Life cycle assessment

—

Carbon footprint report
Polestar 3

Produced in Charleston, USA

Model years
2026-2027

3

This report is for information only and is based solely on an analysis of Polestar 3 (model year 2026 and 2027 “Dual motor” and “Rear motor”. Full study methodology including (but not limited to) goal & scope, function & functional unit, allocation, assumptions and exclusions, data quality requirements and way of working is available in the previous Polestar 3 life cycle assessment report, available via this link: Polestar 3 MY24 LCA Report. To get a full understanding of the methodology used to calculate the carbon footprints in this report, it is recommended to read the first report in conjunction with this one.

The result of this study is dependent upon agreed and validated information from Polestar suppliers and sub-suppliers. During the course of a vehicle program´s life there could arise changes and non-compliances within the supply chain, should such changes or non-compliances arise, Polestar will take corrective actions to achieve the results presented in this report.

BEV: Battery Electric Vehicle

BOM: Bill of Materials

EoL: End-of-Life

GHG: Greenhouse Gas

GWP: Global Warming Potential

IEA: International Energy Agency

IMDS: International Material Data System

IPCC: Intergovernmental Panel on Climate Change

LCA: Life Cycle Assessment

LRDM: Long range Dual motor

LRSM: Long range Single motor

NMC: Nickel Manganese Cobalt

OEM: Original Equipment Manufacturer

PCB: Printed Circuit Board

RER: Rest of Europe

STEPS: Stated Policies Scenario

tCO_2e: Metric ton carbon dioxide equivalents

VCC: Volvo Cars Corporation

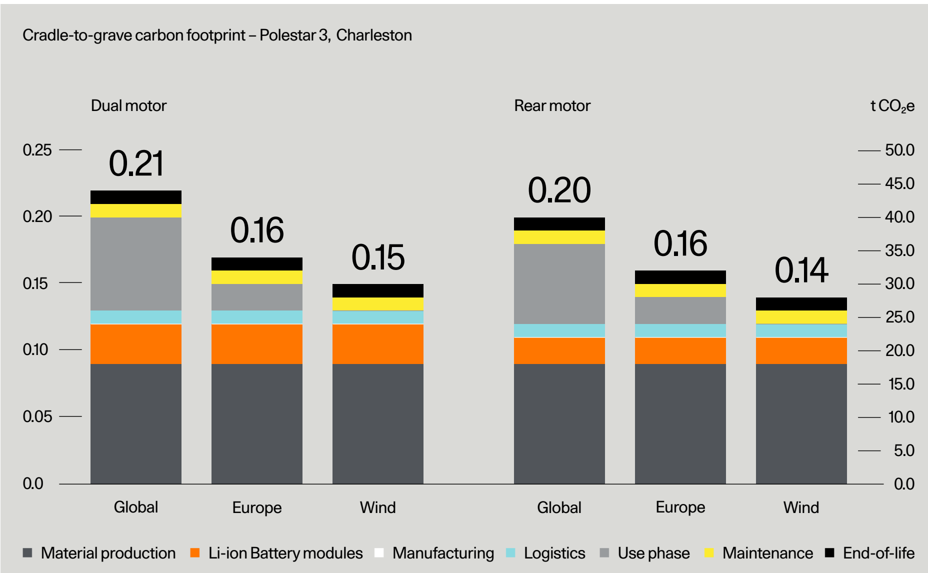
WLTP: Worldwide Harmonised Light Vehicle Test Procedure

Polestar is dedicated to ensuring transparency regarding the environmental impact of its vehicles. This investigation aims to enhance openness by disclosing the carbon footprint associated with our passenger vehicles. The audience includes customers, Polestar employees, investors, automotive OEMs, and other stakeholders with an interest in our vehicle's environmental performance.

The conducted analysis is a Life Cycle Assessment (LCA) focused exclusively on greenhouse gas (GHG) emissions, commonly referred to as a carbon footprint analysis. This assessment analyses the global warming potential (GWP) in accordance with ISO 14067 guidelines, utilising characterisation factors established by the Intergovernmental Panel on Climate Change (IPCC, 2021). The scope of the study spans the entire life cycle of the vehicle, from the extraction and refinement of raw materials to the end-of-life stage.

This report shows the carbon footprint of Polestar 3 Dual motor and Rear motor model years 2026 and 2027, which went into manufacturing in Charleston, USA in late 2025. The two model years are in the aspects of this study, identical. This study is a life cycle assessment (LCA), considering a driving distance of 200 000 kilometres and with a functional unit of "1 vehicle-kilometre". In general, this study adopts conservative assumptions to prevent underestimating the climate impact. There is currently no official standard for LCA of vehicles so the findings of this study should be approached with caution when making comparisons with those of other manufacturers. The study's objective is to comprehend the carbon footprint of the vehicle in its entire lifespan. The aim is to offer valuable insights that can help in making well-informed decisions, including identifying areas where vehicles can minimise their carbon footprint. From previous reports conducted by Polestar, aluminium production and battery module manufacturing have been pointed out as high contributing factors of emission in the vehicle's lifetime. Due to this, Polestar is actively working towards reducing these impacts.

In conclusion, the climate impact of the cradle-to-gate study reveals that 69-70%, depending on motor variant, is credited to the materials utilised in the vehicle's production, aluminium representing the largest part of these emissions followed by iron and steel. The production of battery modules emerges as a significant factor, constituting 18-20% of the cradle-to-gate climate impact. These battery modules have relatively low impact, this is mainly due to the use of 100% renewable electricity in the production of the anode and cathode as well as in cell production. Since the total battery capacity is lower in the Rear motor than the Dual motor, the impact of the Rear motor is lower.



← Figure 1

Total carbon footprint cradle-to-grave for the different electricity mixes. The axis to the left presents the functional unit of 1 vkm and the result in kg CO_2e based on vehicle lifetime of 200 000km and the axis to the right presents the result in tCO_2e per vehicle lifetime of 200 000km.

Using the functional unit “per vehicle kilometre” the cradle-to-grave carbon footprint result varies between 0.21 and 0.15 kg CO_2e per vkm driven for the Dual motor and the result for the Rear motor varies between 0.20 and 0.14 kg CO_2e per vkm (assuming a total lifetime driving distance of 200 000 km). Using the secondary functional unit “lifetime of 1 vehicle” the cradle-to-grave carbon footprint is 41.9-29.3 tCO_2e for the Dual motor and 39.6-28.0 tCO_2e for Rear motor. The range in results is caused by differences in electricity mix scenarios, where the highest value reflects that a global electricity mix is used in the vehicle use phase while the lowest value reflects that electricity from wind power is used. See Figure 1 for visualisation of the results.

Renewable energy sources, particularly wind power, demonstrate potential to reduce lifetime emissions during the use phase. Anticipated improvements in regulatory (WLTP) energy consumption values are expected to reduce energy usage, contributing to environmental sustainability. However, considering alternative future energy scenarios alongside current assessments, such as STEPS, could further enhance energy resource efficiency. Additionally, alternative future energy evolution scenarios, beyond the IEA STEPS scenario assumed in current assessments, could further enhance energy resource efficiency.

