LCA of different vehicle technologies with a look at future trends

Decarbonisation and Resource Efficiency – 100% Renewable Energy and more

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~2010

2050 ?

Peter de Haan, Ratner Zah

Chancen und Risiken der Elektromobilität in der Schweiz

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TEXTE 30/2015

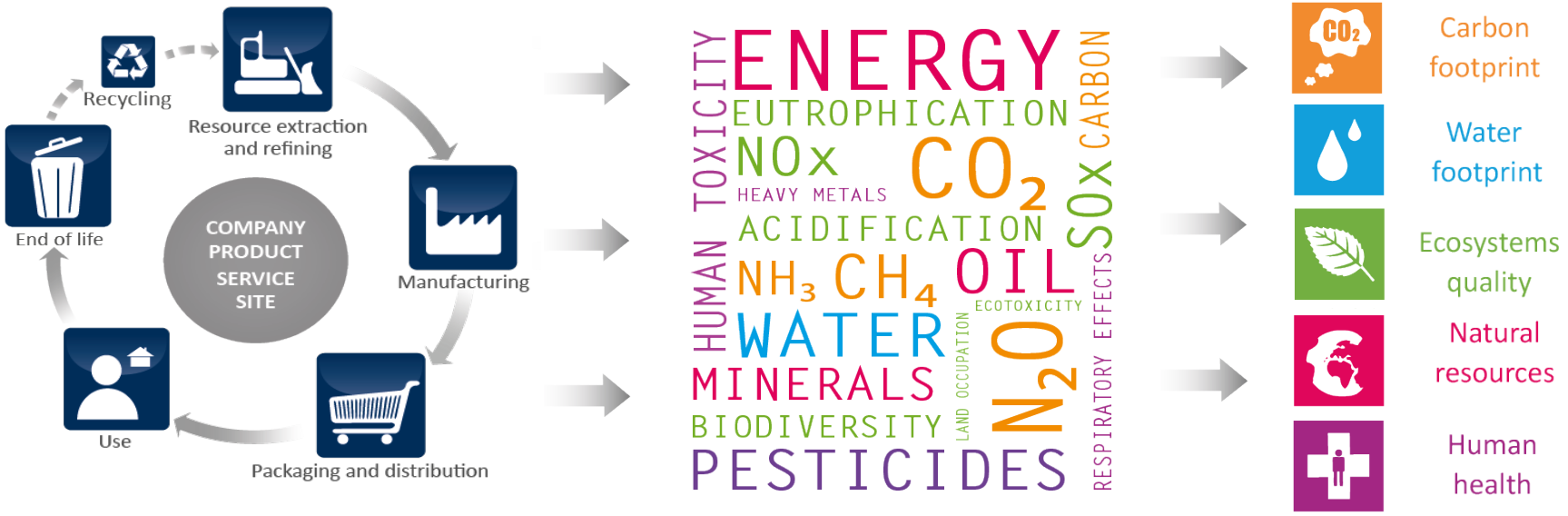
Postfossile Energieversorgungsoptionen für einen treibhausgasneutralen Verkehr im Jahr 2050: Eine verkehrsträgerübergreifende Bewertung

