

LCA of Emerging Technologies: Lessons Learned from a LCA Literature Review on Electric Vehicle vs ICE Vehicle

Ginkgo 21

LCA Conference, Lille 2012



Emerging Technologies: Significant Change in Overall LCA Results

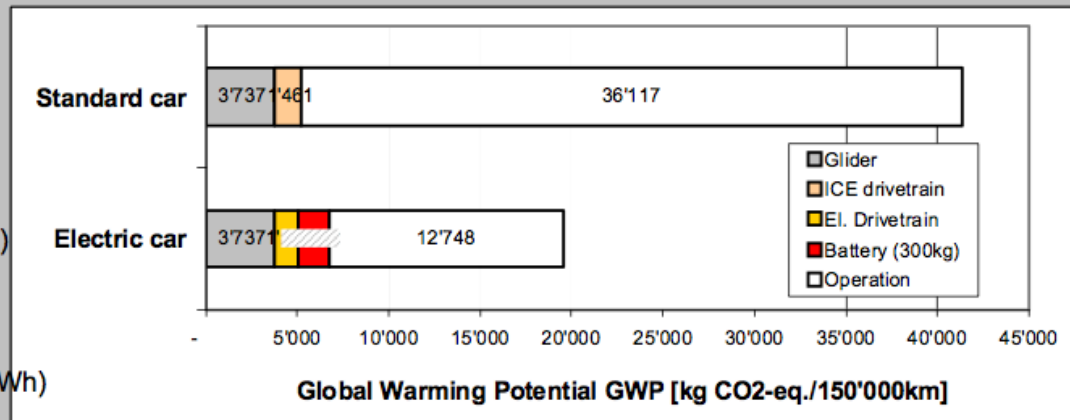
LCA: Entire lifecycle Comparison ICE / BEV vehicle

Global warming potential (kg CO₂-eq) over entire lifecycle (production + 150'000km operation)

ICE, gasoline EURO4
avg. europ. car (golf-class)

BEV, EU-electricity
(UCTE-mix, 593 gCO₂eq/kWh)
300kg battery

(CH-mix, 134 gCO₂eq/kWh)
(EU-coal-mix, 1095 gCO₂eq/kWh)



minus ~53%

Life Cycle Assessment LCA of Li-Ion batteries for electric vehicles, . Gauch, R. Widmer, D. Notter, A. Stamp, H.J. Althaus, P. Wäger Empa - Swiss Federal Laboratories for Materials Testing and Research, EMPA, TSL Technology and Society Lab, 2009

