistor 1206 (weight 0,00004 kg), 10 of Fuse Poly 1206 PTC Resistor (weight 0,00002 kg), 19 of Resistor 1206 (weight 0,000002 kg), 7 of Varistor 1206 (weight 0,000004 kg)
	Transistor, surface-mounted {GLO}| production | Cut-off, U	Ecoinvent 3.8	0,008404 kg	5 of Transistor PowerPAK 1212 (weight 0,001 kg), 13 of Transistor SOT23 (weight 0,000008 kg), 10 of Transistor TO252 (weight 0,00033 kg)
Processing	Mounting, surface mount technology, Pb-free solder {GLO}| mounting, surface mount technology, Pb-free solder | Cut-off, U	Ecoinvent 3.8	0,0235 m2	

4.3.5 Glass window

The glass window (239933-8X20) was modelled in a simplified way, using the ecoinvent process "Flat glass, uncoated {RER}| market for flat glass, uncoated | Cut-off, U". Any production waste is cut off.

4.3.6 Plastic components

The plastic components are summarised in Table 28.

Table 28: Raw materials and transport to the production site

Component (article number)	Weight (kg)	Described in section	Origin	Transport type	Transport distance (km)	Comment
Cellplastic (7218)	5,46	4.3.6.1	Cut off (low weight)			Specific data.
Flooring (2996)	4,22	4.3.6.2	Cut off (low weight)			Specific data.
Other plastic	8,62	4.3.6.3	Cut off (low weight)			Sum of all plastic components not specifically modelled.

4.3.6.1 Cellplastic

The cellplastic (7218) was modelled using an EPD from the supplier that acted as a black box in the model for Cibes lift. The EPD represents EPS80 (EPS Sverige, 2020). It was converted from EPS80 to EPS200 by using the conversion factor of 1,88 given in the EPD. The numbers were also converted from the declared unit of 1 m2 into kg, by using a thickness of 38mm and a density 30 kg/m3 (Jablite, 2022).

4.3.6.2 Flooring

The flooring (2996) was modelled based on specific data from the supplier, as seen in Table 29.

Table 29: Modelling details for 4,22 kg of flooring

	Database process used	Database	Amount	Comment
Materials	Polyvinylchloride, suspension polymerised {RER}| polyvinylchloride production, suspension polymerisation | Cut-off, U	Ecoinvent 3.8	3,503 kg	Plastisol modelled as a suspension polymerised PVC
	Silicon carbide {RER}| production | Cut-off, U	Ecoinvent 3.8	0,1038 kg	Silicon carbide content of Scatter. As a simplification assumed to stand for a third of Scatter weight

	Silica sand {DE}| production | Cut-off, U	Ecoinvent 3.8	0,1038 kg	Quartz content of Scatter, modelled as Silica sand. As a simplification assumed to stand for a third of Scatter weight
	Polyvinylchloride, bulk polymerised {RER}| polyvinylchloride production, bulk polymerisation | Cut-off, U	Ecoinvent 3.8	0,1038 kg	PVC content of Scatter. As a simplification assumed to stand for a third of Scatter weight
	Glass fibre reinforced plastic, polyester resin, hand lay-up {RER}| production | Cut-off, U	Ecoinvent 3.8	0,07784 kg	Scrim is a glass fibre reinforced polyester weave
	Acrylic binder, without water, in 34% solution state {RER}| acrylic binder production, product in 34% solution state | Cut-off, U	Ecoinvent 3.8	0,1359 kg	Adhesive made from water-based modified acrylic, modelled here as acrylic binder (multiplied by 0,34 to account for the ecoinvent model excluding water content)
	Lubricating oil {RER}| market for lubricating oil | Cut-off, U	Ecoinvent 3.8	0,000304 kg	Approximation of consumable: Hydraulic oil, Shell Tellus MX 46. Transport included in market process.
Processing	Transport, freight, lorry 16-32 metric ton, EURO6 {RER}| transport, freight, lorry 16-32 metric ton, EURO6 | Cut-off, U	Ecoinvent 3.8	2567 kgkm	Transport of adhesive (482 km) and other parts (610 km)
	Electricity, medium voltage {SE}| market for | Cut-off, U	Ecoinvent 3.8	0,0533 kWh	
Production waste	Waste polyvinylchloride {CH}| treatment of, municipal incineration with fly ash extraction | Cut-off, U	Ecoinvent 3.8	0,062 kg	Approximation for production waste which is mostly PVC
	Municipal solid waste {SE}| treatment of, incineration | Cut-off, U	Ecoinvent 3.8	0,007 kg	Proxy for incineration of waste adhesive

4.3.6.3 Other plastic

All plastic components except the cellplastic and the flooring were grouped into one category called “other plastic”. This was simply modelled with the process “Polyethylene terephthalate, granulate, bottle grade {GLO}| market for | Cut-off, U” in the Ecoinvent 3.8 database.

4.3.7 Other components

Once all of the components and materials described in sections 4.3.1-4.3.6 were modelled, there remained a number of smaller components that were grouped into the category "other components". These were modelled generically, as seen in Table 30, except for the glue which was modelled with specific data (see Table 31 below), and the door closer, which was based on an EPD.

Table 30: Modelling details for other components and materials

Material	Weight (kg)	LCI database representation	Database	Comment
Door closer	2,64	-	EPD	This model simply uses an EPD for door closers by ARGE/GEZE (GEZE, 2016). It was complemented by 200 km of transportation to site.
Glue (3188)	2,33	-	-	See Table 31 below
Zinc	0,81	Zinc {GLO}| market for | Cut-off, U	Ecoinvent 3.8	Sum of all zinc components, approximated with a generic process
Lubricating oil	0,71	Lubricating oil {RER}| market for lubricating oil | Cut-off, U	Ecoinvent 3.8	Sum of all lubricating oil, approximated with a generic process.
Brass	0,54	Brass {CH}| market for brass | Cut-off, U	Ecoinvent 3.8	

Table 31: Modelling details for 1 kg of glue (3188)

	Database process used	Database	Amount	Comment
Materials	Aliphatic Isocyanates, at producer/EU-27	Industry data 2.0	0,53 kg	Approximation for "prepolymer based on aromatic polyisocyanat" (CAS: 67815-87-6)
	Methylene diphenyl diisocyanate {RER}| market for methylene diphenyl diisocyanate | Cut-off, U	Ecoinvent 3.8	0,33 kg	Approximation for difenylmetan-4,4'-diisocyanat (CAS: 101-68-8) and difenylmetan-2,4'-diisocyanat (CAS: 5873-54-1)
	Formaldehyde {RER}| market for formaldehyde | Cut-off, U	Ecoinvent 3.8	0,14 kg	Approximation for "oligomeric MDI" (CAS: 32055-14-4)

	Polyethylene, high density, granulate {Europe without Switzerland}| polyethylene, high density, granulate, recycled to generic market for high density PE granulate | Cut-off, U	Ecoinvent 3.8	0,0509 kg	Packaging
	Steel, low-alloyed {GLO}| market for | Cut-off, U	Ecoinvent 3.8	0,0889 kg	Packaging. Approximation for steel drum
	Tap water {RER}| market group for | Cut-off, U		19,39 kg	
Processing	Electricity, medium voltage {DE}| market for | Cut-off, U	Ecoinvent 3.8	16,35 kWh	Approximation for 14,19 kWh "non renewable fuel energy from German power grid" plus 1,45 "renewable energy from German power grid". They also reported "9 kWh fuel energy feedstock from parent process", but it was excluded since it is presumably included in the parent processes

4.4 Manufacturing (A3)

In this chapter, the activities carried out by Cibes to assemble the lift are presented. All activities are presented per one lift.

4.4.1 Energy

Energy consumption in manufacturing comes from assembling the different parts of the lift. The amount of 112,5 kWh is a rough estimate by Cibes based on reported energy requirements for assembly of other elevator modules on market. The elevator is divided into 5 parts, each requiring 20-25 kWh to assemble: Pre-assembly, Doors, Fronts, Drive package and Platform.

Table 32: Energy use in production

Energy type	Energy source	LCI data representation in ecoinvent 3.8	Amount (kWh, kg, m^3)	Certificate?
Electricity	Swedish grid	Electricity, medium voltage {SE}| market for | Cut-off, U	112,5 kWh	-

4.4.2 Direct emissions

There are no direct emissions reported.

4.4.3 Consumables

There are no production consumables reported.

4.4.4 Packaging

Packaging for the lift is two sets of packaging made of wood, plywood and steel, one for the bulk of the lift and one for the lift screws and guide profiles. The lift needs 67,44 kg of bulk packaging and 70 kg of packaging for the lift screws and guide profiles. The packaging is transported 121 km from the supplier.

Table 33: Raw materials and transport to the production site, for 1 kg of bulk packaging and 1 kg of packaging for lift screws and guide profiles.

Material	Amount	LCI database representation	Database	Comment
Bulk packaging				
Wood	0,0012 m3	Sawnwood, board, softwood, dried (u=20%), planed {Europe without Switzerland}| market for sawnwood, board, softwood, dried (u=20%), planed | Cut-off, U	Ecoinvent 3.8	Using a density for softwood of 430 kg/m3 (for pinewood)
Plywood	0,0007 m3	Plywood {RER}| market for plywood | Cut-off, U	Ecoinvent 3.8	Using a density for plywood of 680 kg/m3, for birch plywood (https://www.woodproducts.fi/content/plywood)

Material	Amount	LCI database representation	Database	Comment
Steel	0,0540 kg	Steel, unalloyed {GLO}| market for | Cut-off, U	Ecoinvent 3.8	
Packaging for lift screws and guide profiles				
Wood	0,0009 m3	Sawnwood, board, softwood, dried (u=20%), planed {Europe without Switzerland}| market for sawnwood, board, softwood, dried (u=20%), planed | Cut-off, U	Ecoinvent 3.8	Using a density for softwood of 430 kg/m3 (for pinewood)
Plywood	0,0008 m3	Plywood {RER}| market for plywood | Cut-off, U	Ecoinvent 3.8	Using a density for plywood of 680 kg/m3, for birch plywood (https://www.woodproducts.fi/content/plywood)
Steel	0,0720 kg	Steel, unalloyed {GLO}| market for | Cut-off, U	Ecoinvent 3.8	

4.4.5 Internal transports

There are no internal transports reported.

4.4.6 Production waste

There is no production waste reported.

4.5 Transport of finished goods (A4)

The finished products are loaded onto a truck. The total weight, including packaging, is 1100 kg.

Table 34: Distribution of products

Product	Transport type	Transport distance (km)	Comment
A5000 (1100 kg)	Transport, freight, lorry 16-32 metric ton, euro6 {RER}| market for transport, freight, lorry 16-32 metric ton, EURO6 | Cut-off, U	1600	Amount represents the distance between Cibes facilities in Gävle and the location of an average customer (in central Europe, approximated by Amsterdam)(Google Maps).

4.6 Installation (A5)

Energy for installation is assumed to be negligible. Thus, the only relevant activity in module A5 is the disposal of the packaging, see Table 35. No packaging is presently reused, so all is sent to generic waste treatment, using the process “Municipal waste collection service by 21 metric ton lorry {CH}| processing | Cut-off, U” to send the waste (137,4 kg) an assumed distance of 50 km.

Table 35: Disposal of packaging delivered with the product

Material	Amount (kg)	Disposal method	LCI data representation in ecoinvent 3.8	Comment
Wood	119,4	Incineration	Waste wood, untreated {CH}| treatment of, municipal incineration | Cut-off, U	Incineration of sawnwood and plywood from bulk packaging and packaging of guide profile and lift screw
	9,4	Sanitary landfill	Waste wood, untreated {CH}| treatment of, sanitary landfill | Cut-off, U	Landfill of sawnwood and plywood from bulk packaging and packaging of guide profile and lift screw
Steel	8,43	Recycling	Steel and iron (waste treatment) {GLO}| recycling of steel and iron | Cut-off, U	Steel from bulk packaging and packaging of guide profile and lift screw
	0,2334	Incineration	Scrap steel {CH}| treatment of, municipal incineration | Cut-off, U	Incineration of steel from bulk packaging and packaging of guide profile and lift screw
	0,01838	Inert landfill	Scrap steel {CH}| treatment of, inert material landfill | Cut-off, U	Landfill of steel from bulk packaging and packaging of guide profile and lift screw

4.7 Usage (B1-B7)

The use of the lift entails energy use and some maintenance.

The energy use of the lift was measured and calculated based on a certification by Liftinstituut, following the standard EN-ISO 25745-2:2015 (see Appendix 6). According to this report, the yearly energy use was 193,23 kWh. Over the reference service life of 25 years, the total energy use is then 4,83 MWh, which was modelled with the process “Electricity, low voltage {Europe without Switzerland}| market group for | Cut-off, U”, to reflect an average European customer.

Maintenance was simply modelled as a change of oil, see table Table 36.

Table 36: Materials consumed in the use phase (B2)

Material or energy	Quantity	Reference service life	LCI data representation in Ecoinvent 3.8	Comment
Change of lubricating oil	0,71 kg	25	Lubricating oil {RER}| market for lubricating oil | Cut-off, U	Due to lack of data, one oil change was assumed during RSL, in accordance with other elevator types

4.8 End-of-Life (C1-C4)

The end of life stages were modelled generically, due to a lack of data on what happens to the product after it reaches the end of its life. Consequently, all materials were sent to the generic waste scenario summarised in Table 37. The only exception was electronics. Since electronics are not captured by the generic scenario, it was instead assumed that all electronics were separated and that all copper and steel is recovered and recycled, while the rest is incinerated.

The end of life model included transport by municipal waste collection services at an assumed 50 km to the nearest waste treatment facility. Dismantling was cut off.

Table 37: Summary of waste scenario ("Waste (waste scenario) {NL}| treatment of waste | Cut-off, U"), showing the rate of different waste management options for different waste types (except electronics).

Waste type	Recycling rate	Incineration rate	Landfill rate
Cardboard	94,8%	4,8%	0,4%
Packaging paper	94,8%	4,8%	0,4%
Glass	91,8%	7,6%	0,6%
Ferro metals	97,1%	2,7%	0,2%
Aluminium	91,3%	8,1%	0,6%
Steel	97,1%	2,7%	0,2%
Plastics	38,4%	57,1%	4,5%
PE	38,4%	57,1%	4,5%
PET	38,4%	57,1%	4,5%
PP	38,4%	57,1%	4,5%
PS	38,4%	57,1%	4,5%
PVC	38,4%	57,1%	4,5%
Paper	94,8%	4,8%	0,4%
Newspaper	94,8%	4,8%	0,4%
Compost	48,0%	48,2%	3,8%

4.9 Benefits from material recycling or energy recovery (D)

The D module is a system expansion aimed to represents the benefits from end of life waste treatment. It was modelled in a simplified manner, by picking out the largest waste flows and calculating the avoided material- and energy production. All numbers were based on the end of life modelling done in the C-module (see section 4.8).

The following materials were considered in the model of the D module:

- Aluminium
- Electronics
- Glass
- Plastic
- Steel
- Wood

Table 38 summarises the model for calculating the benefit of the material that is recycled at the end of life.

Table 38: Amount of each material that is recycled.

Material	Parameters	Amount for recycling (Q*(R2-R1))	Avoided process	Database
Aluminium	R1= 0,019*77,46 R2= 0,913*77,46 Q= 1	69,25 kg	Aluminium, primary, ingot {IAI Area, EU27 & EFTA}| market for | Cut-off, U	Ecoinvent 3.8
Electronics (copper)	R1= 0 kg R2= 1*10,64 kg Q= 1	10,64 kg	Copper, cathode {GLO}| market for | Cut-off, U	Ecoinvent 3.8
Electronics (steel)	R1= 0 kg R2= 1*34,49 kg Q= 1	34,49 kg	Steel, low-alloyed, hot rolled {GLO}| market for | Cut-off, U	Ecoinvent 3.8
Glass	R1= 0 kg R2= 0,918*44 kg Q= 1	40,39 kg	Polycarbonate {RER}| production | Cut-off, U	Ecoinvent 3.8
Plastic	R1= 0 kg R2= 0,384*18,31 kg Q= 0,8	5,625	Polyethylene terephthalate, granulate, bottle grade {GLO}| market for | Cut-off, U	Ecoinvent 3.8
Steel (painted)	R1= 0 kg R2= 0,971*668,27 kg Q= 1	648,9 kg	Painted steel (see section 4.3.1.2)	Adapted EPD-input
Steel (electro-galvanized)	R1= 0 kg R2= 0,971*97,70 kg Q= 1	94,87 kg	Steel electrogalvanized steel/EU	Industry data 2.0
R1 is the amount of recycled material used as raw material input **R2** is the amount sent to recycling at end of life, based on the material weight and the recycling rate described in the waste scenario in Table 37 (except for electronics, where copper and steel are assumed to be 100% recycled) **Q** is the ratio between the value of the secondary and primary material (simplified assumption used for each material)				

The energy recovered from incinerating materials is shown in Table 39. This energy was then used to calculate the avoided heat production by plugging it into the following avoided process in ecoinvent 3.8: "*Heat, for reuse in municipal waste incineration only {NL}| market for | APOS, U*". The waste incineration process was chosen from the APOS (or "allocation at the point of substitution") library, as a proxy for heat production from waste. This is because it contains both the inputs and outputs of the incineration process (unlike the corresponding process in the "Cut-off" library, which is an empty process because of the polluter pays principle).