Für Mensch & Umwelt

Umwelt Bundesamt

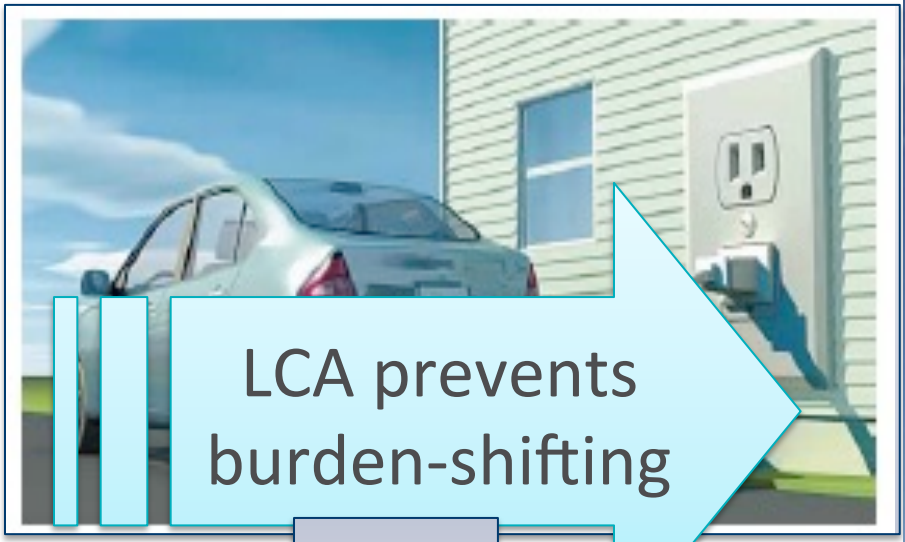
What is Life Cycle Assessment

Life cycle assessment



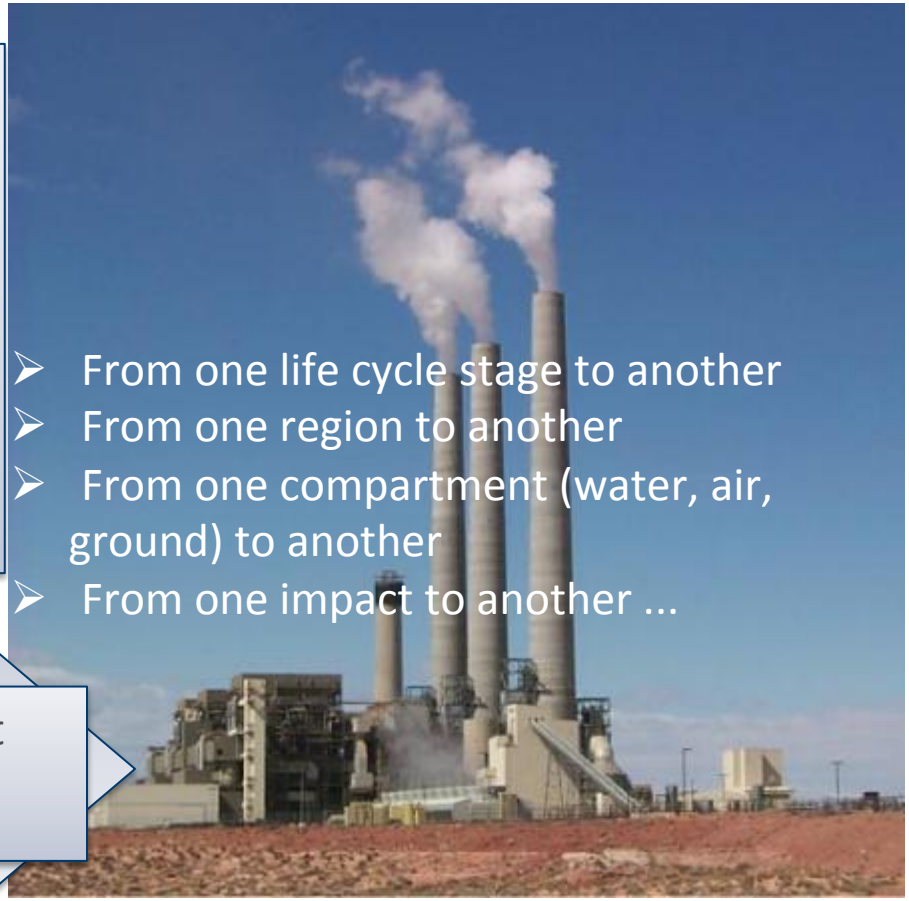
- **Vision** for multiple emissions, resource use and wastes
- Identification of hot-spots
- Deliver science-based **decision-making tools**

Why LCA?



LCA prevents burden-shifting

Emissions displaced, not eliminated



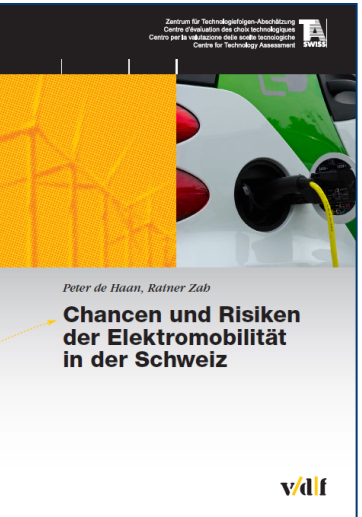
- From one life cycle stage to another
- From one region to another
- From one compartment (water, air, ground) to another
- From one impact to another ...

