Life Cycle Assessment
Methods and independent verification

Life Cycle Assessment (LCA) based on DIN EN ISO 14040 and DIN EN ISO 14044

We are currently particularly observing the global warming potential as impact category that converts certain environmental impacts into CO_2 equivalents. Volkswagen AG commissioned TÜV NORD CERT Prüf- und Umweltgutachtergesellschaft mbH as an independent external body to carry out the critical review of this LCA study in accordance with the applicable standards DIN EN ISO 14040 and DIN EN ISO 14044. In accordance with the standard, the manufacturing phase from raw material extraction, the use phase comprising passenger transportation over 200,000 km in the WLTP driving cycle and the dismantling for recycling (without battery system) were used as framework. The environmental impacts were assessed via a special software including a database with average upstream chain values. For selected parts like the battery cells separate analyses were carried out.

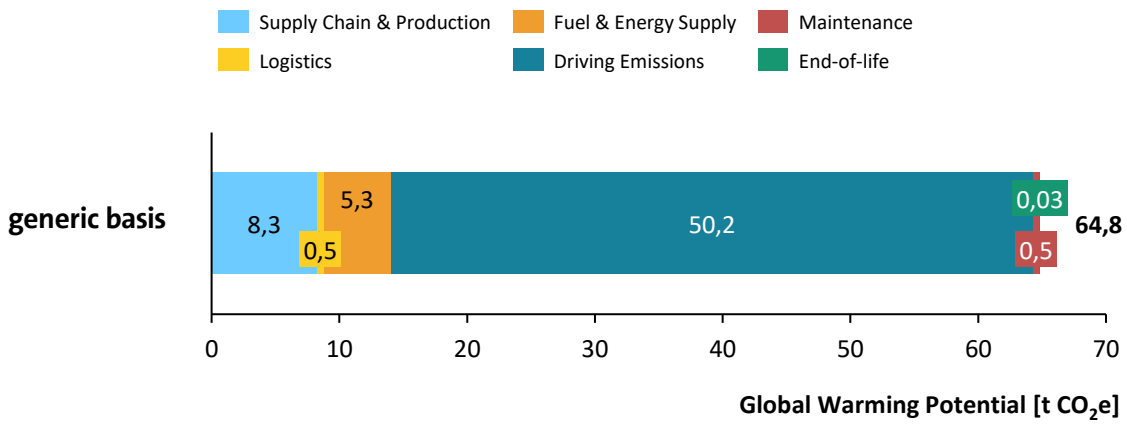
With regard to the state of the art of LCAs, it should be noted that the calculation methods for LCAs in the automotive industry are subject to constant further development. Amongst others generic data and assumptions are increasingly being replaced by vehicle- and company-specific data, thus future calculations may lead to significant deviations from previous LCA values. Therefore LCAs are to be understood as a status at the time of execution (snapshot of the respective assumptions), do not represent a guaranteed product property in a legal sense and are not suitable for comparisons with LCAs from other car manufacturers. Respective harmonizing EU standards are expected to be published in 2025.

Crafter 130 kW
CO_2e-emissions by life cycle phases

Overview LCA Crafter 130 kW

Vehicle: Crafter 3,5 t KAST MR 130 kW FroAG8
Configurations: market Germany, model year '21
Functional unit: passenger transportation over 200,000 km in WLTP test cycle
System boundaries: production in Europe (not site-specific), avg. logistics
WLTP Fuel consumption combined in l/100 km: 9,575 l/100 km*; **CO_2 emission combined in g/km:** 251 g/km per 100 km*
Maintenance: oil, tires, starter batter, brakes, AdBlue, brake fluid (statistical data)
End-of-life phase: no credits for recovery (cut-off)
Critical Review: TÜV NORD CERT, date of validity statement: 2021-10-22

CO_2e-emissions Crafter 130 kW



*The consumption values only apply to the model from the life cycle assessment. Deviations from models with other equipment are possible.

Nutzfahrzeuge

Crafter 130 kW
LCA methodology

Software, Data Basis and Scope

Software
- Sphera LCA for Experts version 10.05.0.78

LCA database and data sets
- Sphera LEAD database content version 2020.1 with extension databases and data-on-demand datasets, respective VW Group mapping list
- VW Group datasets: paint shop, final assembly, glass, tires, press hardening, logistics
- Logistics via VW logistic system (only GWP)

Calculation Rules
- DIN EN ISO 14040/44
- VW Group LCA Guidelines version 1.0

Scope
- According to the life cycle approach the system boundaries comprise the entire product life span (from production to use phase and end-of-life). Emissions from further scope 3 categories like business travel, employee commuting, franchises etc. as defined in the greenhouse gas protocol are not covered and are considered for the calculation of the VW group KPI "Decarbonization Index".

