Life Cycle Assessment Pulsar Plus

Product Innovation and Research

wallbox™

Life Cycle Assessment

1. Objectives of the study

Project objectives

The aim of this study is to develop a **Life Cycle Assessment (LCA) of an electric vehicle charger from Wallbox, in order to evaluate the environmental impact associated to its life-cycle** from cradle-to-grave.

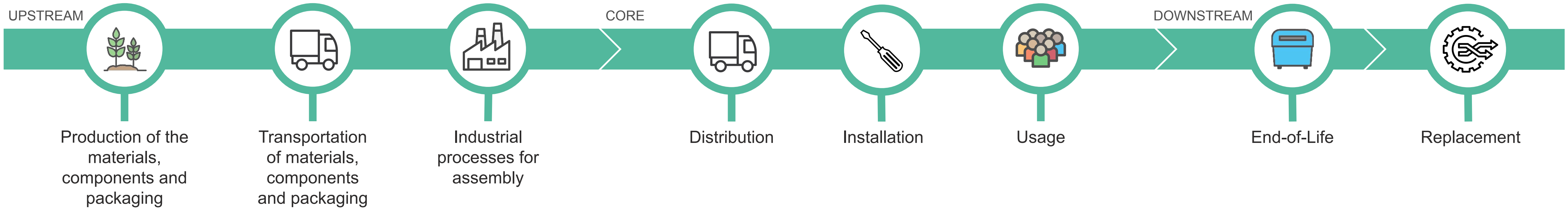
Through this study, Wallbox obtains quantitative environmental information associated with all stages of the life of a Wallbox Pulsar Plus electric vehicle charger. This can be useful to identify sources of impact, sort priorities, make decisions focused on minimizing the environmental impact of similar or future products, implement eco-design strategies, and communicate environmental product information to users.

Specific objectives:

- Know, analyze and evaluate the environmental impact of an electric vehicle charger from Wallbox, model Pulsar Plus, using LCA methodology.
- Identify critical aspects within the life cycle of the Pulsar Plus charger where eco-design strategies could be applied to minimize environmental impacts of the product.

2. Methodology

Methodology.



The environmental impact of the Pulsar Plus charger is calculated through the Life Cycle Assessment (LCA) methodology in accordance with ISO 14040 and Product Environmental Profile (PEP) for electric and electronic products and electric vehicle chargers, which analyses all life cycle stages of the product, from the extraction of raw materials to their End-of-Life and subsequent management. The impact assessment method used is CML-IA and Cumulative Energy Demand (CED), and the database Ecoinvent v3.7.

Reference product. The product under study is the Wallbox Pulsar Plus model (PN code PLP1-0-2-2-9-002), with 5 meters of cable, type 2 connector, power of 7.4kW, standard characteristics and black color.

Functional unit. The study is developed using the following functional unit (1):

1. *Wallbox Pulsar Plus charger PLP1-0-2-2-9-002 with a supposed lifespan of 10 years*.

*Impacts are also translated to the following functional unit (2):

2. *Supply 1 kWh to one vehicle with the Wallbox Pulsar Plus charger PLP1-0-2-2-9-002*.

Scope of the study and system boundaries. This is a cradle-to-grave study, which means that all life cycle stages of the product are considered.

Environmental indicators.

Definitions.

Used method. CML-IA

Global Warming Potential (GWP). Global warming potential due to increased concentration of greenhouse gases. It causes a rise in the global temperature of the planet and in the frequency and intensity of atmospheric phenomena. *kg CO_2 equivalent*

Abiotic Depletion Potential (ADP). Potential reduction in the availability of resources. It is defined for each extraction of resources based on the reserves and the decumulation rate. *kg Sb equivalent*

Abiotic Depletion Potential for fossil fuels (ADPf). Potential reduction in the availability of fossil resources. It is defined for each extraction of resources based on the reserves and the decumulation rate. *kg MJ equivalent*

Acidification Potential (AP). Potential decrease in the pH of the medium due to the emission of acidic substances. It causes an increase in the acidity of the hydric systems and soil. *kg SO_2 equivalent*

Environmental indicators.

Definitions.

Used method. CML-IA

Eutrophication Potential (EP). Potential accumulation of nutrients in aquatic systems. This generates a barrier of organic matter that prevents sunlight from reaching organisms that inhabit the aquatic bottom, which consequently die. In addition, the decomposition of their tissues causes a decrease in available oxygen and generates compounds that are toxic to many organisms. *kg $PO^{3-}{}_{2}$ equivalent*

Human Toxicity Potential (HTP). Potential effect of toxic substances on human health. Mainly, it causes carcinogenic and respiratory diseases. *kg 1,4-DB equivalent*

Ozone Depletion Potential (ODP): Potential reduction of the ozone layer that protects the Earth from ultraviolet radiation due to halogenated compounds that are present in the atmosphere. It causes skin diseases. *kg CFC-11 equivalent*

Fresh Water Aquatic Ecotoxicity (FWAE): Potential contamination of the aquatic ecosystem by toxic substances existing in the environment. It causes the alteration of the environment, with the loss of biodiversity and/or extinction of species. *kg 1,4-DB equivalent*

Environmental indicators.

Definitions.

Used method. CML-IA and CED (only for Energy Use)

Marine Aquatic Ecotoxicity (MAE). Potential contamination of the marine ecosystem by toxic substances existing in the environment. It causes the alteration of the environment, with the loss of biodiversity and/or extinction species. *kg 1,4-DB equivalent*

Terrestrial Ecotoxicity (TE). Potential contamination of the terrestrial ecosystem by toxic substances existing in the environment. It causes the alteration of the environment, with the loss of biodiversity and/or extinction species. *kg 1,4-DB equivalent*

Photochemical Oxidation (PO). Potential contribution to the impacts already generated by oxidizing contaminants that, due to their radioactive nature, oxidize organic molecules. When oxidizing contaminants become in contact with the airways, they affect tissues and cause diseases. *kg* C_2H_4 *equivalent*

Energy Use (non-renewable and renewable). Potential use of energy, coming from non-renewable and renewable sources. *MJ equivalent*

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3. Inventory analysis

Data origin and inventory.

	Production of the materials, components and packaging	Transportation of materials, components and packaging	Industrial processes for assembly	Distribution	Installation	Usage	End-of-Life	Replacement
Scope	Resources and manufacturing processes required for the manufacture of the raw materials and components of the product and its primary packaging. Packaging of raw materials and components and its disposal is also included.	Transportation of raw materials, components, and primary packaging from the supplier to Wallbox logistics platform.	Resources, auxiliary materials and industrial processes used to assemble the reference product and packaging components. Waste and discarded materials generated by manufacturing processes are included.	Transportation from Wallbox logistics platform to the installation site.	Materials and processing of components required for the installation which will not be incorporated until the station is installed; and processing of the packaging waste generated during the installation.	Electrical energy consumption by the charging system associated with heat dissipation when recharging the vehicle, and with its operation, as well as the vehicle consumption.	Transportation required to collect the end-of-life product and transfer it from the installation site to the final treatment site; and final treatment processes for all materials and components of the product.	Products that require repair, from the total produced.
Source	Data and technical sheets provided by Wallbox, hypothesis developed by inèdit (materials allocation in certain components) and PSR hypotheses (disposal scenarios for packaging waste[1]).	Google Maps (road mileage), es.distance.to (air mileage), and ecoinvent v3.7 (sectorial data of transport of raw materials).	Data provided by Wallbox and data from inèdit (electricity mix calculator).	Google Maps (road mileage), es.distance.to (air mileage), sea-distances (sea mileage), and ecoinvent v3.7 (sectorial data of transport of raw materials).	Data provided by Wallbox, hypotheses developed by inèdit (materials allocation in certain components), Google Maps (road mileage), es.distance.to (air mileage), and PSR hypothesis (disposal scenarios for packaging waste[1]).	Data provided by Wallbox, PSR hypothesis (data, equations and calculation[2]), and data from inèdit (electricity mix calculator).	PCR hypothesis (transportation and disposal parameters[3]).	Data provided by Wallbox.

[1] Source: *Specific Rules for Electric Vehicle Charging Infrastructures (PSR-0018-ed1-EN-2021 09 13)*, p.17
[2] Source: *Specific Rules for Electric Vehicle Charging Infrastructures (ANNEXE_PEP-PSR-0018-ed1-FR-2021 09 13)*
[3] Source*: Product Category Rules for Electrical Electronic and HVAC-R Products (PCR-ed4-EN-2021 09 06)*, p.64

Main hypotheses.

- **Charging cable.** According to the PSR[1], it is included in the study as it cannot be separated from the station.
- **Materials from components.** For some components, assumptions were made in relation to the component materials and their proportions, some of which are as follows:

  EV gun. Materials are simplified due to lack of information regarding its exact composition, therefore only the main material given by Wallbox is assumed (high density polypropylene (HDPP)).

  Raspberry Pi. It is assumed to be similar to a PCB board, i.e. 30% metal (mostly copper), 40% fiberglass (mostly silicon), 30% others (mostly plastic, considered as acrylonitrile butadiene styrene (ABS)) [2].

  Pulsar Plus Cover and Body Assembly, and Holster. An average optimal composition by weight of 80% polycarbonate (PC) and 20% ABS is assumed[3].
- **Packaging of materials and components acquired.** Only the main ones were considered.
- **Industrial processes.** An office electricity consumption of 2.983 kWh/person*year is taken as a reference[4].
- **Waste from industrial processes.** It is estimated as 0,001% of the total impact of production and transportation of materials, components and packaging, according to data provided by Wallbox of the total cost of raw material lost during the production of 1 Pulsar Plus.

[1] Source: *Specific Rules for Electric Vehicle Charging Infrastructures (PSR-0018-ed1-EN-2021 09 13),* p.13
[2] Source: *https://www.designlife-cycle.com/raspberry-pi*
[3] Source: *https://www.mexpolimeros.com/pc%20abs.html*
[4] Source: *Exemple 4 Auditoria energètica d'edifici. Cas pràctic en un gran edifici d'oficines*, p. 12

Main hypotheses.