Table 39: Calculation of the energy recovered from incineration based on the amount of material sent to incineration and an estimation of its lower heating value (LHV).

Material	Material sent to incineration (weight * incineration rate)	LHV (simplified estimates)	Energy recovered/avoided
Electronics (non-copper or -steel)	59,8 - 10,64 - 34,49 = 14,67 kg	8 MJ/kg (estimated LHV of mixed waste, according to https://people.engr.ncsu.edu/barlaz/Lectures/22wtepart1.pdf)	117,4 MJ
Plastic	0,616*18,31 = 11,28 kg	30 MJ/kg	338, MJ
Wood	0,927*128,8 = 119,4 kg	19 MJ/kg	2269 MJ

5 Life cycle impact assessment (LCIA)

5.1 Results

In this part, the result from the different environmental impact assessment methods will be presented. First, the results from the method Environmental Footprint 3.0 (EF), Midpoint and Endpoint are presented, second from the method IPCC GWP 2013 100 and third the inventory results based on the list of aspects required by the relevant PCR. Note that the LCIA results are relative expressions, which means that they do not predict impacts on category endpoints or the exceeding of thresholds, safety margins or risk.

Sankey diagrams are used to display the results as flow diagrams where the thickness of the arrows reflects the relative amount of that flow. All the nodes cannot be displayed simultaneously due to the vast amounts of background data. Therefore, only processes that contribute to a minimum of 4% of total impacts are shown in the diagram.

All tables are presented in two sets, one per functional unit (1 tkm) and one per lifetime (19,71 tkm over 25 years).

5.1.1 Environmental Footprint Midpoint

The total environmental impact of the A5000 and Kalea A4 Primo lifts is presented in two tables below. Table 40 shows the life cycle impacts per functional unit, i.e. the impacts from providing 1 ton*km of function. Table 41 shows the total impacts over the entire 25 year lifetime of the lift (which are simply a factor of 20 larger than the numbers in Table 40, see the calculation of the transportation performance, TP, in section 4.1). These numbers are only comparable to other lifts with similar characteristics, like a reference service life of 25 years or a similar number of trips per day.

Table 40: Environmental footprint 3.0 midpoint results per functional unit (1 tkm), for the A5000 lift and the Kalea A4 Primo

Impact category		Unit	A1-C4	A1	A2	A3	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Climate Change	Fossil	kg CO2 eq	298	174	3,55	3,92	182	14,7	0,46	0	0,04	0	0	0	97,1	0	0	3,07	1,45	0	-170
	Biogenic	kg CO2 eq	5,52	3,65	0,00	-10,3	-6,61	0,01	8,41	0	0,00	0	0	0	2,99	0	0	0,00	0,72	0	-5,33
	Land use and LU change	kg CO2 eq	1,00	0,73	0,00	0,03	0,77	0,01	0,00	0	0,00	0	0	0	0,23	0	0	0,00	0,00	0	-0,67

Impact category	Unit	A1-C4	A1	A2	A3	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Total	kg CO2 eq	307	180	3,56	-6,28	177	14,7	8,88	0	0,04	0	0	0	100	0	0	3,07	2,17	0	-176
Ozone depletion	kg CFC11 eq	2,50E-05	1,46E-05	8,06E-07	4,59E-07	1,59E-05	3,40E-06	9,58E-08	0	2,80E-08	0	0	0	4,89E-06	0	0	6,65E-07	6,09E-08	0	-1,56E-05
Acidification	mol H+ eq	1,74	1,06	0,03	0,03	1,12	0,04	0,00	0	0,00	0	0	0	0,55	0	0	0,02	0,00	0	-1,01
Eutrophication, freshwater	kg PO_4^{-3} eq	5,15E-01	2,05E-01	6,63E-04	5,92E-03	2,11E-01	2,95E-03	1,27E-04	0	4,04E-05	0	0	0	3,00E-01	0	0	1,41E-04	4,28E-04	0	-1,79E-01
Eutrophication, freshwater[9]	kg P eq	1,68E-01	6,67E-02	2,16E-04	1,93E-03	6,88E-02	9,62E-04	4,12E-05	0	1,32E-05	0	0	0	9,78E-02	0	0	4,58E-05	1,39E-04	0	-5,82E-02
Eutrophication, marine	kg N eq	2,31E-01	1,04E-01	5,83E-03	9,51E-03	1,19E-01	8,47E-03	2,11E-03	0	4,81E-05	0	0	0	9,21E-02	0	0	7,97E-03	7,78E-04	0	-9,70E-02
Eutrophication, terrestrial	mol N eq	2,20	1,01	0,06	0,10	1,18	0,09	0,02	0	0,00	0	0	0	0,81	0	0	0,09	0,01	0	-0,94
Photochemical ozone formation	kg NMVOC eq	6,85E-01	3,36E-01	1,91E-02	3,15E-02	3,86E-01	3,55E-02	6,62E-03	0	9,55E-04	0	0	0	2,23E-01	0	0	3,07E-02	1,86E-03	0	-3,06E-01
Resource use, minerals and metals[10]	kg Sb eq	1,56E-02	1,46E-02	1,15E-05	3,08E-05	1,46E-02	5,20E-05	5,50E-07	0	6,91E-07	0	0	0	9,00E-04	0	0	2,61E-06	3,55E-06	0	-1,34E-02
Resource use, fossils[10]	MJ	4707	2219	52,7	102	2374	222,5	6,02	0	2,22	0	0	0	2058	0	0	40,5	3,61	0	-2224
Water use	m3 depriv.	64,4	34,4	0,15	4,90	39,5	0,68	0,02	0	0,01	0	0	0	24,1	0	0	0,02	0,12	0	-34,0
Particulate matter	disease inc.	1,05E-05	6,14E-06	2,61E-07	6,34E-07	7,0E-06	1,18E-06	7,28E-08	0	2,29E-09	0	0	0	1,76E-06	0	0	4,35E-07	1,96E-08	0	-5,44E-06
Ionising radiation	kBq U-235 eq	72,6	11,8	0,27	3,22	15,3	1,15	0,03	0	0,01	0	0	0	55,9	0	0	0,18	0,03	0	-10,6
Ecotoxicity, freshwater	CTUe	6557	4828	40,2	141	5008	175	4,24	0	1,32	0	0	0	1303	0	0	22,0	44,2	0	-4242
Human toxicity, cancer	CTUh	3,27E-07	2,50E-07	1,47E-09	2,66E-08	2,78E-07	5,62E-09	1,76E-09	0	3,01E-11	0	0	0	4,00E-08	0	0	3,85E-10	9,17E-10	0	-1,99E-07
Human toxicity, non-cancer	CTUh	8,25E-06	6,63E-06	3,92E-08	8,45E-08	6,75E-06	1,76E-07	7,14E-09	0	8,05E-10	0	0	0	1,28E-06	0	0	1,56E-08	1,62E-08	0	-6,39E-06
Land use	Pt	2127	365	33,0	1190	1588	155	1,39	0	0,31	0	0	0	373	0	0	7,28	1,59	0	-275

[9] For the impact category Eutrophication, freshwater, the result per unit kg P is used as basis for calculating the result per unit kg PO_4^{-3} eq, using the factor 3,07

[10] Disclaimer: The results of this environmental impact indicator shall be used with care as the uncertainties of these results are high or as there is limited experience with the indicator.

Table 41: Environmental footprint 3.0 midpoint over the entire lifetime of the A5000 and Kalea A4 Primo lifts (25 years, with a total transportation performance of 19,71 tkm)

Impact category		Unit	A1-C4	A1	A2	A3	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Climate Change	Fossil	kg CO2 eq	5881	3430	70,0	77,3	3578	289	9,15	0	0,87	0	0	0	1915	0	0	60,6	28,6	0	-3348
	Biogenic	kg CO2 eq	109	71,9	0,05	-202	-130	0,25	166	0	0,00	0	0	0	59,0	0	0	0,02	14,1	0	-105
	Land use and LU change	kg CO2 eq	19,8	14,4	0,03	0,68	15,1	0,12	0,00	0	0,00	0	0	0	4,53	0	0	0,01	0,01	0	-13,3
	Total	kg CO2 eq	6044	3550	70,1	-124	3496	290	175	0	0,88	0	0	0	1979	0	0	60,6	42,8	0	-3470
Ozone depletion		kg CFC11 eq	4,93E-04	2,88E-04	1,59E-05	9,05E-06	3,13E-04	6,70E-05	1,89E-06	0	5,52E-07	0	0	0	9,64E-05	0	0	1,31E-05	1,20E-06	0	-3,07E-04
Acidification		mol H+ eq	34,2	20,9	0,50	0,58	22,0	0,82	0,08	0	0,01	0	0	0	10,9	0	0	0,37	0,04	0	-19,8
Eutrophication, freshwater		kg PO_4^{-3} eq	10,2	4,03	0,01	0,12	4,16	0,06	0,00	0	0,00	0	0	0	5,92	0	0	0,00	0,01	0	-3,52
Eutrophication, freshwater[11]		kg P eq	3,31	1,31	0,00	0,04	1,36	0,02	0,00	0	0,00	0	0	0	1,93	0	0	0,00	0,00	0	-1,15
Eutrophication, marine		kg N eq	4,54	2,04	0,11	0,19	2,35	0,17	0,04	0	0,00	0	0	0	1,82	0	0	0,16	0,02	0	-1,91
Eutrophication, terrestrial		mol N eq	43,3	19,8	1,27	2,06	23,2	1,82	0,42	0	0,01	0	0	0	16,0	0	0	1,72	0,14	0	-18,5
Photochemical ozone formation		kg NMVOC eq	13,5	6,62	0,38	0,62	7,62	0,70	0,13	0	0,02	0	0	0	4,40	0	0	0,61	0,04	0	-6,03

[11] For the impact category Eutrophication, freshwater, the result per unit kg P is used as basis for calculating the result per unit kg PO_4^{-3} eq, using the factor 3,07

Impact category	Unit	A1-C4	A1	A2	A3	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Resource use, minerals and metals[12]	kg Sb eq	0,31	0,29	0,00	0,00	0,29	0,00	0,00	0	0,00	0	0	0	0,02	0	0	0,00	0,00	0	-0,26
Resource use, fossils[10]	MJ	92772	43741	1038	2003	46782	4385	119	0	43,8	0	0	0	40572	0	0	799	71,2	0	-43828
Water use	m3 depriv.	1270	678	2,99	96,6	778	13,3	0,39	0	0,26	0	0	0	475	0	0	0,41	2,46	0	-670
Particulate matter	disease inc.	2,07E-04	1,21E-04	5,15E-06	1,25E-05	1,39E-04	2,33E-05	1,43E-06	0	4,52E-08	0	0	0	3,46E-05	0	0	8,58E-06	3,86E-07	0	-1,07E-04
Ionising radiation	kBq U-235 eq	1431	233	5,26	63,4	302,0	22,6	0,53	0	0,23	0	0	0	1101	0	0	3,61	0,68	0	-209
Ecotoxicity, freshwater	CTUe	129247	95151	792	2771	98714	3442	83,5	0	26,0	0	0	0	25676	0	0	435	871	0	-83609
Human toxicity, cancer	CTUh	6,44E-06	4,93E-06	2,90E-08	5,25E-07	5,48E-06	1,11E-07	3,47E-08	0	5,93E-10	0	0	0	7,89E-07	0	0	7,59E-09	1,81E-08	0	-3,92E-06
Human toxicity, non-cancer	CTUh	1,63E-04	1,31E-04	7,72E-07	1,66E-06	1,33E-04	3,48E-06	1,41E-07	0	1,59E-08	0	0	0	2,52E-05	0	0	3,08E-07	3,20E-07	0	-1,26E-04
Land use	Pt	41918	7186	651	23461	31298	3056	27,5	0	6,11	0	0	0	7355	0	0	143	31,4	0	-5426

[12] Disclaimer: The results of this environmental impact indicator shall be used with care as the uncertainties of these results are high or as there is limited experience with the indicator.

5.1.2 Environmental Footprint Endpoint

The environmental footprint endpoint shows the contribution of each environmental impact category to the total environmental impact. This is done by calculating a weighted single score and comparing the contribution from different impact categories, see Figure 9.

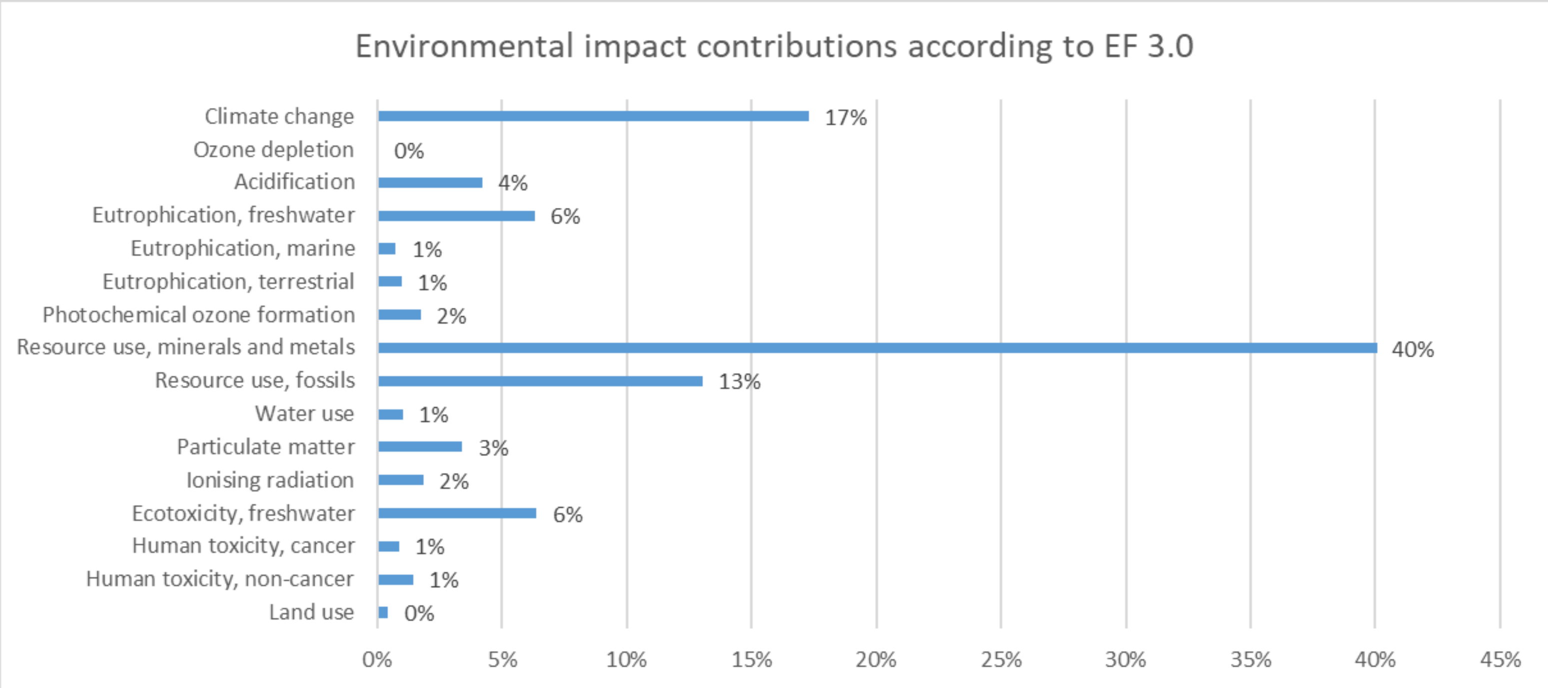

Figure 9: Share of total weighted environmental impact in mPt, for the A5000 lift

Figure 10 shows a Sankey diagram of the product life cycle, showing all processes that contribute more than 4% of the total environmental impact.