Input/output	Polestar 3
Vehicle:	Polestar 3
Assessed variants:	Polestar 3 Dual motor and Polestar 3 Rear motor
Model years assessed:	MY26 and MY27
Equipment level assessed:	Expected highest selling equipment level
Assessed manufacturing sites:	Volvo Cars manufacturing site in Charleston, USA
LCA standard:	ISO 14067
Cut-off:	No cut-off criteria applied for product mass or energy use Simple cut-off approach for recycled content
Functional units:	"1 vkm" and "lifetime of 1 vehicle"
Analysis period:	200 000 km over 15 years
Use phase el. consumption method:	WLTP
WLTP driving range:	635 km (Dual motor), 604 km (Rear motor)
Battery cathode chemistry:	NMC
Battery capacity:	106 kWh (Dual motor), 92 kWh (Rear motor)
Life cycle scope:	Cradle-to-gate and cradle-to-grave
Included life cycle stages:	Raw material extraction and processing Refining of raw materials into parts bought by Volvo Cars Inbound logistics Manufacturing in Volvo Cars plant in Charleston, USA Outbound logistics Electricity consumption in use phase Vehicle maintenance in use phase End-of-life treatment of the vehicle
Full LCA methodology and explanations available at:	Polestar 3 LRDM MY24 LCA Report

← Table

Overview of the methodological choices for the LCA of the Polestar 3.

This table outlines an overview of the methodological choices for the LCA of the Polestar 3. The full methodology is available via the following link: Polestar 3 LRDM MY24 LCA Report.

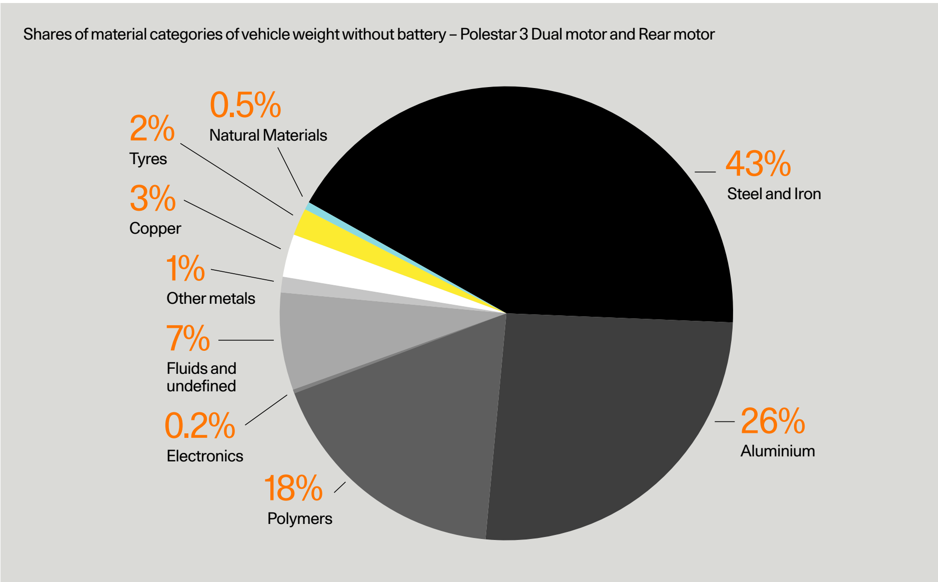
Authors

Emil Inberg
Environmental Sustainability Specialist, Polestar

Contacts

Emil Inberg
Environmental Sustainability Specialist, Polestar
emil.inberg@polestar.com

Alexandra Odbjer
Manager Sustainability, Polestar
alexandra.odbjer@polestar.com



← Figure 2

Shares of material categories of vehicle weight without battery. Note: the material composition of both the Dual motor variant and the Rear motor is very similar.

The products

Polestar only develops battery electric vehicles; the Polestar 2, Polestar 3, Polestar 4 and Polestar 5. The study assesses two variants of Polestar 3 model years 2026/2027, the Dual motor variant and the Rear motor variant. These variants are produced both in Volvo Cars facilities in Chengdu, China and in Charleston, USA. This study assesses vehicles produced in Charleston, USA during 2025 & 2026. The variants are produced with different specifications. This study encompasses the specifications expected to have the largest sales volumes. The products studied are presented in Table 1. Figure 2 shows the material composition by weight for the two Polestar 3 variants.

Table 1 →

Studied vehicles.

Polestar 3 MY26/MY27	Dual motor	Rear motor
Total weight vehicle	2 490 kg	2 315 kg
Li-ion battery modules type and capacity	NMC, 106 kWh	NMC, 92 kWh
Weight of battery modules	458 kg	400 kg
Energy usage WLTP	19.1 kWh/100 km	17.6 kWh/100 km
Preliminary range (WLTP)	635 km	604 km

Changes in methodology and data since Polestar 3 original carbon footprint study

The previously published Polestar 3 LCA report describes and motivates the way of working to obtain data, data sources, LCA databases and software, relation to standards, system boundaries, allocation methods, assumptions, and limitations. The original report also describes material categories, manufacturing methods, transport, use phase, maintenance, and end-of-life treatment. The original Polestar 3 LCA report can be accessed through this link. This chapter only describes the changes made in either methodology or data, from the previous Polestar 3 LCA. All other methodology is the same as in the previous Polestar 3 LCA and are described in that report.

Methodology

There have been no larger changes in the overall methodology from the previous Polestar 3 LCA report, smaller changes have been made which are listed in the subsequent sections. The methodology can be accessed in full here.

Naming

For the model years 2026 and 2027 of the vehicle there have been naming changes. The Polestar 3 Long range Dual motor have been renamed the “Polestar 3 Dual motor” and the Polestar 3 Long range Single motor has been renamed “Polestar 3 Rear motor”.

Data

There have been changes made concerning the data related to aluminium in this report as well as changes to the overall weight of the Polestar 3 variants, which is described below. Data concerning the battery has also changed, since the battery has been updated from a 400V system to an 800V system. Another change in data concerns the use phase assumptions based on the International Energy Agencies (IEA) Stated Policies Scenario (STEPS). Since the time of publishing the first Polestar 3 LCA report, IEA has released new datasets on how they predict the world's energy mixes to evolve.

Products

The second model year of Polestar 3, MY25, brought the “Long range Single motor variant” (now renamed the “Polestar 3 Rear motor”. This variant has one less motor, leading to a lower overall vehicle weight compared to the Dual motor variant. This difference has implications on the use phase since the electricity consumption is lower with one motor. Now, in model year 2026/2027, the battery capacity of the Rear motor variant has been reduced from 111 kWh to 92 kWh. The battery capacity of the Polestar 3 MY26/27 Dual motor variant has also been changed from 111 kWh to 106 kWh. For both variants, these changes have resulted in overall weight reductions.