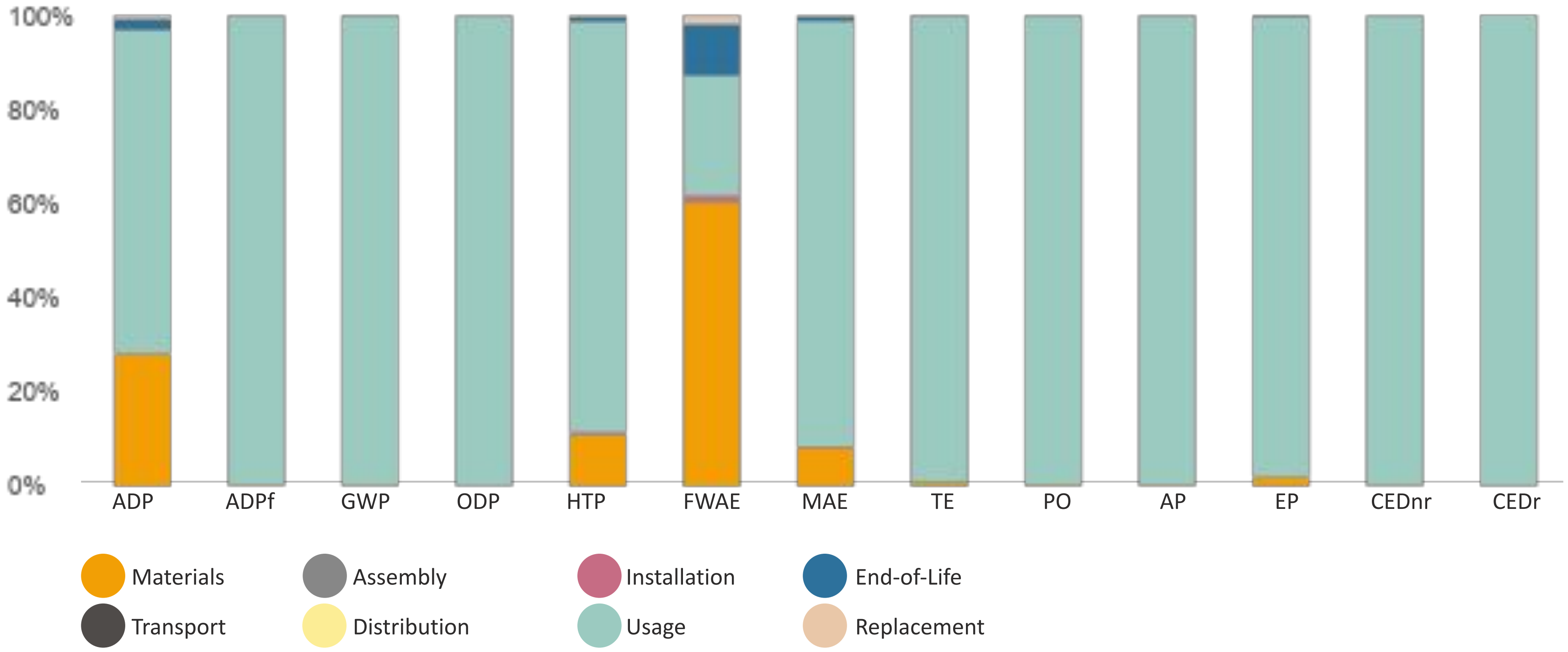
- **Material transportation and product distribution.** Means of transport by road are quantified from standard lorries data (EURO-4 Diesel, 16-32t); by sea, from standard inland waterways barges data; and by air, from standard aircrafts data, depending on the length of the journey (short-haul aircraft for less than 1500km of travel, medium-haul aircraft for between 1500km and 4000km, and long-haul aircraft for more than 4000km). In cases where the means of transport is a combination of air and sea, a distribution of 50% by air and 50% by sea is considered.
- **Use.** It is assumed an average vehicle consumption of 219,4 kWh/month. Intrinsic consumption of the charger is defined according to PSR parameters[1]. It is assumed that users are connected to the Spanish grid (data from 2021).
- **End-of-Life scenarios**: Disposal scenarios for packaging waste in ‘production of the materials, components and packaging’ and ‘installation’ stages are defined by the PSR parameters[1], while waste transportation and disposal scenarios in the ‘End-of-Life’ stage are defined from the PCR parameters[2]. The processes of energy and material recovery (recycling) of the different waste have been included, considering the processes of recovery and treatment of waste until a product that can be used as a raw material in a new life cycle is obtained.

[1] Source: *Specific Rules for Electric Vehicle Charging Infrastructures (PSR-0018-ed1-EN-2021 09 13),* p.17
[2] Source*: Product Category Rules for Electrical Electronic and HVAC-R Products (PCR-ed4-EN-2021 09 06),* p.64

4. Results

LCA results.

Relative environmental impact of Wallbox Pulsar Plus life cycle stages:

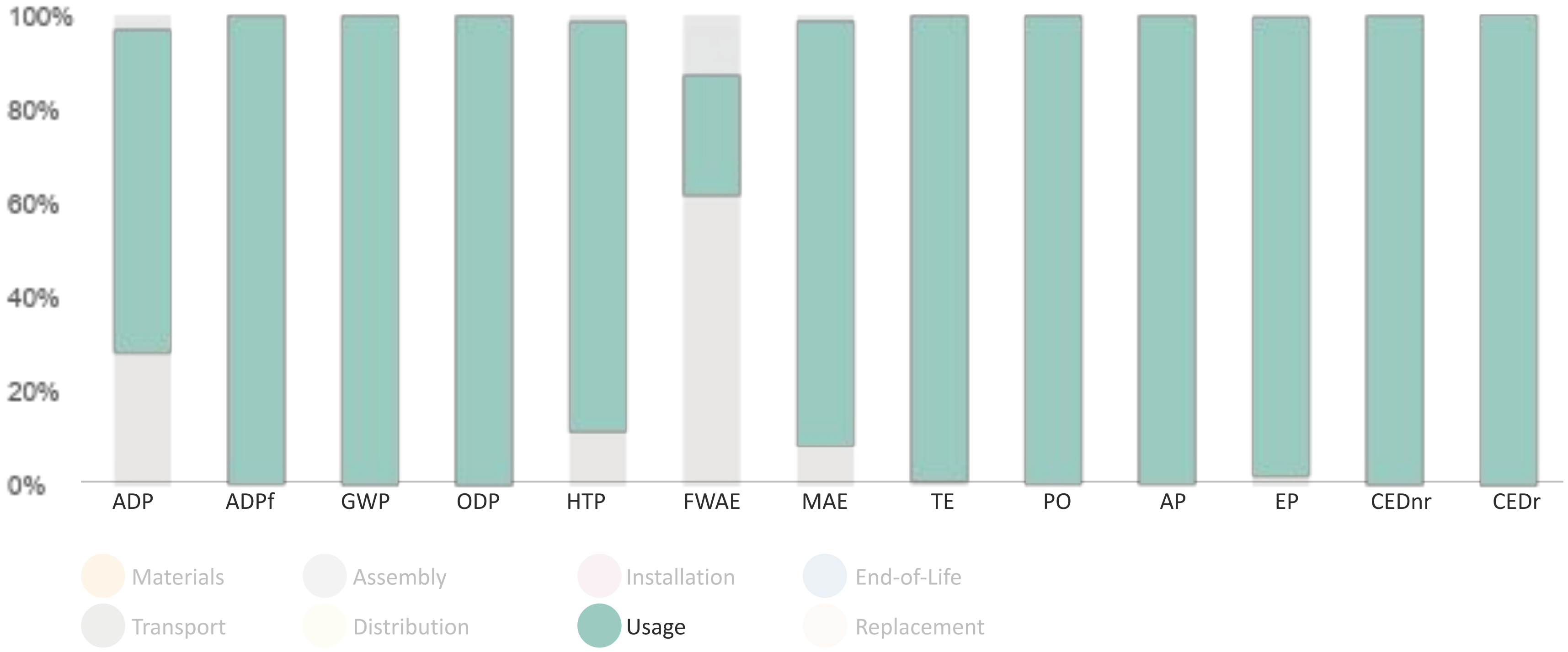


ADP: Abiotic Depletion
ADPf: Abiotic Depletion (fossil fuels)
GWP: Global Warming Potential
ODP: Ozone Layer Depletion
HTP: Human Toxicity
FWAE: Fresh Water Aquatic Ecotoxicity
MAE: Marine Aquatic Ecotoxicity
TE: Terrestrial Aquatic Ecotoxicity
PO: Photochemical oxidation
AP: Acidification
EP: Eutrophication
CEDnr: Cumulative Energy Demand (non-renewable)
CEDr: Cumulative Energy Demand (renewable)

The life cycle stage that has the **major contribution** (between 25% and 100%) in most of the environmental impact categories is the **Usage stage**. It is followed by the Materials stage, which is significant in 4 out of the 13 categories (fresh water ecotoxicity, abiotic depletion, human toxicity and marine ecotoxicity), and the End-of-Life stage, being representative in 1 out of 13 (fresh water ecotoxicity). The rest of stages have a relatively lower contribution (between 0% and 2%).

LCA results.

