KLEEMANN
Your 1st Choice in Lifts

Environmental fact sheet: Atlas 2:1

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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.

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

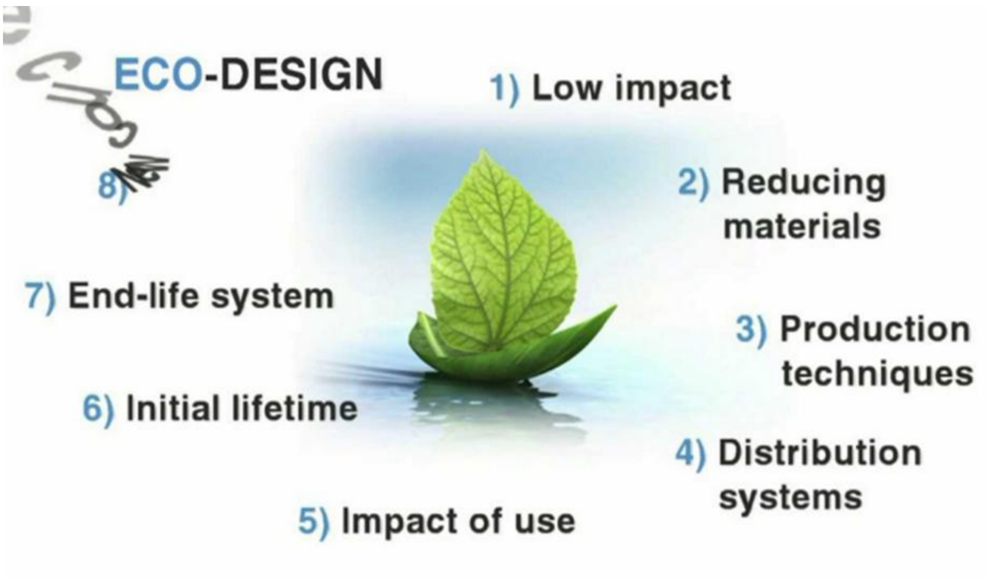
Scope: Eco-design is an approach of designing products with special consideration for the environmental impacts of the product during its whole lifecycle. In a life cycle assessment, the life cycle of a product is usually divided into procurement, manufacture, use, and disposal. It is a growing responsibility 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. Also, on the basis of the pattern of usage and calculation of consumed energy in a lift system, VDI 4707/1 was carried out, and a number of considerations and assumptions for the average operation throughout the life cycle of the lift.



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® 7 was used, with the method ReCiPe Endpoint, hierarchist version, for the major part of the Environmental Impact Assessment. Also, the German VDI standard 4707/1 was used for the classification of the product in the field of energy efficiency during its usage stage.

In the case of the integrated lift system and for the present document the study of the system begins from the purchase of raw materials to the final disposal.

The method of eco-design is applied to a lift system which is developed, manufactured and distributed by KLEEMANN. The adoption of such a model design contributes as a catalyst to reduce the environmental impact and cost.

Product structure and reference model

Atlas 2:1 MRL is a standard traction machine room-less elevator. Below are reported its main characteristics and applications:

Suspension Ratio	2:1
Cabin's Journey	Max 45m
Payload	Max 1000kg
Nominal Speed	Max 1.6m/s
Driving Mechanism	Synchronized motor with permanent magnets

Following presented data are for a typical reference model:

Reference model	Atlas 2:1 MRL
Type	E/M elevator Atlas 2:1
Estimated lifetime	25 years
Journeys per year	200,000
Payload	630kg
Nominal speed	1 m/s
Route	15 m
Number of stops	6
Average journey time	19 sec
Suspension Ratio	2:1
Cabin's Dimensions	1100 × 1400 mm
Door opening	1000 mm
Cabin lighting type	LEDs
Motor driving	VVVF
Automation table	Stand by mode

Analysis of life cycle parameters of the new products

In accordance to the relevant literature, the major environmental impact on the life cycle is during the usage stage, followed by the stage when materials are acquired and energy is consumed during construction. 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 and installation shall contribute much lower in overall impact.

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

Raw materials

In the following tables are presented the raw materials per subsystem and the improvements on this level according to the Eco-design.