Aluminium production and refining

Opposed to the previous Polestar 3 LCA, aluminium parts for which the origin of raw material is unknown it has been assumed that this aluminium has a carbon footprint of global average, which is based on an expert judgement by Polestar logistics specialists. The aluminium used in some identified parts in the vehicles comes from smelters utilising renewable electricity for smelting, the emission factors used for some of these parts are primary data from parts suppliers. Other parts have been modelled with a fossil emission factor representing hydropower aluminium smelting in China based on supplier information.

Aluminium parts which have a share of recycled aluminium have been identified. The recycled content includes both post-consumer material and post-industrial material in accordance with the definition of recycled content in ISO 14021 "Environmental Labels and Declarations".

The share of aluminium produced using recycled aluminium has been modelled using a partly aggregated dataset (open energy inputs). The Sphera dataset "RNA: Secondary aluminium ingot (95% recycled content)" is used as the raw material for the recycled content modelling. These changes concerning aluminium have an implication on the total carbon footprint of the Polestar 3. The shares of aluminium sources are given in Table 2.

Table 2 →

Aluminium from different sources by share of total aluminium weight.

Polestar 3	Dual motor	Rear motor
Aluminium from smelters using renewable electricity	18%	19%
Recycled aluminium	15%	11%
Standard Chinese aluminium	4%	5%
Aluminium, global average	62%	65%

Steel production and refining

The raw material used for unalloyed steel is modelled as cold rolled and hot dip galvanised steel. This is divided into two main flows which are (i) steel sourced directly by Volvo Cars to the assembly plant in Charleston, USA and (ii) steel sourced and processed by suppliers to Volvo Cars. The modelling of steel sourced by Volvo Cars applies a material utilisation degree based on Volvo Cars internal data. The material utilisation degree of the insourced steel is confidential information. Modelling of steel sourced and processed by suppliers applies a material utilisation degree of 63%, as described in the previous Polestar 3 LCA report. Approximately 50% of steel raw material in the finished Polestar 3 vehicle is sourced by Volvo Cars of which 70% is produced in the USA and 30% is produced in Europe. The total recycled content of the steel sourced by Volvo Cars to the Polestar 3 is approximately 27%.

Battery

For model year 2026/2027 the Polestar 3 has been upgraded from a 400V battery architecture to an 800V architecture. Along with this change the composition of the cathode active materials have also changed, with reductions the nickel content of the cathode active material. With these changes the same measures to reduce the carbon footprint of the battery as in the first model year of Polestar 3 (model year 2024) are still in effect. These are 100% renewable electricity in the battery cell production as well as in the production of the anode and cathode active materials. The results for the battery climate impact were provided by the supplier in an updated LCA report made according to Polestar and Volvo Cars guidelines and in line with ISO 14044.

The scope includes analysing processes from raw material extraction to the finalised product at the battery company gate. The impact categories focus on GWP over 100 years. Evaluation was based on two functional units: “kWh capacity of battery cells”, and “kWh capacity of battery modules”. Primary data has been collected by the battery manufacturer from manufacturing plants and contracted suppliers as well as data on specific energy sources. Electricity is primarily sourced via power purchase agreements from hydroelectric powerplants, and thermal power is generated from natural gas. Generic data was based on attributional modelling and represent the process's geographical region and extracted from LCI databases like Ecoinvent and Sphera (GaBi professional). Additionally, there have been reductions in total battery capacity in both the Dual motor and Rear motor variants. Both variants use identical battery cells and modules. This has led to reductions in the carbon footprint from the battery modules compare to the Polestar 3 model year 2024.

Electronics

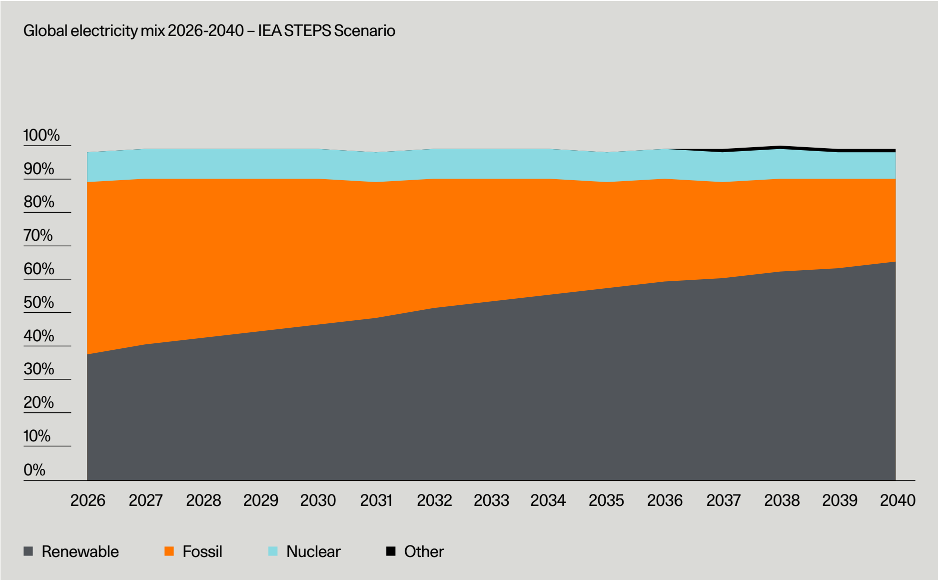
Data on the total weight of electronics have been updated in this report due to the use of a new bill of materials for model year 2026/2027 of Polestar 3. The new bill of materials identifies a lower total weight of electronics in the Dual motor variant compared to model year 2024. As in the first LCA study, all materials that are used in electronic devices that are not PCBs have been sorted into other categories, such as copper or different types of polymers. For the category “electronics” a generic data set from Ecoinvent 3.9.1 has been used. This dataset represents the production of lead-free, mounted PCBs.

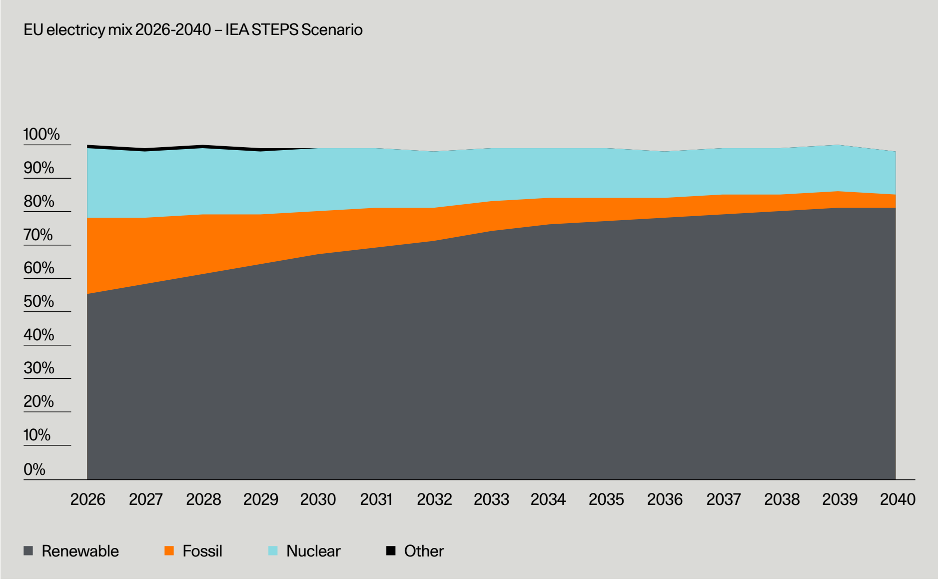
Manufacturing

Representative figures for energy consumption in the Charleston factory are not available at the time of writing this study. Therefore, the consumption of electricity and natural gas per produced vehicle from the Chengdu factory (also producing Polestar 3) for the year 2024 is used to estimate the GHG emissions related to manufacturing. The figures on consumption from Chengdu are increased by 20% to limit the risk of underestimation. Expected electricity sources are 90% hydro power and 10% solar power from on-site solar installations. Country specific datasets for hydropower, solar power and natural gas are applied to the energy consumption figures.

