Key factors of the overarching aspects in vehicle LCA methodology

GRPE IWG on A-LCA, April 13, 2023

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A-LCA-06-13

Key factors of the overarching aspects

Scope:

- **total vehicle lifetime**, e.g., 18 years
- **land-use change emissions** of biofuel production
- methane leakage emissions

Usage phase:

- future-looking, **lifetime average fuel and electricity mix**
- real-world fuel/electricity consumption, especially for plug-in hybrids

Production phase:

- definition on when to allow usage of **secondary data**

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Using primary or secondary production data?

Primary data: manufacturer-provided carbon intensity

Allows to display efforts by individual suppliers/manufacturers

But:

- Requires full reporting along the value chain: from mining to manufacturing
- Requires cross-border, thorough, and frequent audit by third parties

Secondary data: generic carbon intensity datasets

Allows reporting when primary data is not available

But:

- Does not display efforts by individual suppliers/manufacturers
- Requires definition of dataset quality or selection of eligible datasets

➡ The methodology needs to define when to allow usage of secondary data: Leaving the option between both may distort results for the total industry.

Thank you!

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Appendix

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1) Vehicle lifetime and lifetime mileage

Vehicle lifetime:

- Total useful vehicle lifetime, from production to recycling,
- not only from production to export as used vehicle

- Europe:
  - 18 years
  - 198,000 km to 270,000 km
- U.S.:
  - 18 years
  - 314,000 km to 337,000 km

- China (estimated):
  - 15 years
  - 256,500 km to 285,000 km
- India (estimated):
  - 15 years
  - 165,000 km to 188,000 km

Bieker (2021). A global comparison of the life-cycle GHG emissions of combustion engine and electric passenger cars.

2) Lifetime average fuel and electricity mix

Environmental impact of a product (attributional):

- **Future-looking grid average** electricity mix needed:

  What is the average carbon intensity of electricity consumption? How will it change during the vehicle's lifetime?

→ **Long-term electricity mix scenarios**

Goal of LCA?

Environmental impact of a policy (consequential):

- **"Long-term" marginal** electricity mix needed:

  Which new power plants will be build to meet additional electricity demand in future?

→ **Long-term electricity mix scenarios**

→ In both cases, it is **not realistic** to assume that the **electricity mix remains constant** over 15 to 18 years of a vehicle life**.**

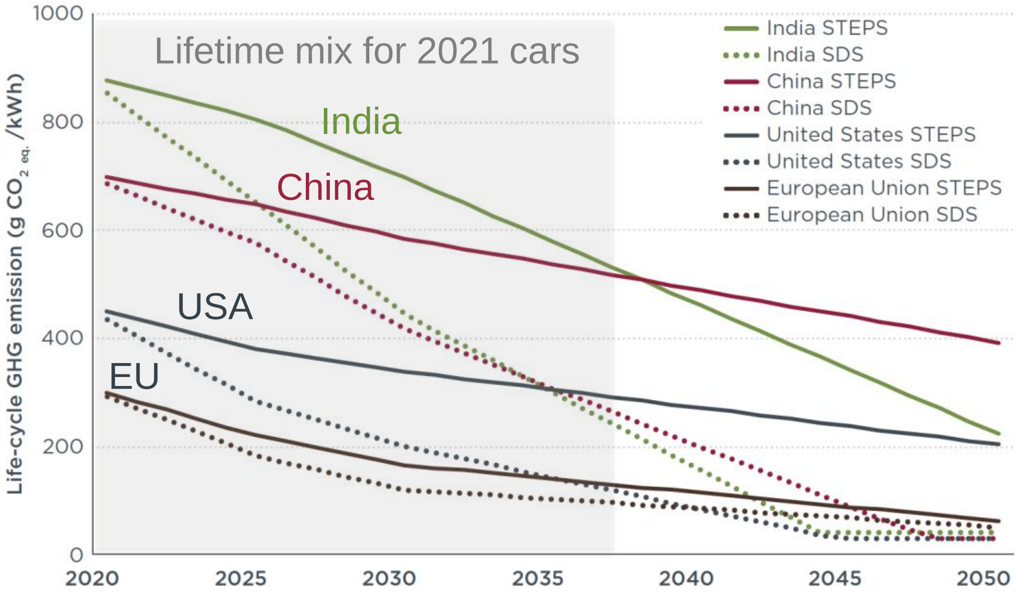
2) Lifetime average fuel and electricity mix

Vehicle lifetime average carbon intensity of fuel/electricity mix:

- Average **biofuel blend:**
  Changes in average biofuel mix according to stated policies

- Average **electricity mix** (IEA scenarios):
  Projected future mix **based on stated policies** (solid lines)

Life-cycle GHG emissions of electricity consumption



Bieker (2021). A global comparison of the life-cycle GHG emissions of combustion engine and electric passenger cars.