Input variables

Production phase
- Vehicle configurations in dominant market with standard equipment and with additional equipment for maximum weight
- Supply chain and in-house production in Europe (not site-specific)
- Application of reduction measures on part level confirmed by respective validation reports and validity statements

Use Phase
- Fuel & Energy supply (Well-to-Tank): EU-fuels
- Consumption (Tank-to-Wheel): Worldwide Harmonized Light Vehicles Test Procedure (WLTP) for 200.000 km
- Maintenance: oil, tires, starter batter, brakes, AdBlue, brake fluid (statistical data)

End-of-life
- Generic vehicle segment specific model for dismantling without battery system and without credits for recovery (cut-off approach)

Verification

- Critical Review by TÜV NORD CERT: validity statement from 2021-10-22 (Audit Report No. 35303800) for LCA background report from 2021-10-20

With regard to the state of the art of LCAs, it should be noted that the calculation methods for LCAs in the automotive industry are subject to constant further development. Amongst others generic data and assumptions are increasingly being replaced by vehicle- and company-specific data, thus future calculations may lead to significant deviations from previous LCA values. Therefore LCAs are to be understood as a status at the time of execution (snapshot of the respective assumptions), do not represent a guaranteed product property in a legal sense and are not suitable for comparisons with LCAs from other car manufacturers. Respective harmonizing EU standards are expected to be published in 2025.

Nutzfahrzeuge

Crafter 130 kW
LCA methodology - glossary

CML methodology
The Life Cycle Impact Assessment (LCIA) and the characterization model are based on the CML methodology (as of August 2016), which has been developed at the University of Leiden at the Centrum voor Milieukunde Leiden (CML) in the Netherlands. With this methodology, the assessment of environmental impact potentials is based on accepted scientific models.

Critical Review
Process described in ISO 14044 intended to ensure consistency between a life cycle assessment and the principles and requirements of the International Standards on life cycle assessment as described in ISO 14040, carried out by an independent expert.

Cut-off approach
For the secondary materials emerging from vehicle recovery processes at the end of life, no credits are issued within the life cycle assessment. Only the expenditures and emissions of the recovery processes are considered. For vehicles with a high-voltage battery, the end of life of the battery including thermal deactivation and shredding is not assessed.

Global Warming Potential (GWP)
The global warming potential describes the emission of greenhouse gases, which lead to an increase of the heat absorption of solar radiation within the atmosphere and thus can contribute to climate change, e.g. an increase of global average temperatures. The reference substance for the global warming potential is carbon dioxide. All other greenhouse gases (e. g. CH_4, N_2O, SF_6) are projected to carbon dioxide in terms of their impact on global warming (CO_2 equivalents or CO_2e).

Greenhouse Gas Protocol (GHG Protocol)
A partnership between the World Resources Institute and the World Business Council for Sustainable Development providing accounting and reporting standards, sector guidance and calculation tools for emissions reporting. It establishes a comprehensive, global, standardized framework for measuring and managing emissions and divides emissions into three scopes: scope 1 - direct GHG emissions (of company), scope 2 - electricity indirect GHG emissions, scope 3 - other indirect GHG emissions

ISO 14040/44
ISO 14040 and ISO 14044 define the standard for an ISO-compliant Life Cycle Assessment (LCA). ISO 14040 provides the 'principles and framework' of the standard, while ISO 14044 provides an outline of the 'requirements and guidelines'.

Life Cycle Assessment (LCA)
LCA addresses the environmental aspects and potential environmental impacts (e.g. use of resources and environmental consequences of releases) throughout a product's life cycle from raw material acquisition through production, use and end-of-life treatment (i.e. cradle-to-grave). An LCA study consists of the phases (1) goal and scope definition, (2) inventory analysis, (3) impact assessment and (4) interpretation.

Sphera LCA for Experts
The software LCA for Experts (common name: GaBi, "Ganzheitliche Bilanzierung") from Sphera is a LCA modelling and reporting application. The content databases include many raw materials and processes in every phase from extraction to end-of-life across the supply chain.

Worldwide Harmonized Light Vehicles Test Procedure (WLTP)
The WLTP is a globally harmonized standard for determining the levels of pollutants, CO_2 emissions and fuel consumption of traditional and hybrid cars, as well as the range of fully electric vehicles.

The specified fuel consumption and emission data are determined in accordance with the measurement procedures prescribed by law. 1 January 2022, the WLTP test cycle completely replaced the NEDC (New European Driving Cycle) test cycle and therefore no NEDC values are available for new type approved vehicles after that date. This information does not refer to a single vehicle and is not part of the offer but is only intended for comparison between different types of vehicles. Additional equipment and accessories (additional components, tyre formats, etc.) can alter relevant vehicle parameters such as weight, rolling resistance and aerodynamics, affecting the vehicle's fuel consumption, power consumption, CO_2 emissions and driving performance values in addition to weather and traffic conditions and individual driving behavior. Due to more realistic testing conditions, fuel consumption and CO_2 emissions measured according to WLTP will in many cases be higher than the values measured according to NEDC. As a result, the taxation of vehicles may change accordingly as of 1 September 2018. For further information on the differences between WLTP and NEDC, please visit www.volkswagen.de/wltp. Further information on official fuel consumption data and official specific CO_2 emissions for new passenger cars can be found in the "Guide to fuel economy, CO_2 emissions and power consumption for new passenger car models", which is available free of charge from all sales dealerships and from DAT Deutsche Automobil Treuhand GmbH, Hellmuth-Hirth-Str. 1, D-73760 Ostfildern, Germany and at www.dat.de/co2.