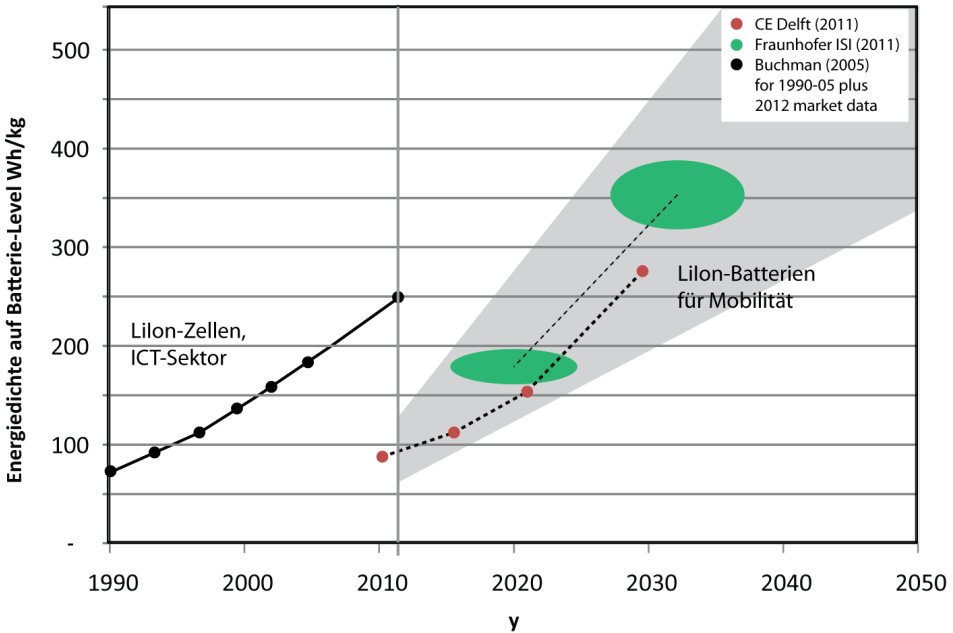
Trends for the future of mobility

Life Cycle Assessment of vehicles: today to 2050

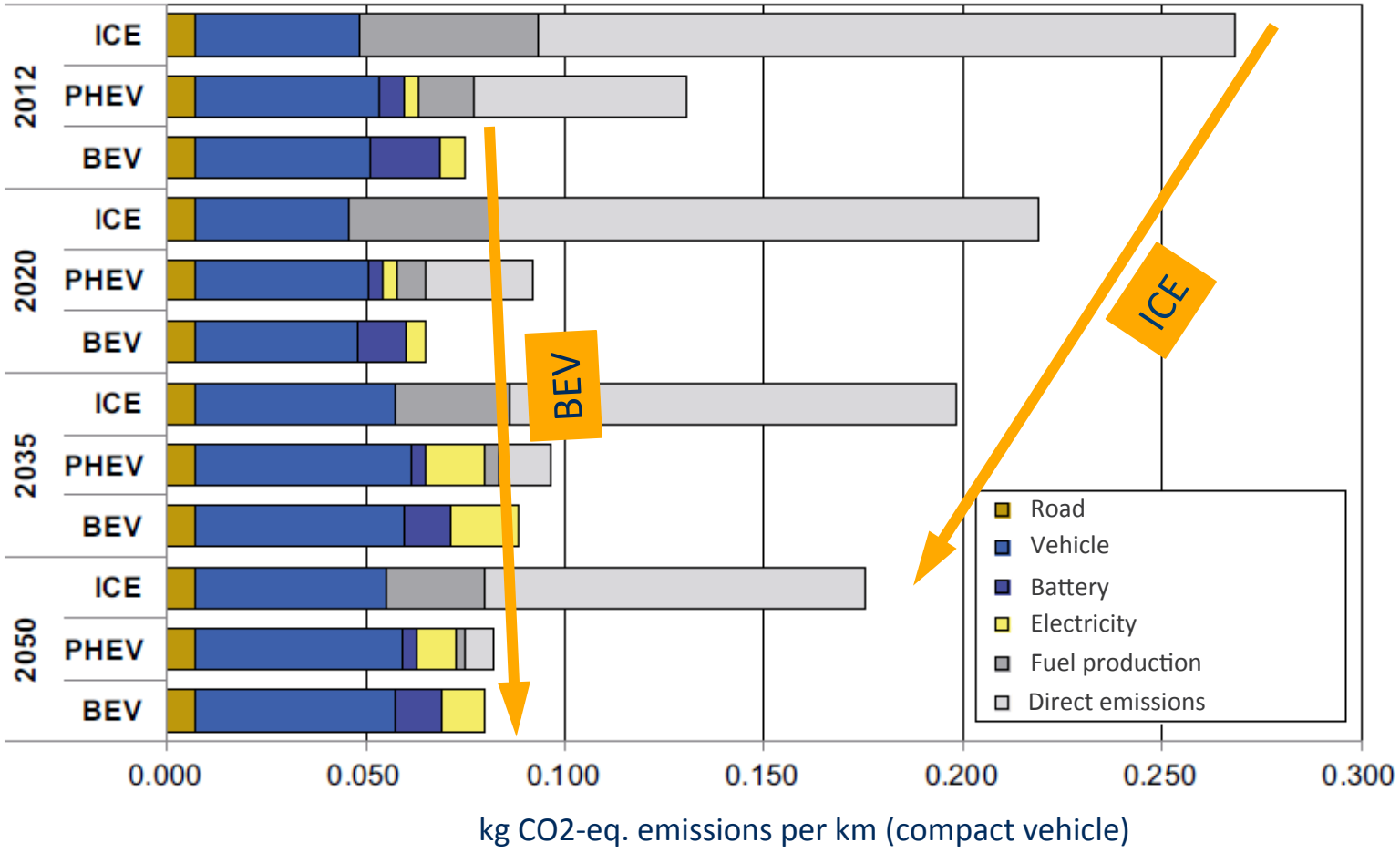
LCA of future passenger vehicle transport assuming:

- Compact class vehicle (ICE, BEV, PHEV)
- Efficiency improvements in chassis and drivetrains
- Energy portfolio based on Swiss BFE Scenarios to 2050
- Battery developments estimations