1. Cabin

Material	Quantity to Atlas B (kg)	Quantity to Atlas N (kg)
Polyvinyl chloride, PVC	2.55	2.55
MDF, high density fiberboard	23.8	23.8
Hot rolled steel, ST37	97.91	97.91
Stainless steel	1.97	1.97
Stainless steel, Ferro	129.85	129.85
Alloy hot rolled steel Zn Coated	10.88	10.88
Glass-Mirror	14.9	14.9
Glass of lighting	0.36	0.36

2. Ctw Frame & ctws

Material	Quantity to Atlas B (kg)	Quantity to Atlas N (kg)
Hot rolled steel, ST37	907	63
Alloy hot rolled steel Zn Coated	63	64
Polyvinyl chloride, PVC	1	1
Concrete	-	767
Mc Nylon	-	5
Cast Iron	17	-
Polyurethane	0.52	0.52
Wire rope steel	60.82	60.82

3. Guide rails & brackets

Material	Quantity to Atlas B (kg)	Quantity to Atlas N (kg)
Cold rolled steel St44	346.94	346.94
Hot rolled steel St 37	458.46	458.46
Alloy hot rolled steel Zn Coated	12.2	12.2

4. Land doors (6 floors)

Material	Quantity to Atlas B (kg)	Quantity to Atlas N (kg)
Hot rolled steel St 37	375.38	375.38
Alloy hot rolled steel Zn Coated	15.33	15.33
Aluminum	9.72	9.72
Polyvinyl chloride, PVC	2.93	2.93

5. Car door

Material	Quantity to Atlas B (kg)	Quantity to Atlas N (kg)
Hot rolled steel St 37	42.34	42.34
Stainless steel, Ferro	12.69	12.69
Alloy hot rolled steel Zn Coated	0.94	0.94
Aluminum	1.62	1.62
Copper	0.489	0.489
Polyvinyl chloride, PVC	0.998	0.998

6. Car Frame

Material	Quantity to Atlas B (kg)	Quantity to Atlas N (kg)
Hot rolled steel St44	171.9	28.5
Steel C45	11	11
Alloy hot rolled steel Zn Coated	-	138.2
Aluminum	-	0.6
Mc Nylon (pulley)	-	10
Cast Iron	25.6	-
Polyurethane	0.76	1.7

7. Electronic Equipment

Material	Quantity to Atlas B (kg)	Quantity to Atlas N (kg)
Ups	15	15
Polyvinyl chloride, PVC	24.71	24.71
Copper	9.84	9.84
Hot rolled steel St 37	52.33	52.33
Glass of lighting	10	10
Circuit board	6	6

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.

	Ctw Frame & ctws	Car Door	Cabin	Total (min)
Laser	34.18	38.46	7	45.46
Welding	25.26	121.17		146.43
Saw	31.60	2.85	1.74	36.19
Drill	1.60	1.32	0.93	3.85
Bending	18.62	31.62	91.82	142.06
CNC	12.80	35.60		48.4
Punching	0.32	1.98	27.81	30.11
Scissors	3.05	3.05	37.58	43.68
Staking			10	10
Consumed Energy	**86.241kWh**	**88.123kWh**	**70.032kWh**	**244.396kWh**

Painting

Concerning the product's painting process the improvement was important since an amount of materials has been replaced with others with antioxidant protection. By this way, the amount of the painting has been reduced about 80% compared to the previous model.

Transportation & Packaging

Transportation: Average mileage for the product from the production site to the installation site is 1200km (average distance from the factory to the various installations in accordance with the measurements of 2012). 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:

	Wood	Polyethylene for packaging	Nails	Carton for packaging
Ctw frame & ctws	76.9	2.6	1.3	-
Ancillaries	12	-	-	8
Doors	38.4	6.2	0.9	3
Cabin	48.6	7.5	0.5	-
Guide rails	31.8	0.5	-	-
Electronic Equipment	21.32	-	1.44	23.28
Total	229.02	16.8	4.14	34.28

Installation

KLEEMANN does not deal with the part of the installation, but 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.