Relative environmental impact of Wallbox Pulsar Plus life cycle stages:



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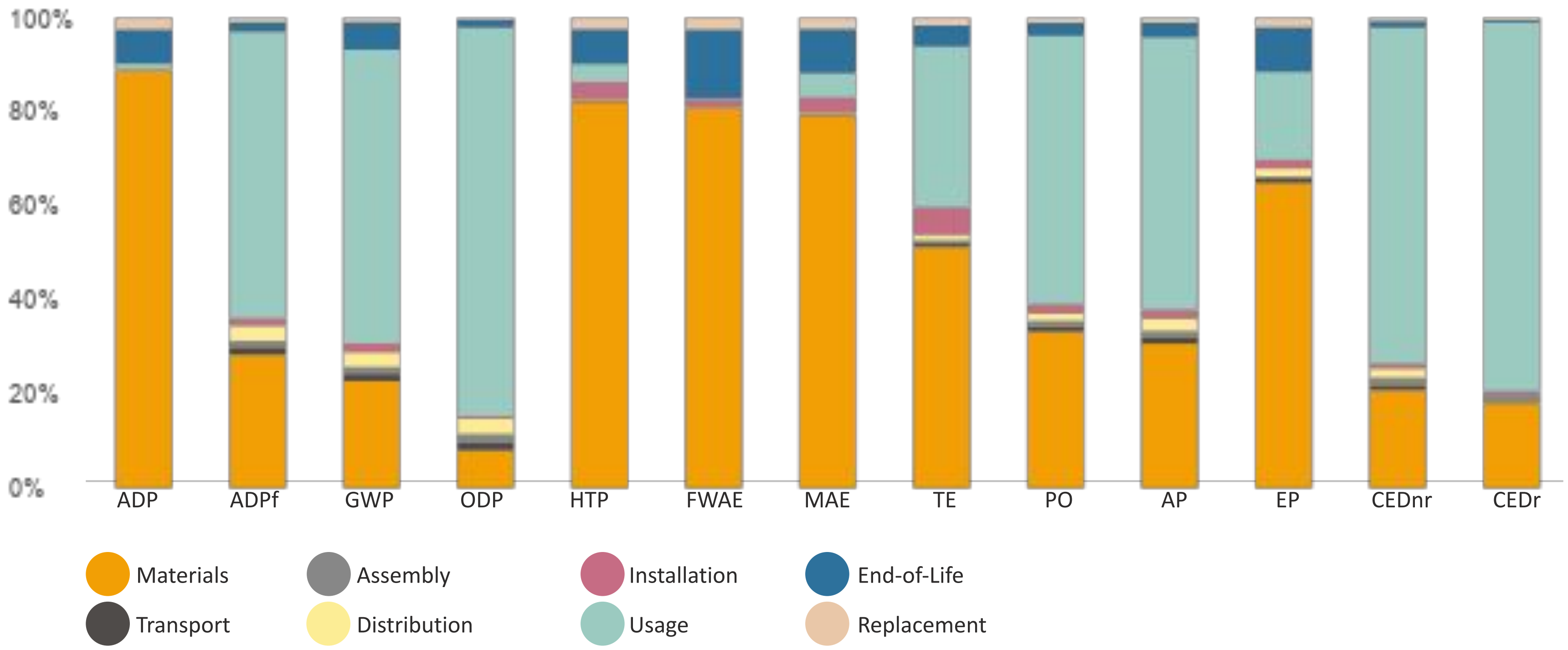
The environmental impacts associated with the Usage stage are due to the production and distribution of the energy required to charge the vehicle, mainly caused by the use of **non-renewable sources**, which represent 53% of the Spanish electricity grid. Energy required is for both vehicle and charger consumption, being vehicle consumption the Usage stage activity which requires more energy (99,4%).

LCA results.

Relative environmental impact of Wallbox Pulsar Plus life cycle stages, excluding vehicle consumption:



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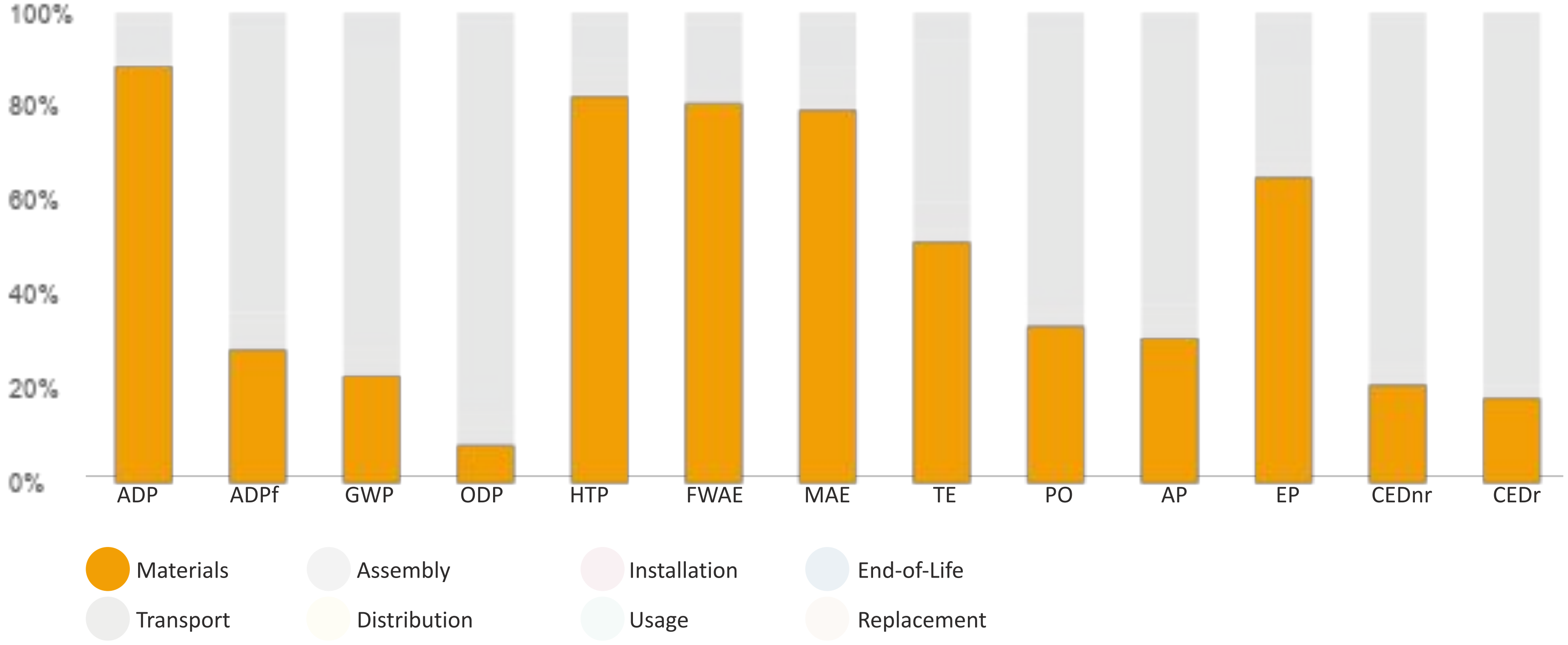
The life cycle stage that has the **major contribution** is the **Materials stage** (between 18% and 89%), closely followed by the **Usage stage** excluding vehicle consumption (between 1% and 83%). End-of-Life stage is significant in most categories (between 1% and 15%). The Distribution stage is representative in 4 out of the 13 categories (abiotic depletion -fossil fuels-, global warming potential, ozone layer depletion, and acidification), the Installation stage is significantly present in 3 out of 13 (terrestrial ecotoxicity, human toxicity, and marine aquatic ecotoxicity) and the Replacement stage is notable in 2 out of 13 (abiotic depletion and freshwater aquatic ecotoxicity). The rest of the stages, Assembly and Transport, have a relatively lower contribution.

LCA results.

Materials stage

Relative environmental impact of Wallbox Pulsar Plus life cycle stages, excluding vehicle consumption:



ADP: Abiotic Depletion
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The environmental impacts associated with the Materials stage are due to a combination of the following factors:

- The use of materials that have high unit emissions during their extraction and manufacturing phase (such as copper, electric cable, polycarbonate and polyamide for the components of the charger, and PET/ALU/PE mix for the packaging materials).
- The use of large quantities of materials to produce the charger (mainly polypropylene, copper and polycarbonate).

The environmental impacts of this stage are mostly associated to **copper** (present in the Pulsar China CT PCBA, Pulsar Plus HV PCBA and Raspberry Pi components), **polypropylene** (present in the EV Gun) and **polycarbonate** (present in the Pulsar Plus Halo Assembly, Pulsar Plus Cover Assembly, Pulsar Plus Body Assembly and Holster components).

LCA results.

Usage stage

Relative environmental impact of Wallbox Pulsar Plus life cycle stages, excluding vehicle consumption:

ADP: Abiotic Depletion
ADPf: Abiotic Depletion (fossil fuels)
GWP: Global Warming Potential
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HTP: Human Toxicity
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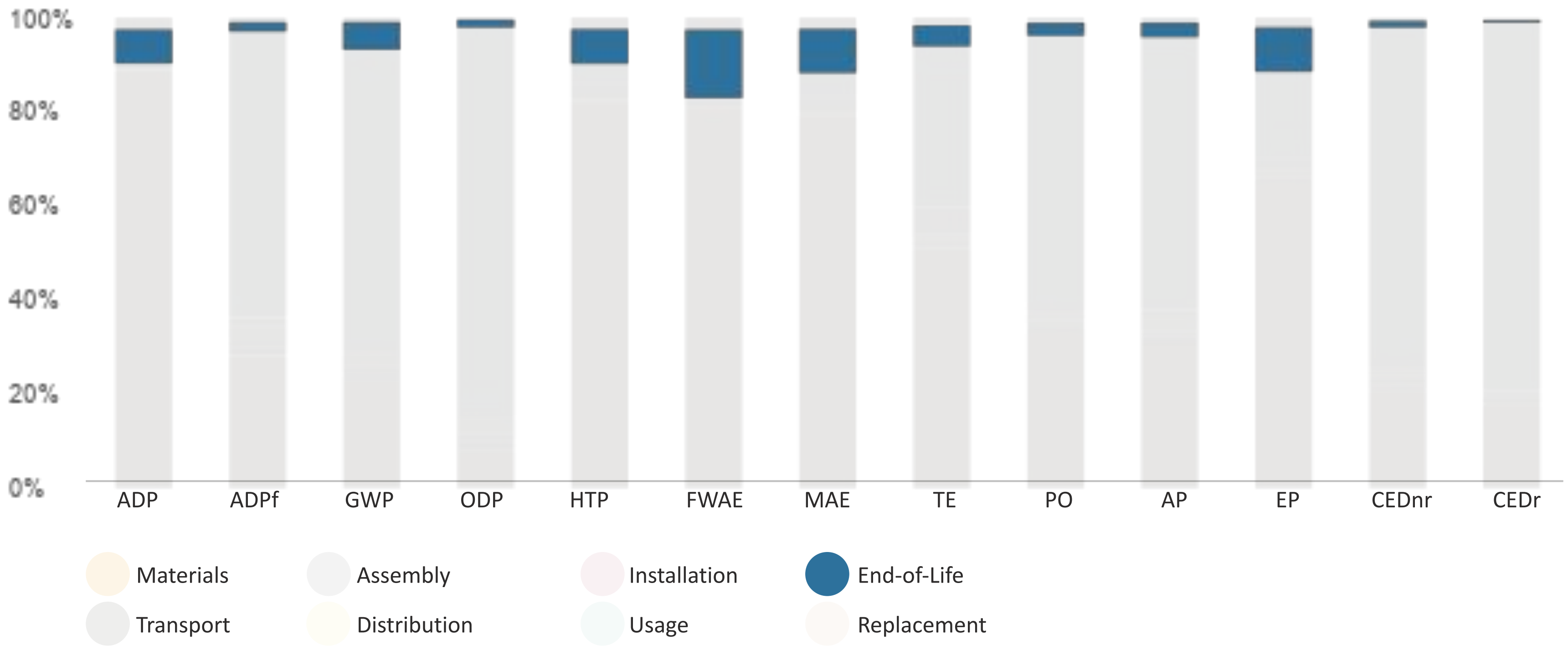
The environmental impacts associated with the Usage stage, excluding vehicle consumption, are due to the production and distribution of the energy required by the charger to develop its function, mainly caused by the use of **non-renewable sources**, which represent 53% of the Spanish electricity grid. Major impact is due to the intrinsic consumption of the charger, rather than its losses.

