
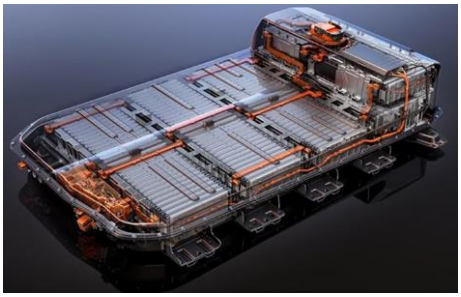


Life Cycle Assessment of Electric Vehicles

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Steps Towards Circularity & Climate Neutrality

Expert Workshop

Vienna, Austria

May 15 – 16, 2025

Organised by IEA HEV Task 46 and JOANNEUM RESEARCH

Introduction

Electric vehicles have the potential to substitute for conventional vehicles to contribute to the sustainable development of the transportation sector worldwide, for example, in the reduction of greenhouse gas (GHG) and particulate emissions. There is international consensus that the improvement of the sustainability of electric vehicles can only be analysed based on life cycle assessment (LCA), which includes the production, operation, and the end-of-life treatment of the vehicles and the energy/fuel cycle. All environmental impacts must include the whole value chain, and - if relevant - interactions from recycling in the dismantling phase to the production phase, if recycled materials are used to produce new vehicles or other products.

The main activities influencing the environmental impacts of electric vehicles on a life cycle basis are:

1) Production and life time of the battery,
2) Electricity consumption of the vehicle in the operation phase, incl. e.g. energy demand for heating,
3) Source of the electricity, only additional renewable electricity maximizes the environmental benefits and
4) End of life treatment of the vehicle and its battery (e.g. reuse, material recycling).

Since 2011 the Technology Collaboration Program (TCP) on *"Hybrid and Electric Vehicle (HEV)"* of the International Energy Agency (IEA) is operating Tasks dealing with various aspects of Life Cycle Assessment of different vehicles. In Task 46 *"LCA of Electric Trucks, Buses, Other Vehicles and V2X-Services"* there is a special focus on assessing Circularity and Climate Neutrality using dynamic LCA. 14 countries are participating in Task 46 – AT, AUS, CA, CH, DE, ES, EU27, NL, NO, KR, SE, TK, UK, US – represented by LCA expert and institutions.

The IEA HEV Task 46 (2022 – 2025) analysis different environmental effects using LCA of electricity based propulsion systems – battery electric, hydrogen fuel cell and e-fuels - in comparison to fossil fuels. In addition to the identification of the most relevant methodological issues, necessary inventory data and impact categories, new approaches for assessing "climate neutrality" and "circularity" in a LCA perspective are developed and applied in case studies.

Climate Neutrality and Circularity

Climate neutrality and circularity are two main challenges for a sustainable development. Circularity and climate neutrality can only be addressed by the methodology of dynamic Life Cycle Assessment (LCA), where GHG emissions, resource demand and material recovery are calculated and assessed over the life time from construction, operation until the end of life management of a product or service.

Climate Neutrality and Circularity are assessed in LCA based on the GHG emissions and the mass flows over the lifetime. Therefore, the following definitions of Climate Neutrality and Circularity are necessary as for two new additional impact categories not yet covered in LCA

"Climate Neutrality Potential (CNP)" and a *"Circularity Potential (CPO)"*. These definitions were developed in IEA HEV Task 46 and applied for the first time in different LCA Case studies:

A product or service is "climate neutral" and "circular", if its whole life cycle - production, operation and end-of-life uses only (Figure 1)