The ecological impact during the installation procedure is limited to:

a. using several tools (drill, lift truck, etc)

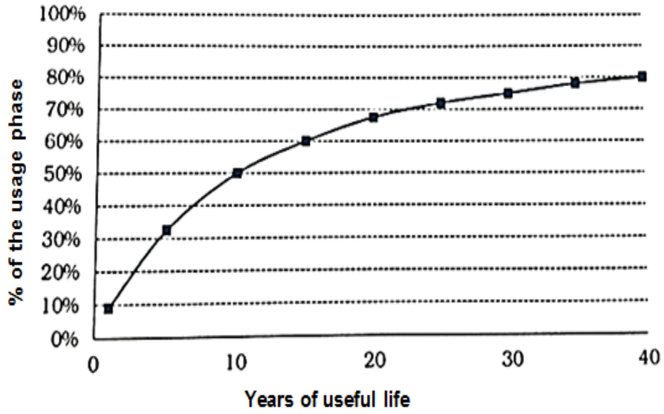
b. Daily transportation of the technicians to the installation area.

The average estimated time for completing the installation of this elevator is 5 days for a crew consisted of two technicians. Generally, this procedure does not affect much the elevator's ecological print.

Operation – Use

It has been pointed out, on the basis of surveys which have been carried out on this field, that the maximum impact on the environment can be observed in the consumption period. Showing the catalytic role has for the products of lifts. More specifically, if a product has usage duration of 25-30 years the use phase would be responsible for 75% of the whole environmental impact, whereas the same phase would only represent 50% of the environmental bill if it had a reduced life of 10years. On the other hand, an increased product life will always reduce the impact of the materials phase, because the number of functional units served will increase.

In the following figure, the percentage of environmental impact associated with the use phase of the lift (y-axis) and in accordance with the years of working life (x-axis) (LCA and energy modeling of lifts, Ana Lorente Lafuente, 2013).



The total electric power consumption during lifetime of an elevator depends on the usage frequency and is separated into two different procedures:

a. Consumption during the movement
b. Stand by consumption

It has to be mentioned that in buildings with low frequency of elevator usage, the standby mode could participate even to the 80% of the total energy consumption.

Following is specified the energy consumption of the reference model Atlas 2:1, as it has been defined already.

The analysis is based on measurements which took place in our facilities, while the data analysis follows the VDI 4707-1 standard.

The experimental results about the consumption during the movement for a complete journey and the stand by consumption has been registered as follows:

a. Consumption during the movement: **25Wh**
b. Stand by consumption: **36Wh**

According to the VDI 4707-1 standard for 150,000 trips per year the results are:

- Trips per day: **411**
- Average travel time per 24hours: **0.86h**
- Average time on standby mode per 24hours: **23.14h**
- Daily consumption during travel: **1798.1Wh**
- Daily consumption during standby mode: **833.2Wh**
- Total daily consumption: **2631.3Wh**
- Total annual consumption: **960.4KWh**
- Total lifetime consumption (25years): **24.01MWh**

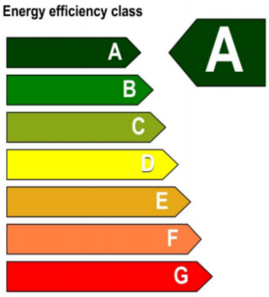
The ecological footprint because of this energy consumption can be determined only if it is known the kind of the electric energy production. The productive systems through brown coal (lignite) have a notable eco – print. The estimated emission is 0.5 kg CO_2 per KWh.

According to the results of total energy consumption, the CO_2 emission corresponds to 20,580kg of CO_2.

Energy efficiency class of Atlas 2:1 (reference model)
according to VDI 4707/part 1

Case study: KLEEMANN presents the results based on measurements carried out in KLEEMANN premises for the evaluation of energy efficiency of Atlas 2:1 (reference model) according to VDI 4707/Part 1. The specific item achieved the A class energy rating from the VDI 4707, concerning 411 trips per day.

Manufacturer: KLEEMANN HELLAS S.A. **Location:** Kilkis, Greece **Lift Model:** Atlas 2:1, Traction **Lift Type:** Electric operated passenger lift	**Energy efficiency class**
Nominal load: 630kg **Nominal speed:** 1 m/s **Operating days per year:** 365	
Standby demand: 36 W ***Energy demand class:*** A	
Specific travel demand: 0.93 mWh/(kg·m) ***Energy demand class:*** C	
Usage category 2 according to VDI 4707 *Comparison of energy efficiency classes is only possible under equal usage.* ***Date:*** *26/07/2019* ***Reference:*** *VDI 4707 Part 1* *(Issue March 2009)*	**Nominal demand per year for nominal values shown:** 960.4 kWh **Daily total energy demand:** 2631.3 Wh



Maintenance - Repairs

KLEEMANN does not deal with maintenance but offers all the spare parts that this process 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), from the use of electricity during maintenance (max 6 x 1 kWh including the motion of the lift).