Logistics

The first Polestar 3 LCA report utilised average data on logistics based on Volvo Cars company-wide GHG emissions related to both inbound and outbound logistics. The present report utilises actual logistics GHG emissions data for the Polestar 3 vehicles delivered from the Charleston plant during the first half of 2025. Since Polestar 3 is produced in Volvo Cars plant, Volvo Cars has provided GHG emissions data for transports from tier 1 suppliers to the manufacturing site in Charleston, USA (inbound transport) as well as GHG emissions data for transports from the manufacturing site to customer handover (outbound transport). The outbound transport calculation is based on distances to the markets which have received Polestar 3 vehicles produced in Charleston, USA during the first half of 2025. The methodology to calculate emissions is developed in line with the ISO 14083 standard.





← Figure 3

Predicted share of energy production sectors in the Stated Policies Scenario (STEPS) for global electricity mix, year 2026 to 2040.

← Figure 4

Predicted share of energy production sectors in the Stated Policies Scenario (STEPS) for EU electricity mix, year 2026 to 2040.

Use phase

The energy consumption during driving of model year 2026/2027 of Polestar 3 Dual motor has been reduced from 19.6 kWh/100km for model year 2025 to 19.1 kWh/100km for the present model year, which result in a lower carbon footprint in the use phase.

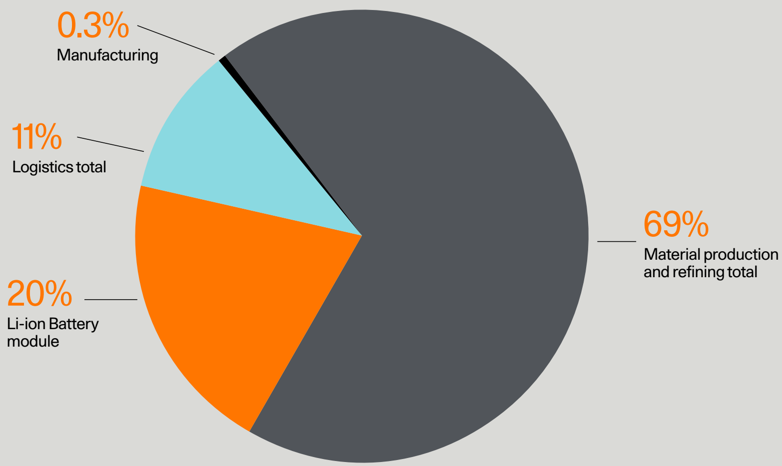
Data updates have been made concerning the use phase of the Polestar 3. More recent data on how the electricity mix might evolve in the EU and Globally have been acquired from the IEAs World Energy Outlook 2024 Extended Dataset[1]. The used electricity mix scenario is their STEPS scenario, which is their more conservative scenario, under which global warming would rise to 2.4°C by 2050[2]. STEPS reflects current policy settings based on a sector-by-sector and country by country assessment of the specific policies that are in place, as well as those that have been announced by governments around the world. Figures 3 & 4 visually represent the development of electricity sources. It is evident that the production of electricity from fossil sources is expected to diminish, gradually being replaced by renewable sources based on the IEA STEPS data.

As in the previous report, the analysis assumes that 50% of a vehicle's total lifetime mileage is covered in the initial five years, equivalent to 20 000 kilometres per year, while 30% is driven in the subsequent five years, amounting to 12 000 kilometres annually. During the last five years of the vehicle's life, it is assumed that the yearly distance driven is 8 000 km, amounting to the total 200 000 kilometres over a 15-year period. This assumption makes the analysis less reliant on future electricity mixes resulting in a more conservative calculation.

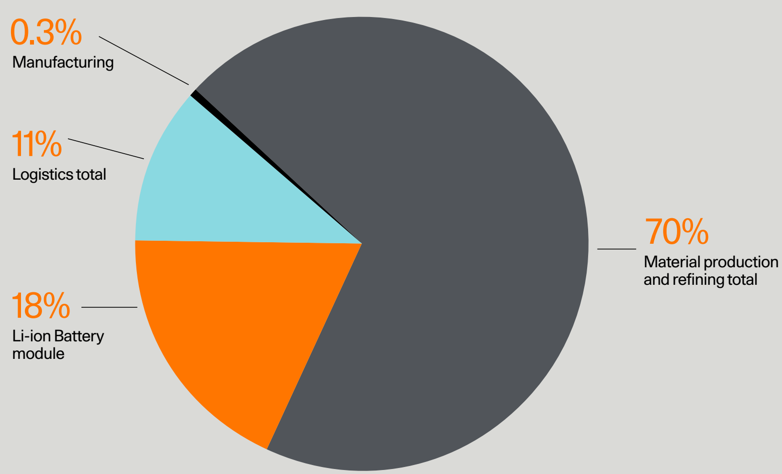
1 World Energy Outlook 2024 - IEA

2 Executive summary - World Energy Outlook 2024

Polestar 3 MY26 Dual motor



Polestar 3 MY26 Rear motor



← Figure 5

Share of cradle-to-gate emissions for one Polestar 3 Dual motor.

The subsequent section shows the findings of the study. It will start by showing cradle-to-gate results followed by results for cradle-to-grave. No updated sensitivity analysis for the cradle-to-grave result has been made in this report as the result is very similar and will vary in a similar manner. See Section 3.3 in the original report: Polestar 3 MY24 LCA Report.

Cradle-to-gate

The results showcased in Figures 5 and 6 display the different life cycle stages shares of the total carbon footprint from cradle-to-gate concerning the production of 1 Polestar 3 Dual motor and 1 Polestar 3 Rear motor. The largest contributor to the climate impact stems from the materials utilised in the vehicle's production, constituting 69-70% of the total climate impact. Subsequently, the battery modules contribute significantly, accounting for 18–20% of the cradle-to-gate climate impact, while 11% of the total footprint is associated with logistics and 0.3% associated with manufacturing processes in Volvo Cars plant in Charleston, USA.

Table 3 presents the comprehensive climate impact in tCO_2e throughout the cradle-to-gate life cycle of the two variants of the vehicle. The total climate impact accounts for 24.38 – 25.64 tCO_2e for the entire vehicle depending on variant. Material production and refining is the category with the largest carbon footprint impact. See visualisation of results in Figure 7.

