Environmental fact sheet: Freight Cabin

Studied and drafted at KLEEMANN SA
Dr. Sfampa Ioanna, Group Innovation Researcher

2024

Contents

Foreword

Environmental protection is a practice of protecting the natural environment, for the benefit of both the environment and humans. With awareness of environmental protection increasing worldwide, demand for more efficient products to reduce energy and resource consumption is more urgent than ever. The possible environmental impacts associated with products have sparked interest in developing methods to understand and minimize these impacts. Life-cycle assessment (LCA) is a technique to assess environmental impacts associated with all the stages of a product's life from raw material extraction through materials processing, manufacture, distribution, use, repair and maintenance, and disposal or recycling. LCAs can help avoid a narrow outlook on environmental concerns by compiling an inventory of relevant energy and material inputs and environmental releases; Evaluating the potential impacts associated with identified inputs and releases and also interpreting the results to help make a more informed decision.

An important aspect on the companies' awareness is the ISO 14000 family of standards, which provides practical tools for companies and organizations of all kinds seeking to manage their environmental responsibilities. ISO 14006 provides guidelines to assist organizations in establishing, documenting, implementing, maintaining and continually improving their management of eco-design as part of an environmental management system (EMS).

Vertical – transportation products are indispensable to urban mobility and accessibility. Passenger comfort and attractive design must be integrated into a large, complex system. combining that with an environmental approach is a creative challenge.

Introductory information

KLEEMANN Hellas S.A. is active in the field of construction and design of integrated complete lift systems. It is one of the largest companies in this sector to the European and international market and its distribution network expands to more than 100 countries.

Since 2012, KLEEMANN implements an environmental management system (EMS) for its facilities. This system has been certified according to ISO 14001 and covers the production unit (office facilities and factories) in the industrial area of Kilkis. The company also applies quality management system certified in accordance with ISO 9001 and implements the principle of product eco-design in accordance with ISO 14006 since 2015.

The strategic objective for the company is the sustainable development in full harmonization with the environmental protection, resulting in environmentally superior products. That aim can be achieved by adhering to fundamental rules, criteria and mechanisms for environmental protection, pollution prevention and protection of human health. This ensures preservation of natural resources and the gradual restoration of the environment. The main goal is to redesign all of our products on the basis of eco-design process. The strategy is motivated by three factors: nature, society, economy.

The largest lift company in Greece presents the model of eco-design. The procedure of LCA in our products is constantly a growing part of research and development. This is the main and most important pillar of innovation on technological achievement. It is the most important step on achieving an integrated environmental approach on the products design.

Description of steps and procedures of eco-design

Scope: Eco-design is an approach of designing products with special consideration for the environmental impacts of the product during its whole lifecycle. In a life cycle assessment, the life cycle of a product is usually divided into procurement, manufacture, use, and disposal. It is a growing responsibility and understanding of our ecological footprint on the planet.

Terminology: The flow of energy and materials, as well as the type of pollutants examined in each system, is the part of a product's life. The system is determined by the boundaries, which are defined in advance. System boundaries in this study are the receipt of raw materials in our facilities up to the final recycling and disposal of the product.

Required data: The data required for the completion of the study are the units of materials and energy required for the entire life cycle of a product as well as the quantification of their effects.

However, in a study of life cycle it is clear that some of the data will be taken from some pertinent cases and are necessarily accepted as they appear in them. As much as we are stretching the limits of the system the analysis of inputs and outputs becomes more difficult. If no suitable data is available, the best estimation is used.

The data relating to the production process are calculated accurately, while the impact of the extraction and production of raw materials have not been addressed.

Procedure description

Upstream procedures

- These are procedures which take place regardless the manufacturing of the product such as mining raw materials, transport within the supply chain. These are processes which will not be examined in this document.

Production and core processes

- These are the principal manufacturing processes of the product. The procedures of carrying materials and waste management resulting from the above, even if carried out by third parties, are also included.

Downstream procedures

- These are the processes no more controlled by the product manufacturer, but by the product owner. This covers the private transportation of the product to the consumer, consumption of the energy or other consumables, adequate maintenance and end of-life processes of the used product.

Calculations and environmental impact assessment

The part of the measurement of environmental impact is the criterion for the improvement actions that are required in order to reduce the first. To calculate these impacts, Software Sima Pro® 8 was used, with the method ReCiPe Endpoint, hierarchist version, for the major part of the Environmental Impact Assessment.

The method of eco-design is applied to an elevator cabin, used as a freight cabin, which is designed, manufactured and distributed by KLEEMANN. The adoption of such a model design contributes as a catalyst to reduce the environmental impact and cost.

1. Raw materials
2. Manufacturing processes
3. Transport & Packaging
4. Installation
5. Operation - Use
6. Maintenance - Repairs
7. Disposal - Recycling

Product structure and reference model

The product that has been assessed on the basis and principles of eco-design is the New Freight Cabin. A freight cabin refers to an elevator car specifically designed for transporting heavy goods and large items. These are known as freight elevators, and their cabins are built to handle higher weight capacities and larger dimensions compared to passenger elevators.

The reference model is a cabin of the dimensions of 1850mm x 3150mm and height of 2670mm. The design of that new models was under the vision of substituting formerly produced models. Up until now, there has not been a specific product designed to meet this need. It could be regarded as a custom-made solution that was developed and studied separately for each case. For the sake of comparison, we considered a product of similar dimensions and a similar concept, without any special cladding or particular material.

The freight cabin of an elevator is a type of cabin specifically designed for transporting items such as heavy equipment or commercial cargo between different levels of a building. This type of elevator typically features robust construction and high capacity to support the weight of the loads. Freight elevator cabins are often used in industrial areas, storage facilities, and other locations where safe and efficient transportation of large and heavy items is essential.

The New Freight Cabin is a modern design that offers high performance and safety in the transport of heavy loads. It incorporates durable materials and structural elements that ensure maximum strength and durability.

Regarding the production process, the designing team focused on optimizing and standardizing procedures, thereby allowing for repeatability and reducing production time. The implementation of these improvements enhances the efficiency of the production process while also conserving resources and reducing production costs.

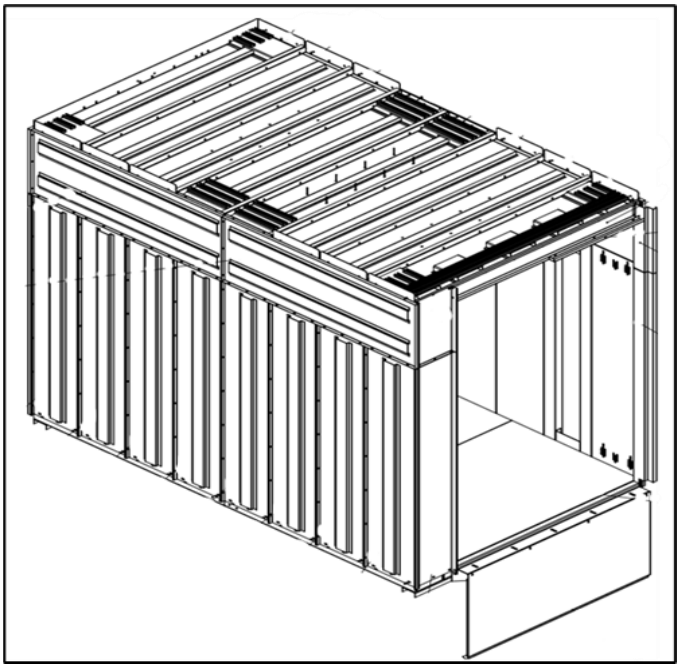


Figure 1: New Freight Cabin design

The designing team focused on following the principles of eco-design and according to this aimed on the followings:

1. Minimization of unused raw material aims at both cost efficiency and the optimization of the final environmental footprint. The way to achieve this goal led the team to combine parallel and vertical sheet metal pieces for the cabin walls.