LCA results.

End-of-Life stage

Relative environmental impact of Wallbox Pulsar Plus life cycle stages, excluding vehicle consumption:



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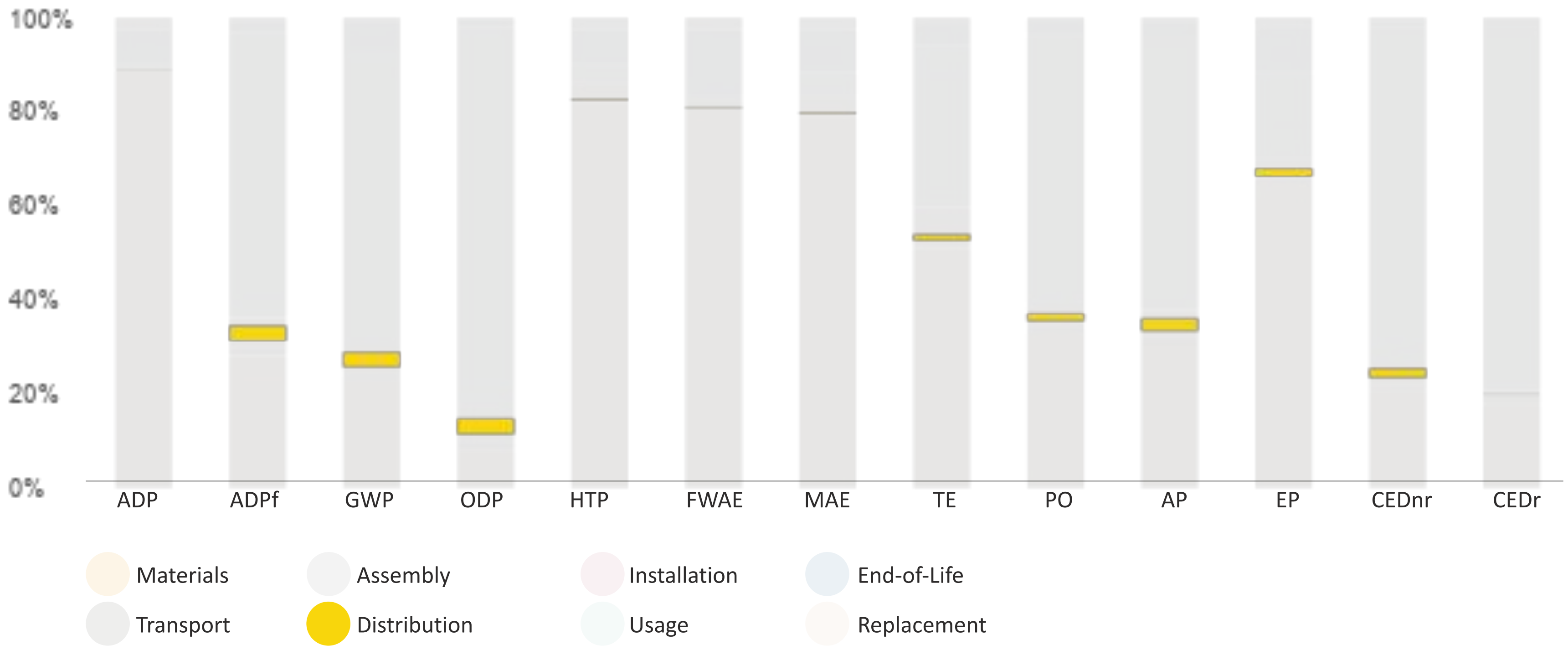
The environmental impacts associated with the End-of-Life stage are due to:

- Firstly, final waste treatment and disposal (mainly by **incineration** during energy recovery processes and **landfill**).
- Secondly, waste collection and transportation to disposal facilities.

LCA results.

Distribution stage

Relative environmental impact of Wallbox Pulsar Plus life cycle stages, excluding vehicle consumption:



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The environmental impacts associated with the Distribution stage are due to a combination of the following factors:

- The use of means of transport with high unit emissions (for most categories: air > road > sea).
- The distribution of chargers over long distances.

The environmental impacts of this stage are mostly associated to **aviation**, despite not being the main distribution mean (24% of tkm), and **road transportation**, which is the main distribution mean (54% of tkm).

LCA results.

Installation stage

Relative environmental impact of Wallbox Pulsar Plus life cycle stages, excluding vehicle consumption:

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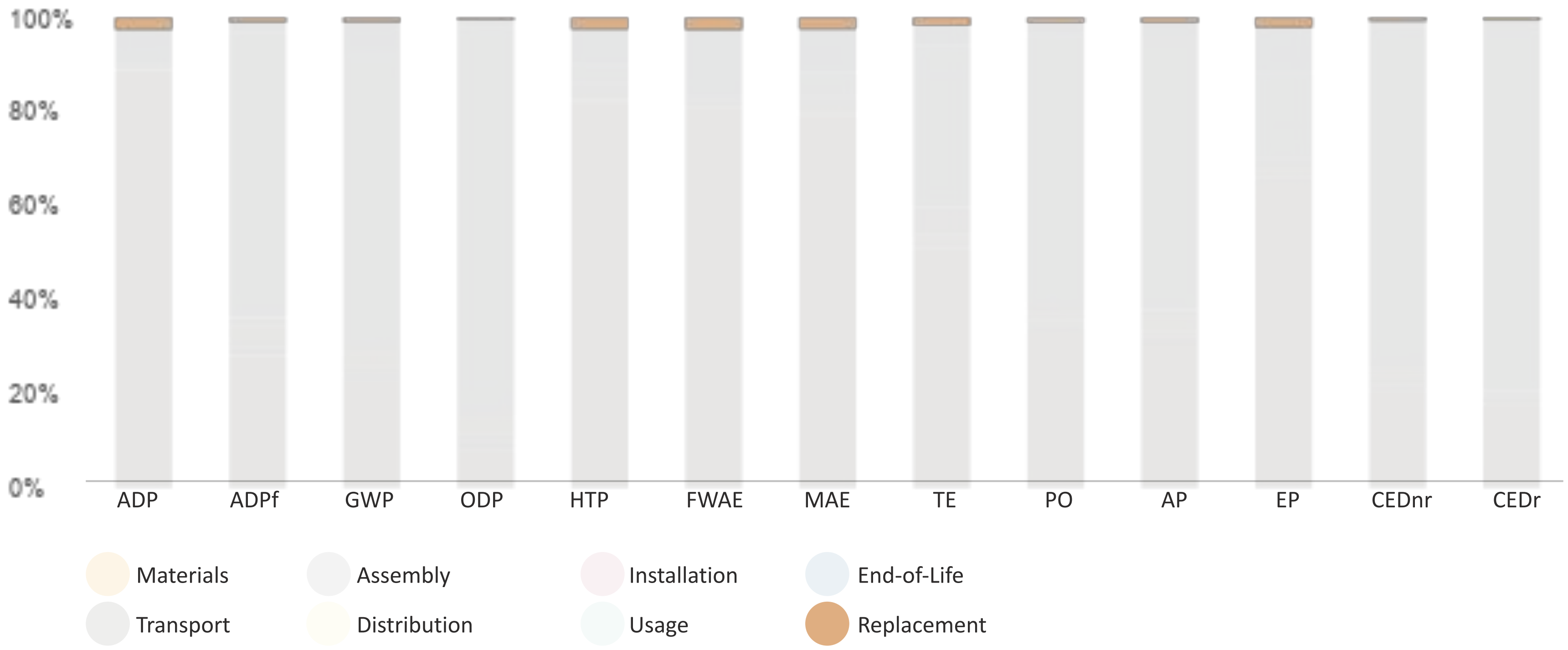
The environmental impacts associated with the **Installation stage** are basically due to the **extraction of materials** and subsequent **manufacture** of the components used to install the charger (mainly the **screws**).

LCA results.