- reused components
- secondary/recycled material
- renewable energy

and makes

- zero waste and
- zero GHG emissions

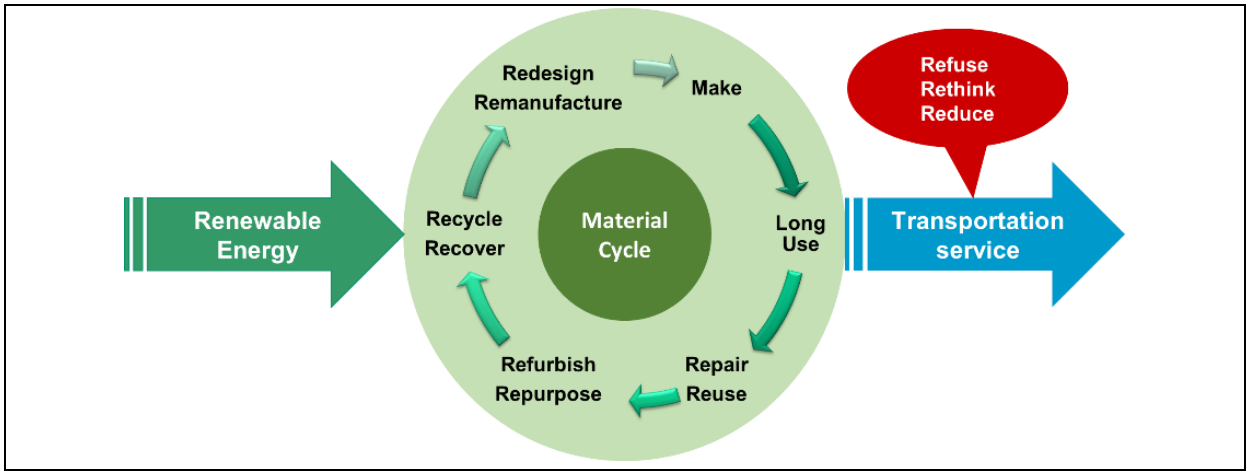

Figure 1: Circularity and Climate Neutrality for transportation services

The indicators for the assessment in the LCA are

- Circularity Potential (CPO): calculated with mass flows of the Inventory Analysis in the lifetime using the Material Circularity Index (MCI) applying the Linear Flow Index of materials ($LFI_{material}$) and the Utility Factor of the product ($UF_{product}$)MCI = $LFI_{materials}$ * $UF_{product}$. The calculated MCI is between =5 (linear) to 100% (circular). The MCI was developed by the Ellen MacArthur Foundation.
- Climate Neutrality Potential (CNP): calculated with the GHG emissions in the lifetime using the top-of-atmosphere radiative forcing potential in W/m².

These definitions show that Climate Neutrality and Circularity are visionary and long term targets, but the LCA based assessment of products and services show if future developments are going "towards" Climate Neutrality and Circularity. E.g. zero GHG emissions in operation phase.

Aim of the workshop

The expert workshop on

"Life Cycle Assessment of Electric Vehicles - Steps Towards Circularity & Climate Neutrality"

takes place on May 15 – 16, 2025 in Vienna/Austria.

Based on the context of Climate Neutrality and Circularity, the aim of the expert workshop is to analyse, assess and discuss the environmental effects of electric vehicles, the scientific assessment approach and its practical relevance for industry, government and consumers.

The main topics of the workshop are

- Relevance of LCA for politics, industry and consumers
- Methodological aspects of LCA
- Approaches to assess Climate Neutrality and Circularity
- LCA results of electric vehicles in comparison to other fuels
- Results of IEA HEV Task 46
- Stakeholder information exchange and
- Further R&D demand

In addition, a scientific visit to e-mobility related projects and places in/around Vienna will be organised and possibilities for an intensive exchange between/with experts and stakeholders in breaks and interactive formats.

The format of the workshop are presentations, discussions and interactive group work.

The workshop is in-person only and organised by JOANNEUM RESEARCH.

The management of the task and the Austrian participation and are financed by the Austrian Climate and Energy Fund and the FFG.

Contact

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gerfried.jungmeier@joanneum.at

Program

Welcome address from Austrian Ministry and IEA HEV.

PRESENTATIONS

The Role of LCA in European Policies Dina Silina (European Commission)

LCA of Vehicles for Consumer Information – Achievement and Future Perspectives Alexandra Damyanov (GreenNCAP)

LCA of Chinese Passenger Vehicles Xin Sun (CATARC, CN)

LCA of Climate Neutral Construction Machinery for the Olympic Games Dia Adhikari Smith (The University of Queensland, AUS) tbd

Assessing Circularity and Climate Neutrality in Dynamic LCA - Results of IEA HEV Task 46 Gerfried Jungmeier (JOANNEUM RESEARCH, AT)

Carbon Capture and Storage (CCS): Global Perspectives and Challenges for Implementation David Misch (Montanuniversitaet Leoben, AT)

LCA of an Electric Fire Truck N.N. (Rosenbauer, AT) tbd

LCA PRESENTATIONS OF TASK 46 PARTNERS

Towards the Harmonization of LCA for Vehicles – Results from the TransSenus Project Niklas Hill (Ricardo, UK)