2. Avoiding the use of UPN in the design of the cabin platform. UPN refers to a category of steel profiles in the shape of a 'U'. The name 'UPN' comes from the initials of 'U' and 'Profil Normalisé' (French for 'Standard Profile'). Their shape resembles the letter 'U' and provides strength and stability in various construction applications. These elements are of high mass, and the goal in this project was to replace them with elements made from sheet metal up to 3mm thick. This approach leads to a lighter construction, using less massive raw material, and consequently, a smaller environmental footprint.

3. Another goal of the project was to minimize welding during the construction of the cabin. Welding is widely used in many fields and applications, but there are some limitations and potential drawbacks. Depending on the situation and application requirements, some of these reasons may include:
    a. <u>Impact Resistance</u>: In some cases, welds may not withstand impacts or vibrations well, especially if not properly designed or if operating conditions are extreme.
    b. <u>Quality Control</u>: The quality of welds can be affected by various factors, such as temperature, working conditions, and other elements. Difficulty in quality control can be a disadvantage.
    c. <u>Heat Effects</u>: During the welding process, high temperatures can cause changes in material properties, such as loss of hardness or structural inconsistencies.
    d. <u>Maintenance and Repairs</u>: In some cases, welds can complicate maintenance and repairs, especially if cutting or disassembly is required.
    e. <u>Environmental Impact</u>:
        i. *Energy Consumption*: Welding processes, such as electric welding, may require significant energy consumption.
        ii. *Waste Production*: Welding can create waste, such as ash, welding residues, and other by-products, which need to be properly managed and recycled.
        iii. *Fume Emissions*: During welding, fumes containing chemical substances may be produced. These emissions may require appropriate safety measures for worker safety.

4. Finally, an additional important objective was to create a roof consisting of relatively small pieces to facilitate the installation process. Achieving this goal reflects an effort to improve ergonomics, efficiency, and ease of installation. Typically, the roof of an elevator is designed as a single surface for aesthetic, safety, and functional reasons. However, a single roof can cause problems during installation due to weight and size, making it difficult to manage inside the cabin. By using smaller pieces, it is possible to achieve flexibility in roof design and facilitate adaptation to more complex geometries. Additionally, the easy installation of small pieces allows workers to operate with greater precision and enables efficient roof installation, reducing construction time and cost. Furthermore, the use of small pieces allows for easy transportation and storage of the material, as well as the ability to address potential issues or replace only defective or worn pieces without the need to replace the entire roof. This approach helps reduce waste and improve the sustainability of the cabin.

Analysis of life cycle parameters of the new products

The life cycle analysis (LCA) is a methodology used to assess the environmental impacts of a product or service throughout its entire life cycle, from raw material extraction to disposal or recycling. The life cycle stages are typically divided into four main categories:

1. *Raw materials acquisition and processing*: This includes all the activities involved in extracting, refining, and processing the raw materials that are used to manufacture the product.

2. *Manufacturing*: This includes all the activities involved in transforming the raw materials into the finished product, such as assembly, packaging, and transportation.

3. *Use*: This includes all the activities involved in using the product, such as energy consumption and emissions associated with operating and maintaining the product.

4. *End of life*: This includes all the activities involved in disposing of the product, such as recycling, landfilling, or incineration.

By analyzing the environmental impacts of each of these stages, LCA can provide valuable insights into how to reduce the environmental footprint of a product or service over its entire life cycle.

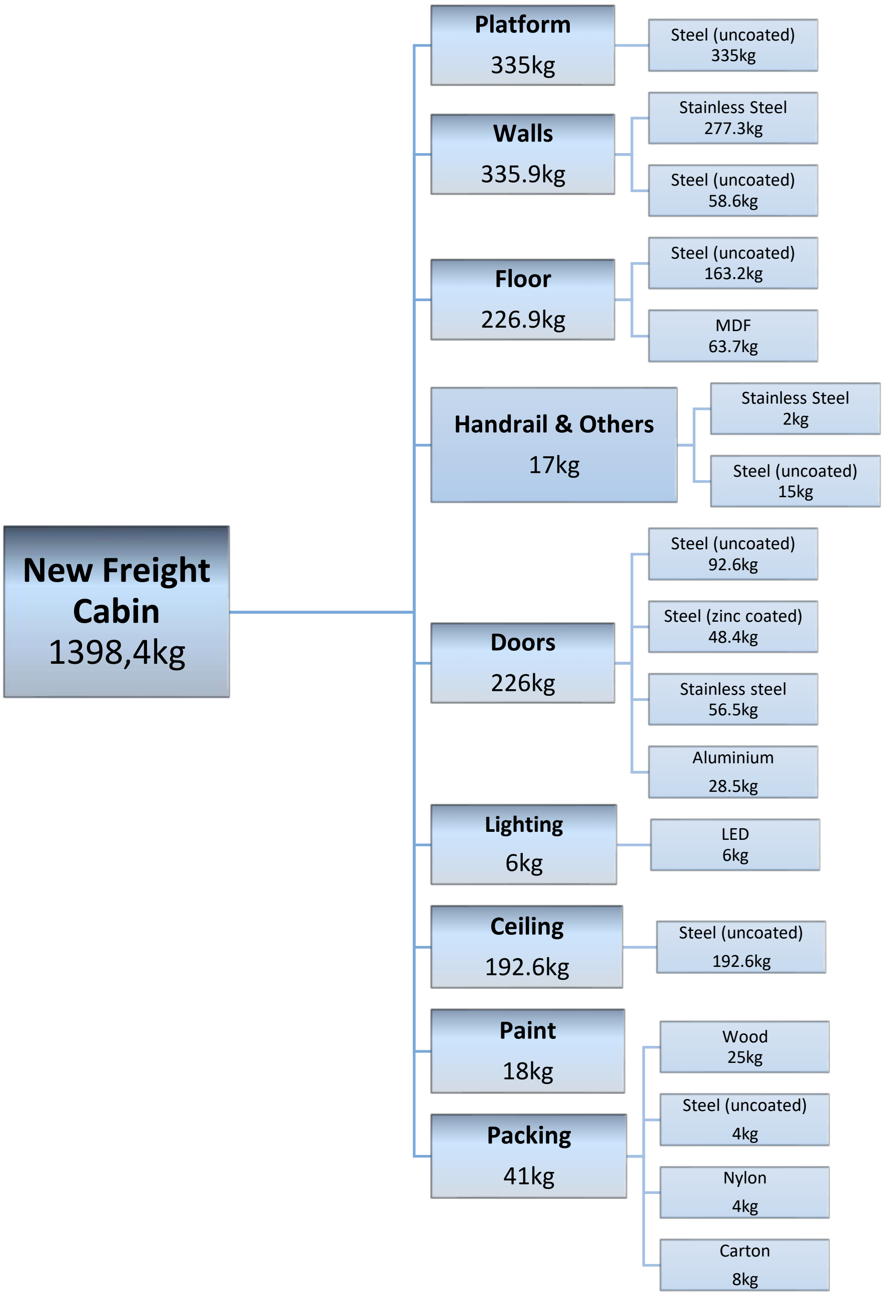
This year’s assessed piece is sub-system of an elevator. As a sub-system during its use there is no energy consumed, so the LCA is focused only on the other 3 stages, namely raw materials, manufacturing and end-of-life. These are the stages that company takes into account and interfere with the process of eco-design. The service plays also an important role in product's life cycle. The other parameters related to the life cycle of a product, such as packaging, transport, installation and maintenance shall contribute in overall impact.

