

Environmental Report BMW X5 xDrive45e

Abstract

Goal and scope:

The scope of the study is the life cycle assessment of the BMW X5 xDrive45e Plug-in-hybrid, Model Year 2019. Its purpose is to assess the environmental impacts of the entire vehicle and its components according to the product responsibility strategy of the BMW Group. These results are important for the further development and optimization of the next BMW X5 PHEV generation.

System boundaries:

The system boundaries consist of all material and energy flows, input and output collected according to ISO 14040 with the following level of detail:

- From sourcing and production of raw materials to production, to use phase, to recycling (incl. transport logistic).
- Use phase: assumed mileage 250.000 km, consumption according to worldwide harmonized test procedure (WLTP) for Plug-in-hybrid vehicles.
- Software and database GaBi 9©.
- Material data from material balance of the BMW X5 45e.
- The impact assessment is based on the CML-method (January 2016) developed at Leiden University in the Netherlands (Guinée and Lindeijer 2002).
- A critical review of the environmental report is done by an external auditor.
- The compilation and assessment process was verified by TÜV Rheinland assessing compliance with the internal process description as well as verifying data and environmental information used (validation attached).

The functional unit and the reference flow are defined as the BMW X5 45e vehicle as an ECE-basis version with a use phase of 250.000 km according to the WLTP at SOP (start of production) in 2019. The Plug-in-hybrid power train consists of the BMW TwinPower Turbo 6-cylinder petrol engine and an eDrive electric motor as well as a high-voltage battery (lithium-ion technology).

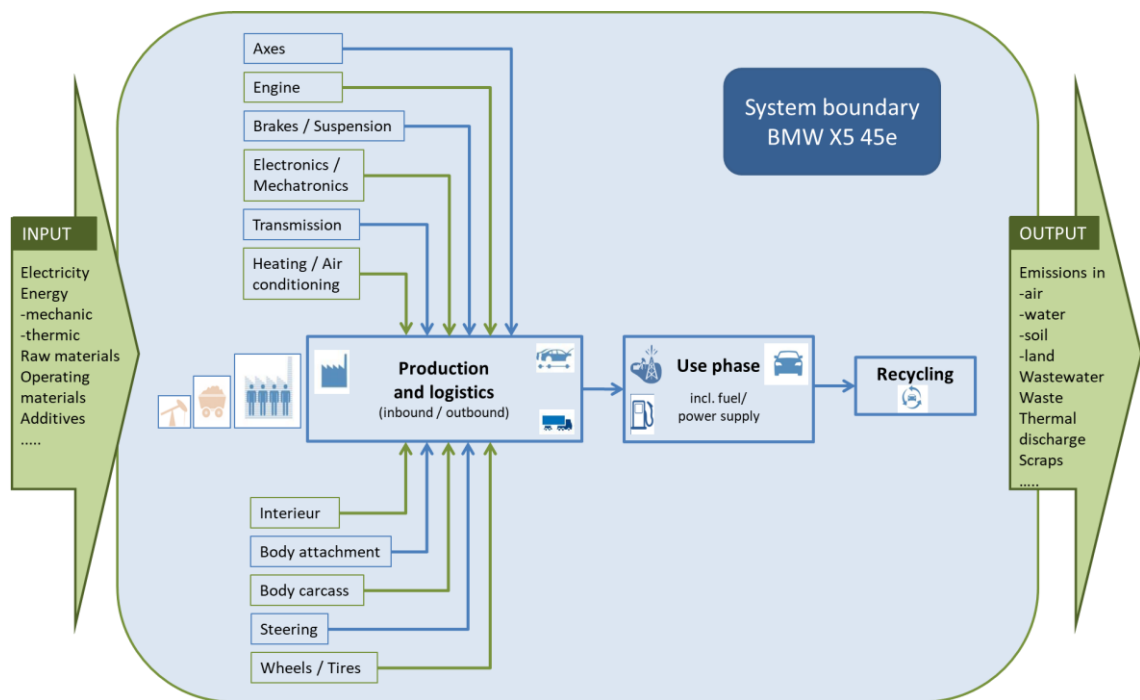
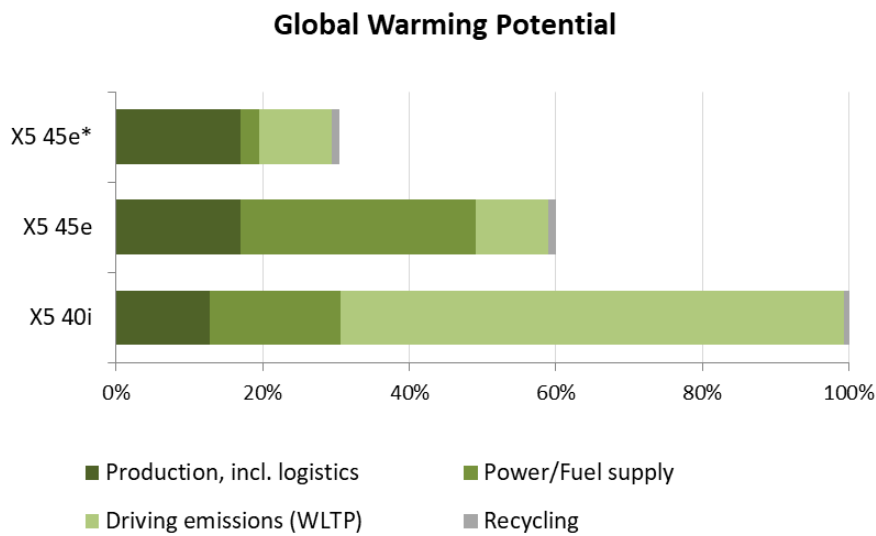


Fig. 1: Flowchart input / output data of the BMW X5 series

The LCA according to ISO 14040/44 refers to environmental aspects and potential environmental impacts along the life cycle of a product from the raw material extraction to the manufacturing process, to the use phase, and to the recycling at the end of the vehicle's life.