LCA of Electric Vehicles - Modelling, Database & Results Jarod Kelly (ARGONNE, US)

Powering European Union Net Zero Future by Escalating Zero Emission HDVs and Logistic Intelligence Simone Ehrenberger (DLR, Germany)

An in-depth Life Cycle Assessment and Comparison of the GHG Emissions Performance of Specific BEV and ICE Vehicles Robin Smit (Transport Energy/Emission Research, AUS)

LCA of Hydrogen-electric Vehicles XiaoYu Wu (University of Waterloo Canada, CA)

Circularity and LCA Víctor José Ferreira (IREC, ES)

GROUP WORK

Specific challenges/ pecularities of LCA modellings for trucks, ships, rail and other vehicles towards climate neutrality and circularity

Identification of R&D demand

Panel discussion

SCIENTIFIC VISITS

Electric buses

PV power plants
Charging station infrastructure

REGISTRATION

Please send an e-mail with participant name, institution and country to:
gerfried.jungmeier@joanneum.at

Task 46 "LCA of Electric Trucks, Buses, Other Vehicles and V2X-Services"

Members: Austria, European Commission, Canada, Germany, Norway, Republic of Korea, Spain, Sweden, Switzerland, The Netherlands, UK, USA and IEA AMF Task 64[1]

Observers: Turkey and Australia

1 Introduction

Electric vehicles (EVs) have the potential to substitute conventional vehicles to contribute to the sustainable development of the transportation sector worldwide, for example, in the reduction of greenhouse gas (GHG) emissions, fossil energy consumption and particle emissions. There is international consensus that the improvement of the sustainability of EVs can only be analyzed based on life cycle assessment (LCA), which includes the production, the operation, and the end of life (EoL) management of the vehicles and the fuel cycle.
In recent Tasks 19 and 30 there was a strong focus on LCA of passenger vehicles and its comparison to gasoline and diesel vehicles. However, due to the strong development and market introduction of other battery electric vehicles this new task will focus on LCA of other battery electric vehicles (BEV) than passenger cars and will also compare the environmental effects it to other fuels made from electricity like hydrogen and e-fuels. These are hydrogen fuel cell vehicles (H_2-FCV) and internal combustion engines using e-fuels (e-fuel ICE).

2 Objectives

The IEA HEV TCP Task 46 (2022 – 2025) "LCA of electric Trucks, Buses, other Vehicles and V2X Services" started in January 2022.

The main objectives are (Figure 1)

- Stakeholder involvement in three expert workshops
- Technology and system description with vehicle and infrastructure data, relevant issues and LCA data on buses, trucks, other vehicles and V2X services with different fuel/propulsion systems
- Case studies on LCA of
    - Buses
    - Trucks (from delivery truck to huge trucks incl. catenary line)
    - Other vehicles e.g. mining trucks, fire trucks and
    - V2X-services e.g. V2H, V2G, energy storage

[1] 2022 - 2024

- LCA comparison to renewable hydrogen, e-fuel systems and conventional fuels (Figure 2)
- Assessing "climate/CO_2-neutrality" and "circularity" in a LCA perspective and methodology
- Dissemination and publications, e.g. presentations/contribution at conferences, Contributions to Annual Report and newsletter
- Identify R&D demand