The eco-designed cabin is about gradually to substitute older cabins. This substitution leads not only to new and eco-designed products, but also to the reduction of the products' range. The additive advantages are the reduction of SKUs (Stock Keeping Units) and their management and storing cost.

Raw materials

The company is gradually trying to co-operate with suppliers who meet the environmental criteria which are set by standards. So up to the present time, at least 50% of the company's suppliers operate with an environmental management system and ISO14001 certification.

The total mass of the cabin for the life cycle inventory without packing is almost 1145kg for the New Freight Cabin. The sub-assemblies and the materials That the cabin is consisted of, are presented in the following figure:



Manufacturing processes

Listed below are the manufacturing processes through which each component and the individual parts of the product are made. The facilities of the company have been amended as to the production line (lean flow), which ensures low stocks and flexibility at the same time.

Reference model	New	Old
Ceiling	72.46	77.54
Doors	3	3
Floor	2	2.5
Handrail & Others	1	1
Platform	23.5	54
Walls	91	90
Total consumed energy (kWh)	**192.96**	**228.04**

Transportation & Packaging

Transportation: Average mileage for the product from the production site to the installation site is 800km (average distance from the factory to the various installations in accordance with the measurements of 2014). The carriage of cargo is up to 16tones.

Packaging: For the packaging of products wood, nylon, nails and cartons are used. The packaging for by-product required is listed below:

Material	Quantity [kg]
Wood pallet	25
Nylon	4
Steel (nails etc)	4
Carton boxes	8

Installation

KLEEMANN provides all the necessary auxiliary tools to the installer so that the time and energy to be spent are reduced to the minimum level. Because of this and because the time and the energy per installation can vary these data are not calculated in detail. An approximation over the installation concerning the man-hours needed is generally 10days and one day for each extra elevator stop. Present report concerns only the cabin so the installation time only for this sub-system is considered to be 8 hours.

Operation – Use

This year evaluation centers concerns a sub-system of an elevator, particularly the cabin. As the cabins do not consume any energy during operation themselves, this step of the procedure is not considered in the assessment.

Maintenance - Repairs

KLEEMANN offers all the spare parts that a maintenance requires. The maintenance work is a continuous process throughout the phase of operation of the lift. It consists of (a) the periodic preventive maintenance and (b) the unregulated operations required after a failure.

Preventive maintenance is obligatory by the legislation of each country; however, the frequency varies. In each case the lift can be considered serviced six times a year from a team of two technicians. The maintenance procedure in addition to the transfer of technicians at the spot includes a limited use of tools and materials (light, grease, etc). The ecological footprint of this phase can be estimated from the fuel consumption for the transfer of staff (6 x 15 km per year).

Typically, the elevator cabin does not require any maintenance, aside from the replacement of lamps, over its lifespan of approximately 25 years.

Disposal - Recycling

In the final stage of an elevator life cycle, a crucial factor is the ability to recycle the product as thoroughly and easily as possible. To accomplish this, the optimal design scenario is one that enables the dismantling of the materials into separate categories for recycling.

KLEEMANN lifts comprise a high percentage of recyclable materials such as metal, alloy steel, cast iron, aluminum alloy, and copper, which can be reused directly. The cabin is particularly easy to dismantle, allowing for efficient recycling of the individual components.

- *Metal:* The walls, platform, ceiling, handrail, screws, doors and other miscellaneous items such as bolts and nuts, can all be recycled, with steel components such as black, galvanized, and stainless steel being particularly valuable in the recycling process. By recycling these materials, we reduce waste and conserve natural resources, making the elevator industry more sustainable and environmentally friendly.
- *LED:* The LED lighting should also follow the proper procedure after being removed. In the European Union (EU), there are regulations in place for the disposal and recycling of electronic waste, including LED lighting. The EU's Waste Electrical and Electronic Equipment (WEEE) Directive requires that manufacturers and importers of electronic equipment take responsibility for the proper disposal of their products. Under the WEEE

Directive, consumers can return their used LED lighting to the manufacturer or retailer, who must then ensure that the product is properly recycled. Consumers can also take their used LED lighting to designated collection points or recycling centers, which are typically operated by local governments or private companies. Additionally, the Restriction of Hazardous Substances (RoHS) Directive restricts the use of certain hazardous substances, such as lead, mercury, and cadmium, in the manufacture of electronic equipment, including LED lighting. This helps to reduce the environmental impact of electronic waste and protect human health.

- *MDF:* When disposing of MDF (Medium-Density Fiberboard), it is important to follow proper disposal procedures to ensure that it is managed in an environmentally responsible manner. In many countries, MDF is considered to be a type of wood waste and can be disposed of through wood waste recycling programs. MDF waste can be taken to wood recycling centers or to construction and demolition waste facilities where it can be sorted and processed for material recovery or energy recovery.

Following the proposed procedures at least 99% of the cabin can be recycled.

Environmental Impact Assessment

Terminology

Materials: For the calculation of the indicator for the production of materials, including all the procedures, from the extraction of raw materials to the final production stage. The calculation includes even the transfers made during the production of the material.

Manufacturing processes: Indicators of production processes represent the emissions both from the production process itself, as well as those which were released during the production of electricity used from each production process.

Transport: Indicators of transport include the effects of emissions caused both for the production of fuels and their combustion during the process of transport of the products.