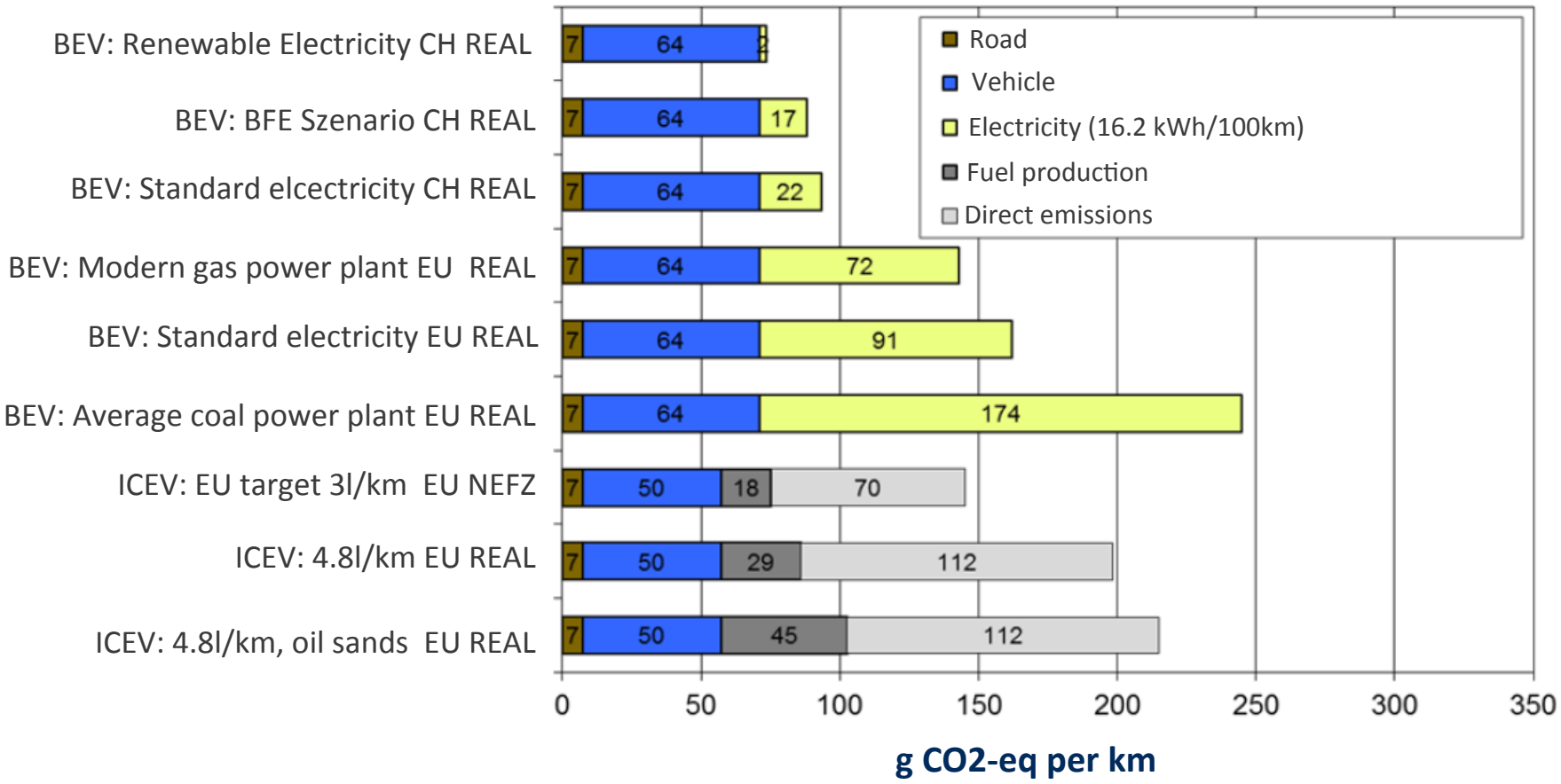




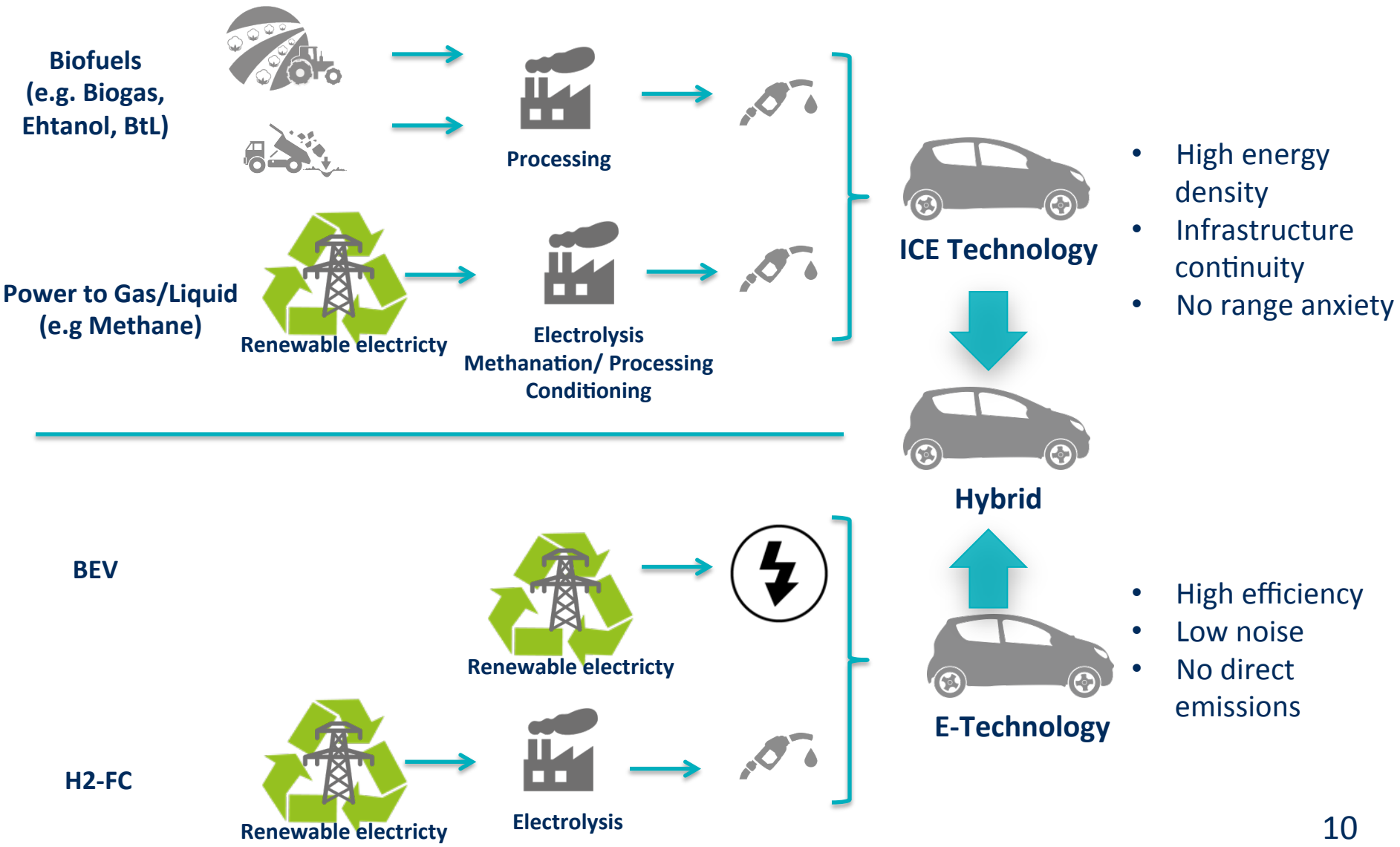
Development of CO2-emissions (Swiss perspective)



Relevance of renewable electricity (2035)