Replacement stage

Relative environmental impact of Wallbox Pulsar Plus life cycle stages, excluding vehicle consumption:



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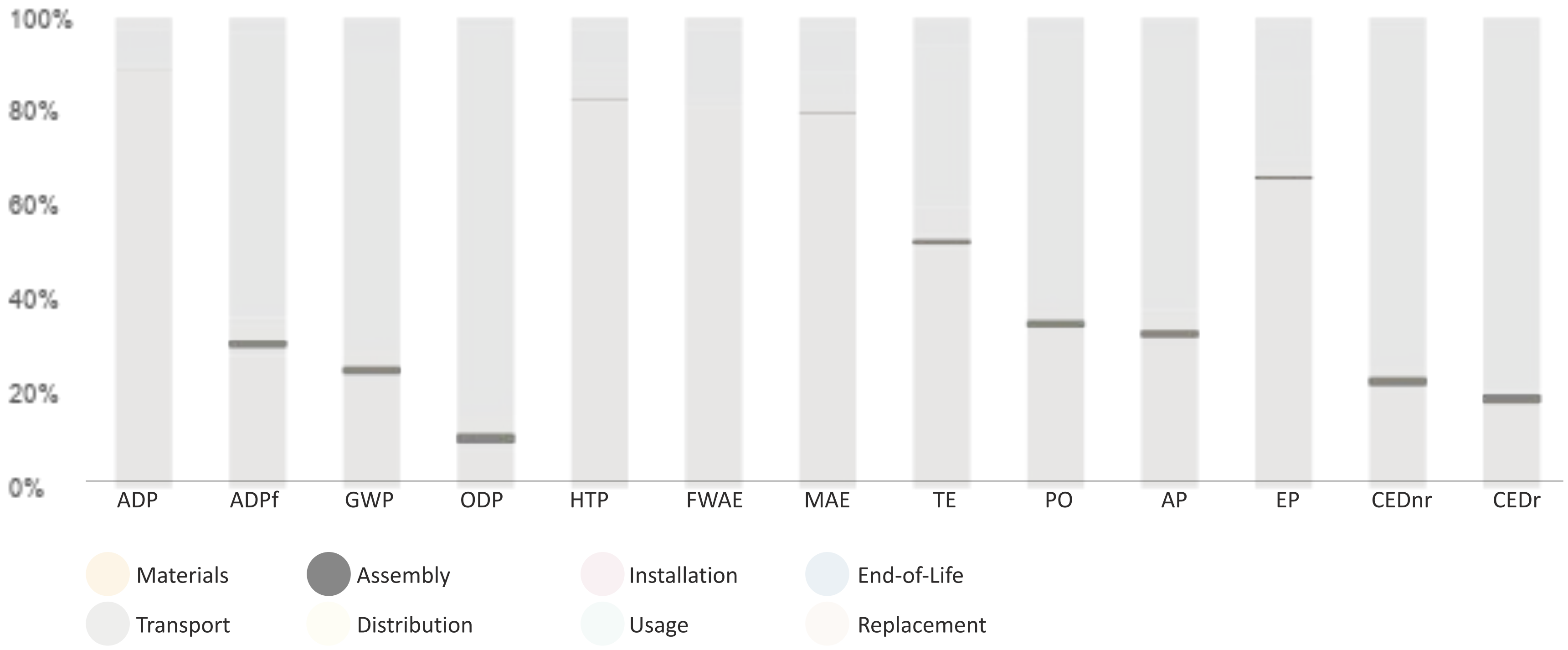
The environmental impacts associated with the Replacement stage refer to the **manufacture of new chargers** due to discarded ones. It includes all life cycle stages, except for the Usage one.

LCA results.

Assembly stage

Relative environmental impact of Wallbox Pulsar Plus life cycle stages, excluding vehicle consumption:



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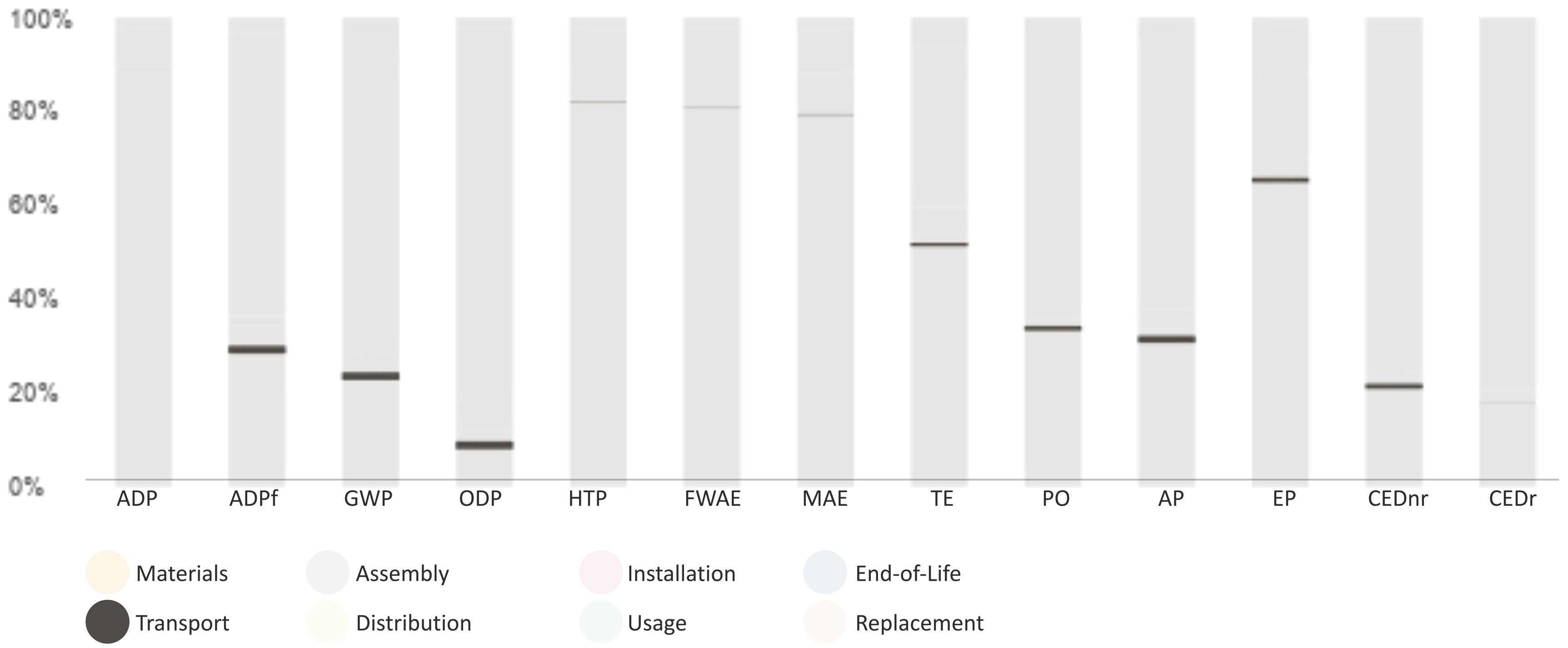
The environmental impacts associated with the Assembly stage are primarily due to the production and distribution of the energy needed to assemble the charger components. Mostly, due to the use of **non-renewable sources**, which represent 57% of Iberdrola's electricity grid.

LCA results.

Transport stage

Relative environmental impact of Wallbox Pulsar Plus life cycle stages, excluding vehicle consumption:



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The environmental impacts associated with the Transport stage are due to a combination of the following factors:

- The transportation of large quantities of materials over long distances, from their origin to the assembly facility.
- The use of means of transport with high unit emissions (air > road > sea for most categories).

The environmental impacts of this stage are mostly associated to the **EV Gun**, which represents a significant quantity over certain distance, and the **Pulsar China CT PCBA**, which is distributed from China by air.

5. Conclusions

Conclusions.

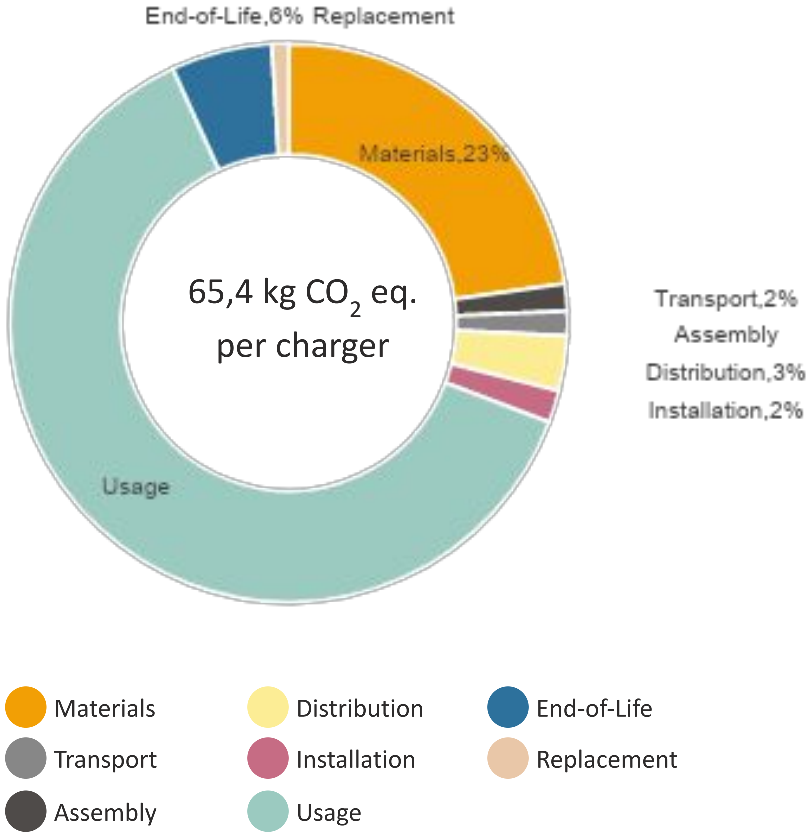
The LCA study concludes that the environmental impacts associated with the Wallbox charger are mainly due to energy consumption during its **Usage stage**. This is followed by the consumption of energy and material resources required to manufacture the components of the charger in the **Materials stage**, as well as the emissions derived from the management and disposal of the system waste during the **End-of-Life stage**.

Based on this study, potential **eco-design opportunities** have been identified. Analyzing and assessing their potential application is considered valuable for minimizing the environmental impact of the charger in future designs.

6. Annex:
results by most relevant impact categories

LCA results.

Global Warming Potential, excluding vehicle consumption.



65.4kg CO2 eq. is equivalent to travelling from Barcelona to Donosti (San Sebastián), Euskadi by an average ICE tourism vehicle.

Data from European Environment Agency

Usage stage. The impact refers to the production and distribution of the energy needed by the charger to develop its function (based on the electricity mix of Spain). 99% of the impacts is due to intrinsic consumption of the charger, while resting 1% derives from energy losses.

Materials stage. 88% of the impact results from the extraction of raw materials and the manufacturing of the different components acquired (mainly due to the use of polypropylene, which is used in large quantities, and copper and polycarbonate, which have higher unit emissions). An 11% derives from the manufacture of the packaging components of the charger (mainly cardboard), and the remaining 2% from the production of the packaging used in the components acquired.

End-of-Life stage. 20% of the impact relates to waste transport to disposal facilities and 80% to waste management and final disposal (mainly by waste incineration).