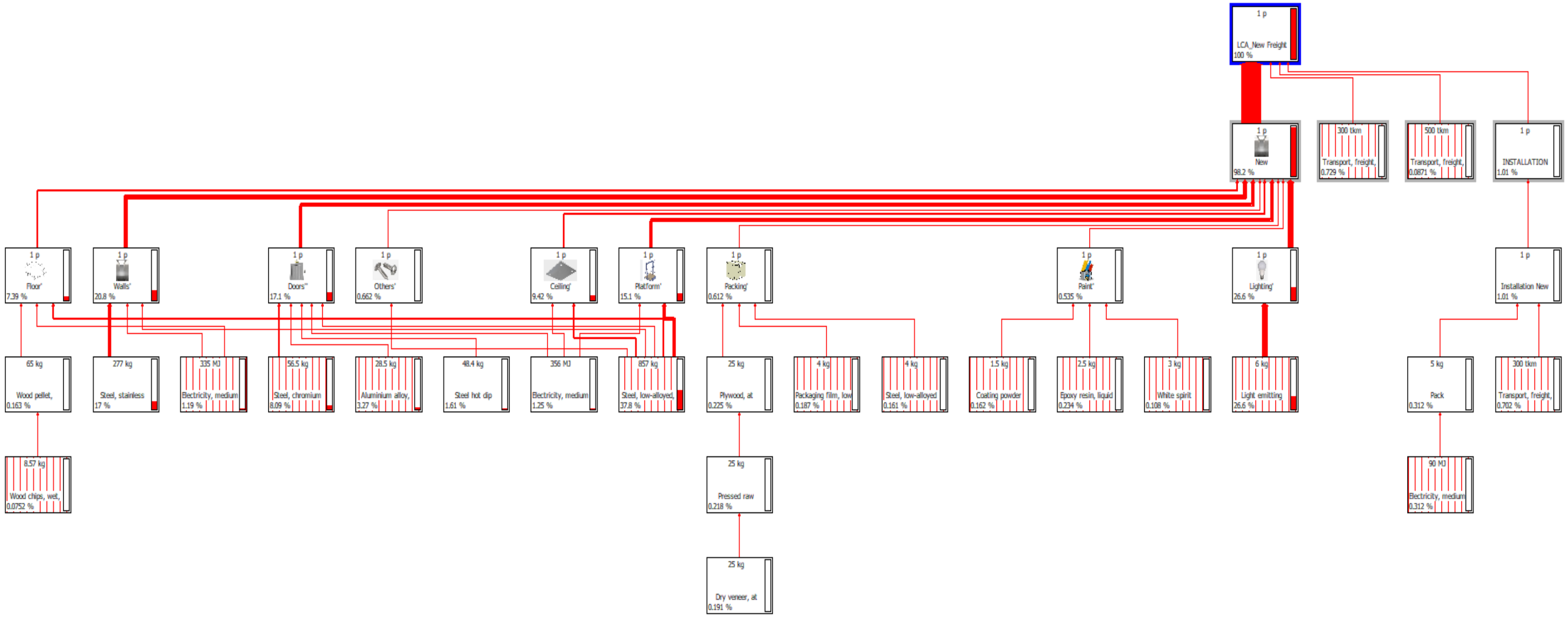
Power Consumption: Indicators of energy are referred to the mining of various fossil fuels, such as lignite, and their use for the electricity production. These indicators will vary from country to country due to different technology and the energy mix used for the production of electricity. These indicators include a separate indicator for the production of energy in the country of usage.

Disposal Procedures and collection: This category includes indicators for the recycling of various materials, incineration, burial at burial site and using biological treatment

The assessment of operational phase based on system UCTE mix of electricity low voltage.

The results of this study illustrate the environmental impact of the New Freight Cabin. It is also possible to devise again the study and with other methods of analysis. On the diagrams extracted from the software SimaPro® is illustrated a comparative study between the earlier model to the newly designed.

First of all, is shown the Product Structure Tree, where the cabin is presented as function of its life cycle, including the manufacturing part, the transportation, the usage phage, till the disposal scenario. The sub-assemblies that contribute with the major percentage are described through the materials and the processes they are consisted of.



1 p
LCA_New Freight
100 %
1 p
New
98.2 %
300 tkm
Transport, freight,
0.729 %
500 tkm
Transport, freight,
0.0871 %
1 p
INSTALLATION
1.01 %
1 p
Floor'
7.39 %
1 p
Walls'
20.8 %
1 p
Doors''
17.1 %
1 p
Others'
0.662 %
1 p
Ceiling'
9.42 %
1 p
Platform'
15.1 %
1 p
Packing'
0.612 %
1 p
Paint'
0.535 %
1 p
Lighting'
26.6 %
1 p
Installation New
1.01 %
65 kg
Wood pellet,
0.163 %
277 kg
Steel, stainless
17 %
335 MJ
Electricity, medium
1.19 %
56.5 kg
Steel, chromium
8.09 %
28.5 kg
Aluminium alloy,
3.27 %
48.4 kg
Steel hot dip
1.61 %
356 MJ
Electricity, medium
1.25 %
857 kg
Steel, low-alloyed,
37.8 %
25 kg
Plywood, at
0.225 %
4 kg
Packaging film, low
0.187 %
4 kg
Steel, low-alloyed
0.161 %
1.5 kg
Coating powder
0.162 %
2.5 kg
Epoxy resin, liquid
0.234 %
3 kg
White spirit
0.108 %
6 kg
Light emitting
26.6 %
5 kg
Pack
0.312 %
300 tkm
Transport, freight,
0.702 %
8.57 kg
Wood chips, wet,
0.0752 %
25 kg
Pressed raw
0.218 %
90 MJ
Electricity, medium
0.312 %
25 kg
Dry veneer, at
0.191 %

Damage Assessment

To quantify how much impact a product or service has in the different impact categories, we use characterization factors (CFs). CFs express how much a single unit of mass of the intervention contributes to an impact category; how much 1 kg of chemical emission contributes to Eco toxicity, for instance. Next chart compares the pair of cabin models according to their contribution to different impact categories.

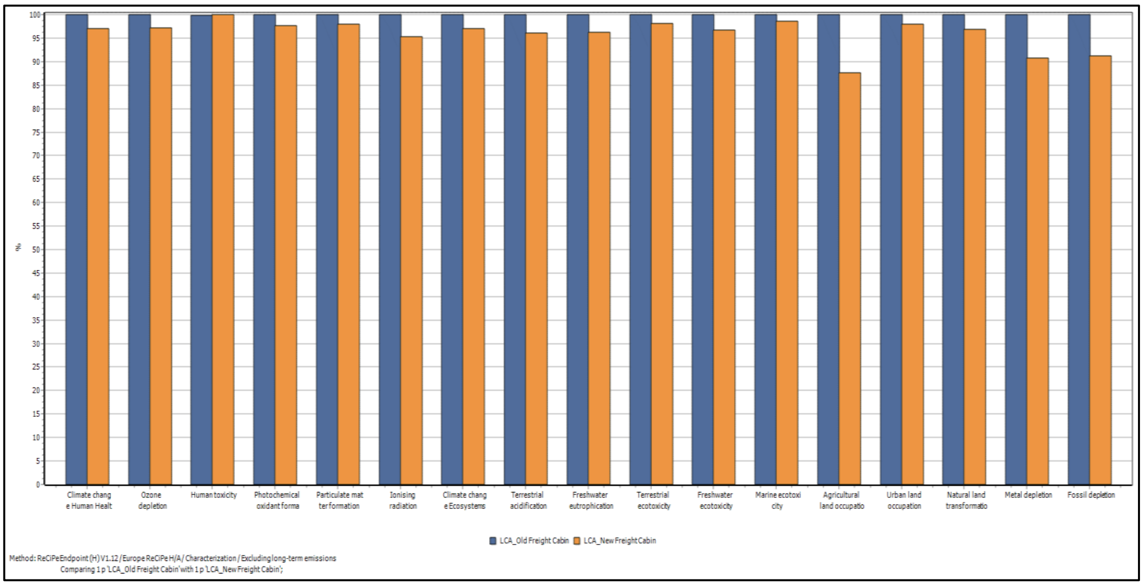


Figure 2: CFs comparison of New and Old Freight Cabin

The results of the comparison indicate that the newly designed cabin has reduced effect in the majority of the categories. Is specially mentioned the category "metal depletion". This shows a notable difference between the two designs, which can be attributed to the reduction of raw materials that are predominantly metallic in the eco-designed cabin. Overall, the eco-designed product outperforms the other design in several other categories as well.