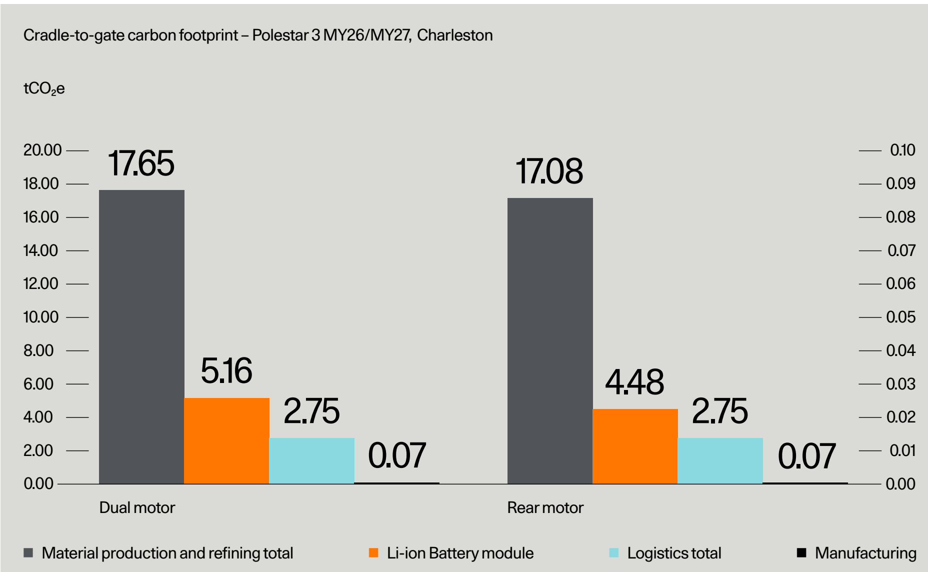
Table 3 →

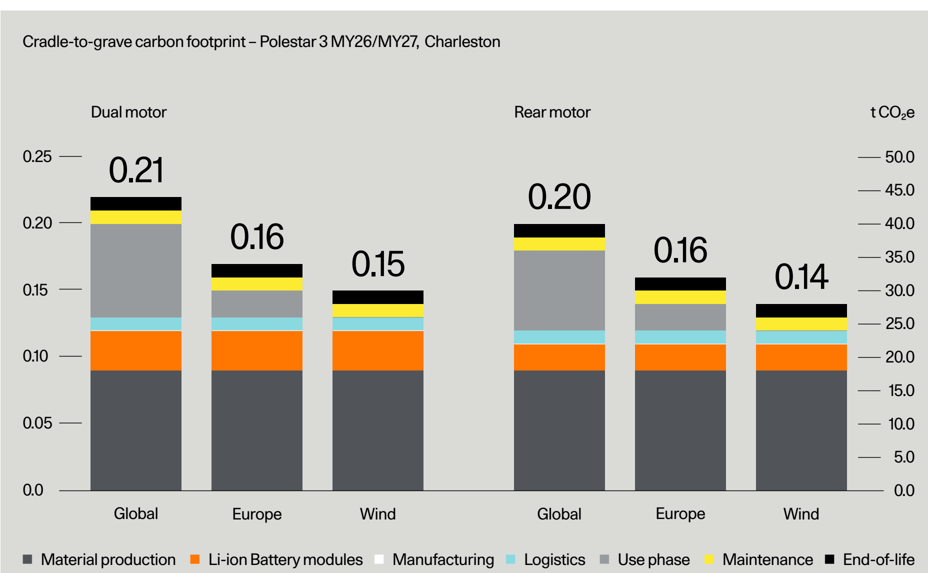
Cradle-to-gate total climate impact in tCO_2e for the life cycle of the vehicle.

Polestar 3 MY26/MY27 tCO_2e	Dual motor	Rear motor
Materials production and refining	17.65	17.08
Li-ion battery modules	5.16	4.48
Logistics	2.75	2.75
Manufacturing	0.07	0.07
Total, Cradle-to-gate	25.64	24.38

← Figure 6

Share of cradle-to-gate emissions for one Polestar 3 Rear motor.





← Figure 7

Cradle-to-gate carbon footprint for the Polestar 3 MY26/MY27 variants, including Materials production and refining, Li-ion battery modules, Manufacturing and Logistics. Results are shown in tCO_2e per functional unit (200,000 km lifetime range) and kg CO_2e/vkm

Cradle-to-grave

The results of the comprehensive LCA for the vehicles, considering three distinct electricity mixes, are presented in Figure 8 as well as Tables 4 and 5 for the cradle-to-grave study. Depending on the electricity mixes in the use phase, the climate impacts differ.

The life cycle stages with the most significant climate impact on the global electricity mix are materials production and refining, use phase and production of Li-ion battery modules.

During the use phase, large variations are observed based on the electricity sources used for charging the vehicle. Wind power electricity exhibits the least climate impact during the use phase, followed by the average EU electricity mix. Appendix 2 in this report present a North American electricity grid mix scenario and how it compares to the three other scenarios.

Table 4 →

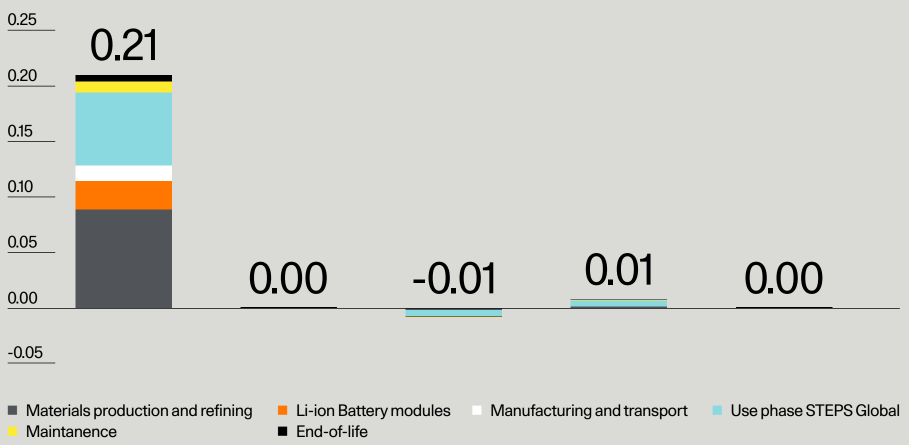
Cradle-to-grave carbon footprint for Polestar 3 MY26/MY27 variants, with different electricity mixes used in the use phase. Results are shown in GWP100 gCO_2e per functional unit 1vkm (200,000 km lifetime range).