Finally, the lubricant used to lubricate the guides can be estimated as 2 L per year.

The work required after a failure of the lift is difficult to assess accurately.

However, on the basis of the engineering of the lifts and the statistics, these amounts can be tackled satisfactorily.

For the reference elevator and an estimated lifetime of 25 years, for 150,000 trips per year, the following analysis could be referred:

- Wire rope of suspension replacement: **6 times**
- Friction pulley replacement / repair: **3 times**
- Motor replacement / repair: **1 time**
- Automation table replacement: **1 time**
- Inverter replacement: **1 time**
- Cabin replacement: **2.5 times**
- Loose parts replacement (lamps, switches, etc): **60 times**
- Transition to the building after calling for repair, without replacing any assembly, or for evacuation: **40 times**

The above repairs and replacements demand limited use of electrical devices and for that reason their Eco – print is restricted to the use of brand-new assemblies and the disposal of the used ones, and also to the fuel consumption during the transporting to and from the building, which is estimated as 114.5×15 = 1717 km.

Disposal - Recycling

Key element in the final stage of the life cycle is the easiest and the fullest possible recycle of the product. The best scenario for a lift is to be designed in such a way that its materials can be dismantled and easily separated into various categories for recycling.

KLEEMANN lifts comprise a high percentage of metal, alloy steel, cast iron, aluminum alloy and copper that can be recycled directly.

The lighting equipment, the UPS system and the engine contain heavy metals and their final disposal must be to specialized collection spots.

General instructions for disposal: The basic distinction in hazardous substances and in secondary raw materials should be carried out during the course of the dissolution in accordance with the following classification:

- Hazardous waste
- Waste Electrical and electronic equipment
- Non-magnetic steel waste
- Scrap aluminum
- Magnetic steel and scrap
- Residues containing copper (cables, motor)
- Lead waste (batteries)
- The waste for incineration

If the whole lift at the end of its life is able to be transferred to the central plant of KLEEMANN, the company takes over its full recycling.

Environmental Impact Assessment

The environmental impact assessment concerning the lifetime of Atlas 2:1 N MRL was held by the Eco – Indicator method in the software SimaPro 7 and includes the following:

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.

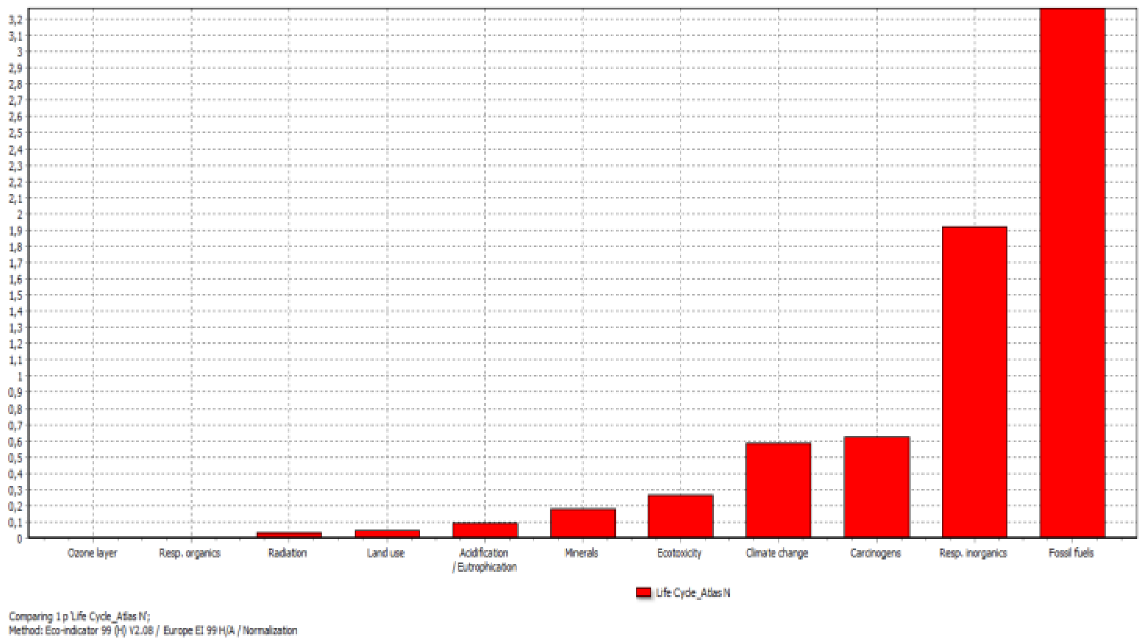
Disposal Procedures and collection: This category includes indicators for the recycling of various materials, incineration, burial at burial site and using biological treatment