In the next chart the total impact per model and comparatively is presented. The purpose of damage assessment is to combine a number of impact category indicators into a damage category. In the damage assessment step, impact category indicators with a common unit can be added. All impact categories that refer to human health are expressed in DALY (disability adjusted life years). DALYs caused by carcinogenic substances can be added to DALYs caused by climate change.

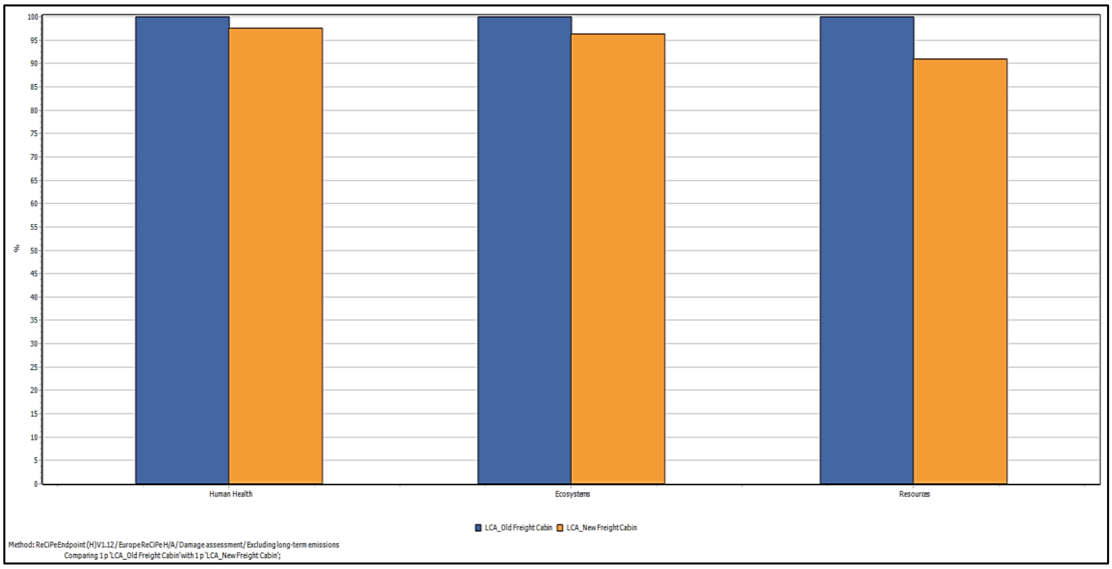


Figure 3: Total impact in damage assessment comparison of New and Old Freight Cabin

The comparison between the pair of models clearly demonstrates a reduction in environmental impact, particularly in the area of resource usage. Also, the reduction achieved in the area of human health, while indirect, is particularly significant. Additionally, the new design has a positive impact on the deterioration of the environment and the balance of ecosystems affected by the extraction and initial processing of materials. Overall, the results indicate that the new design has made significant strides towards reducing the negative impacts associated with production and resource usage.

Normalization

There are several methods for comparing impact category indicator results, one of which is normalization using a reference (or normal) value. This involves dividing the impact category indicator by the reference value. A commonly used reference value is the average yearly environmental load in a particular country or continent, divided by the number of inhabitants. By normalizing the impact category indicators, they are transformed into a unit that is comparable across all categories, which simplifies the comparison process.

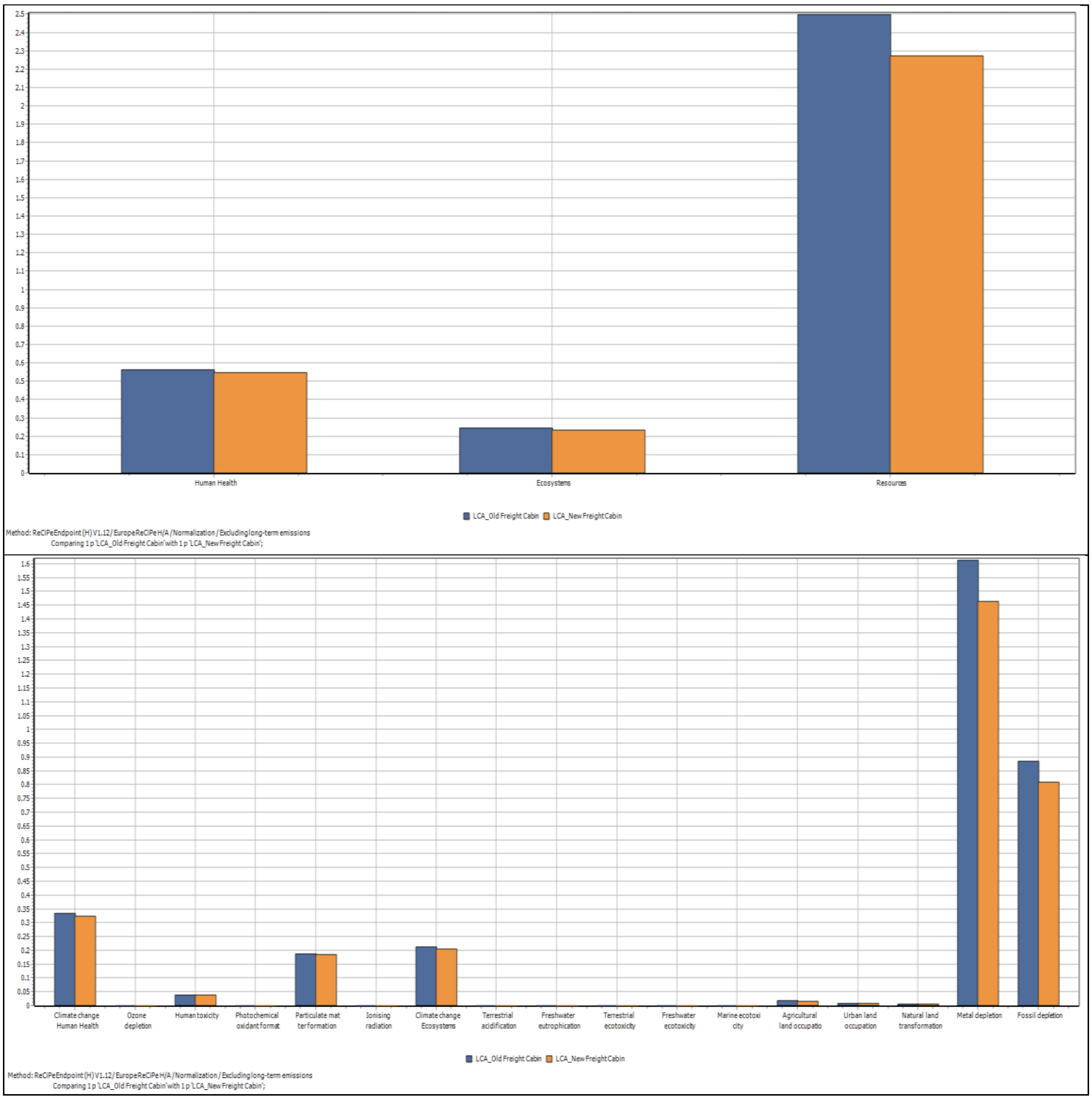


Figure 4: Normalized impact of New compared to Old Freight Cabin

From the above figures is revealed that metal depletion and fossil depletion are the most prominent categories impacted by the cabin, while their contribution to climate change (in terms of human health and ecosystem) and particulate matter formation is relatively less significant. Nevertheless, the new cabin, demonstrate significant improvements across all categories.

