

VOLVO CONSTRUCTION EQUIPMENT LCA/CARBON FOOTPRINT PRINCIPLES

Volvo CE carbon footprint principles

As part of its efforts to address climate change and act towards a net-zero greenhouse gas emission value chain, Volvo CE is disclosing the carbon footprint for all its main products.

As there are no *Product Category Rules* established for the construction equipment industry, the *Environmental Product Declaration* standard is not applicable. This means product carbon footprint reports disclosed by different OEMs in the construction equipment industry are not directly comparable due to variations in for example methodology, system boundaries, and input data.

Based on global standards

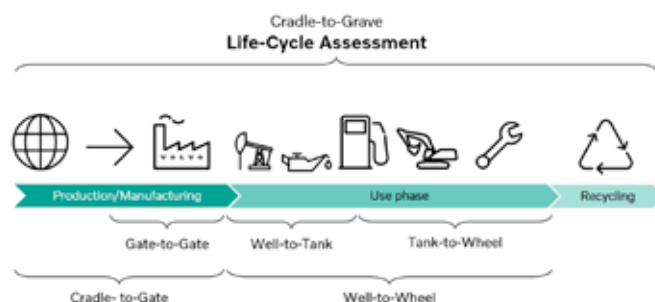
The principles to calculate the Volvo CE carbon footprint are based on primarily two global standards – the global ISO standard for Life Cycle Assessment and the Green-house Gas Protocol. This approach covers consequently all steps in the value-chain from raw materials extraction to product end-of-life.

Exceptions

While still fulfilling the LCA standard requirements, the product carbon footprint report does not cover the emissions generated from:

- Solvents from surface coating in-house at Volvo CE and at suppliers
- Packaging materials used for inbound logistics
- Impact from recycling process for all residual material, except aluminum and steel
- Waste- and wastewater treatment
- Personnel-related travels, business travel, etc.
- Machines repair, due to unplanned machine breakdowns, change of tires and other wear, as well as transports and recycling of the materials, except aluminum and steel

The product value chain



Definitions

Carbon footprint: A measure of a product's climate change impact.

CML2001: An environmental impact category that was developed by CML in 2001. The current version was updated in January 2016.

CO₂ equivalent (CO₂ eq): A unit used for emissions of greenhouse gases by considering their Global Warming Potential (GWP) in relation to carbon dioxide.

Cradle-to-Grave: A system boundary that includes all activities occurring during the life cycle, starting from raw material acquisition (cradle) to waste handling of the used product (grave).

Cut-off rules (for waste management): In this study the cut off rule implies that no credit is given for the materials that are recovered and sent to additional product life cycles.

EPD (Environmental Product Declaration): A global standard that quantifies environmental information on the life cycle of a product to enable comparisons between products fulfilling the same function.

Functional unit: The unit that all inputs, outputs and the results in the study are related to. The results are only valid for the functional unit.

GWP (Global Warming Potential): An environmental impact indicator used to measure the climate impact by considering the degree to which the substances emitted from the system investigated contribute to an increased radiative forcing.

Green House Gas Protocol: A global standardized method of measuring and managing greenhouse gas emissions from e.g., a company's entire value chain, its operations and decisions.

LCIA (Life cycle impact assessment method): A method of converting the life cycle inventory into potential impacts. There are several methods that are based on different methodologies.

LCA (Life Cycle Assessment): A standardized method for quantifying a product's impact on the environment across its entire life cycle.

OEM: Original Equipment Manufacturer

Product Category Rules (PCR): A set of product specific rules to ensure that functionally similar products are assessed in the same way when conducting the LCA and for product comparison.

Science Based Target initiative (SBTi): A method for companies to set scientifically based targets in line with the Paris agreement. Which means that they commit to making the adjustments required for staying at a global temperature increase of 1.5 degrees Celsius.

Time coverage: The year the study is being conducted.

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Principles based on the Green-house Gas Protocol:

Scope	Applied by Volvo CE
1 Direct emissions	Covers all in Scope 1: Direct emission from fuels and processes at Volvo CE production sites.
2 Indirect emissions	Covers all in Scope 2: Indirect emissions from purchased energy at Volvo CE production sites, such as electricity and district heating.
3.1 Purchased goods and services	Emissions from raw materials calculated by means of GWP factors for each material, and tier 1 suppliers' scope 1, 2 and 3.3 emissions during production of Volvo CE parts.
3.3 Fuel and energy-related activities	Emissions across the energy and electricity value chain that not included in scope 1 or scope 2.
3.4 Upstream transportation and distribution	Logistics data calculated by transportation distance and transport mode. Generic data used to calculate the carbon dioxide emissions.
3.5 Waste generated in operations (steel/iron)	All raw materials used to manufacture a machine are included in the analysis, ie no credit is given for the materials that are recycled and sent to additional product life cycles.
3.9 Downstream transportation and distribution	Downstream transport and distribution from Volvo CE's production plants to the end customer have been calculated as an average of the distance and mode of transport to the most common destinations. Generic data used to calculate the carbon dioxide emissions.
3.11 Use of sold products	<p>To calculate the impact per operating hour, a calculated lifetime of 10 years is applied and the use of standard diesel MK1 (well-to-wheel), the electric product is calculated based on the average electricity mix for EU. The use phase comprises of fuel consumption and service/maintenance. To calculate the impact from the fuel, data from Volvo CE CareTrack is used, giving the following data:</p> <ul style="list-style-type: none"> • Average fuel consumption (l/h) • Average idling (% of operating time) • Average operating time (h/y) • Field population <p>For service/ maintenance, the calculations are based on the most common service interval since it may vary depending on operating conditions. The maintenance phase covers all planned filter and oil changes.</p>
3.12 End-of-Life treatment of sold products	The End-of-Life phase includes recycling of parts of the products to new raw material, limited to steel/iron and aluminum. All other materials are assumed to be managed according to current waste legislation. The calculation assumes that 100% of the steel/iron and aluminum in the products is recycled. No further emissions from e.g., transports, cleaning and disassembly are included in the End-of-Life phase. The effects of the process of converting the machine to new raw material during recycling is calculated and added. No credits due to the recyclability of the material are included. The positive effect is arising in the next generation of products with a larger proportion of recycled material.

Principles based on the ISO 14040/44:2006:

Items	Applied by Volvo CE
Functional unit	Kg CO ₂ -eq per operating hour, per the SBTi definition
System boundaries	Cradle-to-grave
Impact assessment method	CML2001 – Jan 2016. The time horizon used is GWP 100 years, excl. biogenic carbon. It only includes the fossil carbon dioxide and thereby excludes the uptake and emissions of biogenic carbon dioxide.
Cut-off rules	In this study the cut off rule implies that no credit is given for the materials that are recovered and sent to additional product life cycles.
Allocations	Mass allocation (by weight) and volume allocation (by hours or number of units)