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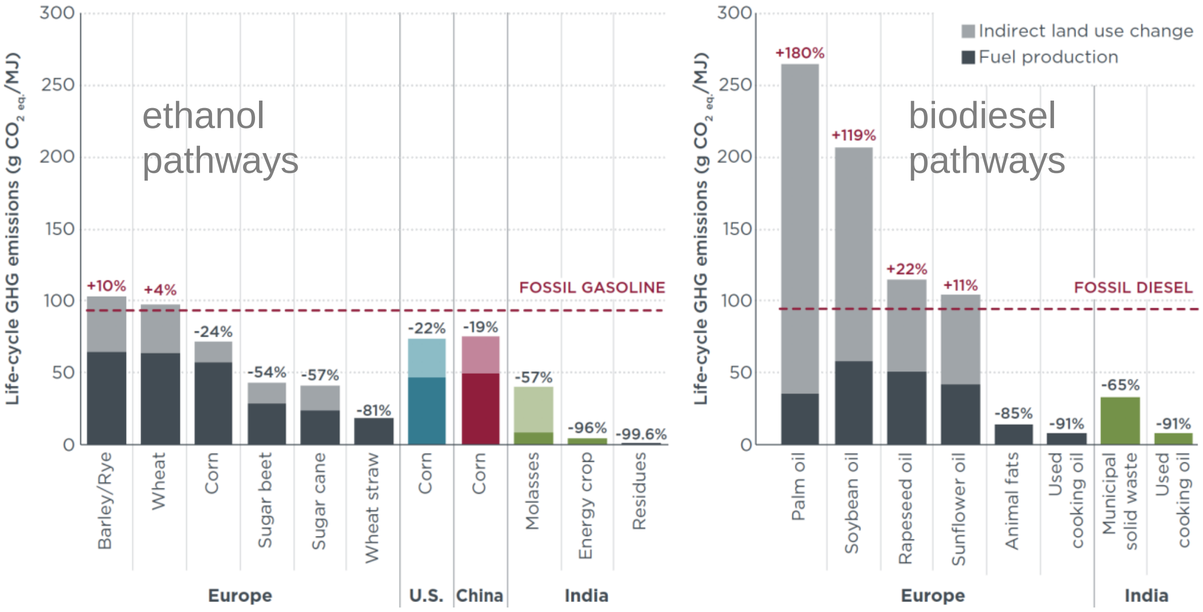
3) Land use change emissions of biofuel production

Indirect land use change (ILUC) emission of biofuels:

- **Food-based biofuels:** high ILUC emissions
- **Residue- and waste-based biofuels:** low ILUC emissions

Most biofuels are food-based!

Biofuel production and indirect land use change emissions



Bieker (2021). A global comparison of the life-cycle GHG emissions of combustion engine and electric passenger cars.

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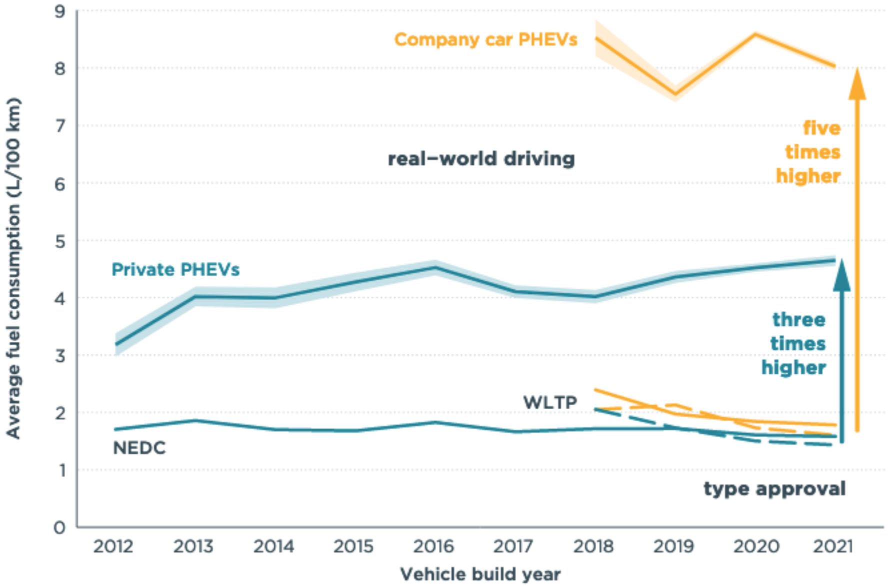
4) Real-world fuel and electricity consumption

Fuel and electricity consumption:

- **Average real-world usage**
  - **Conventional cars and BEVs:** 14%-20% higher than WLTP
  - **Plug-in hybrid vehicles:** three to five times higher than WLTP

Similar findings for plug-in hybrid usage in the U.S. (Isenstadt et al., 2022)

Real-world vs. WLTP fuel consumption of plug-in hybrids in Europe



- Plötz et al. (2022). Real-world usage of plug-in hybrid vehicles in Europe.
- Dornoff et al. (2020). On the way to “real-world” CO_2 values.
- ADAC Ecotest (for BEVs and FCEVs)

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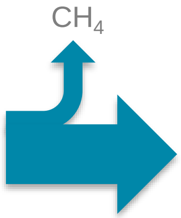
5) Methane leakage emissions of natural gas and natural gas-based hydrogen

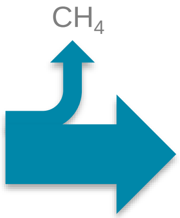
Including the global warming potential (GWP) of methane leakage:

- Methane leakage for **natural gas** and for **grey and blue (CCS) hydrogen**



CNG cars:

- Natural gas extraction/processing
- Natural gas transport/distribution
- Methane slip from the vehicles



Grey and blue (CCS) hydrogen:

- Natural gas extraction/processing
- Natural gas transport
- Steam reforming

Methane is much worse than CO_2:

- 100-year timeframe: **30 times** higher GWP than CO_2
- 20-year timeframe: **85 times** higher GWP than CO_2

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