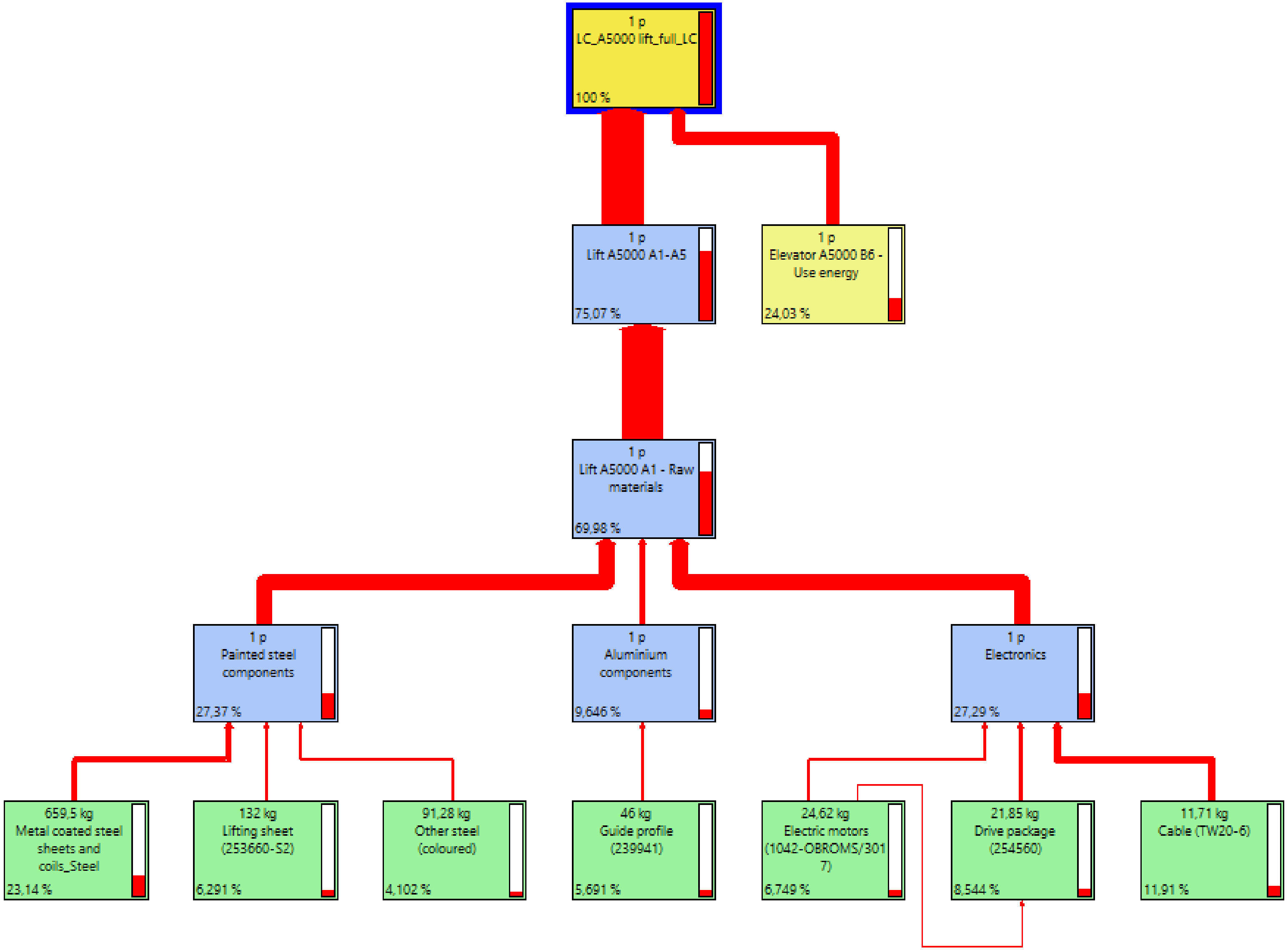

Figure 10: Sankey diagram over Environmental footprint weighted impact (figure hides everything contributing less than 4%)

5.1.3 Climate impact (GWP) - IPCC GWP 2013 100

The total climate impact over the life cycle of the A5000 and Kalea A4 Primo lifts is ca 299 kg CO2-eq. per functional unit, or 5886 kg CO2-eq. over the entire reference service life (RSL = 25 years). Most of these emissions come from the production of materials and components (A1) and from the use-phase (B6), as can be seen in Table 42 and Figure 11.

The Sankey diagram in Figure 12 shows all processes that contribute more than 4% to the total climate impact.

Table 42: Climate impact per module over the life cycle of the Superduper tube, according to IPCC GWP100 2013

Impact category	Unit	A1-C4	A1	A2	A3	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
GWP 100 per f.u.	kg CO2 eq	299	175	3,53	3,87	182	14,6	0,49	0	0,04	0	0	0	96,6	0	0	3,05	1,46	0	-170
GWP 100 per RSL	kg CO2 eq	5886	3450	69,5	76,2	3596	287	9,64	0	0,9	0	0	0	1904	0	0	60,1	28,7	0	-3353

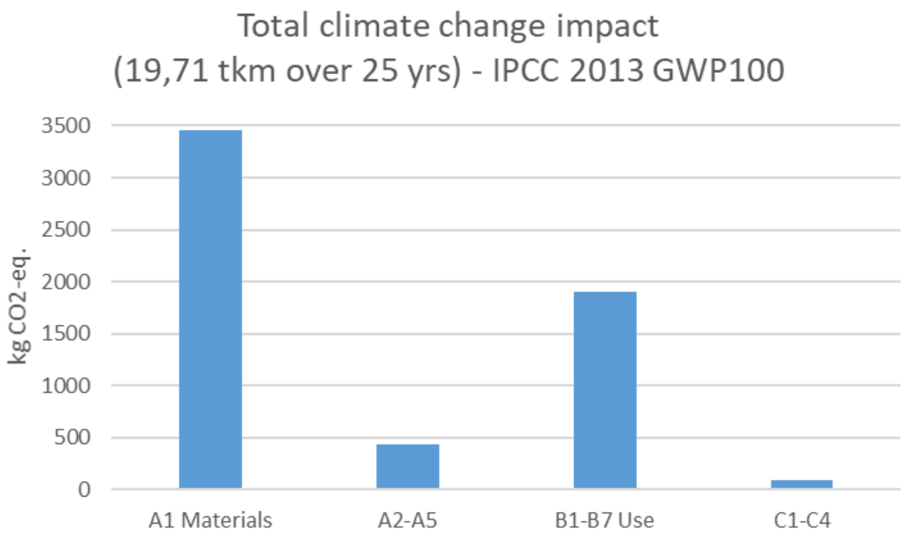

Figure 11: Climate impact according to IPCC 2013 GWP 100

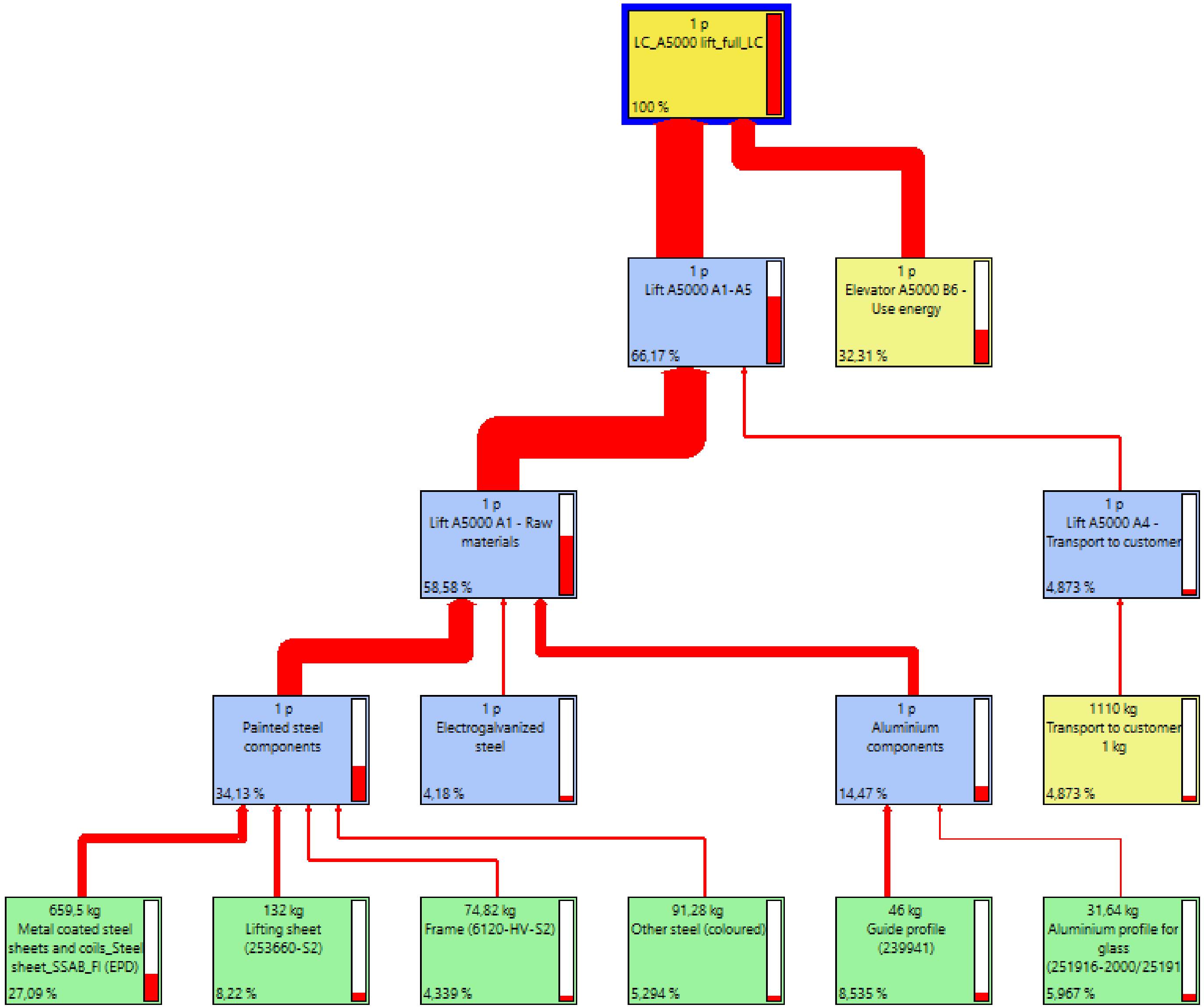

Figure 12: Sankey diagram over share of climate impact contributions per module (figure hides everything contributing less than 4%)

5.1.4 Use of resources and energy CED 1.11

The consumption of resources in terms of energy is measured as primary energy demand with the method Cumulative Energy Demand 1.11 see Appendix 3 for further details on the method). These results are presented in Table 43 and Table 44.

Table 43: Use of resources and energy for module A1-D, per functional unit (1 tkm), for the A5000 lift and the Kalea A4 Primo

Para-meter	Unit	Total	A1	A2	A3	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
PERE	MJ	-67,5	16,3	0	-105	-88,7	0,16	0	0	0	0	0	0	21,0	0	0	0	0	0	-11,4
PERM	MJ	118	0	0	118	118	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PERT	MJ	50,1	16,3	0	12,6	29,0	0,16	0	0	0	0	0	0	21,0	0	0	0	0	0	-11,4
PENRE	MJ	199	66,0	2,84	5,41	74,2	12,0	0,32	0	0,12	0	0	0	110	0	0	2,18	0,20	0	-72,6
PENRM	MJ	53,5	53,5	0	0	53,5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PENRT	MJ	252	120	2,84	5,41	128	12,0	0,32	0	0,12	0	0	0	110	0	0	2,18	0,20	0	-72,6
SM	Kg	0,18	0,18	0	0	0,18	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RSF	MJ	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NRSF	MJ	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FW	M3	0,64	0,52	0,01	0,01	0,53	0,02	0,00	0	0	0	0	0	0,08	0	0	0,00	0,01	0	0
Abbrevi-ations	PERE = Use of renewable primary energy excluding renewable primary energy resources used as raw materials; PERM = Use of renewable primary energy resources used as raw materials; PERT = Total use of renewable primary energy resources; PENRE = Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials; PENRM = Use of non-renewable primary energy resources used as raw materials; PENRT = Total use of non-renewable primary energy resources; SM = Use of secondary material; RSF = Use of renewable secondary fuels; NRSF = Use of non-renewable secondary fuels; FW = Use of net fresh water																			

Table 44: Use of resources and energy for module A1-D, per lifetime (19,71 tkm over 25 years), for the A5000 lift and the Kalea A4 Primo

Para-meter	Unit	Total	A1	A2	A3	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
PERE	MJ	-1330	321	0,70	-2069	-1747	3,18	0,06	0	0	0	0	0	413	0	0	0,22	0,38	0	-224
PERM	MJ	2318	0	0	2318	2318	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PERT	MJ	988	321	0,70	249	571	3,18	0,06	0	0	0	0	0	413	0	0	0,22	0,38	0	-224
PENRE	MJ	3915	1301	55,9	107	1463	236	6,40	0	2,37	0	0	0	2160	0	0	43,0	3,84	0	-1430
PENRM	MJ	1055	1055	0	0	1055	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PENRT	MJ	4970	2356	55,9	107	2519	236	6,40	0	2,37	0	0	0	2160	0	0	43,0	3,84	0	-1430
SM	Kg	3,57	3,57	0	0	3,57	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RSF	MJ	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NRSF	MJ	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FW	M3	12,6	10,2	0,12	0,16	10,5	0,37	0,01	0	0,00	0	0	0	1,61	0	0	0,03	0,10	0	0,00
Abbrevi-ations	PERE = Use of renewable primary energy excluding renewable primary energy resources used as raw materials; PERM = Use of renewable primary energy resources used as raw materials; PERT = Total use of renewable primary energy resources; PENRE = Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials; PENRM = Use of non-renewable primary energy resources used as raw materials; PENRT = Total use of non-renewable primary energy resources; SM = Use of secondary material; RSF = Use of renewable secondary fuels; NRSF = Use of non-renewable secondary fuels; FW = Use of net fresh water																			

5.1.5 Waste production and output flows

The production of waste in terms of final waste and the output of materials for recycling, is measured from the calculation of selected inventory results with our own method[13]. Final waste and output flows, refers to flows that are leaving the system of the LCA. In this LCA only elementary flows (substances) are actually leaving the system.

Table 45: Waste production for module A1-D, per functional unit (1 tkm), for the A5000 lift and the Kalea A4 Primo

Indicator	Unit	A1	A2	A3	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Hazardous waste	kg	0,12	0	0	0,12	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Non-Hazardous waste	kg	0	0	0	0	0	0,48	0	0	0	0	0	0	0	0	0	0	0	0
Radioactive waste	kg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 46: Waste production for module A1-D, per lifetime (19,71 tkm over 25 years), for the A5000 lift and the Kalea A4 Primo

Indicator	Unit	A1	A2	A3	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Hazardous waste	kg	2,30	0	0	2,30	0	0	0	0	0	0	0	0	0	0	0	0	0	2,30
Non-Hazardous waste	kg	0	0	0	0	0	9,42	0	0	0	0	0	0	0	0	0	0	0	0
Radioactive waste	kg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

[13] EPD (2018) EN15804 v3

Table 47: Output flows for module A1-D, per functional unit (1 tkm), for the A5000 lift and the Kalea A4 Primo

Indicator	Unit	A1	A2	A3	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Components for reuse	kg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Material for recycling	kg	4,79E-03	0	0	4,79E-03	0	0,43	0	0	0	0	0	0	0	0	0	0	39,6	0
Materials for energy recovery	kg	0	0	0	0	0	6,06	0	0	0	0	0	0	0	0	0	0	0	0
Exported energy, electricity	kg	1,88E-06	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Exported energy, thermal	kg	3,86E-06	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 48: Output flows for module A1-D, per lifetime (19,71 tkm over 25 years), for the A5000 lift and the Kalea A4 Primo

Indicator	Unit	A1	A2	A3	A1-A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Components for reuse	kg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Material for recycling	kg	9,44E-02	0	0	9,44E-02	0	8,43	0	0	0	0	0	0	0	0	0	0	781	0
Materials for energy recovery	kg	0	0	0	0	0	119	0	0	0	0	0	0	0	0	0	0	0	0
Exported energy, electricity	kg	3,71E-05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Exported energy, thermal	kg	7,61E-05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

5.1.6 Biogenic carbon content

Table 49: Shows the biogenic carbon content of the product and the product packaging

Share of biogenic carbon	Unit	Amount
Biogenic carbon in the product	kg C	0
Biogenic carbon in the packaging	kg C	61

5.2 Method for impact assessment

The methods chosen for assessing the life cycle impact are called **Environmental Footprint 3.0, CML 2001** and **IPCC 2013 GWP 100.** The Environmental Footprint method divides the total environmental impact of the life cycle into 19 different categories. All these different categories represent different environmental effects. Every effect is then assigned points that represent how serious the environmental effect is, the higher the score the more severe the environmental effect. In the end, all the different categories are weighted and summarised to generate a single score for the whole life cycle. The different categories are described in more detail in Appendix 1 (section 8.1.3).