Weighting

The weighting method combines different data classes into a single number by assigning weights based on a valuation principle. These weights express the relationship between human values and changes in the environment. The ReCiPe method, the most comprehensive and recently updated life cycle impact assessment method in Europe, employs harmonized category indicators at both the midpoint and endpoint levels, making it particularly well-suited to assessing relevant environmental effects.

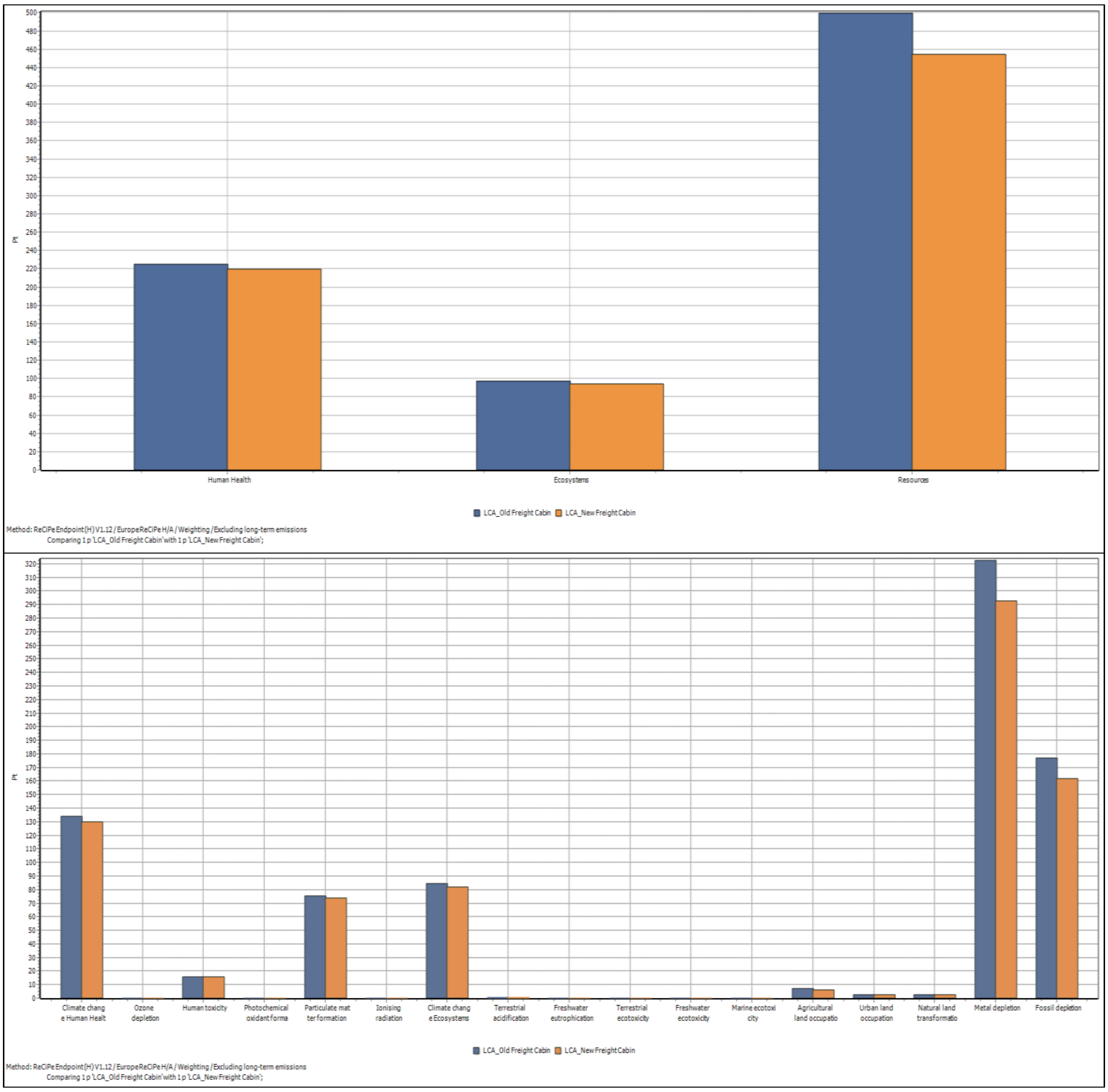


Figure 5: Comparison of New and Old Freight Cabin according to weighting method

The following figure presents the impact of each sub-system on different categories:

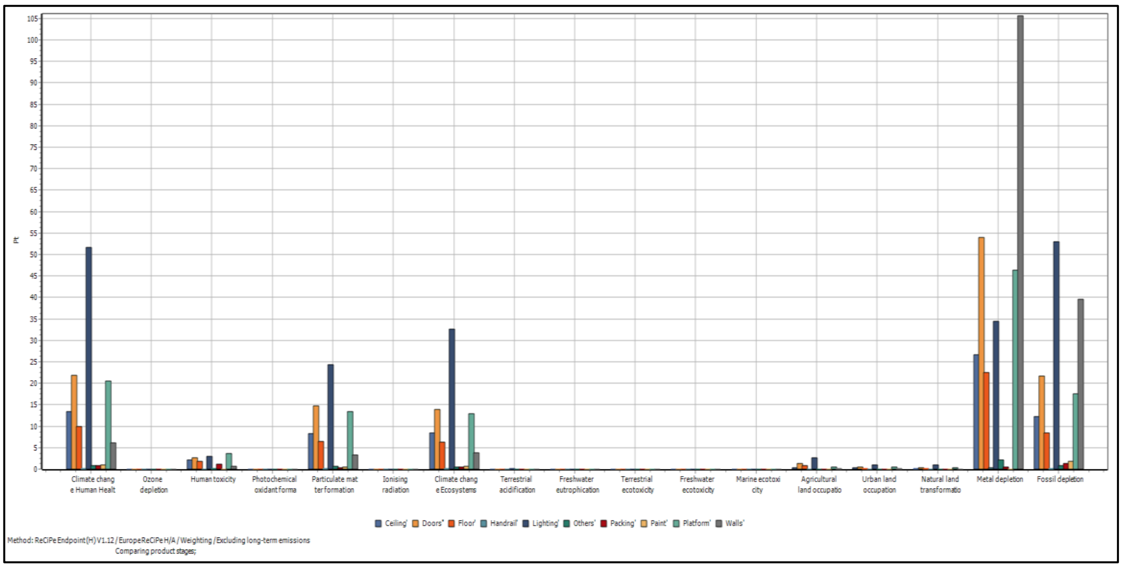


Figure 6: Presentation of each sub-system according to weighting method

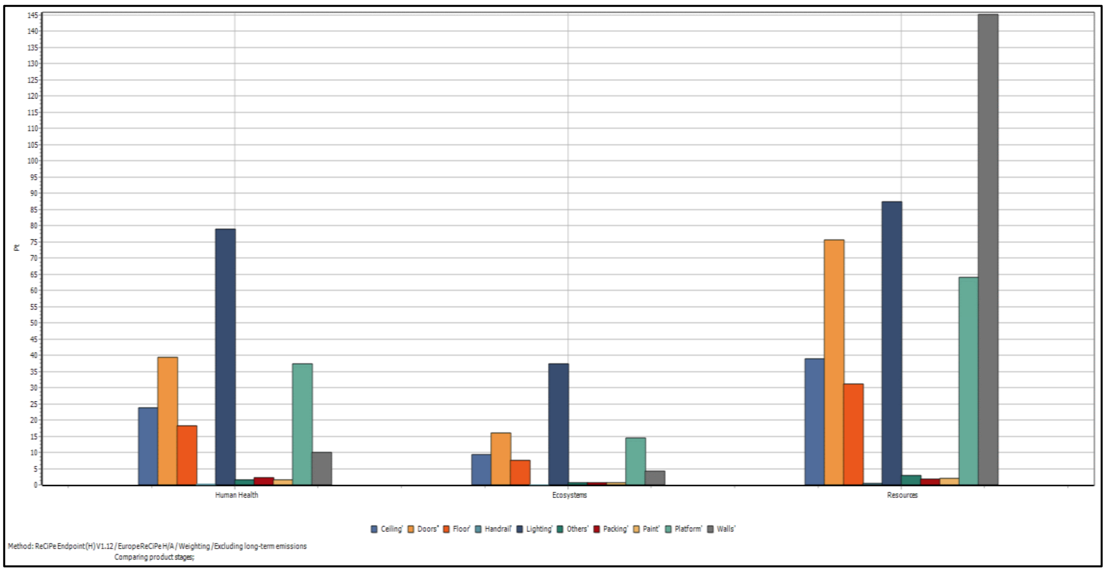


Figure 7: Presentation all sub-system in impact categories according to weighting method

Single Score

In order to compare and identify the varying degrees of environmental impacts, a technique called weighting is used. This involves assigning a numerical value to each environmental effect, based on its relative significance, and combining them to create a single score that represents the overall impact. This single score is commonly used as an index to describe the total environmental impact, making it easier to understand and compare the different effects.

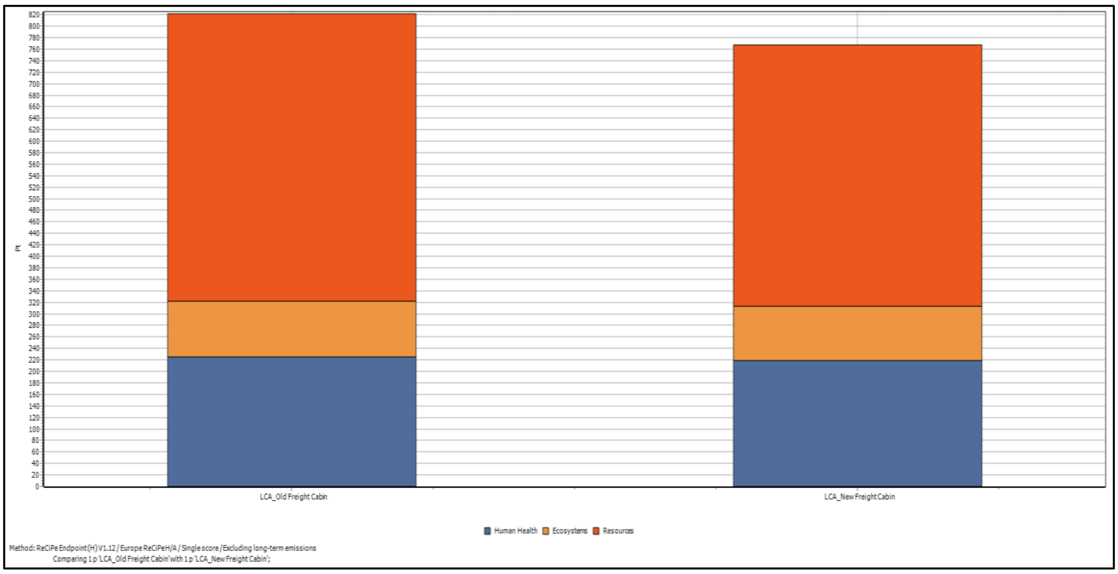


Figure 8: Single score comparison of New and Old Freight Cabin

The next two figures present a similar comparison, but in this case the results are presented per impact category.

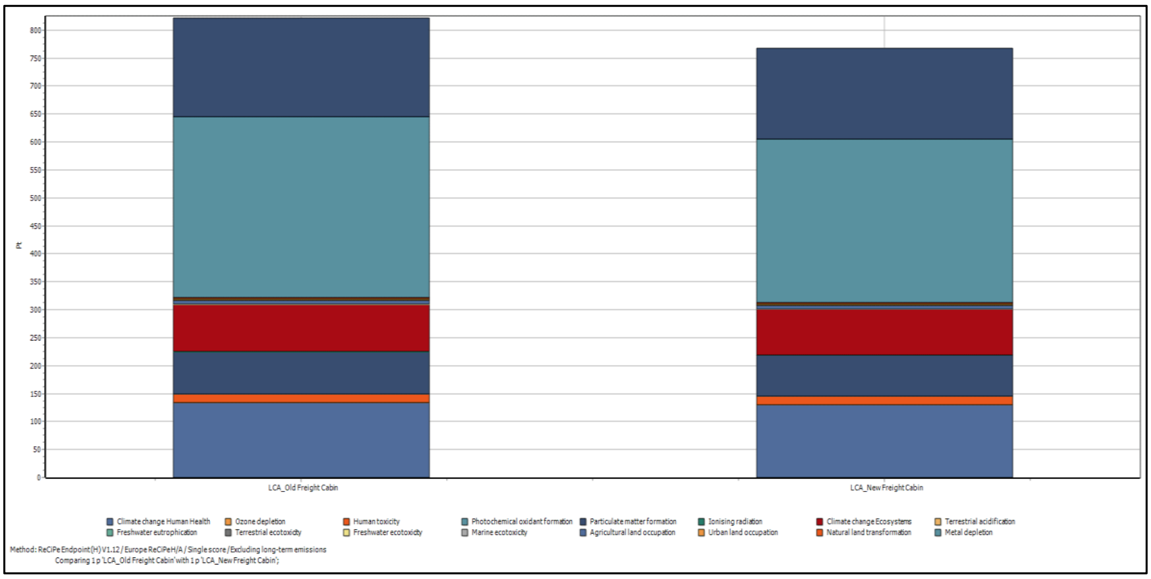


Figure 9: Single score per impact category comparison of New and Old Freight Cabin

The data presented above provides strong evidence that the newly designed product is more environmentally friendly, particularly in terms of reducing the impact on resources affected by raw materials. The figures clearly demonstrate a significant decrease in the use of these resources, underscoring the positive impact of the new designs on the environment.

