IEA HEV Task 19:"Life Cycle Assessment of Electric Vehicles"

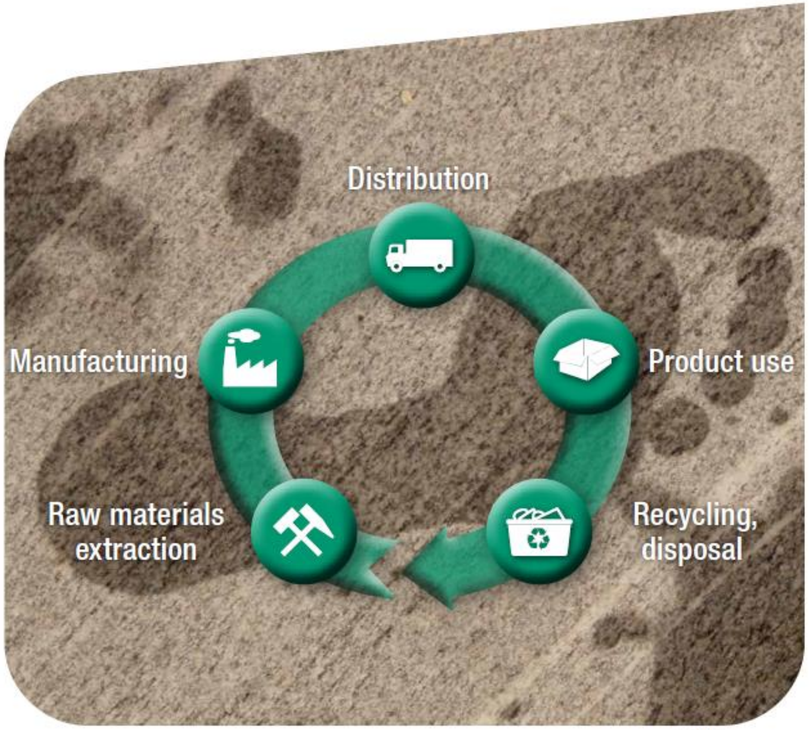
Vermessung der Umwelt in Lebenszyklusanalysen am Beispiel der Elektrofahrzeuge weltweit