In sections 5.2.1-5.2.3 follow some theory behind the modelling and calculations carried out for this report.

5.2.1 Classification and characterisation

The process of determining what effects that an environmental aspect may contribute to is called *classification*, e.g. the use of water contributes to water depletion. *Characterisation* means to quantify how much it contributes, e.g. usage of 1 ton of river water contributes by the factor 1 to water depletion. Evaluating how critical that is in a specific area depends on the current environmental load, the pressure from resource consumption and the eco system's carrying capacity. This is done through *normalisation*.

5.2.2 Weighting

To compare between different environmental effects and to identify "hot spots", so-called *weighting* is applied. The calculated environmental effects are weighted together to form an index called a "*single score*" which describes the total environmental impact.

Because weighting involves subjective weighting (e.g. by an expert panel) it is recommended for internal communication only. Otherwise, there is a risk of mistrust if the choice of weighting method used leads to results that emphasise the "upsides" and hide the "downsides" of the analysed product. For external communication, only *Single issues* should be communicated.

The Environmental Footprint method involves two stages of mechanisms. The first stage is called classification and characterisation and calculates how much an 'environmental aspect' contributes to a specific 'environmental effect'. The stage two-mechanism is called weighting and calculates together all the results from stage one to create a summary result where each 'environmental effect' category is given a score, see in Appendix 1 (section 8.1.3) for further details.

For example, in assessing the environmental impact of the activity 'driving a car', the aspects 'dust from road and tyres' (PM10 emissions) and 'combustion of gasoline' (CO2 emissions) were assessed. Dust contributes to the environmental effect category "damage on respiratory organs" and combustion to "climate change". The results are two Midpoint scores. The two scores were then combined by calculating how much they contribute to damage the safeguard objects; Human health, Ecosystem and Resources, to arrive at the final endpoint, a single score.

5.2.3 Single issues

In contrast to weighted results which are the combined results from many different environmental effect categories, *single issues* focus on just one issue. It is important to break out some single issues that are relevant for the analysed product both considering the environment and marketing. All the different environmental effect categories will still be accounted for in the weighted result.

IPCC 2013 is the successor of the IPCC 2007 method, which was developed by the Intergovernmental Panel on Climate Change. It contains the climate change factors of IPCC with a timeframe of 100 years and calculates the single issue of climate change potential.

6 Interpretation

This section covers the key aspects of the results, sensitivity analyses, scenario analyses and an evaluation of the model and underlying data.

6.1 Key aspects of the results

From a life cycle perspective, the environmental impact of the A5000 lift can mainly be attributed to the production of materials and components (module A1) as well as electricity consumption in the use phase (module B6). The EF 3.0 weighting method expresses the total environmental impact of the product by weighting all impact categories together into a single score (see section 5.1.2). 70% of this single score is caused by the production of raw materials, while 24% is caused by the use phase.

The environmental impact of the raw materials is dominated by resource use of minerals and metals and by climate impacts. The painted steel components (such as steel sheets) represent the largest amount of resource use, along with the electronics (mainly cables, drive package and electric motors) which consume copper[14]. Of the raw materials, the painted steel components also cause most of the climate impacts, as do the aluminium components such as the guide profile.

The use-phase electricity consumption was calculated to be 4,83 MWh of electricity consumed over the lift's lifetime, RSL = 25 years. The majority (ca 85%) of this comes from stand-by energy use. The environmental impact of this electricity consumption is dominated by fossil resource use and climate impacts. The electricity was from an average European grid mix and stood for 32% of total climate impacts (IPCC). Hence, the model of the product system is sensitive to the source of energy in the use phase. If the lift is driven by wind power instead, the total climate impact per functional unit is reduced by 31%. On the other hand, if the energy source is a mix with a high share of non-renewable electricity, the total climate impact per functional unit can increase by up to 55%.

6.2 Sensitivity and scenario analysis

The LCA is a holistic analysis that includes simplifications and value-based choices to cover the complete system. The objective of the sensitivity check is to assess the reliability of the results and conclusions by determining how they are affected by various parameters. Here, four scenarios were investigated, shown in Figure 13 and Figure 14. The baseline represents the model as described in sections 1-5, while the other scenarios are described in sections 6.2.1 - 6.2.3.

In addition to the scenarios presented here, also other sensitivity checks were made. However, they were not presented here since they only insignificantly affected the results, and thus the model is not sensitive to these parameters. They include testing the plausibility of the EPD for steel used as input data by comparing it to generic steel, as well as checking assumptions for the frequency of oil changes and for the selection of which cable to model. Each of these checks showed an effect on the total results by less than 1 %.

[14] Most of the impacts from copper in the ecoinvent 3.8 database come from the depletion of small amounts of Tellurium, where a depletion of 0,2 grams stands for ca 18% of the lift's total EF3.0 single score results. This seems disproportionately high, but investigating the issue was outside the scope of this report.

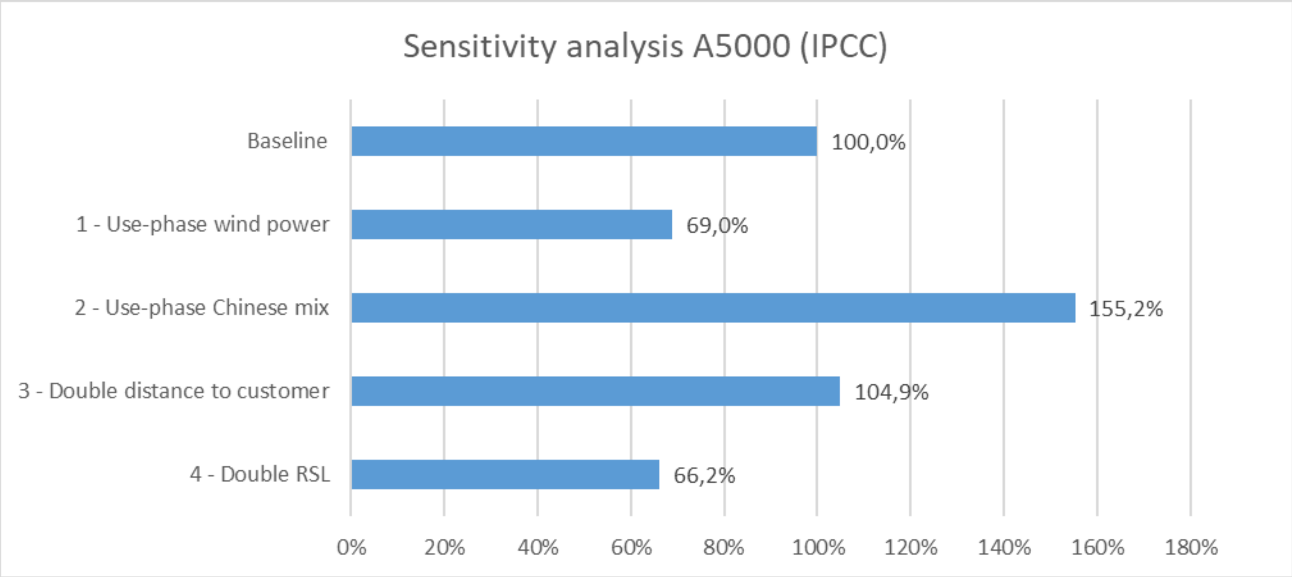

Figure 13: Sensitivity scenario results for the A5000 lift - climate impacts using IPCC 2013 GWP 100

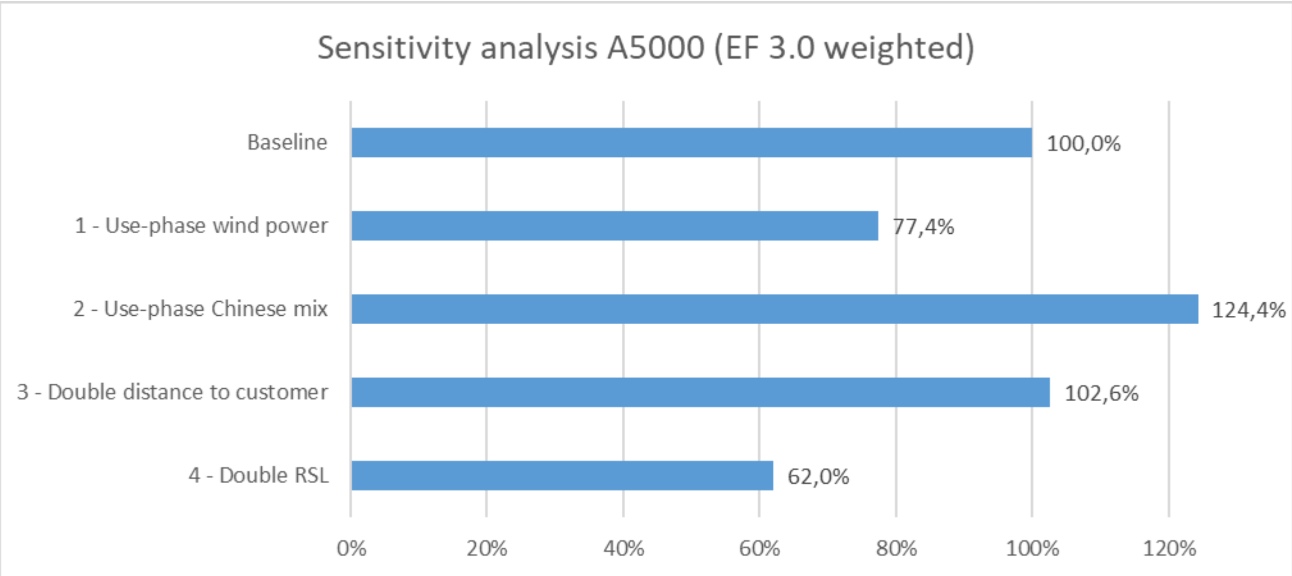

Figure 14: Sensitivity scenario results for the A5000 lift - total weighted impacts using EF 3.0

6.2.1 Sensitivity scenario 1-2: Use phase energy

The impact of the use phase was investigated by varying the source of the electricity, both towards a more renewable source (represented by wind power) and towards a mix with more fossil energy (represented by an average Chinese mix). Changing to wind power would decrease total impact by ca 23% and climate impact by ca 31%. By contrast, a Chinese electricity mix increases impacts by ca 25% and 55%, respectively.

This shows that the use phase energy is a critical parameter in the life cycle of the A5000 lift, and represents both a large opportunity for impact reduction and a large risk for a significant increase of impacts.

Table 50: Details for the sensitivity analysis testing the effects of having different energy sources for the use phase.

	Representation in ecoinvent 3.8	Effect on the results (EF3.0 single score)	Effect on the results (IPCC climate impacts)
Baseline	Electricity, low voltage {Europe without Switzerland}| market group for | Cut-off, U	-	-
Wind power in use	Electricity, high voltage {SE}| electricity production, wind, <1MW turbine, onshore | Cut-off, U	Reduced by 23%	Reduced by 31%
European electricity mix in use	Electricity, low voltage {CN}| market group for | Cut-off, U	Increased by 25%	Increased by 55%

6.2.2 Sensitivity scenario 3: Distance to customer

The significant weight of the finished lift and packaging means that the transportation to the customer may be an important parameter. This was tested by doubling the assumed distance. In the baseline, the distance was chosen to represent the transportation from Cibes facilities to an average European customer in Amsterdam. This increased the total results by 5% and the climate impact by 3%, which is not enormous, but may be significant in a future when clean energy and a durably designed product have reduced impacts from other parts of the life cycle.

Table 51: Details for the sensitivity analysis testing the effects of prolonging the life of the product.

	Distance	Effect on the results (EF3.0 single score)	Effect on the results (IPCC climate impacts)
Baseline	1600 km	-	-
Double distance to customer	3200 km	Increased by 5%	Increased by 3%

6.2.3 Sensitivity scenario 4: Longer life

The potential effects of prolonging the lifetime of the product was tested by doubling the reference service life, from 25 to 50 years (without considering any changes in product design). This reduced the total results by 34% and the climate impact by 38%, which shows the benefit of designing for durability.

It should be noted that a doubled lifetime enables the lift to deliver double the function (double transportation performance or amount of tkm) and the impacts per functional unit are consequently reduced. However, the total impacts over the whole life of the lift would increase, since it is used for more years.

Table 52: Details for the sensitivity analysis testing the effects of prolonging the life of the product.

	Reference service life	Effect on the results (EF3.0 single score)	Effect on the results (IPCC climate impacts)
Baseline	25 years	-	-

Double reference service life	50 years	Reduced by 34%	Reduced by 32%

6.3 Validation and data quality assessment

The model and data are valid for production in Sweden at Cibes Lift Group, and for use in an average European country. An evaluation of the model and underlying data is made by assessing validity, data quality and completeness.

The data collected are often linked to a specific context, a certain facility size, etc. This may mean that data need to be adjusted to represent the system being studied. It is also common for data to be reported in units or quantities that require recalculations. All such adjustments are documented in section 4 (LCI) and in the software used for LCA calculation, SimaPro.

An overall assessment of data quality can be found in Table 53.

Table 53: Data quality assessment for the study.

Aspect	Notes
Data quality assessment scheme	The data quality level and criteria from the PEF category rules have been applied in this study
Geographical coverage	Module A1-A2: Good (Country specific) Module A3 (core): Very good (site-specific) Module A4-C4: Good data, but generic waste scenario not exactly representative
Technological representativeness	Upstream data: Fair - Specific data for ca 50 wt% and 45 % of total environmental impacts (EF3.0). Generic data based on plant averages for the rest Core module (A3): Very good (site-specific) Downstream data: Good data, but generic model not exactly representative
Time-related coverage	Module A1-A2: Good Module A3 (core): Good Module A4-C4: Good data, but generic waste scenario not exactly representative
Validity	The technological and geographical coverage of the data chosen reflects the physical reality of the product system modelled. The data have been validated by double checking with the providers of data at Cibes Lift Group
Plausibility	The model has been checked for plausibility, using EPDs for similar products or components as reference (see Figure 15)
Precision	Material and energy flow quantified based on generic data from the ecoinvent 3.8 database.
Completeness	Data accounts for all known sub-processes. Some processes were modelled directly using generic data from the database ecoinvent 3.8 (using country specific datasets whenever available, otherwise using European or global datasets). For some upstream processes,

	data were received directly from Cibes' suppliers, including energy and material use, which laid the basis for the process models.
Consistency, allocation method, etc.	No allocations were made in specific data
Completeness and treatment of missing data	Data for specific weights of 7 wt% of the lift were unknown. These were modelled by Cibes giving a rough estimate of their material composition.
Final result of data quality assessment	Data quality as required in EN15804 is met.

The plausibility check in Table 53 was done in part by comparing the climate impacts (using the method IPCC) to three other EPDs of lifts. The EPDs published by Otis on their products Gen360 and Gen360 low duty and by Schindler on their product 1000/3000 (user category 2) were used (for comparison, they have transportation performance 893, 434 and 340 tkm, which means that they are larger and belong to a higher usage category than the lift modelled in this report, with TP=19,71 tkm). As seen in Figure 15, the numbers in each life cycle are comparable (A5000 is consistently lower, due in large part to being in a lower usage category), which indicates that the model is plausible.

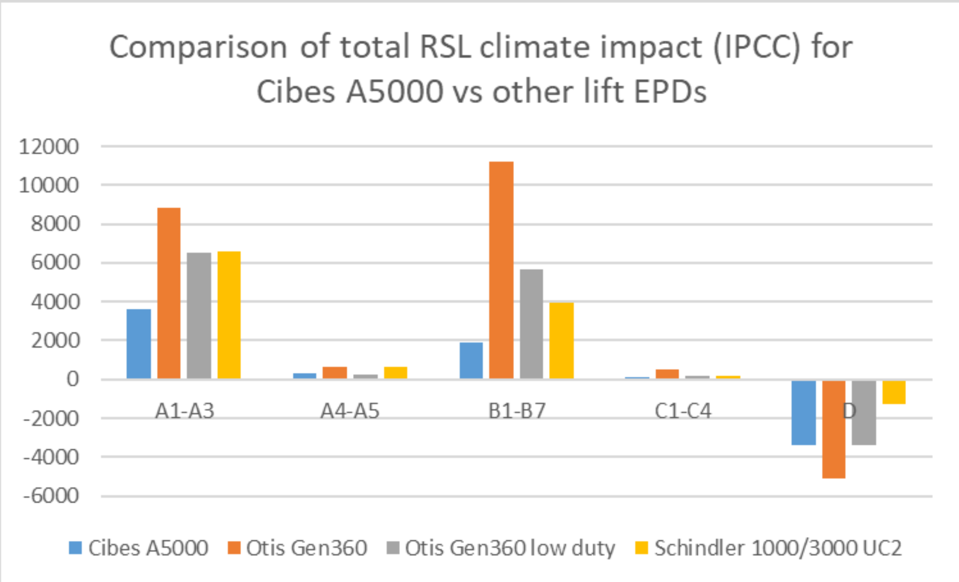

Figure 15: Comparing the results for Cibes A5000 lift with other EPDs of similar products, using IPCC climate impacts.