Potential drivetrain technologies in a decarbonised future

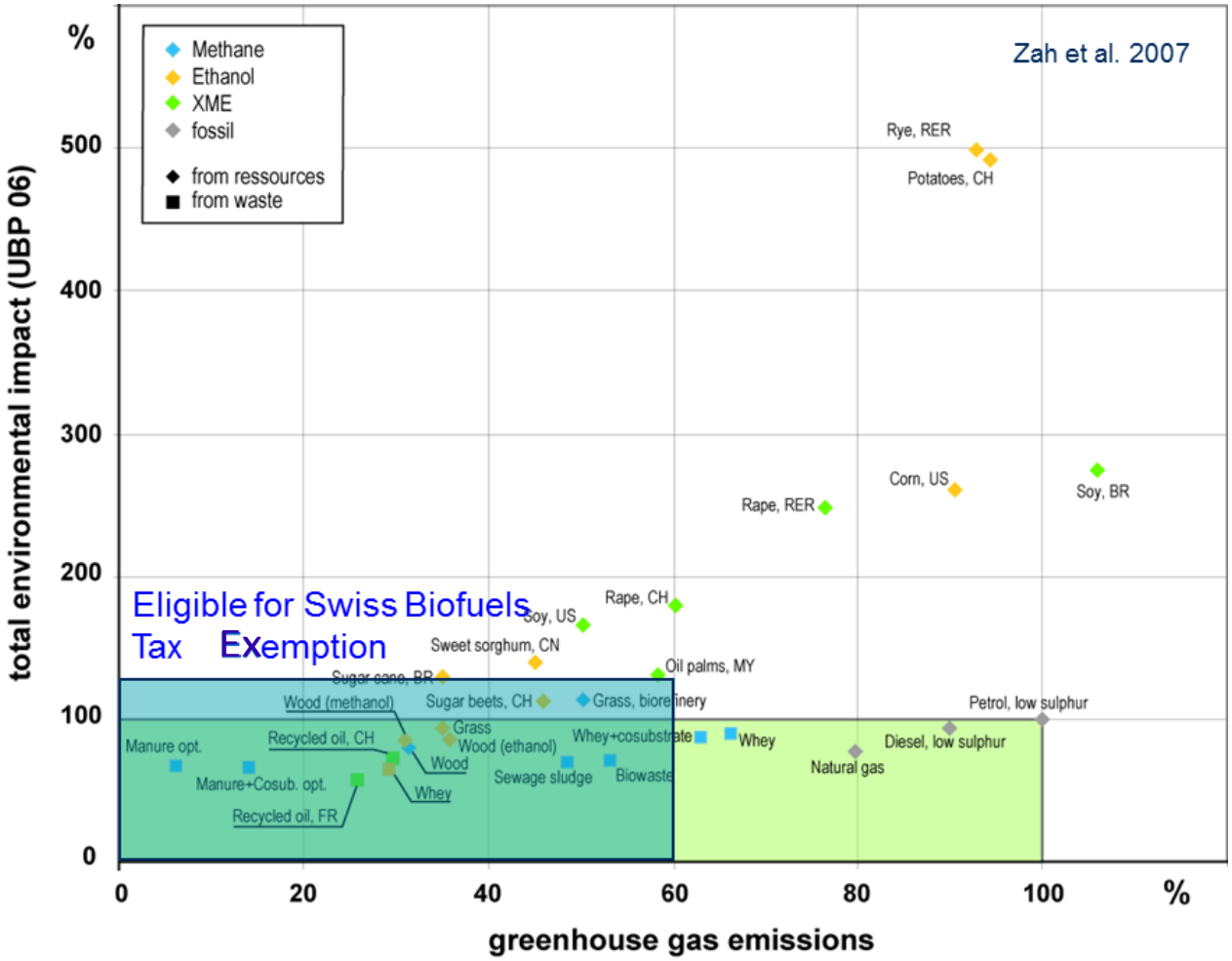


- High energy density
- Infrastructure continuity
- No range anxiety

- High efficiency
- Low noise
- No direct emissions

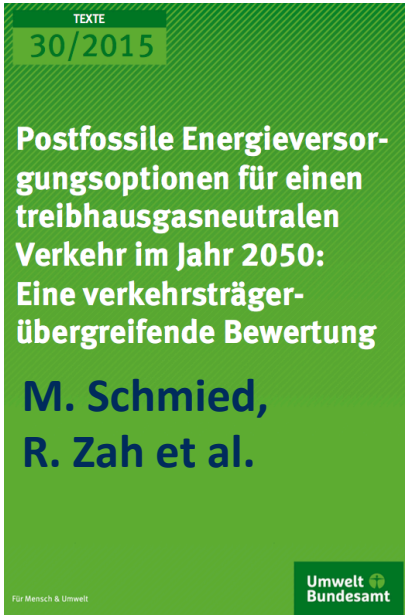
Challenges of biofuels

- Biofuels can have strong environmental impacts due to land use change effects and agricultural emissions
- Choice of environmentally friendly fuels is limited
- Best options are waste based, but these are limited in availability