Polestar 3 MY26/MY27	Dual motor Global	Europe	Wind	Rear motor Global	Europe	Wind
Material production	88.24	88.24	88.24	85.39	85.39	85.39
Li-on battery modules	25.81	25.81	25.81	22.40	22.40	22.40
Manufacturing	0.37	0.37	0.37	0.37	0.37	0.37
Logistics	13.76	13.76	13.76	13.76	13.76	13.76
Use phase	65.33	18.89	2.47	60.20	17.41	2.27
Maintenance	10.28	10.28	10.28	10.28	10.28	10.28
End-of-life	5.63	5.63	5.63	5.51	5.51	5.51
Total, cradle-to-grave	209.41	162.98	146.55	197.91	155.12	139.98

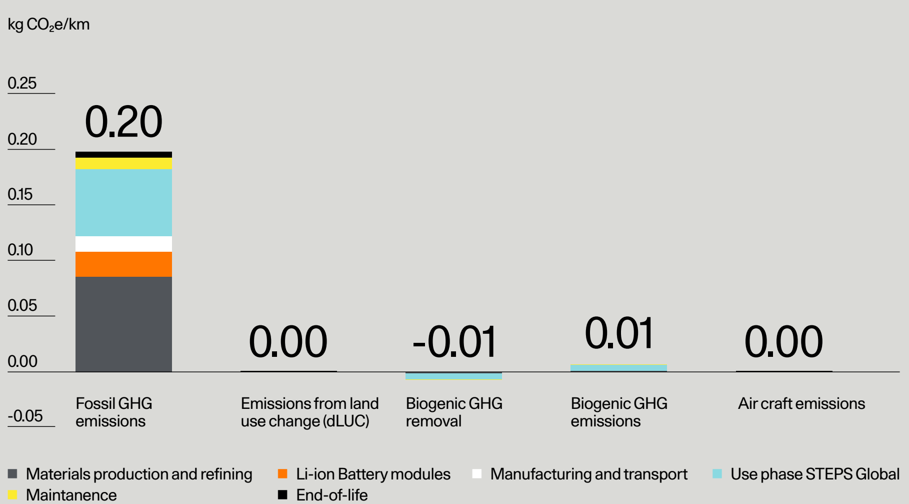
← Figure 8

Cradle-to-grave carbon footprint for Polestar 3 MY26/MY27 variants, with different electricity mixes in the use phase. The use-phase utilises the STEPS scenario from the IEA. Results are shown in kg CO_2e/vkm based on a vehicle lifetime of 200 000km and tCO_2e per functional unit (200,000 km lifetime range).

Cradle-to-grave results all categories – Polestar 3 MY26/MY27 Dual motor



Cradle-to-grave results all categories – Polestar 3 MY26/MY27 Rear motor



← Figure 9

Results cradle-to-grave for the Dual motor variant according to functional unit 1 vkm for the five climate impacts categories according to ISO 14067 with global energy mix in kg CO_2e/vkm.

Table 5 →

Cradle-to-grave carbon footprint for Polestar 3 MY26/MY27 variants, with different electricity mixes used in the use phase. Results are shown in total GWP100 tCO_2e per functional unit 200,000 km lifetime range.

Polestar 3 MY26/MY27	Dual motor Global	Europe	Wind	Rear motor Global	Europe	Wind
Material production	17.65	17.65	17.65	17.08	17.08	17.08
Li-on battery modules	5.16	5.16	5.16	4.48	4.48	4.48
Manufacturing	0.07	0.07	0.07	0.07	0.07	0.07
Logistics	2.75	2.75	2.75	2.75	2.75	2.75
Use phase	13.07	3.78	0.49	12.04	3.48	0.45
Maintenance	2.06	2.06	2.06	2.06	2.06	2.06
End-of-life	1.13	1.13	1.13	1.10	1.10	1.10
Total, cradle-to-grave	41.88	32.60	29.31	39.58	31.02	28.00

Climate impact

According to ISO 14067, this study includes the five different climate impact categories: fossil GHG emissions, emissions from land use change, biogenic GHG emissions and removal, and aircraft emissions.

The five climate change impact categories are shown in Figures 9 and 10. Fossil GHG emissions account for the largest portion of the total climate impact, with 96.7% of total GHG emissions followed by biogenic carbon emissions of 3.29% for both Polestar 3 variants. Land use change emissions together with aircraft emissions are reported negligible in contrast to the other emissions. Biogenic carbon removal is equal in magnitude to biogenic emissions.

These percentages are based on the global energy mix, due to that mix being the most conservative for GWP. The three electricity scenarios are presented fully in Tables 6 and 7 for the Dual motor and single motor variants respectively.

← Figure 10

Results cradle-to-grave for the Rear motor variant according to functional unit 1 vkm for the five climate impacts categories according to ISO 14067 with global energy mix in kg CO_2e /vkm.

Polestar 3 Dual motor	Fossil GHG emissions g CO_2e/vkm.	Emissions from land use change (dLUC) g CO_2e/vkm.	Biogenic GHG removal g CO_2e/vkm.	Biogenic GHG emissions g CO_2e/vkm.	Aircraft emissions g CO_2e/vkm.
Materials production and refining	88.40	0.05	-1.43	1.22	0
Li-ion battery modules	25.81	–	–	–	–
Manufacturing and transport	14.13	–	–	–	–
Use phase STEPS Global	65.29	0.01	-5.45	5.48	0
Use phase STEPS EU	18.82	0.01	-11.78	11.84	0
Use phase Wind	2.46	0	-0.17	0.17	0
Maintenance	10.28	0	-0.33	0.37	0
End-of-Life	5.62	0	-0.07	0.07	0

← Table 6

Results for the Dual motor variant according to functional unit 1 vkm for the five climate impacts categories according to ISO 14067 with different electricity mixes according to STEPS in g CO_2e/vkm.

Polestar 3 Rear motor	Fossil GHG emissions g CO_2e/vkm.	Emissions from land use change (dLUC) g CO_2e/vkm.	Biogenic GHG removal g CO_2e/vkm.	Biogenic GHG emissions g CO_2e/vkm.	Aircraft emissions g CO_2e/vkm.
Materials production and refining	85.54	0.05	-1.36	1.44	0
Li-ion battery modules	22.4	–	–	–	–
Manufacturing and transport	14.13	–	–	–	–
Use phase STEPS Global	60.16	0.01	-5.03	5.05	0
Use phase STEPS EU	17.34	0.01	-10.86	10.91	0
Use phase Wind	2.27	0	-0.16	0.16	0
Maintenance	10.28	0	-0.33	0.37	0
End-of-Life	5.28	0	-0.04	0.06	0

← Table 7

Results for the Rear motor variant according to functional unit 1 vkm for the five climate impacts categories according to ISO 14067 with different electricity mixes according to STEPS in g CO_2e/vkm.

Climate impact from materials production and refining

The primary contributors to GHG emissions from materials production (excluding battery) are aluminium, accounting for 44-45% of the total climate impact, followed by steel and iron at 25-26% depending on variant. Additionally, the climate impact from polymers accounts for 11-12% depending on variant and electronics is at 7-8%. Other categories such as fluids, copper, other metals, and tires also contribute to the overall emissions but to a lesser degree. Figures 11 & 12 display the shares of the total carbon footprint from materials, excluding battery modules, attributed to the different material categories. Table 8 provides the same information in numerical terms. Interesting to note about Table 8 is that the Dual motor variant has higher impact from all materials (due to higher mass of each material), except for the emissions related to aluminium. This is due to the higher share of recycled aluminium present in the Dual motor variant, as described in Table 2.

