

Federal Office for the Environment (FOEN)

Review of additional datasets for the Mobitool integration project

Review report

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Introduction

As part of the work related to the “postulat Grossen” (Po. 19.3374), roughly 800 LCIs for road transport were developed by PSI (later named as Mobitool datasets). In addition to these road transport datasets, another several hundred datasets were also prepared by PSI that contain process required by the road transport datasets, such the production of hydrogen, fuel cells and traction batteries. In this report these datasets are referred to as the “additional upstream datasets”. These datasets were not subject to detailed review during the Mobitool project. However, these datasets required a critical review before they can be integrated into the BAFU:2025 life cycle inventory database. This report documents the review that was implemented by Brian Cox during the Mobitool Integration Project from January to September 2025.

Review of life cycle inventories for on-road vehicles

A full list of the datasets reviewed is included in the appendix. Below follows a short discussion of each dataset group.

Batteries

A total of 73 new battery datasets are to be integrated into the database representing LFP, LTO, NCA, NMC-111, and NMC-622 chemistries. While the cited source of the dataset (Schmidt et al. 2019) is a paper analysing stationary energy storage technology, the datasets were actually developed for transport purposes and are very suitable for this. These datasets were state-of-the-art when they were published and are still valid from the perspective of 2025.

Biofuels

A total of 6 new biofuel datasets are included in the review, which are based on the master’s thesis of Francesco Cozzolini at PSI in 2018. The datasets have not been officially peer-reviewed, which is explicitly mentioned in the meta data for the datasets.

Fuel cells

11 new datasets for hydrogen fuel cells are included in the review. These datasets were originally prepared at by Johannes Hofer and Marco Miotti at PSI and published in 2017 (Miotti et al. 2017). These datasets are based on data for fuel cells for passenger cars, though the Mobitool datasets also use them in heavy duty vehicles. They have been used as an input for multiple peer reviewed publications at PSI such as Cox et al. 2020 and Sacchi et al. 2021.

Hydrogen production

Three hydrogen production datasets are included in this review, which were originally prepared by Karin Treyer and Christian Bauer at PSI and published in 2020 (Antonini et al. 2020). The datasets seem complete, accurate and well documented.

Hydrogen tank

There are 26 datasets included in this review for hydrogen tank production, most of which are to produce carbon fibre, which is a very important input for high pressure hydrogen tank LCI datasets. There are two datasets for complete hydrogen tanks, for which the inventories are taken from a publication in the Journal of Cleaner Production (Evangelisti et al. 2017). The rest of the datasets deal with the production of carbon fibre, also based on a publication in the above-mentioned journal (Benitez et al. 2021). These datasets are

based on peer reviewed publications focussing explicitly on these important datasets. As such, the quality is deemed to be very good.

Electric vehicle charging infrastructure

There are two groups of charging datasets included in this review. The first group includes three datasets for small electric chargers used for electric bicycles and other small electric vehicles ranging from 100 W to 3 kW charging power. These datasets are simply scaled versions of the dataset for an electric scooter charger that is already in the database. It should be noted that the dataset for the electric scooter charger is quite old, though it is unlikely that the LCI for a newer model would change significantly. The second group of datasets are for higher power chargers suitable for use with light and heavy-duty vehicles. These datasets are based on an LCA published in 2001 (Nansai et al. 2001), which was selected because it was the only data source available at the time. It was discovered in this review that the datasets for the 200 kW and 450 kW chargers include a 4 ton lead acid battery, which definitely would not be included in any modern charger in this power range. Furthermore, if a modern charging station were to have a buffer battery it would be of the lithium-ion type. On discussion with Romain Sacchi, we suggest that the storage battery should either be removed from the inventory completely, or replaced by a lithium ion battery with similar power capacity.

Quality, transparency and completeness

As there is no report for the production of these inventories but simply a reference to a journal publication (or Master's thesis) the transparency is somewhat lacking. Another limitation is that it was rarely the author of the Mobitool datasets (Romain Sacchi) that created the original datasets, and in the case of the fuel cell datasets, the original author left PSI more than 5 years before these datasets were used in the Mobitool project. Furthermore, many of these datasets were created in SimaPro for various LCA background databases and had to be converted for use in this project; both processes are subject to errors, such as losses of comments and information about assumptions, units, scaling factors etc.

Overall, the quality, transparency and completeness of the datasets for batteries, hydrogen, and hydrogen tank are judged to be very good, and for the biofuels, fuel cells, and low-power electric chargers to be good. The quality of the high-power electric vehicle charging infrastructure on the other hand is deemed to be questionable due to its age considering the rapid development of the technology, and the use of a very large lead acid battery for buffer storage is unreasonable to include in a modern 200 kW to 450 kW charger.

Conclusion and recommendation

Apart from the storage battery for the high-power electric chargers, the reviewer recommends including these inventories into the BAFU:2025 LCA database. For the high-power electric charger, the reviewer recommends removing the lead acid battery from the 200 kW charger, and either removing it or replacing it with a comparable lithium ion battery for the 450 kW charger. In the medium term, these datasets should be updated with more modern life cycle inventories from the literature.