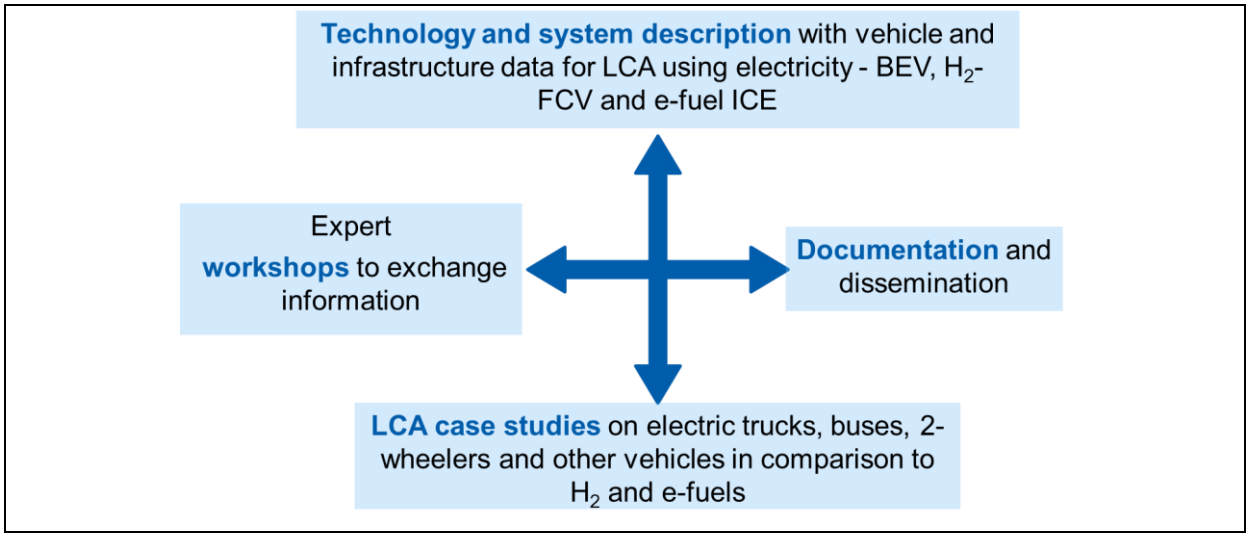

Figure 1: Main objectives of Task 46

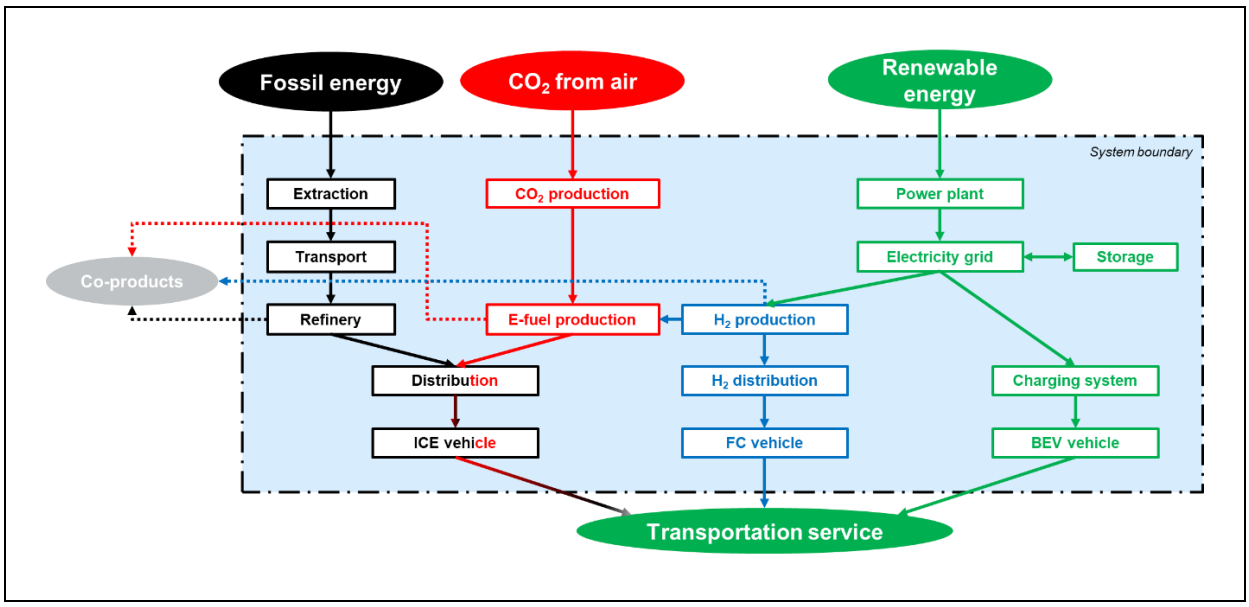

Figure 2: LCA comparison to renewable hydrogen, e-fuel systems and conventional fuels

3 Working Method

Task 46 develops methodologies to help countries to implement EVs by identifying possibilities to maximize the environmental benefits. Besides, various case studies are analysed and networking combined with information exchange is supported within the Task's frames.