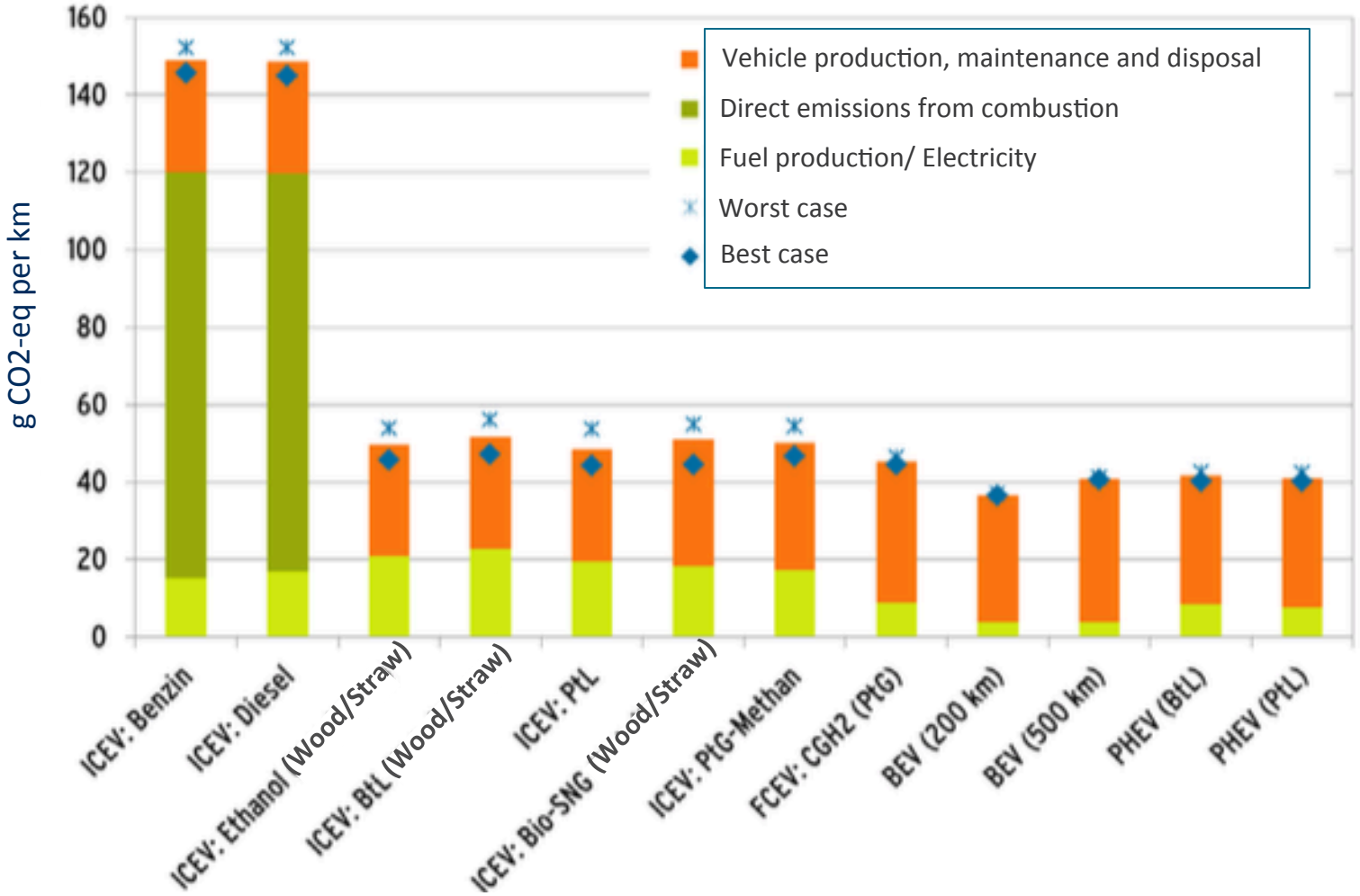


Challenges of potential low carbon options

Biofuels (e.g. Biogas, Ehtanol, BtL)	• Biofuels from cultivated biomass: land competition/ agricultural impacts • Biofuels from waste: good performance, low availability • Ligno-cellulosic biofuels: good performance (straw/ sustainable forestry)
Power to Gas/ Liquid (e.g Methane)	• Require higher amounts of electricity than the direct use in EVs
BEV/PHEVs	• Energy density of battery is low compared to typical fuels (will improve in the future and can be solved with hybrid approaches)
H2-FC	• Require higher amounts of electricity than EVs, uncertainty in future performance regarding efficiency and costs.



GHG Emission per km in 2050



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Wrap-up

Conclusions

- With electric mobility within a strongly decarbonised context the impacts move from the use to the production phase (vehicle, renewable energy technologies).
- Pressure grows on the resource side (e.g. Copper) highlighting the need for effective recycling schemes and research in new materials. Sharing and multi-modal approaches can alleviate the pressure
- Biofuels and Power to Gas/Liquid solutions can play a relevant role in low carbon transportation models. Important to identify when to use renewable electricity directly in BEVs or for the production of PtoX-fuels or biofuels
- There is no optimal solution. Future transport schemes need to look at the best interplay between available technologies

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