Facts:

The life cycle assessment (LCA) of the BMW X5 45e shows the following environmental impacts across the whole life cycle in terms of Global Warming Potential (GWP) (fig. 2). The environmental impacts determined by the life cycle assessments are measured in different units. The GWP, for example, is stated in kilogram CO₂-equivalents (kg CO₂e).



* renewable charging power

Fig. 2: Distribution of global warming potential over life cycle of BMW X5 45e in relation to the conventional BMW X5 40i

Sensitivity analysis:

A sensitivity analysis of different scenarios was carried out for estimating the effect of the choices made regarding methods and data on the results of the study.

Examples of the scenarios considered in the sensitivity analysis are:

- Influence of the data robustness on the life cycle assessment results.
- Influence of the different consumption and electricity availability scenarios during use phase.
- Classification of the BMW X5 45e in relation to conventional vehicle concepts.

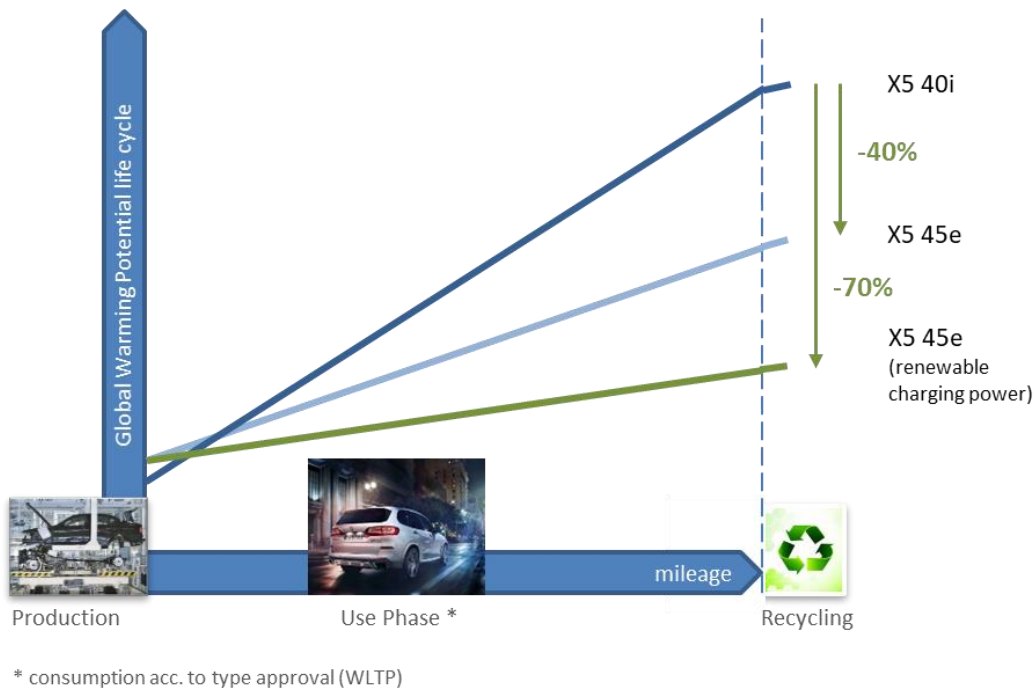


Fig. 3: Classification of the BMW X5 45e in relation to a conventional vehicle concept (X5 40i)

Thanks to the use of BMW EfficientDynamics and eDrive technology, the Global Warming Potential of the X5 45e is about 40% lower than of the conventionally powered X5 40i across the whole life cycle. If renewable energy sources are used for charging, the reduction is at about 70% (fig. 3).

Validation

TÜV Rheinland LGA Products GmbH confirms that a critical review of the life cycle assessment (LCA) study of **BMW AG, Petuelring 130, 80788 München** for the following passenger car

BMW X5 45e Plug-in-Hybrid – 2019 model year

was performed.

Proof has been provided that the requirements of the international standards

- ISO 14040:2006: Environmental management – life cycle assessment – principles and framework
- ISO 14044:2006 + Amd 1:2017: Environmental management – life cycle assessment – requirements and guidelines
- ISO/TS 14071:2014: Environmental management – life cycle assessment – critical review processes and reviewer competencies: additional requirements and guidelines to ISO 14044:2006

are fulfilled.

Results:


- The LCA study was carried out according to the international standards ISO 14040:2006 and ISO 14044:2006 + Amd 1:2017. The methods used and the modelling of the product system correspond to the state of the art. They are suitable to fulfill the goals stated in the study. The report is comprehensive and provides a transparent description of the framework of the LCA study.
- The assumptions used in the LCA study especially fuel consumption based on the current WLTP (Worldwide harmonized Light vehicles Test Procedure) were verified and discussed.
- The assessed samples of data and environmental information included in the LCA study are plausible.

Review process and level of detail:

Verification of input data and environmental information as well as the check of the LCA process was performed in course of a critical data review. The data review considered the following aspects:

- Check of the applied methods and the product model,
- Inspection of technical documents (e.g. type approval documents, parts lists, supplier information, measurement results, etc.) and
- Check of LCA input data (e.g. weights, materials, fuel consumption, emissions, etc.).

Cologne, 12. September 2019



Guido Volberg
Director TCC

Responsibilities:

Sole liability for the content of the LCA rests with BMW AG. TÜV Rheinland LGA Products GmbH was commissioned to review said LCA study for compliance with the methodical requirements, and to verify and validate the correctness and credibility of the information included therein.