Conclusions Might Significantly Differ from one study to the other

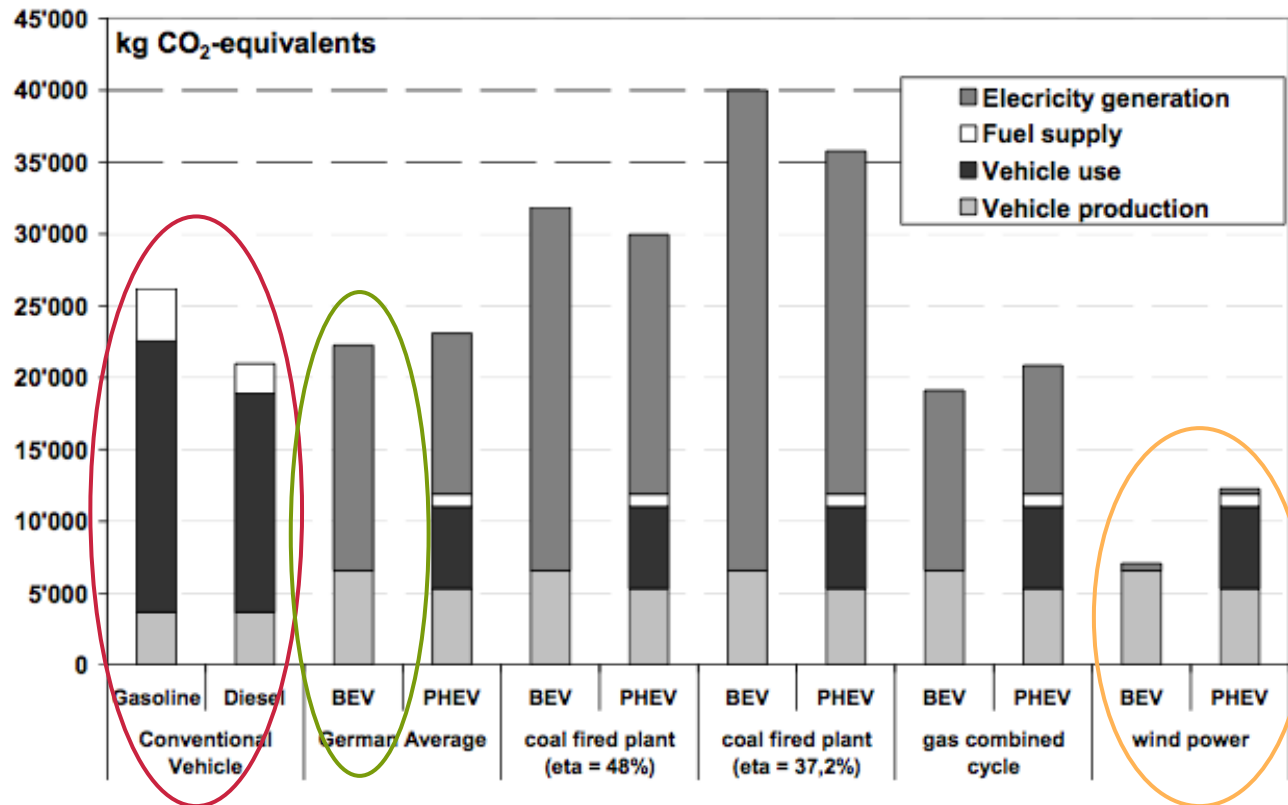
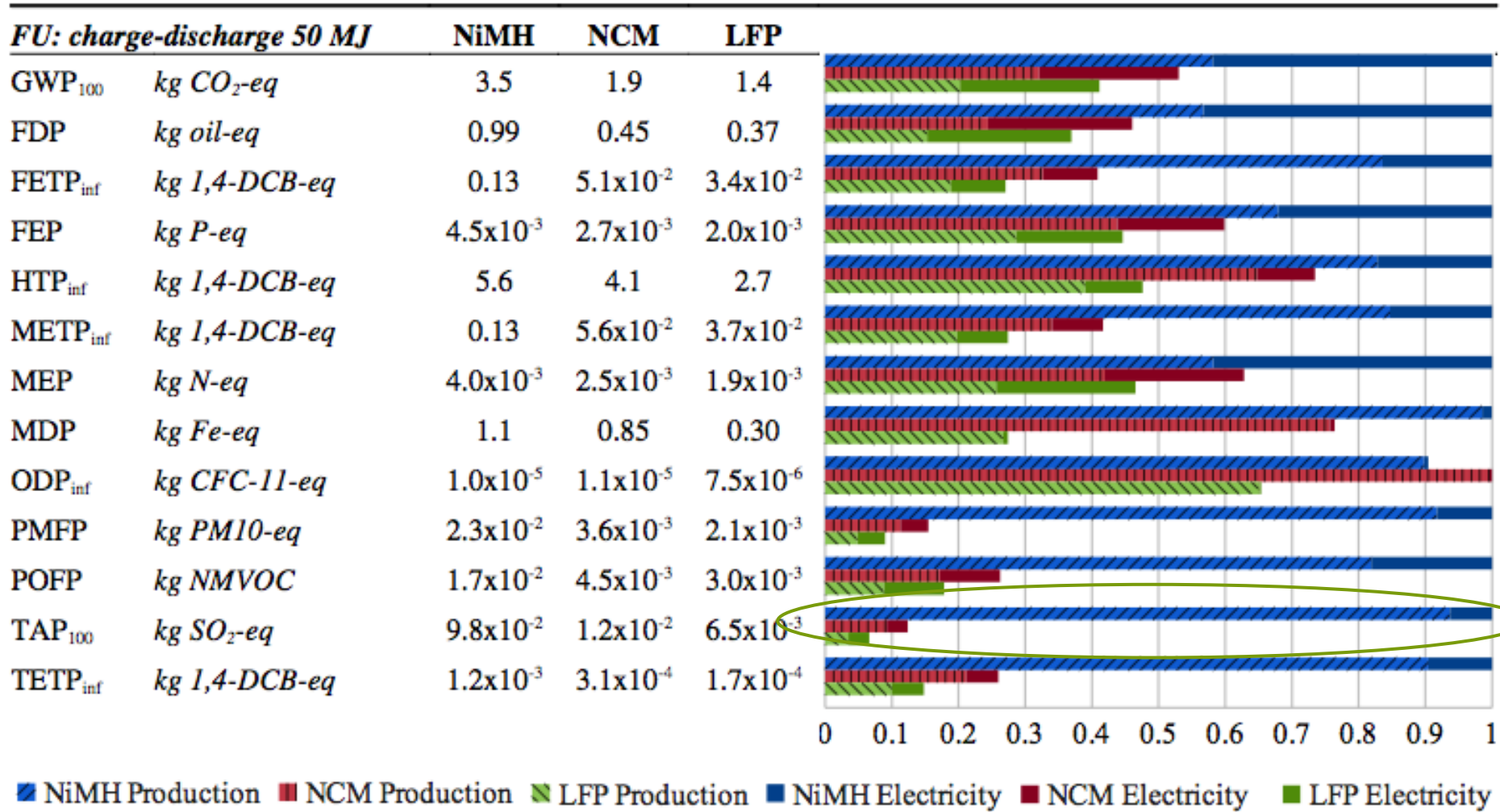