Distribution. 49% of the impact comes from aviation (despite not being the main distribution mean), 46% from road transportation (which is the main distribution mean) and the remaining 5% from maritime transportation (which has low unit emissions).

Installation. 79% of the impact refers to the extraction and manufacturing of the different components required to install the charger (mainly by the screws), 2% of the impact derives from their transportation to the assembly facility, and the remaining 20% from the management and final disposal of the waste generated during this stage (mainly by the landfill and recovery processes of the cardboard, as well as the energy recovery of the plastic).

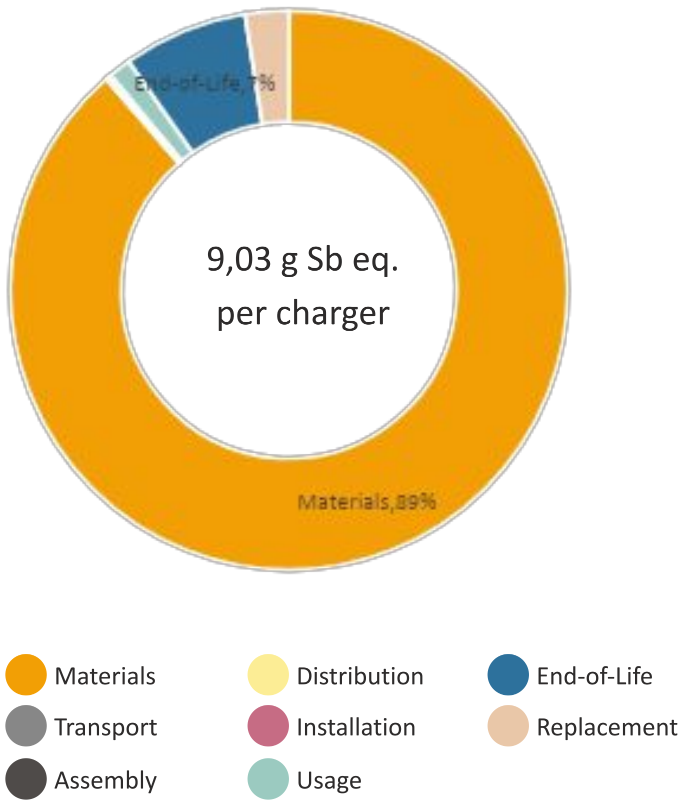
Transport. 90% of the impact refers to the transportation of raw materials and components, from their origin to the assembly facility (it is mostly associated to the EV Gun, since it represents a significant quantity, and the Pulsar China CT PCBA, because it is distributed by air). The remaining 10% is due to the transportation of the packaging materials.

Assembly. 99% of the impact is associated with emissions derived from the production and distribution of the energy needed to assemble the components for the charger's manufacture, mainly by the non-renewable sources, which represent 57% of Iberdrola's mix. The remaining 1% refers to the extraction and manufacturing of consumables, as well as the generation and management of the waste obtained during the manufacturing process.

Replacement. Impact refers to product replacement due to discarded chargers. It is estimated as 2,6% of this impact category (excluding the Usage stage), since it is calculated that 2,6% of chargers need to be replaced.

LCA results.

Abiotic depletion, excluding vehicle consumption.



Materials stage. 99,8% of the impact comes from the use of resources needed to manufacture the charger (specifically from the copper, which accounts for 98,3% of the total impact). The remaining 0,2% refers to the use of materials for the packaging production (both the packaging of the charger and the packaging of the components acquired).

End-of-Life stage. The impact mainly derives from the consumption of resources needed in the recovery processes of waste materials (mainly copper and steel).

Replacement. Impact refers to product replacement due to discarded chargers. It is estimated as 2,6% of this impact category (excluding the Usage stage), since it is calculated that 2,6% of chargers need to be replaced.

Usage stage. The impact refers to the production and distribution of the energy needed by the charger to develop its function (based on the electricity mix of Spain). 99% of the impacts is due to intrinsic consumption of the charger, while resting 1% derives from energy losses.

Installation. 84,2% of the impact is caused by the use of resources needed to manufacture the different components required to install the charger (mainly the screws), 15,7% to manage and dispose the waste generated during this stage (mainly due to additives needed to recover the cardboard waste and transform it into cellulose fibre) and 0,1% to the transport of the components up to the assembly facility.

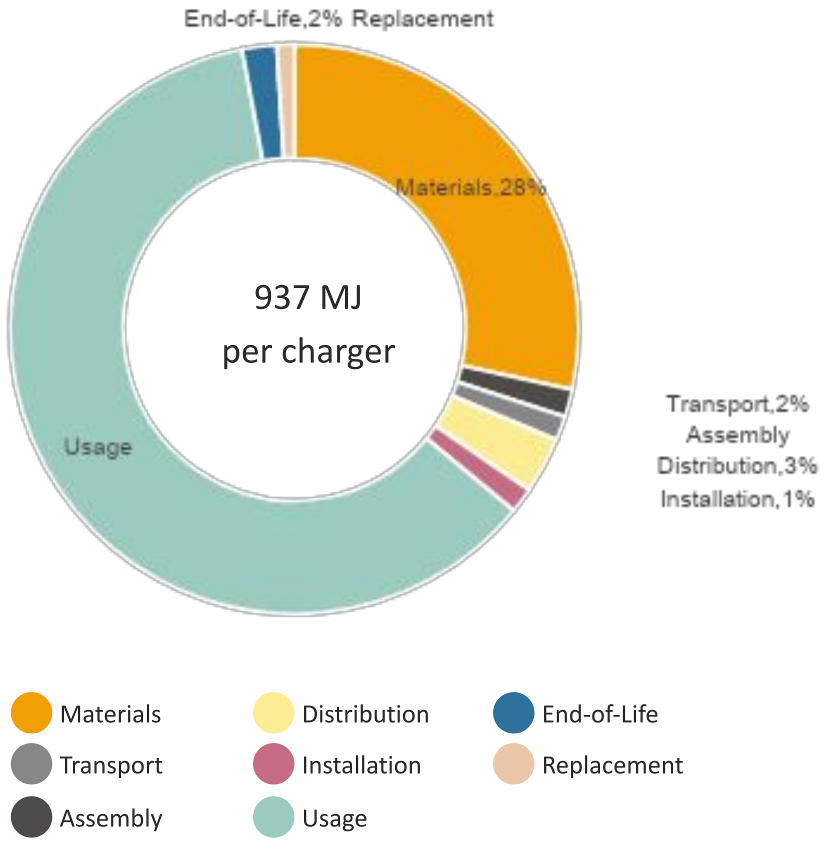
Distribution. The impact refers to the consumption of resources needed to create and maintain transport infrastructures and manufacture the means of transportation. 87,7% refers to road transportation, 7,0% to aviation and 5,3% to maritime transportation.

Assembly. 94,1% of the impact is due to the consumption of resources needed to generate the energy required to assembly the charger components in the assembly facility. The remaining 5,8% refers to the use of resources needed to manufacture the consumables and to manage the waste generated during this stage.

Transport. Emissions are caused by the consumption of resources needed to create and maintain transport infrastructures and manufacture the means of transportation. 83,2% refer to materials and components transport, and 16,8% to packaging materials.

LCA results.

Abiotic depletion (fossil fuels), excluding vehicle consumption.



Usage stage. The impact refers to the production and distribution of the energy needed by the charger to develop its function (based on the electricity mix of Spain). 99% of the impacts is due to intrinsic consumption of the charger, while resting 1% derives from energy losses.

Materials stage. 90,4% of the impact is caused by the non-renewable resources used in the components present in the charger (mainly by the polypropylene, copper and polycarbonate, which have high unit impact). 7,2% are caused by the packaging components of the charger, and 3,2% by the packaging used in the components acquired.

Distribution. Impact is basically associated with fuel consumption. 48,1% is attributed to road transportation, 47,4% to aviation and 4,4% to maritime transportation. Aviation has higher unit emissions than road or maritime transportation.

End-of-Life stage. 63,9% of the impact relates to waste transport to disposal facilities and 36,1% to waste management and final disposal (mainly by the recovery processes due to the use of non-renewable material resources and energy).

Installation. 83,6% of the impact relates to the use of resources needed to manufacture the different components required to install the charger (mainly the screws), 14,2% to manage and dispose the waste generated during this stage (mainly due to the additives needed to recover the cardboard waste and transform it into cellulose fibre) and 2,2% to the transport of the components up to the assembly facility.

Transport. Emissions are caused by the fuel consumption needed by the means of transport, 90,8% refer to materials and components transport (it is mostly associated to the EV Gun, since it represents a significant quantity, and the Pulsar China CT PCBA, because it is distributed by air), and 9,2% to packaging materials.

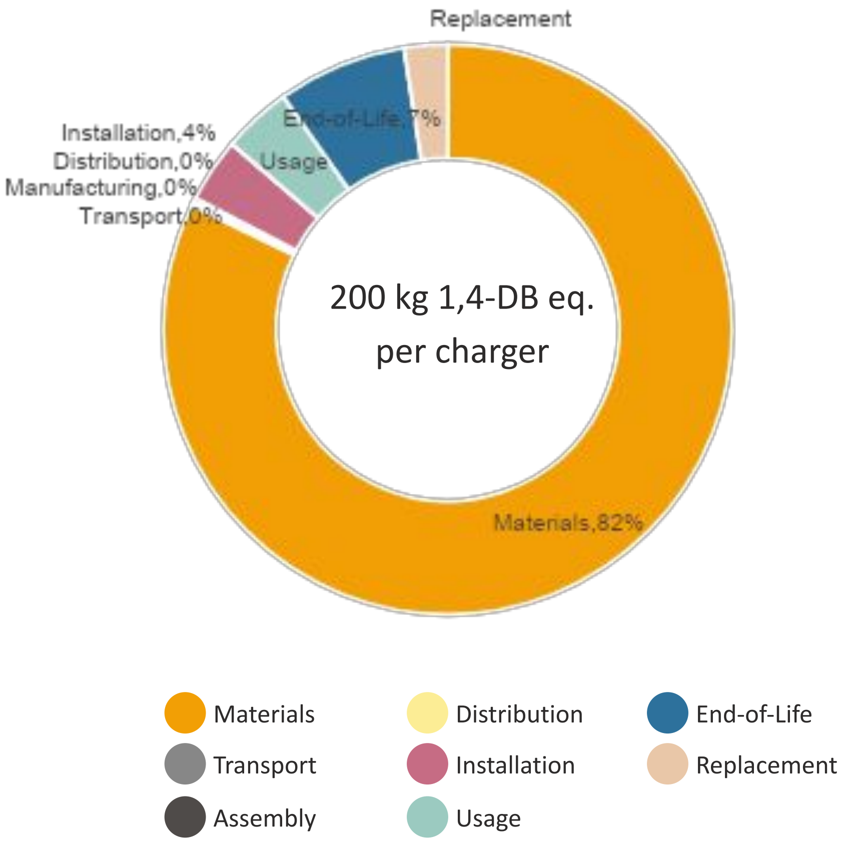
Assembly. 98,4% of the impact is caused by the production of the energy needed to assemble the different components of the charger, mainly by the non-renewable sources consumed (fossil fuel sources represent 57% of Iberdrola's mix). The remaining 1,6% refers to the use of resources needed to manufacture the consumables and to manage the waste generated during this stage.