Table 8 →

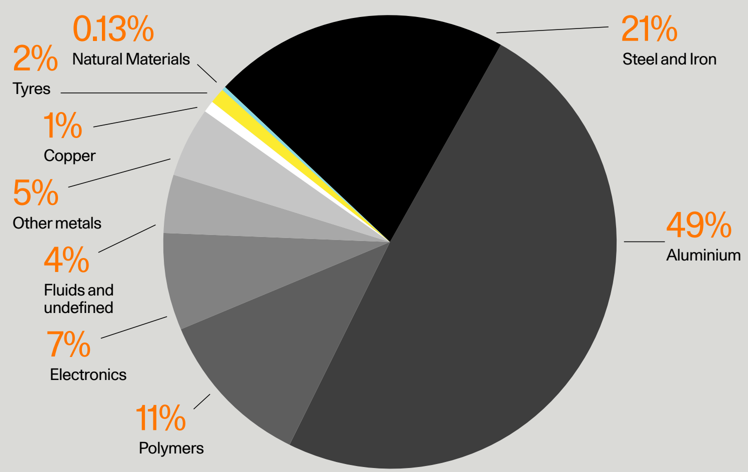
GWP 100 results in tCO_2e for different materials categories, excluding battery modules for the two Polestar 3 variants.

Polestar 3	Dual motor tCO_2e	Rear motor tCO_2e
Steel and Iron	3.75	3.41
Aluminium	8.65	8.57
Polymers	1.97	1.94
Electronics	1.25	1.17
Fluids and Undefined	0.70	0.69
Other Metals	0.84	0.83
Copper	0.22	0.18
Tyres	0.26	0.26
Natural Materials	0.02	0.02

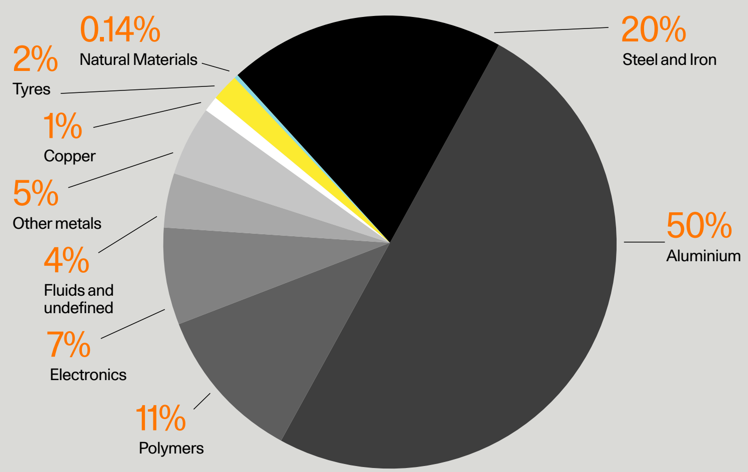
Climate impact of battery

For model years 2026/2027 updated of the battery cells have been made. This has resulted in a lower total carbon footprint of the battery modules in the new model years of Polestar 3 compared to the original model year 2024. The results of the carbon footprint report from the supplier reveal that the primary sources of greenhouse gas emissions are the anode and cathode of the cell, along with the aluminium casing. Additionally, thermal energy from natural gas plays a significant role as a major contributor in the production process. The changes made on the battery modules as well as the reduction of the total battery capacity in the Dual motor variant have resulted in a total battery carbon footprint reduction of approximately 0.7 tCO_2e compared to Polestar 3 Long range Dual motor model year 2024.

Share of GWP100 in kg CO_2e for different material categories – Polestar 3 MY26 Dual motor



Share of GWP100 in kg CO_2e for different material categories – Polestar 3 MY26 Rear motor



← Figure 11

Share of GWP 100 from material production and refining results per material category for the Dual motor variant for different materials categories, excluding battery modules.

← Figure 12

Share of GWP 100 from material production and refining results per material category for the Rear motor variant for different materials categories, excluding battery modules.

Climate impact of electronics

The climate impact of electronics is lower in the Polestar 3 Dual motor model years 2026/2027 compared to model year 2024. This is due to the lower identified total weight of electronics which results in a carbon footprint reduction from electronics of approximately 0.9 tCO_2e. Electronics have a very high emission factor per kg leading to quite small differences in weight having a large impact on the carbon footprint of the material category. For future studies, Polestar intends to research electronics further to improve the accuracy of the impact assessment.

Climate impact of logistics

The climate impact stemming from logistics has increased compared to the original Polestar 3 carbon footprint report for vehicles produced in Chengdu, China. This is due to the incorporation of actual data, specific to the Polestar 3 produced in Charleston, USA. The original report used average numbers for all vehicles manufactured by Volvo Cars, due to lack of actual numbers. This has led to an increase from the first report of approximately 0.9 tCO_2e

Climate impact of use phase

The climate impact of the use phase of the Polestar 3 Dual motor model years 2026/2027 has decreased compared to the impact from the previous model year. This is partly due to (i) the energy consumption per km is lower and primarily (ii) due to that the 2024 IEA STEPS scenario by the IEA anticipates an increase in the share of renewable electricity across the world compared to the 2022 IEA STEPS scenario used in the previous Polestar 3 LCA study. For comparison, the 2022 data anticipated approximately 70% renewables in the EU electricity mix by 2038 while the 2024 data estimate approximately 80% by 2038.

4

Overall, the cradle-to-gate carbon footprint of model years 2026/2027 Polestar 3 Dual motor produced in Charleston, USA is higher than the 2024 model year Polestar 3 Long range Dual motor produced in Chengdu, China, this is primarily due to the use of actual data from logistics related emissions but also due to a difference in the number of parts using aluminium from smelters running on renewable electricity. The total cradle-to-gate increase amounts to approximately 0.9 tCO_2e. The difference would have been higher were it not for the GHG reductions and reduced capacity in the battery modules. Another contributing factor is the lower weight of electronics identified in the new model years of the Polestar 3 Dual motor.

The cradle-to-grave carbon footprint remains largely unchanged even though the cradle-to-gate carbon footprint has increased. This is primarily due to the use of updated datasets from the IEA STEPS scenario used in the use phase of the vehicles, but also thanks to the improved energy efficiency of the vehicle. These factors contribute to the lower carbon footprint in the use phase compared to the first Polestar 3 LCA study on the Long range Dual motor variant. The changes of the cradle-to-grave carbon footprint is dependent on the electricity mix scenario in the use phase. For the Dual motor variant, the global case has been reduced from 0.22 kg CO_2e/vkm to 0.21 kg CO_2e /vkm, the EU case has been reduced from 0.18 to 0.16 kg CO_2e/vkm, and the wind power scenario has increased from 0.14 to 0.15 kg CO_2e/vkm.