Figure 5: Life cycle greenhouse gas emissions of a compact car with different drive trains (120'000km ; 70% urban driving)

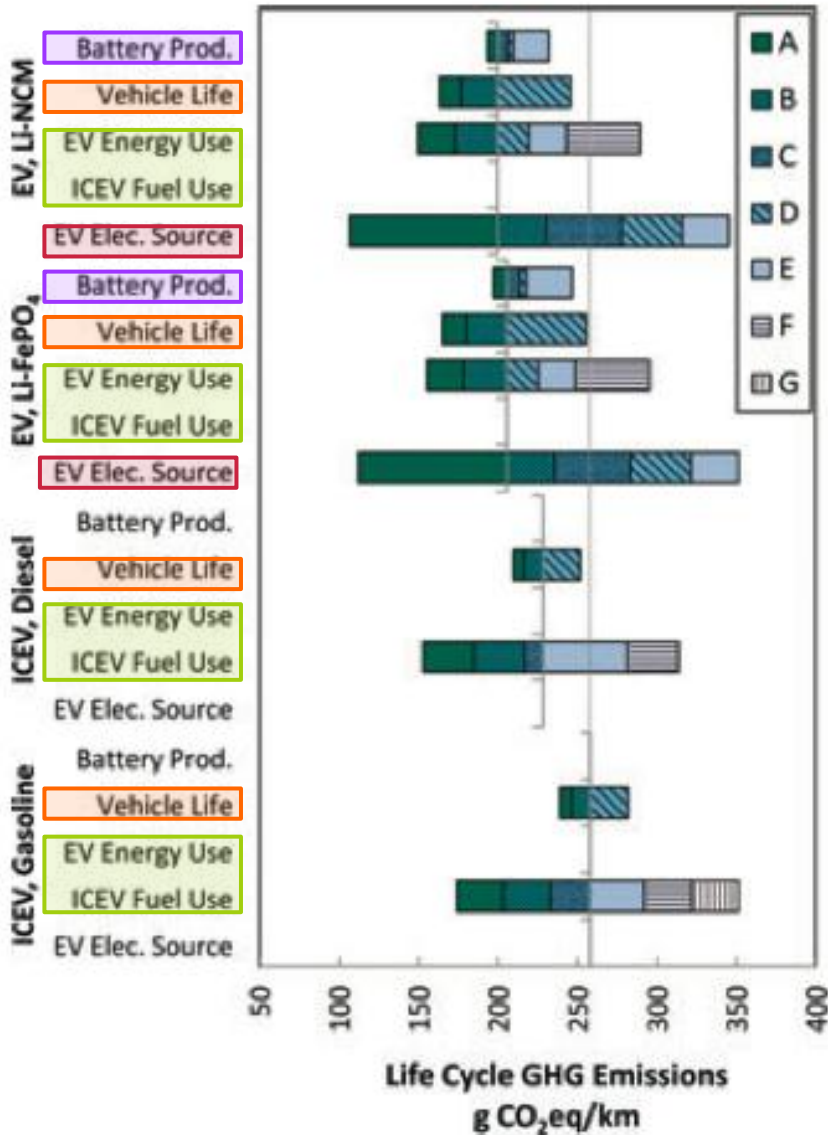
Electric vehicle and plug-in hybrid energy efficiency and life cycle emissions H. Helms, M. Pehnt, U. Lambrecht and A. Liebich Ifeu – Institut für Energie- und Umweltforschung, Wilckensstr. 3, D-69120 Heidelberg (www.ifeu.de)