The assessment of operational phase based on system UCTE mix of electricity low voltage. If a different mixture is applied of electricity of medium or high voltage, a new study can be carried out for the environmental impacts.

The results of this study illustrate the environmental impact of the product Atlas N lifecycle. It is also possible to derive again the study and with other methods of analysis. On the diagrams extracted from the software SimaPro® is illustrated a comparative study.

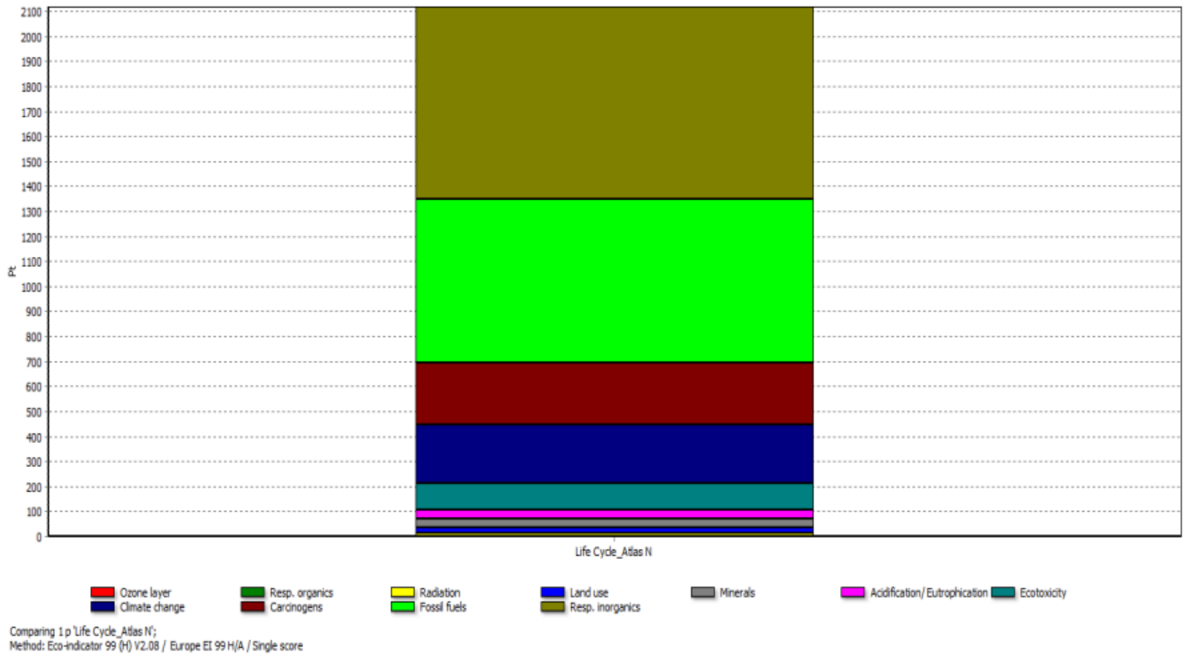
The measurements units:

- For carcinogens, respiratory organics and inorganics, climate change, radiation and ozone layer are DALY (Disability Adjusted Life Years) / kg emission.
- For ecotoxicity is PAF (Potentially Affected Fraction) × m^2 × year / kg emission.
- For eutrophication and acidification is PDF (Potentially Disappeared Fraction) × m^2 × year / kg emission.