Literature

- Antonini, C., Treyer, K., Streb, A., Spek, M. van der, Bauer, C., Mazzotti, M. 2020:** Hydrogen production from natural gas and biomethane with carbon capture and storage – A techno-environmental analysis. *Sustainable Energy & Fuels* 4(6), 2967–2986.
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- Cox, B., Bauer, C., Mendoza Beltran, A., Vuuren, D. P. van, Mutel, C. L. 2020:** Life cycle environmental and cost comparison of current and future passenger cars under different energy scenarios. *Applied Energy* 269, 115021.
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- Miotti, M., Hofer, J., Bauer, C. 2017:** Integrated environmental and economic assessment of current and future fuel cell vehicles. *The International Journal of Life Cycle Assessment* 22(1), 94–110.
- Nansai, K., Tohno, S., Kono, M., Kasahara, M., Moriguchi, Y. 2001:** Life-cycle analysis of charging infrastructure for electric vehicles. *Applied Energy* 70(3), 251–265.
- Sacchi, R., Bauer, C., Cox, B. L. 2021:** Does Size Matter? The Influence of Size, Load Factor, Range Autonomy, and Application Type on the Life Cycle Assessment of Current and Future Medium- and Heavy-Duty Vehicles. [<https://pubs.acs.org/doi/10.1021/acs.est.0c07773>].
- Schmidt, T. S., Beuse, M., Zhang, X., Steffen, B., Schneider, S. F., Pena-Bello, A., Bauer, C., Parra, D. 2019:** Additional Emissions and Cost from Storing Electricity in Stationary Battery Systems. *Environmental Science & Technology* 53(7), 3379–3390.

Appendix

Battery datasets

- anode
- anode current collector, LFP
- anode current collector, LTO
- anode current collector, NCA
- anode paste, LFP
- anode paste, LTO
- anode paste, NCA
- battery BoP
- battery cell, LFP
- battery cell, LTO
- battery cell, NCA
- battery cell, NMC-111
- battery cell, NMC-622
- battery management system
- battery packaging
- battery retention
- battery tray
- bimetallic busbars and washers
- cathode
- cathode current collector, LFP
- cathode current collector, LTO
- cathode current collector, NCA
- cathode paste, LFP
- cathode paste, NCA
- cathode, NMC-622
- cell container
- clamps and fasteners
- cobalt sulfate
- cooling system
- electrolyte
- electrolyte, LFP
- electrolyte, LTO
- electrolyte, NCA
- end-busbar aluminum
- end-busbar copper
- heat transfer plate
- high voltage system
- iBIS
- iBIS fasteners
- inner frame
- lithium iron phosphate [LiFePO₄]
- low voltage system
- lower retention
- ITO electrode material (Li₄Ti₅O₁₂)
- manifolds
- market for styrene butadiene rubber (SBR)
- module fasteners
- module lid
- module packaging
- multilayer pouch
- nCA electrode material (LiNi_{0.8}Co_{0.15}Al_{0.05}O₂)
- negative current collector Cu
- negative electrode paste
- ni_{1/3}Co_{1/3}Mn_{1/3}(OH)₂
- ni_{3/5}Co_{1/5}Mn_{1/5}(OH)₂
- outer frame
- pipe fitting
- positive active material, NMC-111
- positive active material, NMC-622
- positive current collector Al
- positive electrode paste, NMC-111
- positive electrode paste, NMC-622
- radiator
- separator
- separator, LFP
- separator, NCA
- strap retention
- tab Aluminum
- tab Copper
- thermal pad
- tray lid
- tray seal
- tray with fasteners

Biofuel datasets

- biodiesel from cooking oil
- biodiesel, from used cooking oil, at fuelling station
- ethanol from wheat straw pellets
- ethanol, from wheat straw pellets, at fuelling station
- farming and supply of wheat straw
- refined Waste Cooking Oil {RER} | Refining of waste cooking oil Europe | Alloc Rec, U

Fuel cell datasets

- ancillary BoP
- bipolar plate
- catalyst layer
- coating and curing, general manufacturing
- end plate
- essential BoP
- gas Diffusion Layer
- mEA hot pressing
- membrane
- stack
- tie-rods

Hydrogen production datasets

- hydrogen, gaseous, 700 bar, from electrolysis, at fuelling station
- hydrogen, gaseous, 700 bar, from electrolysis, from label-certified electricity, at fuelling station
- hydrogen, gaseous, 700 bar, from SMR of NG, at fuelling station

Hydrogen tank datasets

- carbon fiber, weaved, at factory
- dimethyl sulfoxide production (DMSO)
- exhaust gas treatment 1
- exhaust gas treatment 2
- fiber carbonization (high temp)
- fiber carbonization (low temp)
- fiber coagulation
- fiber drying
- fiber drying 2
- fiber drying 3
- fiber electrolysis
- fiber relaxation
- fiber sizing
- fiber sizing 2
- fiber sizing 3
- fiber stabilization
- fiber stretching and washing
- fiber unwinding
- fiber washing
- fiber winding up
- fuel tank, compressed hydrogen gas, 700bar, with aluminium liner
- fuel tank, compressed hydrogen gas, 700bar, with HDPE liner
- high pressure hydrogen storage tank
- hydrogen refuelling station
- polyacrylonitrile production (PAN) by polymerisation
- spinning dope

Charging infrastructure datasets (low power)

- charging station, 100W
- charging station, 3kW
- charging station, 500W

Charging infrastructure datasets (high power)

- charger
- charging stand
- eV charger, level 3, plugin, 200 kW
- eV charger, level 3, with pantograph, 450 kW
- storage battery