Comparison of Different Batteries



Life Cycle Assessment of NiMH and Li-Ion Battery Electric Vehicles, Hawkins et al., NTNU

Sources of Uncertainty

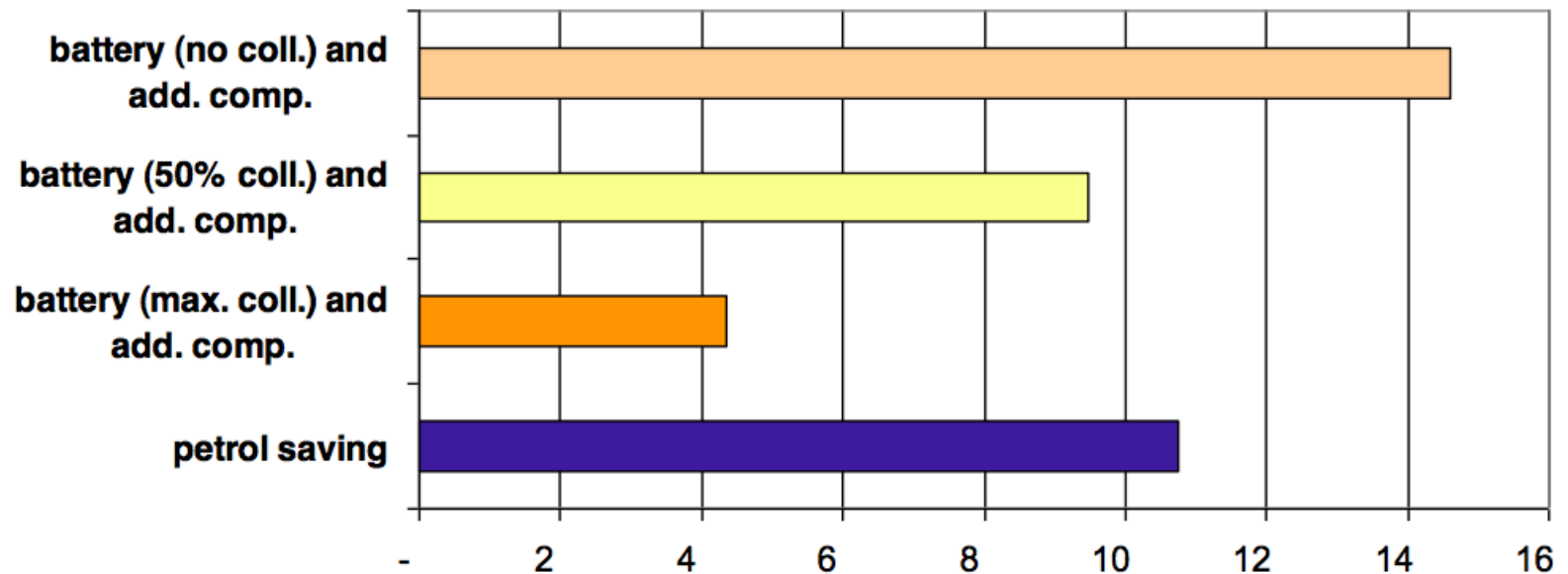


- Electricity source
- Energy / Fuel Use
- Vehicle Lifetime
- Battery production

Comparative Environmental Life Cycle Assessment of Conventional and Electric Vehicles, Troy R. Hawkins, Bhawna Singh, Guillaume Majeau-Bettez, and Anders Hammer Strømman, *Journal of Industrial Ecology*, www.wileyonlinelibrary.com/journal/jie

LCA of Ni-MH Batteries for HEV (Prius)

AP of fuel saving versus battery life cycle at different battery recycling rates (kg SO_{2-eq})