Replacement. Impact refers to product replacement due to discarded chargers. It is estimated as 2,6% of this impact category (excluding the Usage stage), since it is calculated that 2,6% of chargers need to be replaced.

TM

LCA results.

Human toxicity, excluding vehicle consumption.



Materials stage. 99% of the impact is caused by the extraction and manufacturing of copper, which is used in different components needed to manufacture the charger.

End-of-Life stage. 96% of the impact is attributable to the recovery process of copper, followed by the final disposal of polypropylene (both energy recovery and landfill).

Usage stage. The impact refers to the production and distribution of the energy needed by the charger to develop its function (based on the electricity mix of Spain). 99% of the impacts is due to intrinsic consumption of the charger, while resting 1% derives from energy losses.

Installation. 94% of emissions attributed to this stage correspond to the screws used during the process. The remaining 6% is due to the management of the carboard packaging of the product (mainly due to energy and material recovery of the cardboard).

Replacement. Impact refers to product replacement due to discarded chargers. It is estimated as 2,6% of this impact category (excluding the Usage stage), since it is calculated that 2,6% of chargers need to be replaced.

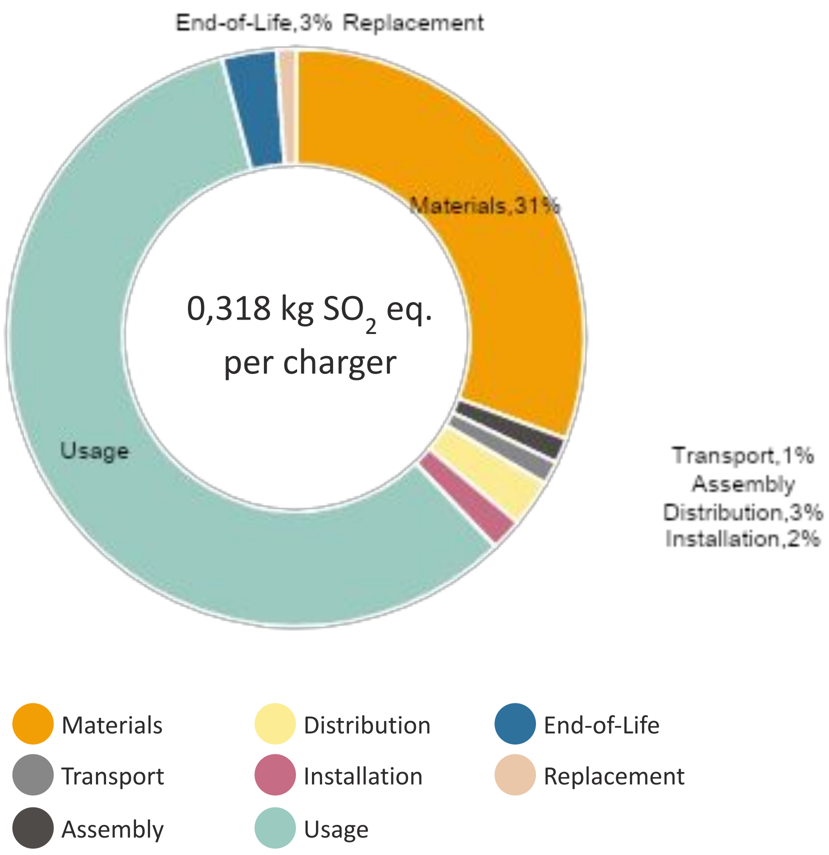
Distribution. 79% of the impact is caused by the consumption of fuels used by road transportation, while 15% is caused by aviation and the remaining 5% by maritime transport.

Transport. 85% of the impact refers to fuel extraction and combustion, mainly caused by the road transportation of the EV Gun and the aviation of the Pulsar China CT PCBA. The remaining 15% is due to the transportation of the packaging materials.

Assembly. 90% of emissions are caused by the electricity consumption (mainly due to the arsenic emitted during coal extraction and end-of-life treatment and to high copper inputs in photovoltaic panels). 9% are caused by the use of adhesive and the remaining 1% by paper.

LCA results.

Acidification potential, excluding vehicle consumption.



Usage stage. The impact refers to the production and distribution of the energy needed by the charger to develop its function (based on the electricity mix of Spain). 99% of the impacts is due to intrinsic consumption of the charger, while resting 1% derives from energy losses.

Materials stage. 93% of the impact results from the extraction of raw materials and manufacturing of the components used to build the charger (mainly due to the high acidification potential of copper and polycarbonate, and to the large use of polypropylene). Auxiliary materials used for the charger's packaging (mainly cardboard) account for the 5% of the potential impact, while the packaging of the components hardly represents 1%.

End-of-Life stage. 70% of the impact refers to the waste management and disposal (mainly treatment of copper scrap), while 30% to waste collection and transportation to disposal facilities.

Distribution. Despite not being the main distribution mean, aviation accounts for the 47% of the stage impact due to its high acidification potential per km, while 44% is attributed to road transportation, which is the main mean of transport. Maritime transport accounts for the remaining 9% of the impact.

Installation. 70% emissions are related to the extraction of raw materials and the manufacturing of the components used to install the charger (mainly screws), 1% to their transportation to the assembly facility, and the remining 29% to the management and final disposal of waste generated during this stage (mainly by the material and energy recovery processes of carboard).

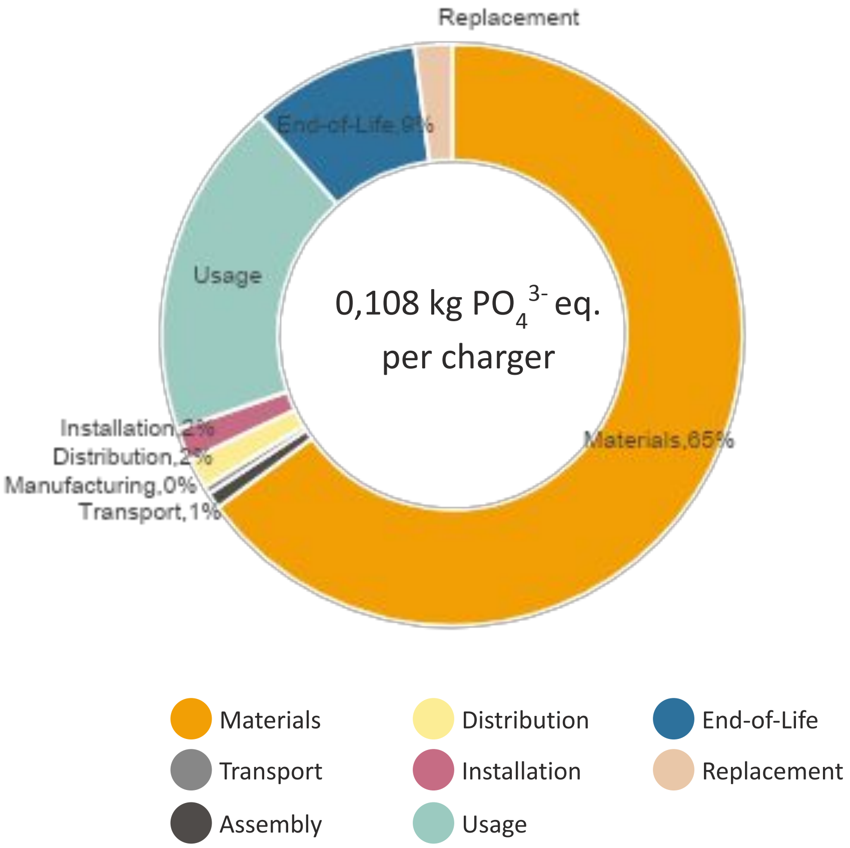
Transport. 88% of the impact is associated to the transportation of raw materials and components to the assembly facilities, mostly by the components distributed by air (Pulsar China CT PCBA) and the components in large quantities distributed by road (EV Gun). The remaining 12% is due to the transportation of the packaging materials.

Assembly. Up to 99% of the impact is related to the production and distribution of the non-renewable energy sources used to produce the electricity consumed within the industrial processes to manufacture the charger, which represent 57% of Iberdrola's energy mix. The remaining 1% is due to the extraction and manufacturing of consumables (mainly adhesive) and, at a lower extent, the management of the waste generated during the manufacturing process.

Replacement. Impact refers to product replacement due to discarded chargers. It is estimated as 2,6% of this impact category (excluding the Usage stage), since it is calculated that 2,6% of chargers need to be replaced.

LCA results.

Eutrophication potential, excluding vehicle consumption.



Materials stage. 93% of the impact is related to the extraction of raw materials and manufacturing of the components to build the charger (being the copper the main contributor, due to its high eutrophication potential related to the intensive use of diesel during mining and intermediate transport of concentrate to the smelter). The packaging used to distribute and sell the chargers (mainly cardboard) is responsible for the 6% of this stage impact. Finally, the remaining 1% corresponds to the packaging of the acquired components.

Usage stage. The impact refers to the production and distribution of the energy needed by the charger to develop its function (based on the electricity mix of Spain). 99% of the impacts is due to intrinsic consumption of the charger, while resting 1% derives from energy losses.