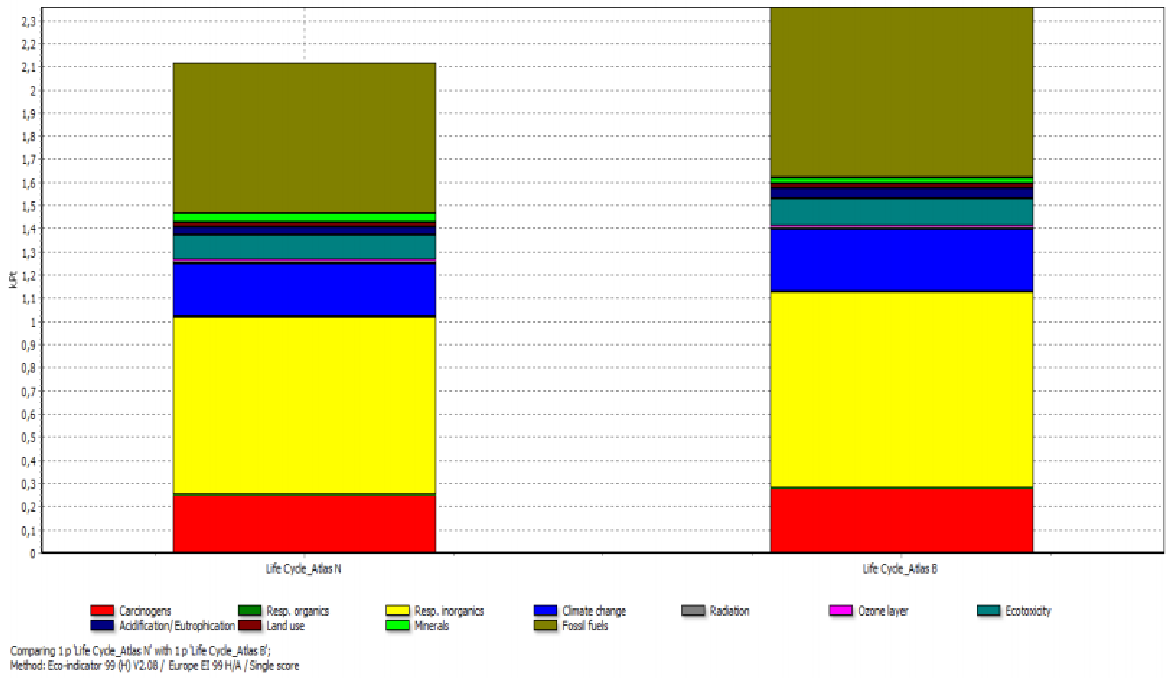


Present analysis compares amount of each phenomenon impact, in pt units.

The land use is represented in measurements units of Potentially Disappeared Fraction (PDF)*m^2*year/m^2. The minerals 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.