Electric Vehicle Might Reduce GWP under certain conditions

Normalized Impacts

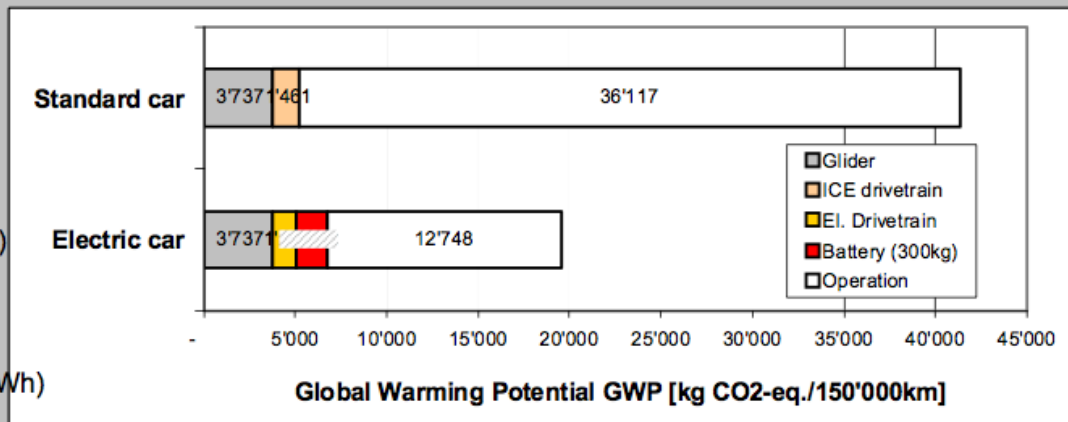
LCA: Entire lifecycle Comparison ICE / BEV vehicle

Global warming potential (kg CO₂-eq) over entire lifecycle (production + 150,000km operation) **23%**

ICE, gasoline EURO4
avg. europ. car (golf-class)

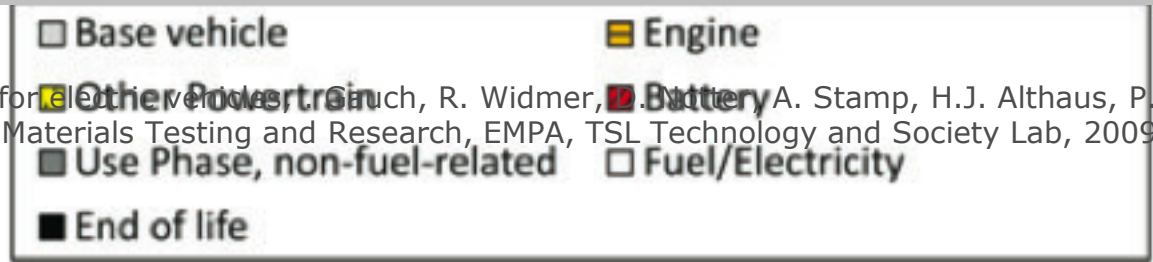
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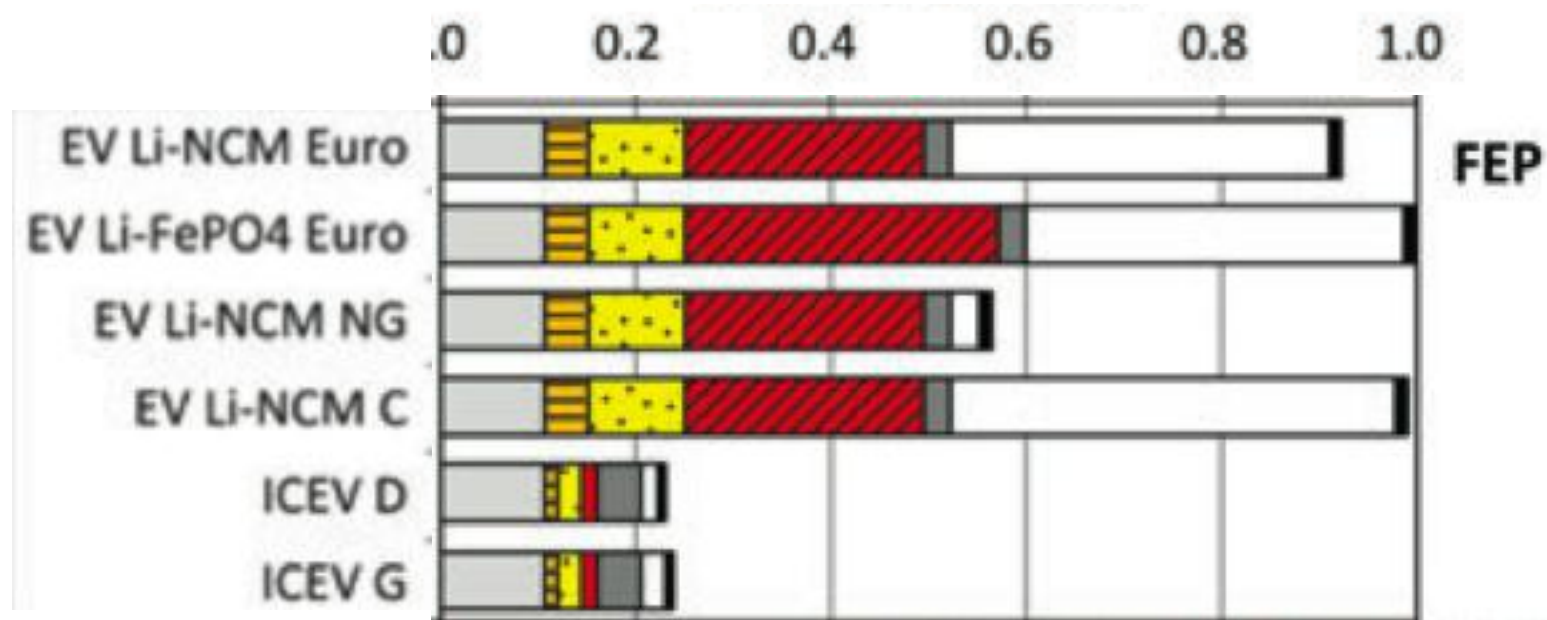