Material category Use phase	Location	Name of LCI dataset	Year	Type	LCI database
Electricity from solar power	RER	Electricity from photovoltaic	2019	agg	Sphera professsional database
Electricity from wind power	RER	Electricity from wind power	2019	agg	Sphera professsional database
Electricity from geothermal	RER	Electricity from geothermal	2019	agg	Sphera professsional database
Electricity from hydro power	RER	Electricity from hydro power	2019	agg	Sphera professsional database
Electricity from bioenergy	RER	Electricity from biomass (solid)	2019	agg	Sphera professsional database
Electricity from nuclear power	RER	Electricity from nuclear	2019	agg	Sphera professsional database
Electricity from unabated coal	RER	Electricity from lignite	2019	agg	Sphera professsional database
Electricity from unabated gas	RER	Electricity from natural gas	2019	agg	Sphera professsional database
Electricity from oil	RER	Electricity from heavy fuel oil (HFO)	2019	agg	Sphera professsional database

Material category Material production and refining	Location	Name of LCI dataset	Year	Type	LCI database
Aluminium	GLO	Aluminium ingot mix IAI	2019	agg	IAI / Sphera professional database
Aluminium	CN	Aluminium ingot mix IAI	2019	agg	IAI / Sphera professional database
Aluminium	RER	Aluminium ingot mix	2023	agg	Sphera professional database
Aluminium, recycled	RER	Treatment of aluminium scrap, post-consumer, prepared for recycling, at remelter	2022	agg	ecoinvent 3.9.1
Steel, unalloyed	GLO	Steel hot dip galvanised	2022	agg	Worldsteel / Sphera professional database
Steel, unalloyed	US/RER	Steel sourced by VCC, Primary data from steel suppliers	2019-2024	agg	N/A
Steel, sintered	GLO	Steel hot dip galvanised worldsteel	2022	agg	Worldsteel / Sphera professional database

A1

← Table 9

Chosen data sets for electricity for use phase.

In the LCA a large number of generic datasets from databases are used. In this appendix the datasets used are listed in Tables 9-11. This appendix only presents changes to the datasets used from the previous LCA study on Polestar 3. The original Polestar 3 LCA contains all other datasets used.

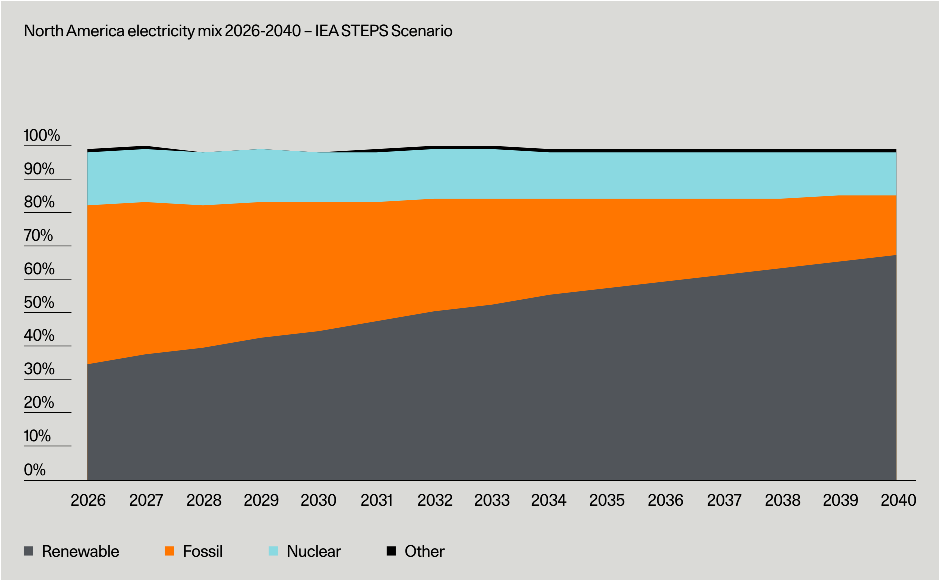
Material category Manufacturing	Location	Name of LCI dataset	Year	Type	LCI database
Electricity	US	Electricity from wind power	2019	agg	Sphera professional database
Electricity	US	Electricity from hydro power	2019	agg	Sphera professional database
Thermal energy	US	Thermal energy from natural gas (East	2019	agg	Sphera professional database

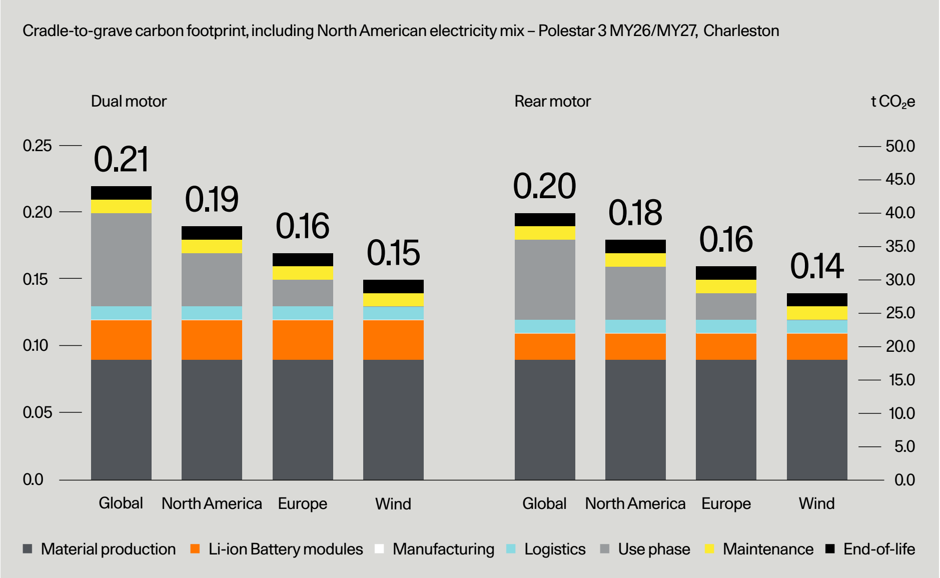
↑ Table 11

Chosen data sets for energy and electricity for manufacturing.

← Table 10

Chosen data sets for updates on Material production and refining.





A2

← Figure A1

Predicted share of energy production sectors in the Stated Policies Scenario (STEPS) for North American electricity mix, year 2026 to 2040.

The Polestar 3 vehicles Produced in Charleston, USA will more regularly, but not exclusively, be sold in the North American market. Therefore, a North American electricity grid scenario in the use phase is added in this Appendix. Figure A1 visually represent the development of electricity sources. It is evident that the production of electricity from fossil sources is expected to diminish, gradually being replaced by renewable sources based on the IEA STEPS data in the North American case.

Figure A2 displays that the electricity grid mix in North America has a higher impact on the cradle-to-grave carbon footprint compared to the EU and wind power scenario, but lower than the global average scenario.

← Figure A2

Total carbon footprint cradle-to-grave for the different electricity mixes. The axis to the left presents the functional unit of 1 vkm and the result in kg CO_2e based on vehicle lifetime of 200 000km and the axis to the right presents the result in tCO_2e per vehicle lifetime of 200 000km.