The impact of the new cabin on each of their subassemblies is presented separately in the following figures, with each subassembly's impact represented by a single score.

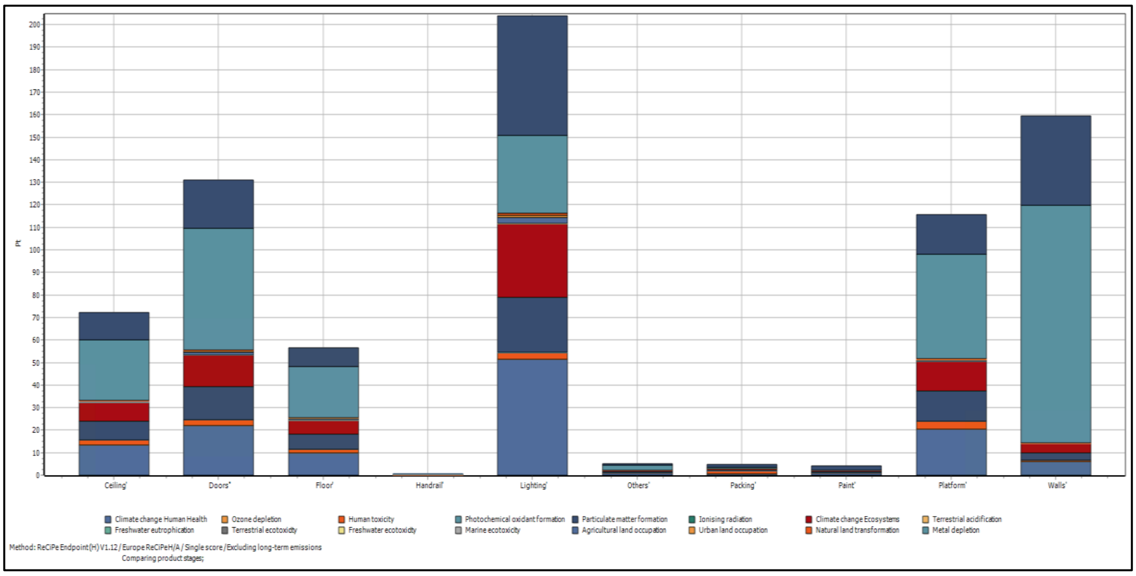


Figure 10: Single score per impact category of New Freight Cabin subassemblies

The burden of land for its use is expressed through the units of Potentially Disappeared Fraction (PDF) * m^2 * year/m^2. The raw materials, which are mined, are quantified as to the surplus of energy per kg of minerals. Finally, the fossil fuels in excess are quantified as energy per exported MJ, kg or m^3.

Three more methods were applied in order to compare different impact indicators. The following table presents these results.

Impact category	Unit	EPD		IPCC		CML - IA	
		Old	New	Old	New	Old	New
Acidification	*kg SO_2 eq*	29.6	28.5			30	28.9
Eutrophication	*kg PO_4^{-3} eq*	4.67	4.49			4.67	4.49
Global warming (GWP100a)	*kg CO_2 eq*	4830	4680	4900	4750	4830	4680
Photochemical oxidation	*kg C_2H_4 eq*	1.89	1.86			1.89	1.86
Ozone layer depletion (ODP)	*kg CFC-11 eq*	0.000354	0.000343			0.000354	0.000343
Abiotic depletion	*kg Sb eq*	0.0985	0.087			0.0985	0.087
Abiotic depletion (fossil fuels)	*MJ*					73800	67400

BEAR IN MIND: If required a corresponding study with other methods in addition to the ReCiPe Endpoint, hierarchist version, can be carried out by the company for any proper use.

Our commitment to sustainable development involves continuously redesigning all of our products with eco-design principles, as well as conducting life cycle analysis and impact assessment. We strive to offer products and services that prioritize the well-being of both people and the environment, and we are dedicated to achieving this through ongoing improvement and innovation.

Appendix

Acidification potential: Phenomenon by which atmospheric rainfall has a pH which is lower than average. This may cause damage in forests and cultivated fields, as well as in water ecosystems and objects in general. This phenomenon is due to the emissions of SO_2, of NO_x, and NH_3, which are included in the Acidification Potential (AP) index expressed in masses of SO_2 produced.

Eutrophication potential: Enrichment of the watercourses by the addition of nitrates and phosphates. This causes imbalance in water ecosystems due to the overdevelopment encouraged by the excessive presence of nourishing substances, so is increased the growth of aquatic plants and can produce algal blooms that deoxygenate water and smother other aquatic life. In particular, the Eutrophication Potential (EP) includes phosphorous and nitrogen salts and it is expressed in grams of oxygen (kg O_2).

Global warming potential (GWP100): Phenomenon by which the IR irradiation emitted by the earth's surface are absorbed by the molecules in the atmosphere, as a result of solar warming, and then re-emitted in the form of heat, thus giving rise to a process of global warming of the atmosphere. The indicator used for this purpose is GWP (Global Warming Potential). This mainly includes the emissions of carbon dioxide, the main greenhouse gas, as well as other gases with a lower degree of absorption of infrared rays, such as ethane (CH_4), nitrogen protoxide (N_2O), chlorofluorocarbons (CFC), which are expressed according to the degree of absorption of CO_2 (kg CO_2).

Ozone depletion potential (ODP): Degradation and depletion of the ozone layer in the stratosphere, which has the property of blocking the UV components of sunlight thanks to its particularly reactive compounds, originated by chlorofluorocarbons (CFC) or by chlorofluoromethanes (CFM). The substance used as a point of reference for assessing the ODP (Ozone Depletion Potential) is trichlorofluoromethane, or CFC-11. ODPs are calculated as the change that would result from the emission of 1kg of a substance to that from emission of 1 kg of CFC-11 (a Freon).

Photochemical oxidation: The index used to translate the level of emissions of various gases into a common measurement to compare their contributions to the change of ground-level ozone concentration. POCPs are calculated as the change that would result from the emission of 1 kg of a gas to that from emission of 1 kg of ethylene.

Depletion of abiotic resources: Two impact categories: Abiotic depletion (elements, ultimate reserves) and abiotic depletion (fossil fuels). Abiotic depletion (elements, ultimate reserves) is related to extraction of minerals due to inputs in the system. The Abiotic Depletion Factor (ADF) is determined for each extraction of minerals (kg antimony equivalents/kg extraction) based on concentration reserves and rate of deaccumulation. Abiotic depletion of fossil fuels is related to the Lower Heating Value (LHV) expressed in MJ per kg of m^3 fossil fuel. The reason for taking the LHV is that fossil fuels are considered to be fully substitutable.

G.E.MI. 14486435000

kleemannlifts.com

KLEEMANN

Your 1st Choice in Lifts