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Comparative Environmental Life Cycle Assessment of Conventional and Electric Vehicles - Troy R. Hawkins, Bhawna Singh, Wager Empa - Swiss Federal Laboratories for Materials Testing and Research, EMPA, TSL Technology and Society Lab, 2009
Guillaume Majeau-Bettez, and Anders Hammer Strømman, Journal of Industrial Ecology, www.wileyonlinelibrary.com/journal/jie



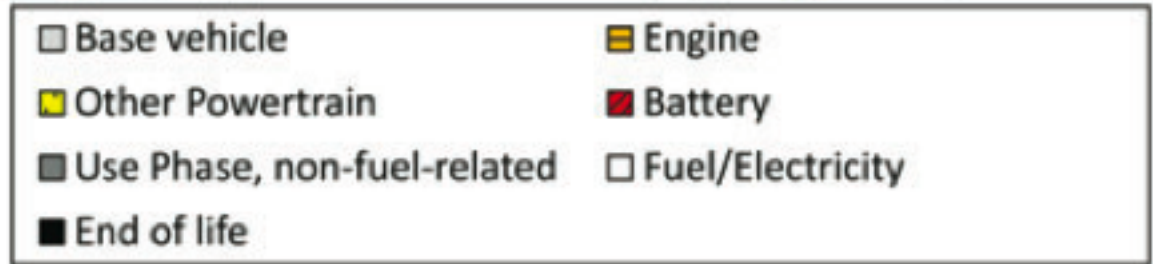
Potential Pollution Transfer: Fresh Water Eutrophication



Comparative Environmental Life Cycle Assessment of Conventional and Electric

Vehicles, Troy R. Hawkins, Bhawna Singh, Guillaume Majeau-Bettez, and Anders Hammer Strømman, *Journal of Industrial Ecology*,

www.wileyonlinelibrary.com/journal/jie



- LCA is not the only tool to assess environmental impact of EV : local impacts might be more important - noise
- Emerging technologies need support to have a chance to improve
- Key directions for improvement
 - Source of electricity => business model, charging infrastructure...
 - Efficiency of the powertrain chain
 - Vehicule lifetime
 - Production and recycled content of batteries