7 Conclusions and recommendations

7.1 How to mitigate the hot spots

The majority of impacts come from the production of materials and components. Particularly, the main hotspots were found in the painted steel components (such as steel sheets) and electronics (mainly cables, drive package and electric motors) which contribute the most to resource use of minerals and metals. Furthermore, the aluminium components (like the guide profile) were hotspots for climate impacts.

These hotspots can, for instance, be mitigated in the following ways (without any particular order of priority):

- Using less material in the product
    - Requires ecodesign
- Using a larger share of recycled material
    - Can be achieved by procurement
- Convincing suppliers of bulk materials (steel, aluminium, glass) to use renewable energy in their production
- Increasing the expected lifetime of the product - Both in terms of durability and in terms of how long an installation will continue to be used before it reaches its end of life
    - Requires ecodesign
- Increasing the reuse and recycling of the product.
    - Can be achieved through communication or altering the business model. Requires more insight and control into the end of life of the product and potentially a take-back system in some form

Another hotspot was the electricity consumption in use phase. This can be mitigated by:

- Ecodesign for improved energy efficiency, particularly of the standby-energy consumption, which represents the largest share (ca 85%) of overall energy consumption
- While Cibes have no direct control over the electricity mix in the use phase, there may be ways to influence this, e.g. by
    - Communicating the importance of using clean energy to Cibes' customers
    - Nudging or implementing reward systems for customers who can prove that they use clean energy.

7.2 How to communicate the results

This report is meant as a technical background that will be made into an EPD. As such, the report acts as the basis for review and ensures that the model is transparent and that the results can be reproduced.

The report shows that fossil and mineral resource use are the most important environmental aspects, but it also shows that climate change and fossil resource use are relevant.

In addition to an EPD, the report can also be used as a basis for ecodesign or for external communication documents or presentations.

7.3 How to reduce uncertainties

Some parts of the model were built on data of low quality and in some cases there were data gaps. Finding more specific data for the following areas can highly improve the overall data quality of the LCA:

- Assembly energy consumption
  - Should be measured or estimated more carefully, now based on a guess
- Unknown weight and material composition for 74 kg of the lift (7%)
  - Now the material composition of this fraction is based on a rough estimate
- Unknown weight for packaging of guide profile and lifting screws
  - Now based on a rough estimation
- Unknown what happens at end-of-life
  - Now built on generic scenarios
- Better data for electric motors
  - Now it's completely generic, and lacks e.g. magnets
- Better data for aluminium components and electrogalvanized components
  - Now completely generic (except the lifting screw)
  - Especially the guide profile, the cross bar, bottom frame and inner ceiling (side)
- Investigate and confirm how much recycled material is used as input into each of the major components
- A minor datagap regards maintenance, which could be modelled more specifically

7.4 Internal follow-up procedures

For EPDs, internal follow-up procedures shall be established to confirm whether the information in the EPD remains valid or if the EPD needs to be updated during its validity period. The GPI state that the main parameters that may mandate an update shall be identified through a sensitivity analysis. The established procedure may or may not involve a contracted verifier. The follow-up shall be at least annually and should be made with a frequency that will allow for an acceptable coverage of changes that might occur.

The procedure should include how the organisation monitors any significant changes that have taken place in the information submitted as input data for the information in the EPD, such as raw material acquisition, transportation modes, manufacturing processes, changes in product design, or updated legislation. The follow-up procedure may be made part of an existing quality or environmental management system.

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9 Appendix list

Appendix 1, Methods for Impact Assessment

Classification and characterisation

Classification means that all categories of data are sorted into different categories of environmental effects (see Figure 16). Readymade methods for this have been used to evaluate environmental effects from a broad perspective and find the categories with the most potential impact. The most commonly used methods include Ecoindicator and EPS. These methods also include characterisation (and weighting, described below). In characterisation, the aim is to quantify each element's contribution to the different categories of environmental effect, respectively. To do this, each category of environmental effect is multiplied with characterisation factors that are specific for the data and the category of environmental effect. The result of the characterisation indicates what or which emissions lead to a significant environmental influence. Each of these characterisations represents the potential environmental influence that could arise if an element were released into the environment or if a resource was consumed. Classification and characterisation are where all items in the inventory are assigned to the effect it is likely to have on the environment.

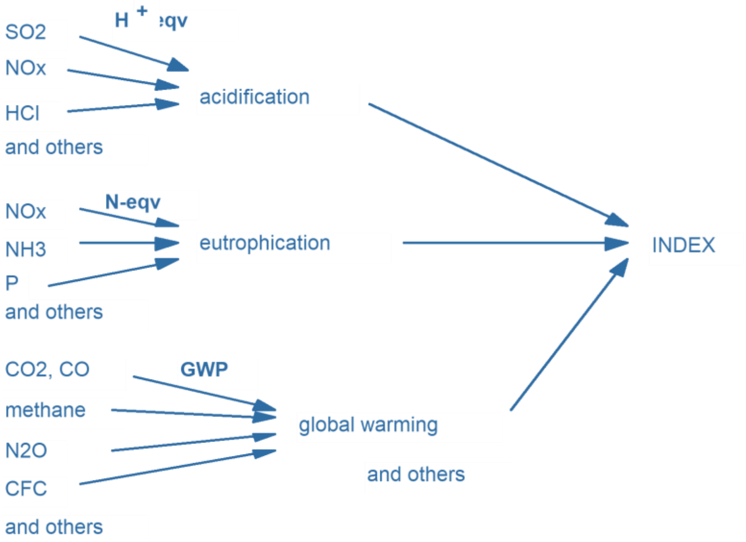

Figure 16: An illustration of the Impact Assessment of an LCA.

When this link is determined, we call it an environmental aspect. This environmental aspect has to be linked between the environment and the process before you can say that it is established and that the process is unsustainable. In the early stages of the Life Cycle Assessment, substances that were found in the inventory are assigned to environmental aspects. In order to contribute to the ultimate goal of sustainability, it is important to also describe the local and global environment. Environmental aspects that may have an impact are located and after that, the link to the inventory and the process path features may be analysed and established.

LCA impact categories vs planetary boundaries

It can be relevant to note that the impact categories described above do not have a one to one correlation with the planetary boundaries as described by Steffen et al. (2015). Table 54 maps the planetary boundaries to mid-point indicators in LCA (when possible) and classifies whether there is a high or low level of correspondence between the indicators.

Climate change, ozone depletion, eutrophication and human- and ecotoxicity are included in similar ways in the two frameworks (Böckin et al., 2020). However, the ILCD indicators of photochemical ozone creation potential and respiratory effects are meant to represent direct human health impacts. The corresponding planetary boundary is atmospheric aerosol loading, but this is instead mainly meant to represent effects on monsoon rains. Furthermore, acidification in ILCD represents impacts from e.g. nitrogen and sulphur oxides on land and water ecosystems, while ocean acidification in the planetary boundaries instead represents the effects of carbon dioxide being dissolved in oceans, thus lowering pH levels and affecting marine life. Moreover, the ILCD standard does not include an indicator that matches the planetary boundary of biospheric integrity, while the closest category can be said to be land use, since it is a driver of biodiversity loss. Lastly, there are some differences between land system change and freshwater use in the planetary boundaries and land use and water use in ILCD, while the planetary boundaries do not include a category for abiotic resource depletion.

Table 54: Planetary boundaries, by (Steffen, W., K. Richardson, J. Rockström, S.E. Cornell, 2015), and mid-point environmental impact indicators in LCA recommended by ILCD (Hauschild & Huijbregts, 2015). Adapted from (Tillman et al., 2020).

Planetary boundaries	Mid-point indicators in LCA as recommended by ILCD	Level of correspondence between impact categories
Climate change	Climate change	High level of correspondence
Stratospheric ozone depletion	Ozone layer depletion	
Biogeochemical flows (nitrogen and phosphorus cycles)	Freshwater, marine and terrestrial eutrophication	
Novel entities (chemical pollution)	Freshwater ecotoxicity	
	Human toxicity (cancer and non-cancer)	
Atmospheric aerosol loading	Photochemical ozone creation	Some correspondence
	Respiratory effects, inorganic	
Ocean acidification	Freshwater acidification	
Biospheric integrity (biodiversity loss)	Resources land use	
Land system change	Resources land use	
Freshwater use	Resources dissipated water	
-	Resources minerals and metals	No correspondence
-	Resources fossils	
-	Ionising radiation	

Weighting
The results of an LCA may depend on the method for impact assessment. There are several different models to assist in the assessment of the environmental impacts connected to the life cycle, e.g. ecological scarcity (ECO), the environmental theme method (ET), ECO indicator (EI), ReCiPe and the Environmental Priority Strategies in Product Design (EPS) method.

Using a weighting method implies that all of the data classes are weighted together so that only one number is expressed for the weighting method. The different data categories are weighed from some form of valuation principle. The basis of valuation could be either individual or a community's political and/or morality valuations. The weighting expresses the relation between values in the community and variations in nature. The more effect or deviation an environmental aspect has from the valuations, the higher the weighting value assigned to that environmental aspect.

The basis of the valuations used to develop weighting methods could be; political decisions, technical-financial conditions, nature conditions, health effects, panels or studies of behavioural patterns. In a weighting method, there is either one or a combination of valuation bases. Since the basis of valuations varies for each weighting method, a comparison between different methods will give a corresponding shift in the result.

The most commonly used weighting methods are collected in the book "The Hitch Hiker's Guide to LCA", written by Baumann & Tillman (Baumann & Tillman, 2004), and the most important are presented below:

Ecoindicator'99 is a weighting method based on the distance-to-target principle, and the target is established as environmental critical loads of 5 % ecosystem degeneration, or similar. Ecoindicator'99 weights are determined from three different cultural perspectives; hierarchist, egalitarian and individualist perspectives. Ecoindicator'99 is based on Goedkoop and Spriensma (Goedkoop & Spriensma, 1999).

EPS 2000 is based on the willingness-to-pay for avoiding damages on environmental safeguard subjects. The EPS method is especially suitable for the assessment of global impacts, such as climate change potential and resource depletion. The EPS indices are prepared by a group at the Chalmers University of Technology and a steering committee from the industry in Sweden.

Among the most common methods, however, are EF and ReCiPe and they deserve some more details, which are presented below.

The impact assessment methods EF 3.0 and ReCiPe 2008
While the Environmental Footprint method is used in this report, it is built on the foundation of the ReCiPe 2008 method, which is presented in detail here.

ReCiPe LCIA Methodology is a methodological tool used to quantitatively analyse the life cycle of products/activities. ISO 14040 and 14044 provide a generic framework. After the goal and scope have been determined and data collected, an inventory result is calculated. This inventory result is often a long list of emissions, consumed resources and sometimes other items. The interpretation of this list is difficult. An LCIA procedure, such as the ReCiPe method is designed to help with this interpretation. The primary objective of the ReCiPe method is to transform the long list of inventory results, into a limited number of indicator scores. These indicator scores express the relative severity of an environmental impact category. In ReCiPe indicators are determined on two levels:

- Eighteen midpoint indicators
- Three endpoint indicators

ReCiPe uses an environmental mechanism as the basis for the modelling. An environmental mechanism can be seen as a series of effects that together can create a certain level of damage to, for instance, human health or ecosystems. For climate change, we know that a number of substances increase radiative forcing. This means that heat is prevented from being radiated from Earth to space. As a result, more energy is trapped on Earth and temperature increases. As a result, we can expect changes in habitats for living organisms, resulting in the potential extinction of species. From this example, it is clear that the longer the chains of environmental mechanisms, the higher the uncertainties (see Figure 17). Radiative forcing is a physical parameter that can be relatively easily measured in a laboratory. The resulting temperature increase is less easy to determine, as there are many parallel positive and negative feedback. Our understanding of the expected change in habitat is also not complete, etc.

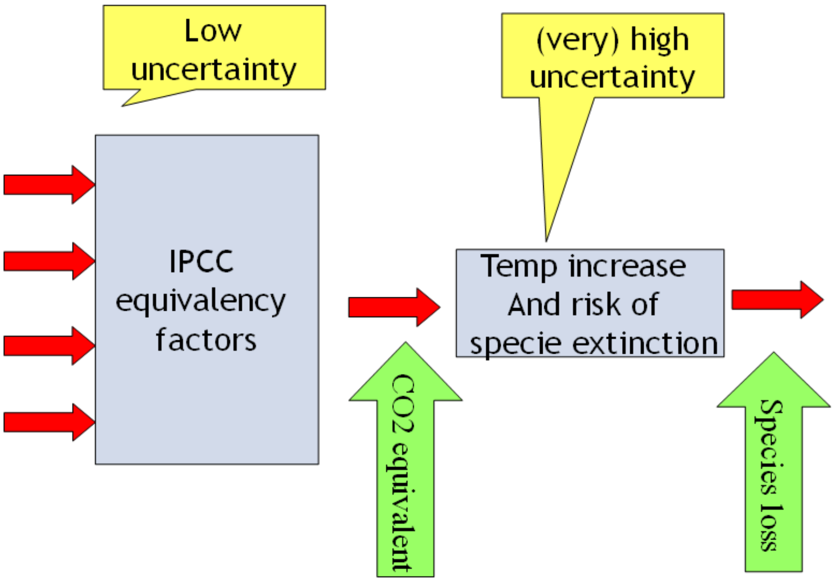

Figure 17: Example of a harmonised midpoint-endpoint model for climate change, linking to human health and ecosystem damage.

Hence, the obvious benefit of only taking the first step is the relatively low uncertainty. However, ReCiPe combines mid- and endpoints. Eighteen midpoint indicators are used, but three much more uncertain endpoint indicators are also calculated. The motivation to calculate the endpoint indicators is that the large number of midpoint indicators is difficult to interpret, partially as there are too many, partially because they have a very abstract meaning. How to compare radiative forcing with base saturation numbers that express acidification? The indicators at the endpoint level are intended to facilitate easier interpretation, as there are only three, and they have a more easily grasped meaning. The idea is that each user can choose at which level they wants to have the result:

- Eighteen robust midpoints, that are relatively robust, but not easy to interpret
- Three easy to understand, but more uncertain endpoints:
    - Damage to Human health
    - Damage to ecosystems
    - Damage to resource availability

The user can thus choose between uncertainty in the indicators on the one hand and uncertainty in the correct interpretation of indicators on the other hand. Figure 18 provides the overall structure of the method.