End-of-Life stage. 93% of emissions are due to the management of the waste generated when the charger reaches the end of its lifetime (mainly during the treatment of copper scrap in its recovery process). The remaining 7% is attributable to the collection and transport to the waste management facilities.

Distribution. 47% of the impact is caused by road transportation, which is the main mean of transport, 42% of emissions are due to aviation, because of its high fuel consumption that results in a high eutrophication potential. The remaining 11% comes from marine transportation.

Installation. 69% of the impact is associated to the extraction of raw materials and manufacturing of the components used to install the charger (mainly screws). Another 30% of emissions are related to the management of the charger packaging waste, while the remaining 1% to the transportation of the installing components.

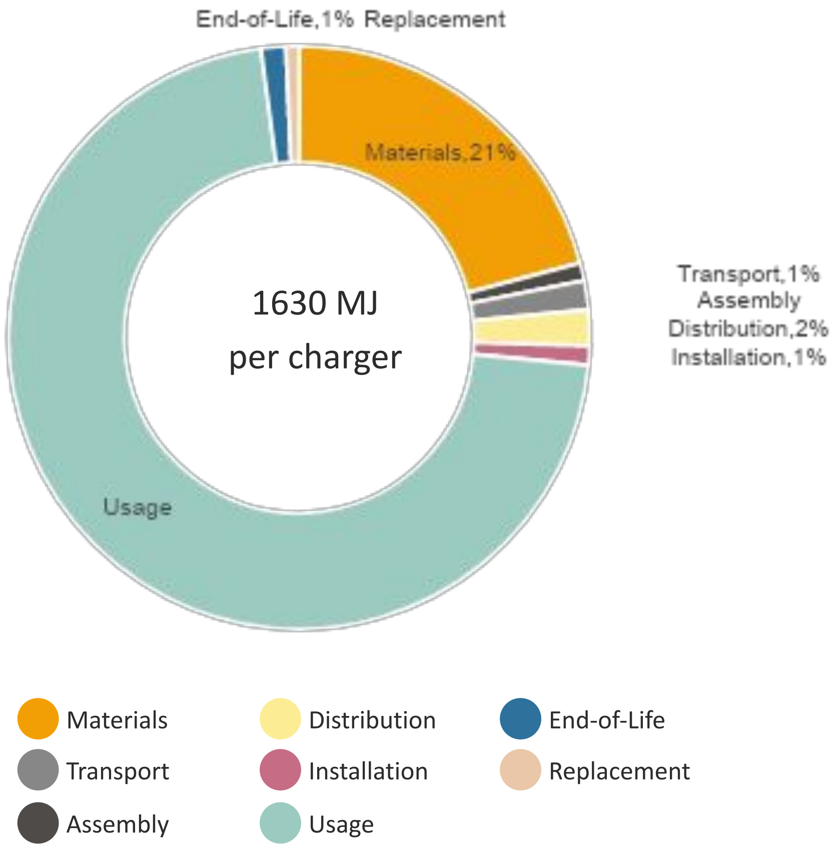
Replacement. Impact refers to product replacement due to discarded chargers. It is estimated as 2,6% of this impact category (excluding the Usage stage), since it is calculated that 2,6% of chargers need to be replaced.

Transport. Emissions produced during the mining of non-renewable energy sources used for the transportation of raw materials and components to the assembly facilities represent 85% of the impact, mostly associated to aviation (Pulsar China CT PCBA) and to the transportation by road of significant quantities of other components (EV Gun). The remaining 15% is due to the transportation of the packaging materials.

Assembly. 96% of emissions are caused by the production and distribution of non-renewable electricity consumed to manufacture the charger, due to the emissions of phosphates during the mining phase of non-renewable electricity sources, which represent 57% of Iberdrola's energy mix. The remaining 4% is caused by the manufacturing of other materials used in this stage (adhesive and paper).

LCA results.

Cumulative Energy Demand, non-renewable excluding vehicle consumption.



Usage stage. The impact refers to the production and distribution of the energy needed by the charger to develop its function (based on the electricity mix of Spain). 99% of the impacts is due to intrinsic consumption of the charger, while resting 1% derives from energy losses.

Materials stage. 91% of the impact is caused by the extraction of raw materials and manufacturing of the charger components, corresponding to materials used in higher quantities (polypropylene, copper, and polycarbonate), which also have high unit impact (together with polyamide, ABS and cable). The remaining 9% is consumed by the manufacturing of the materials used for packaging.

Assembly. 99% of the cumulative energy demand of the manufacturing process is related to the production and distribution of the consumed electricity (57% of Iberdrola's energy mix correspond to non-renewable sources).

Distribution. Aviation, despite not being the main mean of transport used for distribution, represents 47% of the energy demanded in this stage, due to its high fuel consumption intensity. Road transportation accounts for the 49% of the impact, while the remaining 5% corresponds to marine transportation.

End-of-Life stage. 57% of the cumulative energy demand is related to transportation of the waste generated at the end of the charger lifetime from the origin of generation to the disposal facilities. The processes of management and recovery represent 40% of this impact, mainly due to the recovery of copper and polypropylene. The remaining 1% of energy demand is caused by the recovery of materials used during the installation (mainly screws).

Installation. 81% of the cumulative energy demand comes from obtaining raw materials of the components used for the installation of the charger. The management of the packaging waste generated during this process (mainly cardboard), requires 17% of the energy demand, and only 2% is related to the transportation of the materials to the installation sites.

Transport. 90% of the cumulative energy demand is produced by the transportation of materials and components. Main demand of energy is produced by the transport of the components transported by plane (Pulsar China CT PCBA) and by the components that represent large quantities of materials transported by road (EV Gun). The transportation of the packaging materials is accountable for 10% of the energy demand.

Replacement. Impact refers to product replacement due to discarded chargers. It is estimated as 2,6% of this impact category (excluding the Usage stage), since it is calculated that 2,6% of chargers need to be replaced.

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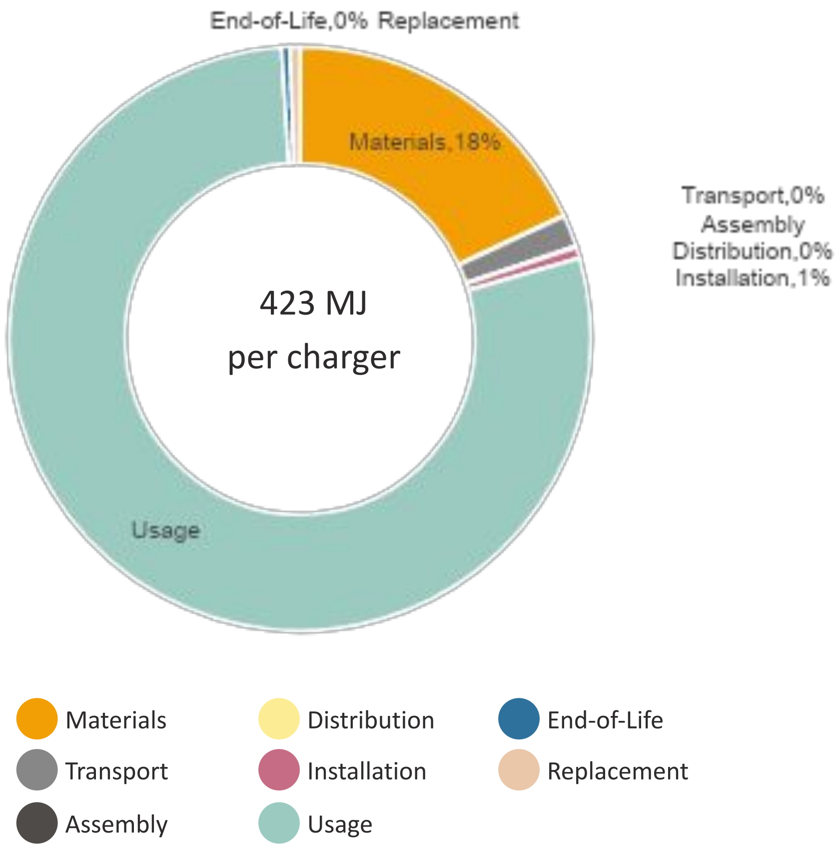
LCA results.

Cumulative Energy Demand, renewable excluding vehicle consumption.



Usage stage. The impact refers to the production and distribution of the energy needed by the charger to develop its function (based on the electricity mix of Spain). 99% of the impacts is due to intrinsic consumption of the charger, while resting 1% derives from energy losses.

Materials stage. 81% of the consumption of energy for this stage is attributed to the extraction of raw materials and manufacturing of the components of the charger (with copper as the most energy-intensive material, followed by polypropylene and polycarbonate). The extraction and manufacturing of the packaging materials for the charger (mainly cardboard) account for 19% of the energy consumption of the materials stage, while the packaging materials of the components cause the remaining 1% of the impact.

Assembly. Up to 100% of the cumulative energy demand of the manufacturing process is related to the production and transportation of the consumed electricity (43% of Iberdrola's energy mix correspond to non-renewable sources).

Installation. The materials and components used during the installation process require 72% of the energy demand of this stage (mainly screws and cardboard). The remaining 28% of the demand is attributable to the management of the packaging waste generated during the installation process (mainly cardboard).

Replacement. Impact refers to product replacement due to discarded chargers. It is estimated as 2,6% of this impact category (excluding the Usage stage), since it is calculated that 2,6% of chargers need to be replaced.

End-of-Life stage. The industrial processes to manage the waste generated at the end of the charger lifetime are responsible for the 87% of the renewable energy demand (mainly for the treatment of copper scrap and polypropylene). The waste transportation requires 9% of the renewable energy and the remaining 4% is due to the energy consumption during the recovery of materials used during installation (mainly screws).

Distribution. Road transportation is the mean of transport with a higher renewable energy demand, 73% of the stage demand, since most of the distribution is made through this mean. Aviation requires 15% of the energy resources, while marine transportation is responsible for 12% of the demand.

Transport. 73% of the renewable energy consumed in this stage is mainly due to the transportation of components by road and by plane. The transportation of the packaging materials is accountable for 27% of the energy demand (mainly cardboard).

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Thanks