Back Up

Electricity Production Mix

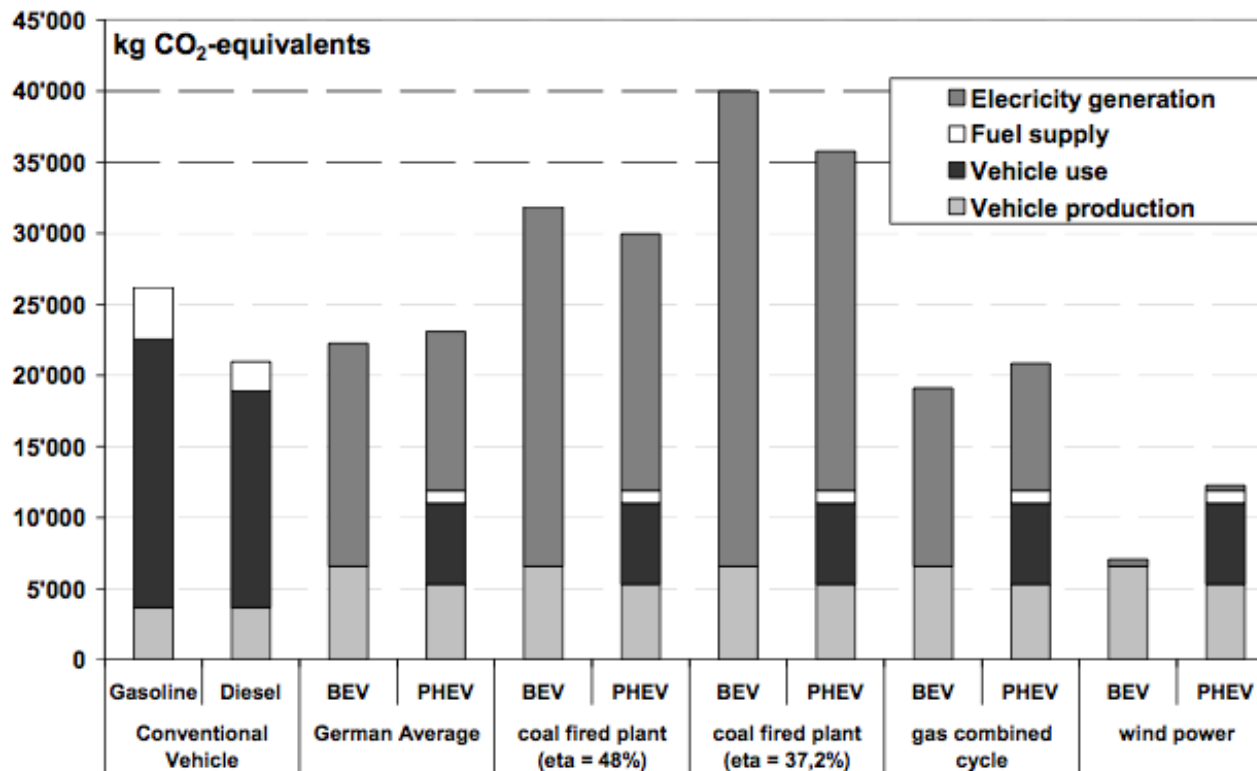


Figure 5: Life cycle greenhouse gas emissions of a compact car with different drive trains (120'000km ; 70% urban driving)

- Electric vehicle and plug-in hybrid energy efficiency and life cycle emissions H. Helms, M. Pehnt, U. Lambrecht and A. Liebichfeu – Institut für Energie- und Umweltforschung, Wilckensstr. 3, D-69120 Heidelberg (www.ifeu.de)