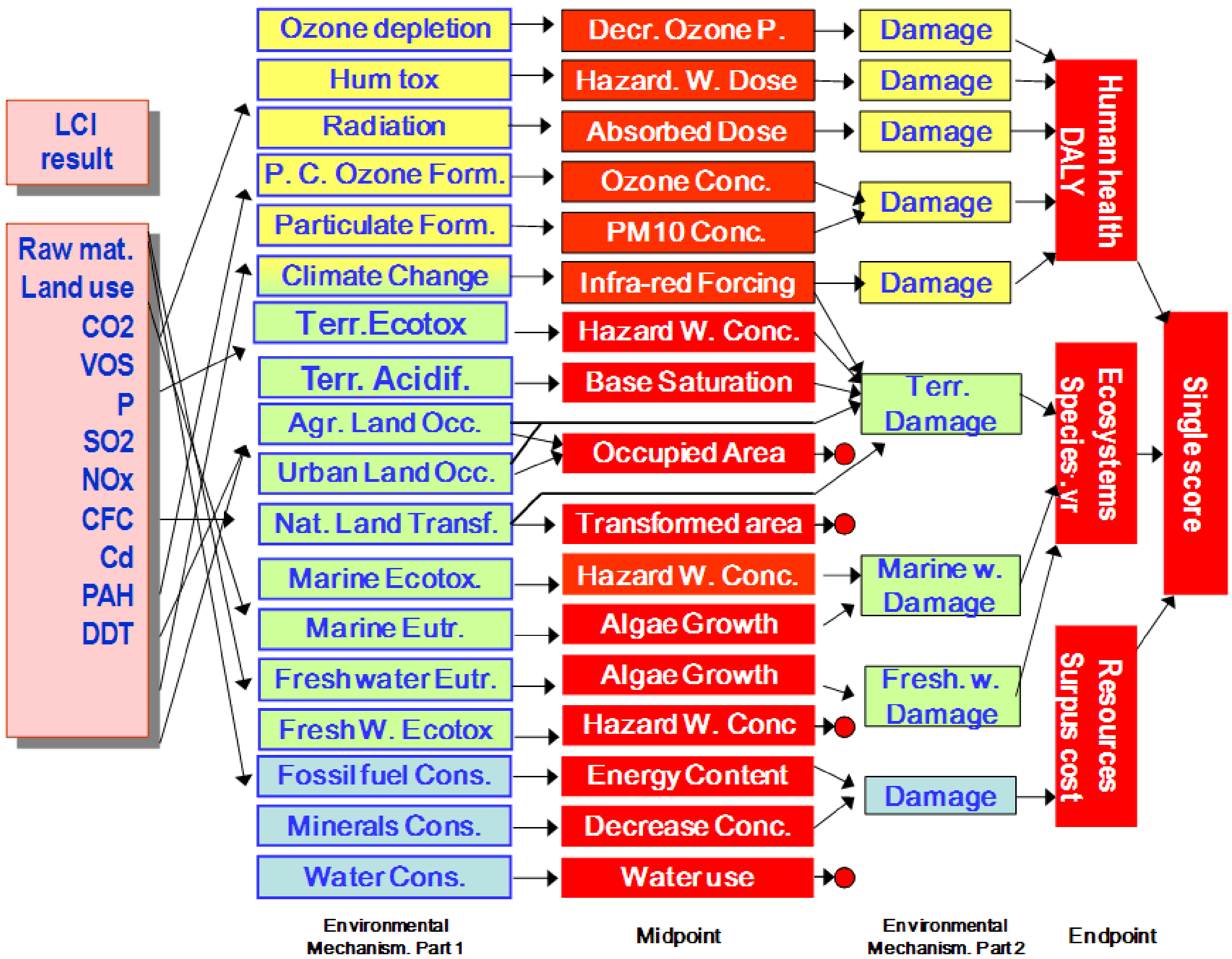

Figure 18: ReCiPe Characterisation links.

A closer description of the different environmental effect categories calculated with ReCiPe Method can be seen below:

Climate change: Climate change causes a number of environmental mechanisms that affect both the endpoint human health and ecosystem health. Climate change models are in general developed to assess the future environmental impact of different policy scenarios. For ReCiPe 2008, we are interested in the marginal effect of adding a relatively small amount of CO_2 or other greenhouse gasses, and not the impact of all emissions

Ozone layer: The characterisation factor for ozone layer depletion accounts for the destruction of the stratospheric ozone layer by anthropogenic emissions of ozone depleting substances (ODS). These are recalcitrant chemicals that contain chlorine or bromine atoms. Because of their long atmospheric lifetime they are the source of Chlorine and Bromine reaching the stratosphere. Chlorine atoms in chlorofluorocarbons (CFC) and bromine atoms in halons are effective in degrading ozone due to heterogeneous catalysis, which leads to a slow depletion of stratospheric ozone around the globe.

Ionising radiation: This describes the damage to Human Health related to the release of radioactive material into the environment.

Photochemical ozone formation: This category represents the potential of nitrogen oxides, carbon monoxide and volatile organic compounds to form ground level ozone, with consequent negative health effects.

Particulate matter formation: Fine Particulate Matter with a diameter of smaller than 10 μm (PM10) represents a complex mixture of organic and inorganic substances. PM10 causes health problems as it reaches the upper part of the airways and lungs when inhaled. Secondary PM10 aerosols are formed in air from emissions of sulphur dioxide (SO2), ammonia (NH3), and nitrogen oxides (NOx) among others (World Health Organisation, 2003). Inhalation of different particulate sizes can cause different health problems.

Acidification: Atmospheric deposition of inorganic substances, such as sulphates, nitrates, and phosphates, cause a change in acidity in the soil. For almost all plant species there is a clearly defined optimum of acidity. A significant deviation from this optimum is harmful to that specific kind of species and is referred to as acidification.

Eutrophication: Aquatic eutrophication can be defined as nutrient enrichment of the aquatic environment. Eutrophication in inland waters as a result of human activities is one of the major factors that determine its ecological quality. On the European continent, it generally ranks higher in the severity of water pollution than the emission of toxic substances. Aquatic eutrophication can be caused by emissions to air, water and soil. In practice, the relevant substances include phosphorus and nitrogen compounds emitted to water and soil as well as ammonia (NH3) and nitrogen oxide (NOx) emitted to air.

Toxicity: The characterisation factor of human toxicity and ecotoxicity accounts for the environmental persistence (fate) and accumulation in the human food chain (exposure), and toxicity (effect) of a chemical. Fate and exposure factors can be calculated by means of 'evaluative' multimedia fate and exposure models, while effect factors can be derived from toxicity data on human beings and laboratory animals.

Land occupation: The land use impact category reflects the damage to ecosystems due to the effects of occupation and transformation of the land. Although there are many links between the way land is used and the loss of biodiversity, this category concentrates on the following mechanisms:

1. Occupation of a certain area of land during a certain time;
2. Transformation of a certain area of land.

Both mechanisms can be combined, often occupation follows a transformation, but often occupation occurs in an area that has already been converted (transformed). In such cases, the transformation impact is not allocated to the production system that occupies an area.

Water depletion: Water is a scarce resource in many parts of the world, but also a very abundant resource in other parts of the world. Unlike other resources, there is no global market that ensures a global distribution. The market does not work over big distances as transport costs are too high. Extracting water in a dry area can cause significant damages to ecosystems and human health.

Depletion of abiotic resources: "Abiotic resources" are natural resources (including energy resources) such as iorn ore, crude oil and wind energy, which are regarded as non-living. Abiotic resource depletion is one of the most frequently discussed impact categories and there is consequently a wide variety of methods available for characterising contributions to this category. To a large extent, these different methodologies reflect differences in problem definition. Depending on the definition, this impact category includes only natural resources, or natural resources, human health and the natural environment, among its areas of protection. Note that the debate on the characterisation of depletion-related impact categories is not settled. (J. B. Guinée et al., 2002)

Appendix 2, IPCC 2013

Direct solar radiation heats the Earth. The heated crust emits heat radiation which is partially absorbed by gases, known as greenhouse gases, in the Earth's atmosphere. Some of this heat radiation radiates back to Earth and heats it. This natural greenhouse effect is essential for life on Earth. However, because of human activity, the presence of greenhouse gases in the atmosphere, such as carbon dioxide, methane, and nitrous oxide, have increased. This affects the natural radiation balance, which leads to global warming and climate changes.

The potential impact on the climate is calculated using the IPCC 2013 GWP 100 v.1.03, model Global Warming Potential, GWP. The impact of climate gases is expressed as carbon dioxide equivalents, CO2 eq. It is the most established scientific method. It has been implemented in other methods, such as GHG protocol and ReCiPe, but then with adaptions.

Appendix 3, Cumulative Energy Demand, CED

Cumulative Energy Demand (CED) is a method to calculate direct and indirect use of energy resources, commonly referred to as *primary energy*. Characterisation factors are given for the energy resources divided into five impact categories:

- Non-renewable, fossil
- Non-renewable, nuclear
- Renewable, biomass
- Renewable, wind, solar, geothermal
- Renewable, water

Some studies also add energy from waste as an indicator. This is not done here, since waste is not considered to be primary energy, and thus the input of energy resources may be less than the final energy (heat and electricity) delivered by the system.

Normalisation is not a part of this method. To get a total ("cumulative") energy demand, each impact category is given the weighting factor 1 (Frischknecht et al., 2007).

Appendix 4, ecoinvent

Ecoinvent is one of the world's leading databases with consistent, open, and updated Life Cycle Inventory Data (LCI). With several thousand LCI datasets in the fields of agriculture, energy supply, transport, biofuels and biomaterials, bulk and speciality chemicals, construction and packaging materials, basic and precious metals, metals, IT and electronics and waste management, ecoinvent offers the most comprehensive international LCI database.

Ecoinvent's high-quality LCI datasets are based on industrial data and have been compiled by internationally recognised research institutes and LCA consultants.

Appendix 5, LCA methodology and ISO 14040

LCA can assist in:

- identifying opportunities to improve the environmental performance of products at various points in their life cycle,
- informing decision-makers in industry, government, or non-government organisations (e.g., for strategic planning, priority setting, product or process design or redesign),
- the selection of relevant indicators of environmental performance, including measurement techniques,
- marketing (e.g., implementing an eco-labeling scheme, making an environmental claim, or producing an environmental product declaration).

Some terms that are used in the method require clarification:

- Environmental aspect - An activity that might contribute to an environmental effect, for example, "electricity usage".
- Environmental effect - An outcome that might influence the environment negatively (Environmental impact), for example, "Acidification", "Eutrophication" or "Climate change".
- Environmental impact - The damage to a safeguarding object (i.e., human health, ecosystems, health, and natural resources).

LCA addresses the environmental aspects and potential environmental impacts) (e.g., use of resources or environmental consequences of emissions) throughout a product's life cycle from raw material acquisition through production, use, end-of-life treatment, recycling, and final disposal (i.e., cradle-to-grave).

A significant part of the environmental impact of a product depends on choices taken during the product development phase, e.g., materials, processes, or functionality. Therefore, the basic principles for abatement come from the discipline of cleaner technology and are defined in the concept of Integrated Product Policy (IPP) as:

"*All products cause environmental degradation in some way, whether from their manufacturing, use, or disposal. LCA management minimises these by looking at all phases of a product's life cycle and acting where it is most effective.*

The life cycle of a product is often long and complicated. It covers all the areas from the extraction of natural resources, through their design, manufacture, assembly, marketing, distribution, sale, and use to their eventual disposal as waste. At the same time, it also involves many different actors such as designers, industry, marketing people, retailers, and consumers. LCA management attempts to stimulate each part of these individual phases to improve their environmental performance. With so many different products and actors, there cannot be one simple policy measure for everything. Instead, there are a whole variety of tools - both voluntary and mandatory - that can be used to achieve this objective."

In 1997, the European Committee for Standardisation published their first set of international guidelines for LCA performance. This ISO 14040 standard series has become widely accepted amongst the practitioners of LCA and is continuously being developed along with progressions within the field of LCA (Rebitzer et al., 2004). The International Organization for Standardization describes the guidelines for LCA in two documents; ISO 14040, which contains the main principles and structure for performing an LCA, and ISO 14044, which includes detailed requirements and recommendations. Furthermore, ISO/TR 14048 includes the format for data documentation (ISO, 2002) as well as technical reports with guidelines for the different stages of an LCA in ISO/TR 14047 (ISO, 2012a) and ISO/TR 14049 (ISO, 2012b), are available in this standard series.

An LCA study has four phases: the goal and scope definition phase, the inventory analysis phase, the impact assessment phase, and the interpretation phase. Figure 19 shows a conceptual representation of this.

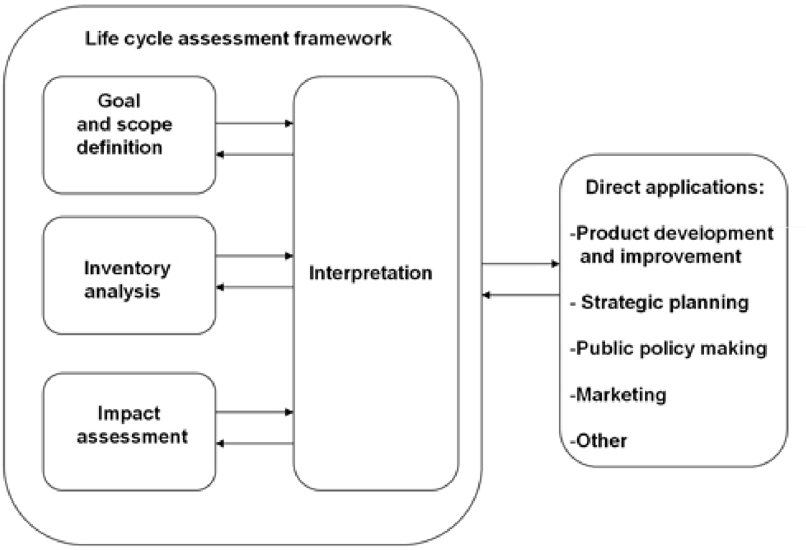

Figure 19: The four phases of the Life Cycle Assessment and some suggestions for how to apply the results and insights

1. The first phase is the definition of goal and scope. The goal and scope, system boundary, and level of detail of an LCA depend on the subject and the intended use of the study. The depth and the breadth of LCA can differ considerably depending on the goal of a particular LCA.

2. The life cycle inventory analysis phase (LCI) is the second phase of LCA. It is an inventory of input/output data concerning the system that is studied. It involves the collection of the data necessary to meet the goals of the defined study.

3. The life cycle impact assessment phase (LCIA) is the third phase of the LCA. The purpose of LCIA is to provide additional information to help assess a product system's LCI results to understand their environmental significance better.

Life cycle interpretation is the final phase of the LCA procedure. The results of the LCI, LCIA, or both are summarised and discussed as a basis for conclusions, recommendations, and decision-making according to the goal and scope definition.

Appendix 6 Report of energy efficiency measurement

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Report of Energy Efficiency Measurement

Report belonging to certificate number	NL18EPCL P180051 ISO	
Date of issue original certificate	23-02-2018	
No. and date of revision	-	
Subject	Energy efficiency labelling lift	
Requirements	EN-ISO 25745-2:2015	
Object number	-	
Project number	P180051	

1. General data

Name and address of installer	Cibes Lift AB	
	Utmarksvägen 13, 802 91, Gävle	
	Sweden	
Name and address of certificate holder	Cibes Lift AB	
	Utmarksvägen 13, 802 91, Gävle	
	Sweden	
Product description	Platform Lift	
Date of examination	23-02-2018	
Examination performed by	E. Verkaik	

2. Basic data of lift

Address of lift	Utmarksvägen 13	
Trademark	Cibes, Kalea, NTD	
Type	A5 with EcoSilent Drive	
Serial no.	-	
Travelling height	3,60	m
Short travel height	0,00	m
No. of stops	2	
Nominal load	400	kg
Nominal speed	0,15	m/s
Average acceleration	0,06	m/s²
Average jerk	0,06	m/s³
Balance ratio	0	%
Control system	CiCon	
Drive control	Frequency converter	
Lighting system	LED	
(Estimated) no. of trips per day	20	

3. Measurements

Measuring equipment / serial number	434	10570010
Date of calibration	19-03-2015	

The energy consumption is determined based upon the EN-ISO 25745-2:2015 method with an unloaded platform. The energy consumption of ancillary power and main power is measured during 5 reference cycles. Also the energy consumption of ancillary power and main power is measured during 5 short cycles. One reference cycle is defined as a trip up and a trip down between the ultimate floors of the total travel height, including the doors active. A short cycle is defined as a trip up and a trip down between floors with a travel distance of at least one-quarter around the mid-point of the total travel height, including the doors active.

Also directly after a cycle, after 5 minutes and after 30 minutes, the energy is measured for one minute.

4. Results

Based on the EN-ISO 25745-2:2015 method the parameters which determine the energy efficiency are measured and calculated.
The relevant results are shown hereunder.

Measurement results

Door cycle time	20,00	s
Average travel distance	3,6	m
Operating days per year	365	
Power in idle mode	24,0	W
Power in standby after 5 min.	18,0	W
Power in standby after 30 min.	18,0	W
Ancillary power during cycles	0,0	W
Energy consumption in 5 reference cycles	39,70	Wh
Energy consumption in 5 short cycles	0,00	Wh
Temperature control room	20	°C
Temperature lift well	20	°C
Temperature on platform	20	°C

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Calculation results

Usage category table 1, determined on the (estimated) no. of trips per day	1	
Load factor acc. to EN-ISO 25745-2:2015	1,05	
Percentage of average travel distance table 2	100	%
Percentage of average load table 3	8	%
Percentage time ratio in idle table 4	13	%
Percentage time ratio 5 min. table 4	55	%
Percentage time ratio 30 min. table 4	32	%
Average running energy per metre	1,10	Wh/m
Start/stop energy consumption	0,00	Wh
Running energy of an average cycle with empty platform	7,94	Wh
Daily running energy	83,63	Wh
Running time per day	0,26	h
Daily non-running (idle/standby) energy consumption	445,76	Wh
Total energy consumption per day	529,39	Wh
Total energy consumption per year	193,23	kWh
Specific running energy for the average running cycle	2,90	mWh/kgm
Specific running energy for the reference cycle	2,76	mWh/kgm

6. Conclusions

Performance level for running	5	
Performance level idle	1	
Performance level standby after 5 min	1	
Performance level standby after 30 min	1	
The lift belongs to energy class	A	

Based upon the results of the energy efficiency measurement Liftinstituut B.V. issues an energy efficiency certificate.