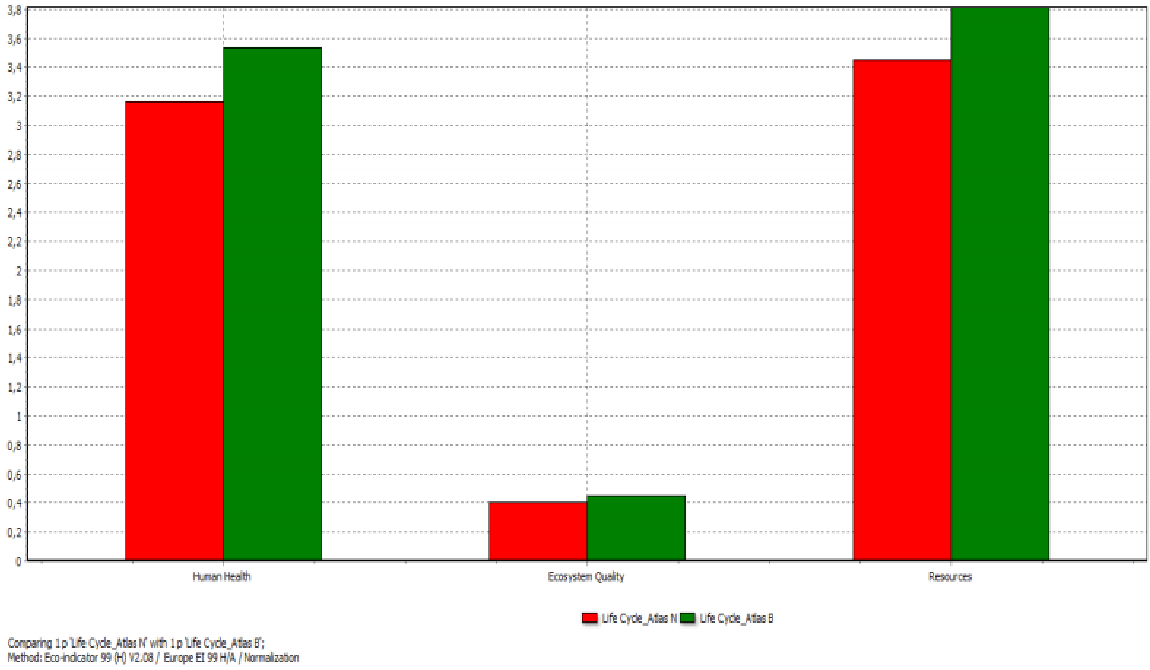


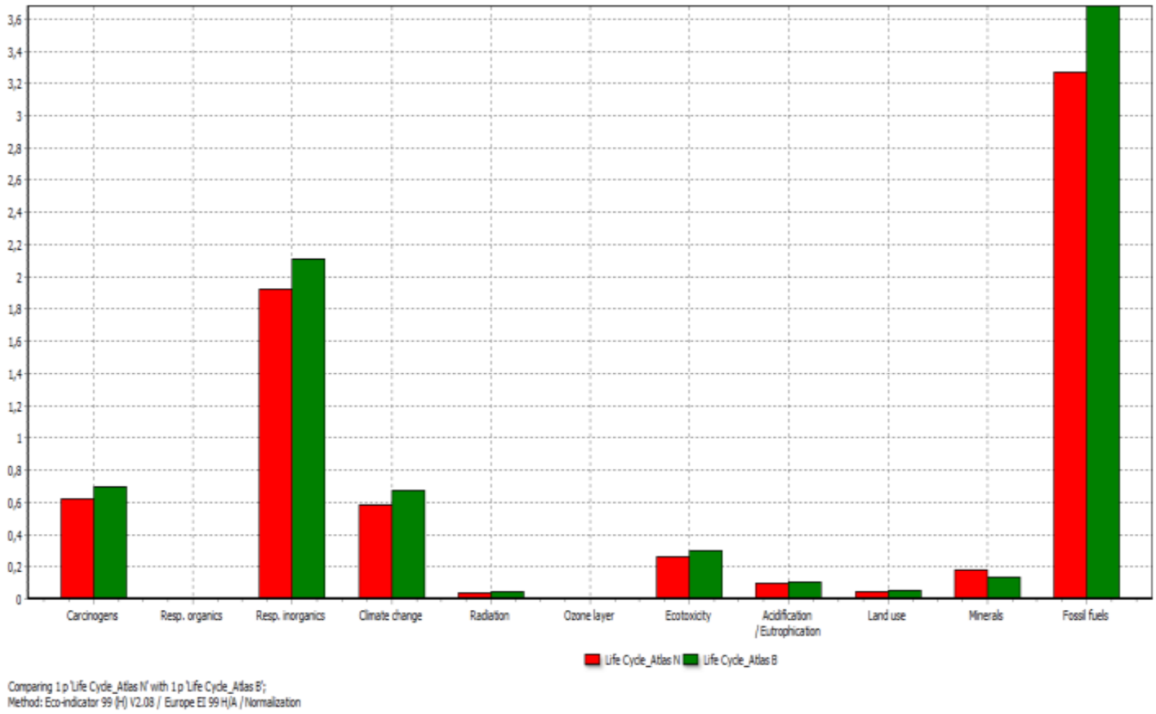
Tables comparing the environmental impacts between the previous model, Atlas B and the new one, Atlas N.



Compering to the earlier model, Atlas N is significantly improved concerning the impact on several phenomena.

The difference is also obvious concerning the impact on human health, ecosystem quality and resources.





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.

The continuous development of all products with these principles of life cycle analysis, impact assessment and Eco design, is the basis for the sustainable development of the services and products offered to the final customer with respect to humans and the environment.

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