The Task proceeds by organizing a series of expert workshops covering the objectives described above with a focus on

- LCA of e-Trucks
- LCA of e-Buses
- LCA of V2X Functionalities
- LCA of Fire e-Truck, e-Ships and Mining e-Truck

4 Contact Details of the Task manager

For further information, please contact the Task 46 Task Manager:

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Acknowledgement

The Austrian participation (2022 – 2025) and the management of the task are financed by the Austrian Climate and Energy Fund and the FFG.

https://ieahev.org/tasks/46/

MEETING LOCATION

Federal Ministry
Republic of Austria
Climate Action, Environment,
Energy, Mobility,
Innovation and Technology

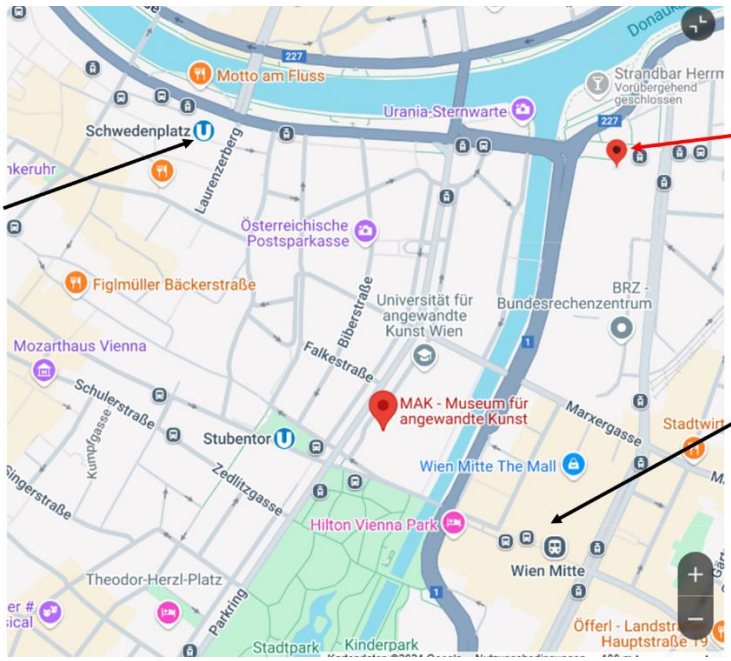
https://www.bmk.gv.at/en.html

Federal Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology (BMK)
Radetzkystraße 2, 1030 Wien

Wenn Sie Zugang zu den Arbeits- und Besprechungsräumen des Bundesministeriums oder zu anderen Behörden im Bundesamtsgebäude haben möchten, müssen Sie sich mit einem gültigen Lichtbildausweis beim Informationsschalter beim Haupteingang identifizieren. Gegen Hinterlegung Ihres Ausweises wird Ihnen am Informationsschalter eine Gästekarte ausgestellt. Sie erreichen den Informationsschalter telefonisch unter +43 (0) 1 71162-657170.

How to get there with public transport:

- metro
  - **U1 Schwedenplatz**: walking 10 min direction Uraniastraße
  - **U3 Landstraße**: walking 12 min leave metro station at *Hintere/Vordere Zollamtsstraße*
  - **U4 Landstraße**: walking 10 min leave metro station at *Hintere/Vordere Zollamtsstraße*
- tram
  - Linie 2 (Station **Julius-Raab-Platz**)
  - Linie 0 und 1 (Station **Hintere Zollamtsstraße**)
- train to **Wien Mitte/Landstrasse**
  - CAT (City Airport Train) from/to airport
  - S1 (Wiener Neustadt Hauptbahnhof – Gänserndorf),
  - S2 (Mödling – Mistelbach/Zaya),
  - S3 (Hütteldorf – Retz),
  - S4 (Meidling – Absdorf-Hippersdorf),
  - S7 (Floridsdorf – Wolfsthal),
  - S9 (Floridsdorf – Wiener Neustadt Hauptbahnhof) und
  - S15 (Mistelbach/Zaya – Hütteldorf).


Metro station
“Schwedenplatz”
Place of
Task 46 workshop
Train/Metro station
“Wien Mitte/Landstrasse”
Motto am Fluss
Urania Sternwarte
Strandbar Herrmann
Schwedenplatz
Laurenzerberg
Österreichische Postsparkasse
Figlmüller Bäckerstraße
Universität für angewandte Kunst Wien
BRZ - Bundesrechenzentrum
Mozarthaus Vienna
Schulerstraße
Falkestraße
Biberstraße
MAK - Museum für angewandte Kunst
Marxergasse
Stubentor
Wien Mitte The Mall
Zedlitzgasse
Hilton Vienna Park
Wien Mitte
Theodor-Herzl-Platz
Parking
Stadtpark
Kinderpark
Donaukanal
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