The certificate is only valid for the product mentioned under 2.

The certificate is issued based on the requirements that are valid at the date of issue. Liftinstituut reserves all rights regarding the validity of the certificate with respect to changes in the requirements or changes in the state of the art of the product.

Prepared by:

E. Verkaik
Product Specialist Certification

Reviewed by:

C. van den Einden
Product manager Machinery

Annex 1. Overview of previous revisions of certificate and report

REVISIONS OF CERTIFICATE AND BELONGING REPORT

Rev.	Date	Summary of revision
-	23-02-18	Original

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Appendix 7 Verification dialogue

Starts on next page

VERIFICATION REPORT FOR EPD OF CONSTRUCTION PRODUCT IN THE INTERNATIONAL EPD® SYSTEM

INTRODUCTION

This document serves as the verification report template of Environmental Product Declarations (EPD) of construction products, aligning with PCR 2019:14 and applicable complementary PCR (c-PCR), in the International EPD® System. For verification report template for EPDs based on the old PCR of construction products in the International EPD® System (PCR 2012:01), see separate document.

This template is mandatory to use for verification of EN 15804-compliant EPDs for construction products in the International EPD® System for both EPD verification and EPD Process Certification. A signed copy of this verification report shall be submitted to the Secretariat as a part of the EPD registration and publication. The verification report shall be available to any person upon request.

This is a living document, which is based on the ECO Platform Audit and Verification Guidelines for ECO EPD Programme Operators Version 3.1 dated November 2019 (modifications have been made for clarity and for updates related to EN 15804:2012+A2:2019). See www.environdec.com for the latest version.

EPD INFORMATION

Registration number of EPD(s): *Please contact the Secretariat to pre-book an EPD registration number.*	S-P-05232
Product name(s):	Cibes A5000
EPD owner:	Cibes Lift Group
Product Category Rules (PCR): *Registration number, name and version* Complementary PCR (c-PCR): *Registration number, name and version*	PCR2019-14 Construction products v1.11 C-PCR-008 Lifts (Elevators)
EPD valid until: *Set by the verifier. Use date format YYYY-MM-DD, e.g. 2024-02-15.*	2027-03-16
Additional comments from verifier:	Click to add text.

VERIFICATION STATEMENT

I hereby confirm that, following the checks performed, in accordance with the limits of the scope of our appointment, nothing has come to the verifier's attention to suggest any data errors or deviations from the requirements by the above-referenced EPD and its project report, in terms of

- the underlying data collected and used for the LCA calculations,
- the way the LCA-based calculations have been carried out to comply with the calculation rules,
- the presentation of environmental performance included in the EPD, and
- any other information included in the declaration

with respect to the procedural and methodological requirements in ISO 14020:2000, ISO 14025:2006, the General Programme Instructions of the International EPD® System, EN 15804:2012+A2:2019 and the reference PCR.

I confirm that, in accordance with the limits of the scope of our appointment, the company-specific data has been examined as regards plausibility and consistency. The declaration owner is responsible for its factual integrity and that the product does not violate relevant legislation.

I confirm that I have sufficient knowledge and experience of construction products, the construction industry, relevant standards and the geographical area of the EPD to carry out this verification.

I confirm that I have been independent in my role as verifier in accordance with the requirements in General Programme Instructions, i.e. I have not been involved in the execution of the LCA or in the development of the declaration, and have no conflicts of interest regarding this verification.

Name and organization of verifier:	Dr Hüdai Kara, Metsims Sustainability Consulting.
Date and location:	2022. 03. 17, OXFORD, UK
Signature: *Add as image or print and sign this document*	

In case of EPD Process Certification, the signature of EPD process owner may also be added.

VERIFICATION CHECKLIST PART A: CALCULATION RULES FOR THE LIFE CYCLE ASSESSMENT AND REQUIREMENTS ON THE PROJECT REPORT:

The following issues must be checked as a minimum. The check consists of checking if the issue is described in the LCA project report and if it is line with the requirements and guidelines in the applicable reference (EN 15804, other standards or PCR). Most issues are mandatory to check, some can be optional.

Any deviations from the requirements should be reported by the verifier. If the issue is in line with the requirements and/or accepted by the verifier, the box “done” can be ticked. If the LCA is already critically reviewed according to ISO 14044 before the verification, no duplications are necessary.

1	GENERAL INFORMATION	MANDATORY (M) / OPTIONAL (O)	REFERENCE	CHECKED AND APPROVED	N/A
1.1	Commissioner of LCA study, LCA practitioner	M	EN 15804 ch. 8.2	√	☐
1.2	Date of issue of LCA report	M	EN 15804 ch. 8.2	√	☐
1.3	Statement that the Life Cycle Assessment study has been performed in accordance with the requirements of EN 15804 and applicable PCRs	M	EN 15804 ch. 8.2 and applicable PCR	√	☐
1.4	Any other independent verification of the data given in the LCI/LCA documentation?	O		☐	√
2	STUDY GOAL	MANDATORY / OPTIONAL	REFERENCE	CHECKED AND APPROVED	N/A
2.1	Reasons for performing the Life Cycle Assessment	M	EN 15804 ch. 8.2	√	☐
2.2	Intended application (e.g. for EPD, databases, publication etc.)	M	EN 15804 ch. 8.2	√	☐
2.3	Target group (B2B, B2C, …)	M	EN 15804 ch. 8.2	√	☐
3	FUNCTIONAL UNIT / DECLARED UNIT	MANDATORY / OPTIONAL	REFERENCE	CHECKED AND APPROVED	N/A
3.1	Functional / Declared unit, including relevant technical specification	M	EN 15804 ch. 6.3.1/6.3.2 and/or applicable PCR or additional specific requirements for certain product groups in applicable c-PCR	√	☐
3.2	Indication of a factor for the conversion into kg	M		√	√

3.3	If product groups (similar products from one manufacturer and/or from different production plants) are formed as averages: a) Description of the type of average b) Description of how the average has been calculated. c) Does the description of the average represent what is declared in the EPD?	M	EN 15804 ch. 8.2	☐	√
4	PRODUCT DESCRIPTION	MANDATORY / OPTIONAL	REFERENCE	CHECKED AND APPROVED	N/A
4.1	Composition of the product. The level of detail: the main components necessary to understand what type of product is concerned (detailed mass description is not necessary if confidential). In case of average EPD: at minimum qualitative description of averages and qualitative description of ranges.	M	ISO 14025	√	☐
4.2	Description of technical and functional characteristics and area of intended application in the building. In case of average EPD: at minimum qualitative description of averages and qualitative description of ranges of functions.	M	Applicable PCR	√	☐
4.3	Flow diagram of main production processes and visualization of system boundaries. Level of detail: see 4.1.	M	ISO 14025	√	☐
5	SYSTEM BOUNDARIES IN ACCORDANCE WITH THE MODULAR DESIGN OF EN 15804	MANDATORY / OPTIONAL	REFERENCE	CHECKED AND APPROVED	N/A
5.1	Description of the life-cycle stages/modules declared. Omissions of life-cycle stages declared.	M		√	☐
5.2	Comprehensive declaration of modules A1-A3 (A1-A5 for services) + C + D as a minimum requirement unless the three conditions for type d) and e) described in PCR 2019:14 chapter 2.2.2 are met, then only modules A1-A3 (A1-A5 for services) applies.	M	EN 15804 ch. 5.2 and applicable PCR	√	☐

5.3	A1 to A3: System boundary a) Description of all processes the modules cover b) System boundary to nature (e.g. between forest and technosphere in wood production) c) Use of secondary materials and secondary fuels and waste produced d) Specification of the “end-of-waste state” for material leaving A1-A3 as waste e) If part of the energy calculation: Reference to the contract/certificate of green electricity f) No offsetting allowed	M CO_2 certificates optional	EN 15804 ch. 6.3.5.2 and applicable PCR	√	☐
5.4	A1 to A3: Allocation of co-products: a) Selection of the allocation factors for co-product allocation b) Justification of selected allocation method (economic, physical) c) Justification of specific allocation processes (e.g. if data are not available to allocate according to the EN 15804 rules) d) No declaration of loads and benefits in Module D from allocation in A1-A3	M	EN 15804 ch. 6.4.3.2 and annex B.1, and CEN TR 16970 ch. 6.4.3.2 ff	☐	√
5.5	A4 to A5 (optional module: mandatory for services): Clear description of all processes the modules cover	M	EN 15804 ch. 6.3.5.3 and applicable PCR	√	☐
5.6	Accounting for losses in the modules in which they arise (e.g. A4, during transport to construction site)	M	EN 15804 ch. 6.3.5.1	☐	√
5.7	B1 to B5 (optional module): Description of all processes the modules cover	M	EN 15804 ch. 6.3.5.4 and applicable PCR	√	☐
5.8	B6 and B7 (optional module): Description of all processes the modules cover	M	EN 15804 ch. 6.3.5.4 and applicable PCR	√	☐
5.9	C1 to C4: Description of all processes the modules cover	M	EN 15804 ch. 6.3.5.5 and applicable PCR	√	☐

5.10	C3:
	• Waste treatment
	• Materials for recycling
	• Impacts of recycling processes to achieve end of waste
	  ○ Justification of the “end-of-waste state”
	  ○ Existing purpose
	  ○ Existing market or demand
	  ○ Compliance with technical requirements and legal guidelines
	  ○ Fulfils limit values for Substances of Very High Concern (SVHC)
		M	EN 15804 ch. 6.3.5.5, ch. 7.2.4.4 (Table 8) and annex B.1, and applicable PCR	√	☐

5.11	C4: Is the complete waste disposal process included in this module? Is its inclusion described transparently and is it plausible?	M	EN 15804 ch. 6.3.5.5	√	☐
5.12	D : System boundary and contents of module justified Assumptions with regard to substituted processes in D incl. year of reference, e.g. assumptions with regard to substitution of electricity and power production. Assumptions regarding quality of the recovered material are documented and justified.	M	EN 15804 ch. 6.3.5.6	√	☐
5.13	D: No benefits or loads of allocated co-products The calculation of the net flows is documented, described transparently and plausible, particularly regarding: • amount of input material recovered from a previous system; • amount of output material to be recovered in a subsequent system; • material losses between the point of end-of-waste and point of substitution.	M	EN 15804 ch. 6.3.5.6 and ch. 6.4.3.3, and applicable PCR	√	☐
6	POWER MIX (E.G. ELECTRICITY)	MANDATORY / OPTIONAL	REFERENCE	CHECKED AND APPROVED	N/A
6.1	Selection of the power mix. Documentation of reference year for the dataset.	M	CEN TR 16970, CEN TR 15941 and applicable PCR	√	☐
6.2	If applicable: Validity (at least for the upcoming year) of the certificates for supplier-specific electricity (e.g. from renewable energy sources) in accordance with the PCR.	M	Applicable PCR	☐	√
7	GREEN ELECTRICITY (MOVED TO 6.2)	MANDATORY / OPTIONAL	REFERENCE	CHECKED AND APPROVED	N/A
8	CRITERIA FOR EXCLUDING INPUTS AND OUTPUTS	MANDATORY / OPTIONAL	REFERENCE	CHECKED AND APPROVED	N/A
8.1	Selection of the cut-off criteria, description of application of the criteria and assumptions in line with standard and PCR	M	EN 15804 ch. 6.3.6 and ch. 8.2, and applicable PCR	√	☐

8.2	List of excluded processes	M	EN 15804 ch. 8.2	☐	√
9	DATA COLLECTION, SELECTED GENERIC DATA	MANDATORY / OPTIONAL	REFERENCE	CHECKED AND APPROVED	N/A
9.1	Selection and use of generic data justified and validity demonstrated	M	EN 15804 ch. 6.3.6, EN 15941 and applicable PCR	√	☐
9.2	Documentation on generic data: Name of the data record and its source (database, literary source, etc.)	M	EN 15941 and applicable PCR	√	☐
9.3	Data collection, including handling of data quality issues, according to LCA rules Assessment period for each module considered in the LCA (e.g. one-year average, etc.) Appropriateness of generic data (temporal, geographical, technological) Declaration of other assumptions concerning generic data, e.g. about data gaps	M	ISO 14044:2006, section 4.3.2, Documentation ISO 14040 and EN 15804 ch. 6.3.7	√	☐
10	VALIDITY OF DATA	MANDATORY / OPTIONAL	REFERENCE	CHECKED AND APPROVED	N/A
10.1	Data adheres to the following requirements: a) Age < 10 years for generic data b) Age < 5 years for specific data c) Specific data based on 1-year average (unless deviations are justified). For products not yet on the market, see www.environdec.com for rules and latest information. d) Time period of 100 years, in case of a landfill scenario: longer if relevant e) Complies with physical reality of the product as far as possible, in terms of geographical and technological coverage	M	EN 15804 ch. 6.3.8, EN 15941, applicable PCR and www.environdec.com	√	☐
10.2	Documentation of data quality assessment	M	EN 15804 ch. 6.3.8.3	√	☐
10.3	Manufacturing data should be reproducible, e.g. by available data management systems. Random checks could be carried out or based on importance; some data could be checked in the verification.	O		√	☐
11	DEVELOPMENT OF SCENARIOS AT PRODUCT LEVEL IN MODULES A4-A5-B-C-D	MANDATORY / OPTIONAL	REFERENCE	CHECKED AND APPROVED	N/A
11.1	Statement that the scenarios included are currently in use and are representative for one of the most probable alternatives. Additional declaration of representative mixes for the relevant region is permissable.	M	EN 15804 ch. 6.3.9 and applicable PCR	√	☐
11.2	Documentation of the relevant technical information, e.g. recycling or reuse rates, with reference to the literature source	M		√	☐

11.3	Default values in CEN TC c-PCR are preferred. Deviations from these values must be justified	M		√	☐
12	ALLOCATIONS	MANDATORY / OPTIONAL	REFERENCE	CHECKED AND APPROVED	N/A
12.1	General allocation principles applied (avoidance of allocation, no double counting / omissions, uniform application of the allocation rules etc.)	M	ISO 14044:2006 ch. 4.3.4	√	☐
12.2	Presentation and justification of allocations in the use of secondary materials or secondary fuels as raw materials	M	EN 15804 ch. 6.4.3 and ch. 8.2, and applicable PCR	☐	√
12.3	Presentation and justification of allocations in the plant (allocation between different products/production lines in a plant)	M		☐	√
12.4	If applicable: Presentation and justification of allocation of multi-input processes (e.g. landfilling or incineration)	M		☐	√
12.5	Co-product allocation correctly applied, see also 5.3	M	EN 15804 ch. 6.4.3.2	☐	√
12.6	Documentation of allocation factors used and their (independent) sources	M		√	☐
12.7	Allocation process for reuse, recycling and recovery, check specifically: a) End-of-waste state b) Conventional average technologies and practices c) Specification and justification of end-of-waste state where applicable d) If selected substituted processes in Module D are in accordance with the c-PCR or (if no c-PCR is available) representative actual processes e) Calculation of net flows in Module D f) Conservative approach, i.e. choice of those scenarios and calculation rules that reflect the highest environmental impacts in comparison to other choices	M	EN 15804 ch. 6.4.3.3 and applicable PCR	√	☐
12.8	Justification if generic data is applied which does not comply with the allocation principles, or where this compliance is not known and there are reasons to doubt it. Expert guess of how this influences the indicator results should be provided.	M	Applicable PCR	√	☐
13	LIFE CYCLE MODELING INFORMATION	MANDATORY / OPTIONAL	REFERENCE	CHECKED AND APPROVED	N/A
13.1	Transparent presentation of LCA modelling (for example by tables, screenshots from LCA software programs etc.)	M	EN 15804 ch. 8.4	√	☐
13.2	Clear description how specific (company) data are used. Is the assignment of company data to the datasets provided by the LCA software, described transparently and is it plausible?	M	EN 15804 ch. 8.4	√	☐