Electricity Production Mix

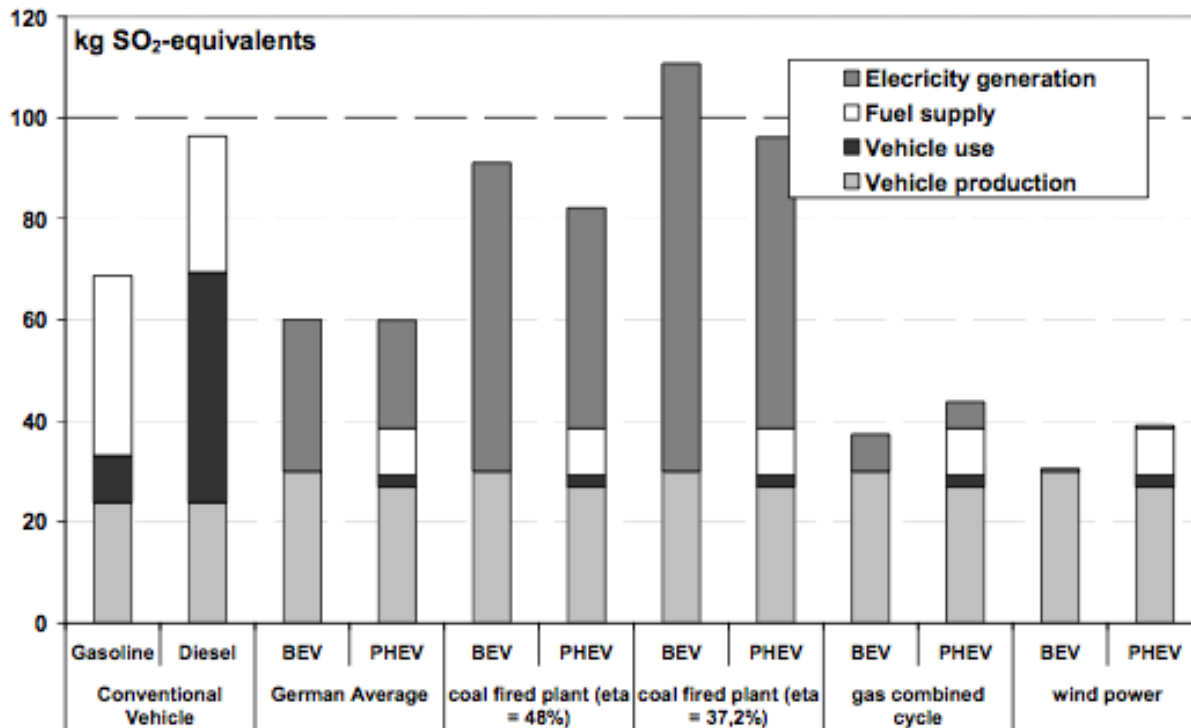


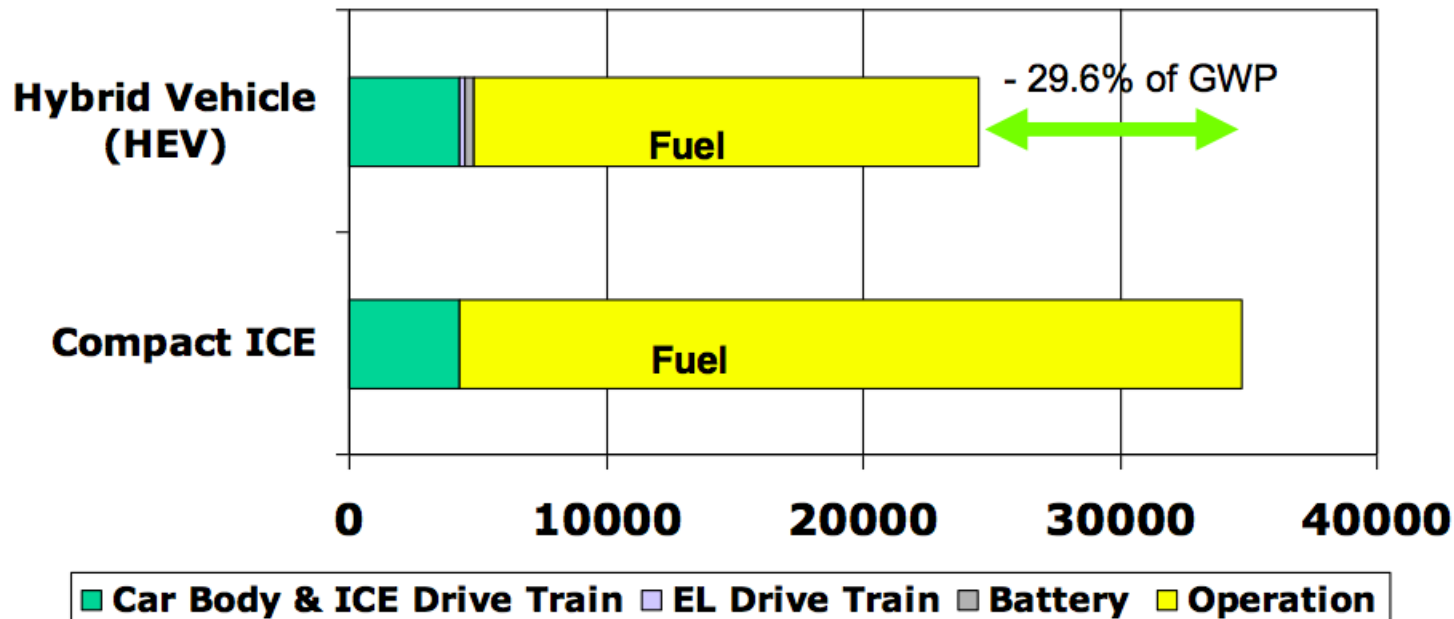
Figure 7: Life cycle acidification of a compact car with different drive trains (120.000km ; 70% urban driving)

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Autant de conclusions que d'études ?

LCA of Ni-MH Batteries for HEV (Drive)

Comparison ICE vs HEV (kg CO₂-eq)



**HEV Prius II allows nearly a 30% reduction for GWP compared to ICE Corolla –
The battery and E-drive contributes 45% (4.550 kg CO₂-eq) to the fuel economy**

La production de la batterie représente un impact significatif