13.3	For several locations/products: Presentation of modelling of all locations and products as well as weighting thereof	M		☐	√
13.4	Plausibility and consistency of data (mass balance, energy balance). This can only be fulfilled with random checks if the effort for a verification shall be reasonable, e.g. - Mass balance of inputs and outputs, e.g. mass balance of material resources (feedstock) input and output (product/waste/emissions/secondary material) - CO and CO2 emissions coherent with the mass input of fossil energetic resources - Are the energy indicators coherent with the energetic resources used?	M	EN 15804 ch. 8.4	√	☐
13.5	Overview of biogenic carbon flows in the different modules	O	EN 15804 ch. 6.4.4 amd ch. 8.2	√	☐
14	PARAMETERS OF THE LIFE CYCLE INVENTORY (LCI) AND LIFE CYCLE IMPACT ASSESSMENT (LCIA)	MANDATORY / OPTIONAL	REFERENCE	CHECKED AND APPROVED	N/A
14.1	Presentation of the parameters in tabular form for all modules A1 to D	M	EN 15804 ch. 7.2.2 and EN 15978 ch. 12.5	√	☐
14.2	Presentation of the parameters describing environmental impact, use of resources, waste categories and output material flows	M	EN 15804 ch. 6.5 and ch. 7.2.3–7.2.5, and applicable PCR	√	☐
14.3	Disclaimers to the relevant core and additional environmental impact indicators	M	EN 15804 ch. 7.2.3.3	√	☐
14.4	Has the packaging been included in the declaration of the LCI-related indicators, e.g. in the quantification of the content of primary energy?	M		√	☐
14.5	Selection of correct characterisation factors and elimination of long-term emissions (>100 years)	M	EN 15804 ch. 8.2 and annex (amendment), and applicable PCR	√	☐
14.6	Justification of characterisation factors applied in case of input/output flows that are not on the list of characterisation factors of the EN 15804 and applicable PCR	M		√	☐
14.7	Information on the environmental impacts in the project report: a) Reference to characterisation models and factors b) Statement that the estimated impact results are only relative statements which do not indicate the end points of the impact categories, exceeding threshold values, safety margins or risks	M	EN 15804 ch. 8.2	√	☐
15	INTERPRETATION	MANDATORY / OPTIONAL	REFERENCE	CHECKED AND APPROVED	N/A
15.1	Interpretation of the results based on a dominance/contribution analysis of selected indicators	O		√	☐
15.2	Relationship between the results of the LCI and the results of the LCIA	M	EN 15804 ch. 8.2	√	☐
15.3	Assumptions and restrictions as regard the interpretation of results in the EPD, in terms of both methods and data.	M	EN 15804 ch. 8.2	√	☐

15.4	In the case where an EPD is declared as an average environmental performance for a number of products, a statement to that effect shall be included in the declaration together with a description of the range/ variability of the LCIA results if significant; the description of the range can be qualitative or quantitative.	M	EN 15804 ch. 8.2	☐	√
15.5	Interpretation of the influence of data quality. An assessment of data quality should be provided if the data quality differs for significant data.	M	EN 15804 ch. 8.2, ISO 14040, CEN TR15941 and applicable PCR	√	☐
15.6	Comprehensive transparency as regards value decisions, justifications and expert opinions, i.e. transparency to avoid misinterpretation.	M	EN 15804 ch. 8.2	√	☐
16	ADDITIONAL INFORMATION	MANDATORY / OPTIONAL	REFERENCE	CHECKED AND APPROVED	N/A
16.1	If additional information is given, check the documentation: a) Laboratory results/measurements listed in the content declaration b) Laboratory results/measurements listed in the functional/technical performance c) Documentation on the declared technical information on individual life-cycle stages not taken into consideration in the construction product's LCA but applicable building assessment (e.g. transport routes, energy consumption during the usage stage, cleaning cycles etc.) d) Laboratory results/measurements pertaining to the declared emissions in indoor air, soil or water during the use stage	M	EN 15804 ch. 8.3	☐	√
16.2	Where relevant: ensure that information additional to EN 15804 is verified e.g. by reference to standards or other publicly accepted test requirements	M	EN 15804 ch. 8.3	☐	√
17	DOCUMENTATION FOR CALCULATING THE REFERENCE SERVICE LIFE (RSL)	MANDATORY / OPTIONAL	REFERENCE	CHECKED AND APPROVED	N/A
17.1	The RSL shall be declared if the full life cycle A1-C4, or the B modules, are declared. Documentation for calculating the reference service life (RSL), shall be representative for the declared product	M	EN 15804 ch. 6.3.4	√	☐

VERIFICATION CHECKLIST PART B: REQUIREMENTS ON THE EPD

This whole section is mandatory to verify. The rules for the EPD format can be found in EN 15804 ch. 7 and in EN 15942.

1	REQUIREMENTS	REFERENCE	CHECKED AND APPROVED	N/A
1.1	EPD includes as general information a) Text "Environmental Product Declaration in accordance with ISO 14025 and EN 15804", prominently visible in the EPD* b) Statement that "EPD of construction products may not be comparable if they do not comply with EN 15804" c) Publisher name*, address*, logo, website d) Name of declared product* e) If applicable: CPC-code f) Declaration owner / Name and address of manufacturer/association g) Geographical scope i.e. market(s) where the product is produced, where it may be applied and where the end-of-life is assumed to take place. h) A statement whether the EPD is a specific or an average EPD. Description of the kind of average i) Names of manufacturer(s) when the EPD declares an average of several manufacturers j) Program logo and website k) Date of issue* + validity (5 years)/date of expire* + date of update if relevant* l) EPD identification (registration number of the EPD on programme operator level and on ECO Platform level). m) Variability for average declaration n) Product composition o) Stages omitted, if not full LCA *These items shall be declared on the front page of the EPD.	EN 15804 ch. 7.1, applicable PCR and ECO Platform List of content to declare in an ECO EPD	√	☐
1.2	PCR name, registration number, version and date. If applicable: c-PCR (complementary PCR).	Applicable PCR	√	☐

1.3	Demonstration of verification: external[1] independent verification, name of third-party verifier	GPI and EN 15804 ch. 7.1 (table 2)	√	☐
1.4	Information on the validity: Does it correspond with the specifications in the project report?		√	☐
1.5	Appropriateness of logos of the company, programme operator and ECO Platform. Appropriateness of pictures.	ECO Platform List of content to declare in an ECO EPD	√	☐
2.	PRODUCT	REFERENCE	CHECKED AND APPROVED	N/A
2.1	The product description is in line with the project report, and clear enough described to identify the declared product ambiguously. Name and location of production site(s).	ECO Platform List of content to declare in an ECO EPD	√	☐
2.2	If applicable: For sector EPDs: explanations on calculations of averages within a product group, and representativeness: a) Information on the most influencing parameters in the LCA; b) Information on restrictions to the use of the EPD; c) Useful information in the EPD for the representativity of the average EPD: - A technical description of the average product group (such as density or a property like U-value); - The number of manufacturing plants included in the EPD; and/ or - The names of manufacturing companies or brands or associations; d) Sampling process if only representative companies/sites are chosen; e) Description of the relative production volume covered by the EPD; f) Geographical coverage; g) The range of products for which the EPD is relevant, even if data from some products have not been used directly in producing the EPD. h) If GWP-GHG indicator results differ by more than ±10 % for A1-A3 (A1-A5 for services): Information on the variation in the composition of the product compared with the average product declared in the EPD.	EN 15804 ch. 7.1, applicable PCR and ECO Platform List of content to declare in an ECO EPD	√	☐
2.3	Specification / identification (picture, name, model)	EN 15804 ch. 7.1 and ECO Platform List of content to declare in an ECO EPD	√	☐
2.4	Indication of the intended use. Application and technical functions of the product.	EN 15804 ch. 7.1 and ECO Platform List of content to declare in an ECO EPD	√	☐

[1] EN15804 ch. 7.2 Table 2 mentions the possibility of internal or external verification. In the ECO Platform external verification is preferred and advised.

2.5	Relevant technical data (additional information is possible) including RSL if applicable (average values or range in case of product groups)		√	☐
2.6	The test standards to which the technical data refers		√	☐
2.7	A description of the main product components and or materials is provided in accordance with the specifications of the PCR (if available) and the project report. As a minimum, the description shall include substances listed in the latest "Candidate List of Substances of Very High Concern for authorisation" if their content exceeds the limits for registration.	EN 15804 ch. 7.1	√	☐
2.8	Description of the manufacturing process / all manufacturing processes if several locations are involved	EN 15804 ch. 7.1	√	☐
3	LCA RULES	REFERENCE	CHECKED AND APPROVED	N/A
3.1	Information on the declared / functional unit corresponds with the specifications of the PCR, c-PCR (if available) and project report	Applicable PCR	√	☐
3.2	EPD type a)cradle-to-gate with modules C1–C4 and module D; b) cradle-to-gate with modules C1–C4, module D and optional modules; c) cradle-to-grave and module D; d) cradle to gate; e) cradle to gate with options; f) construction service EPD: cradle to gate with modules A1-A5 and optional modules	EN 15804 ch. 7.2.2 and applicable PCR	√	☐
3.3	Reporting modules declared (X) and not declared (ND), geography, share of specific data (in GWP-GHG indicator) and data variation. See table 3 in PCR 2019:14.	Applicable PCR	√	☐
3.4	A (simple) flow diagram in accordance with the modular approach	EN 15804 ch. 7.2.1	√	☐
3.5	Description of the system boundary (can be simplified, as a picture or in wording), including the assignment of the analysed processes to the modules	Applicable PCR	√	☐
3.6	If applicable: Description of key assumptions which are not depicted elsewhere in the EPD	Applicable PCR	√	☐
3.7	If applicable: Presentation of the application of cut-off criteria in accordance with the project report	Applicable PCR	√	☐
3.8	Source of generic data used, name and dated version. Description of what upstream and/or downstream data has been applied is optional.	ECO Platform List of content to declare in an ECO EPD	√	☐
3.9	Information on the data collection period and resulting averages		√	☐
3.10	Presentation of the allocations of relevance for calculation in accordance with the minimum requirements of the PCR	Applicable PCR	√	☐
4	LCA: SCENARIOS AND ADDITIONAL TECHNICAL INFORMATION	REFERENCE	CHECKED AND APPROVED	N/A
4.1	Mandatory for all declared modules beyond A3: declaration of assumptions pertaining to the scenarios of the declared modules in accordance with the project report. Information on undeclared modules is optional.	EN 15804 ch. 7.3	√	☐
4.2	If a reference service life is declared in the EPD, presentation of the scenario on which the RSL is based, in accordance with the project report.	EN 15804 ch. 7.3.3.2	√	☐
5	LCA: RESULTS	REFERENCE	CHECKED AND APPROVED	N/A
5.1	Description of the declared / functional unit		√	☐

5.2	Full declaration of results for all required indicators, according to the modular approach. Indicators include those based on LCIA and those based on LCI (e.g. including biogenic carbon content in product and in any accompanying packaging, if applicable). Result table contains: Only values or the letters “ND” (not declared). No blank cells, hyphens or other symbols. The value 0 only for parameters that have been calculated to be 0. “ND” is only for parameters that are not quantified because of no data available. Footnotes shall be used to explain and limitation to the result value.	EN 15804 ch. 6.4.4, 7.2.3, 7.2.4, 7.2.5 7.5 and 8.2, applicable PCR and ECO Platform List of content to declare in an ECO EPD	√	☐
5.4	The declared indicator and other quantitative results shall be identical with the respective values in the project report		√	☐
5.5	In case of product averages: description of the range / variability of the LCIA results. This may be qualitative information.	EN 15804 ch. 7	√	☐
5.6	Deletion of module columns which are not declared (permissible for the Results part).	ECO Platform List of content to declare in an ECO	√	☐
5.7	Formatting the table framework and parameter addressed in accordance with the specifications of the PCR or the program operator rules (including the GPI and possible additional requirements at www.environdec.com).	GPI and www.environdec.com	√	☐
5.8	If applicable: For sector EPDs: If GWP-GHG indicator results differ by more than ±10 % for A1-A3: declare the variation in results between the productions sites.	Applicable PCR	√	☐
6	EVIDENCE FOR TESTS OR CERTIFICATES	REFERENCE	CHECKED AND APPROVED	N/A
6.1	If applicable: Additional information is on release of dangerous substances to indoor air, soil and water during the use stage	EN 15804 ch. 7.4	√	☐
6.2	If applicable: Declaration of the relevant evidence for 6.1, or information where to find this evidence	Applicable PCR	√	☐
7	REFERENCES	REFERENCE	CHECKED AND APPROVED	N/A
7.1	List of references	Applicable PCR	√	☐
8	ANNEX	REFERENCE	CHECKED AND APPROVED	
8.1	An Annex may contain all additional information required for specific national use in different countries.	ECO Platform List of content to declare in an ECO EPD	√	☐
9	MACHINE-READABLE EPD INFORMATION	REFERENCE	CHECKED AND APPROVED	N/A
9.1	If applicable: Information in the machine-readable EPD format correspond with the verified information of the EPD		☐	√

VERIFICATION CHECKLIST PART C: REQUIREMENTS FROM OTHER STANDARDS AND REFERENCES

This whole section is mandatory to verify. It has been added to ensure that e.g. any programme-specific requirements that are not included in Parts A and B are part of the verification.

1	OTHER STANDARDS AND REFERENCES	REFERENCE	CHECKED AND APPROVED	N/A
1.1	Compliance with other requirements in ISO 14020	ISO 14020	√	☐
1.2	Compliance with other requirements in ISO 14025	ISO 14025	√	☐
1.3	Compliance with other requirements in EN 15804:2012+A2:2019	EN 15804:2012+A2:2019	√	☐
1.4	Compliance with other requirements in ISO 21930:2017, if applicable	ISO 21930:2017	√	☐
1.5	Compliance with other requirements in General Programme Instructions in the International EPD® System and complementary requirements at www.environdec.com	General Programme Instructions	√	☐
1.6	Compliance with other requirements in referenced Product Category Rules (PCR) available at www.environdec.com	Applicable PCR(s)	√	☐

DIALOGUE BETWEEN VERIFIER & EPD OWNER DURING THE VERIFICATION PROCESS

N^O	CHAPTER, ARTICLE, PARAGRAPH, TABLE	TYPE OF COMMENT*	REFERENCE TO CHECKLIST OR PROGRAMME INSTRUCTIONS	VERIFIER COMMENT AND RECOMMENDATION	EPD OWNER ANSWER	FINAL VERIFIER STATEMENT
				EPD		
1	EPD, Page 1	Ed		Please update the ECO Platform logo. New version of ECO Platform logo is available. Use one that I will send with my email.	New logo has been added	DONE
2	EPD, Page 1	Ed		Please also update the expiry date as suggested on the EPD (in line with verifier statement)	Suggestion for publication and expiry dates have been added. Unclear exactly what date can/should be used, so we wrote 16 march (next week and in five years time).	OK
3	EPD, Page 1	Ed		Kalea A4 mini or primo? LCA report suggest the latter. Also LCA report refers to products as A5000 and Kalea A4 Primo suggesting that they are two different products. Here you use A5000/Kalea A4 mini suggesting they are same? Confusing..	There has been some confusion in the naming of the products. In the end, it is like this: The Cibes A5000 and Kalea A4 Primo are identical products but sold by different brands. They are both represented by the LCA report, and they are then presented in two separate EPDs. (The use of “A4000” and “A4 mini” was simply due to misunderstandings. The correct names are Cibes A500 and Kalea A4 Primo)	OK
4	EPD, Page 1	Ed		Please add a logo of the Company and product image	Added	OK
5	EPD, Page 3	Ed		Company and product information is missing.	Info on company and product added	OK
6	EPD, Page 10	Te		The results on the Table do not match with the results in the LCA report. Please check.Please write the product and its functional unit on the heading of the Table. The number format should	This was a mistake in copying and pasting between the LCA and the EPD. The LCA numbers are correct. The EPD tables have been updated.	ACCEPTED

				be in 3-significance.	Functional unit has been clarified above the results table. Number format has been updated to 3 significance figues. Also, the format (scientific or decimal) is consistent for each row/impact category	
7	EPD, Page 10	Te		Please add the following disclaimer as well on the bottom of the Table and refer back to here *Disclaimer 3 EP-freshwater: This indicator is calculated both in kg PO4 eq and kg P eq as required in the charactarization model. (EUTREND model, Struijs et al, 2009b, as implemented in ReCiPe; http://eplca.jrc.ec.europa.eu/LCDN/developerEF.xhtml)	Disclaimer has been added	OK
8	EPD, Page 11			The results for RSL (25 years) do not match with the ones in the LCA report	Numbers updated to match.	OK
9	EPD, Page 12			Please provide resources and output flows for each declaration: 1 tkm results and 25 years life time results	This is now included in both LCA and EPD	OK
LCA Report						
10				Please follow the above comments for the LCA report as well. Some of my comments are also available on the report.	All comments in the LCA report have been adressed, and any changes marked for clarity. An additional change was made to correct a minor mistake where some packaging wood had been assigned to the A1 module. Changes are marked in the LCA report.	OK
11						

Add more rows, as needed.

* Editorial (Ed), General (Ge) or Technical (Te)