Gerfried Jungmeier

J. Dunn

S. Ehrenberger

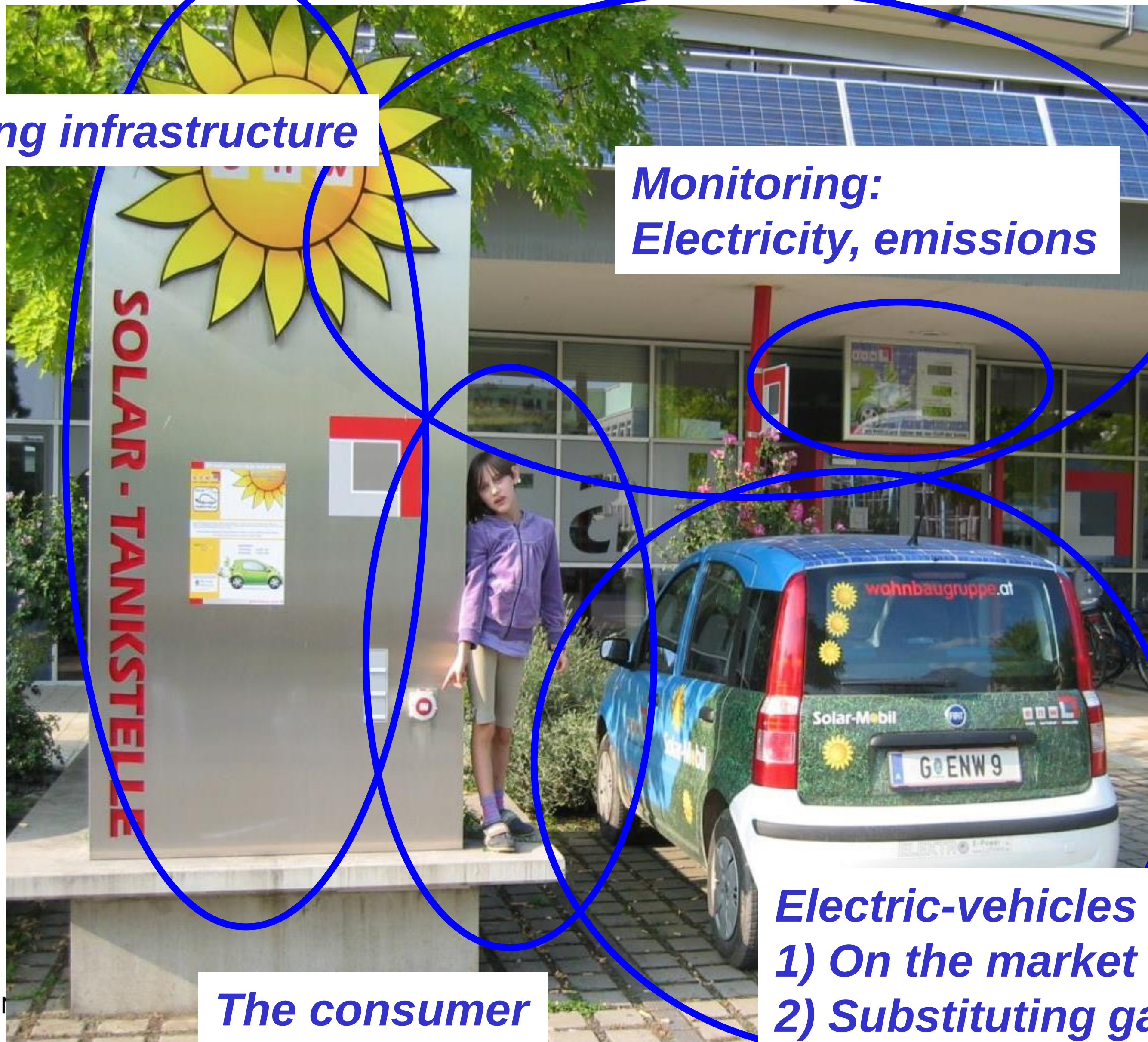
R. Widmer



EnInnov2016

14. Symposium Energieinnovation | 10.02.–12.02.2016

Challenges for the Successful Market Introduction of Electric-Vehicles



Charging infrastructure

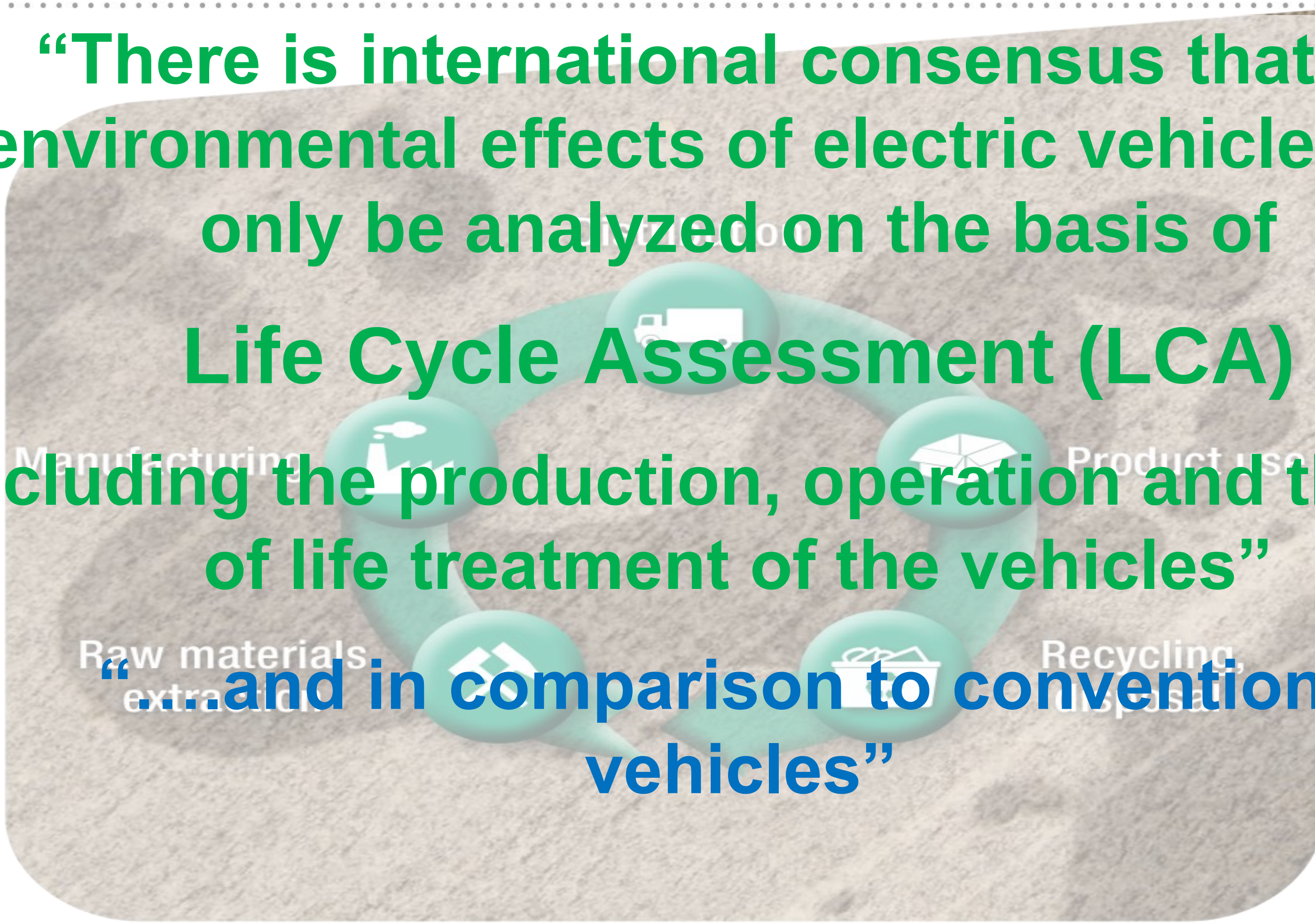
Monitoring: Electricity, emissions

Additional renewable electricity

The consumer

Electric-vehicles
1) On the market available
2) Substituting gasoline&diesel

Statement on Environmental Assessment of Electric Vehicles



“There is international consensus that the environmental effects of electric vehicles can only be analyzed on the basis of

Life Cycle Assessment (LCA)

including the production, operation and the end of life treatment of the vehicles”

“….and in comparison to conventional vehicles”

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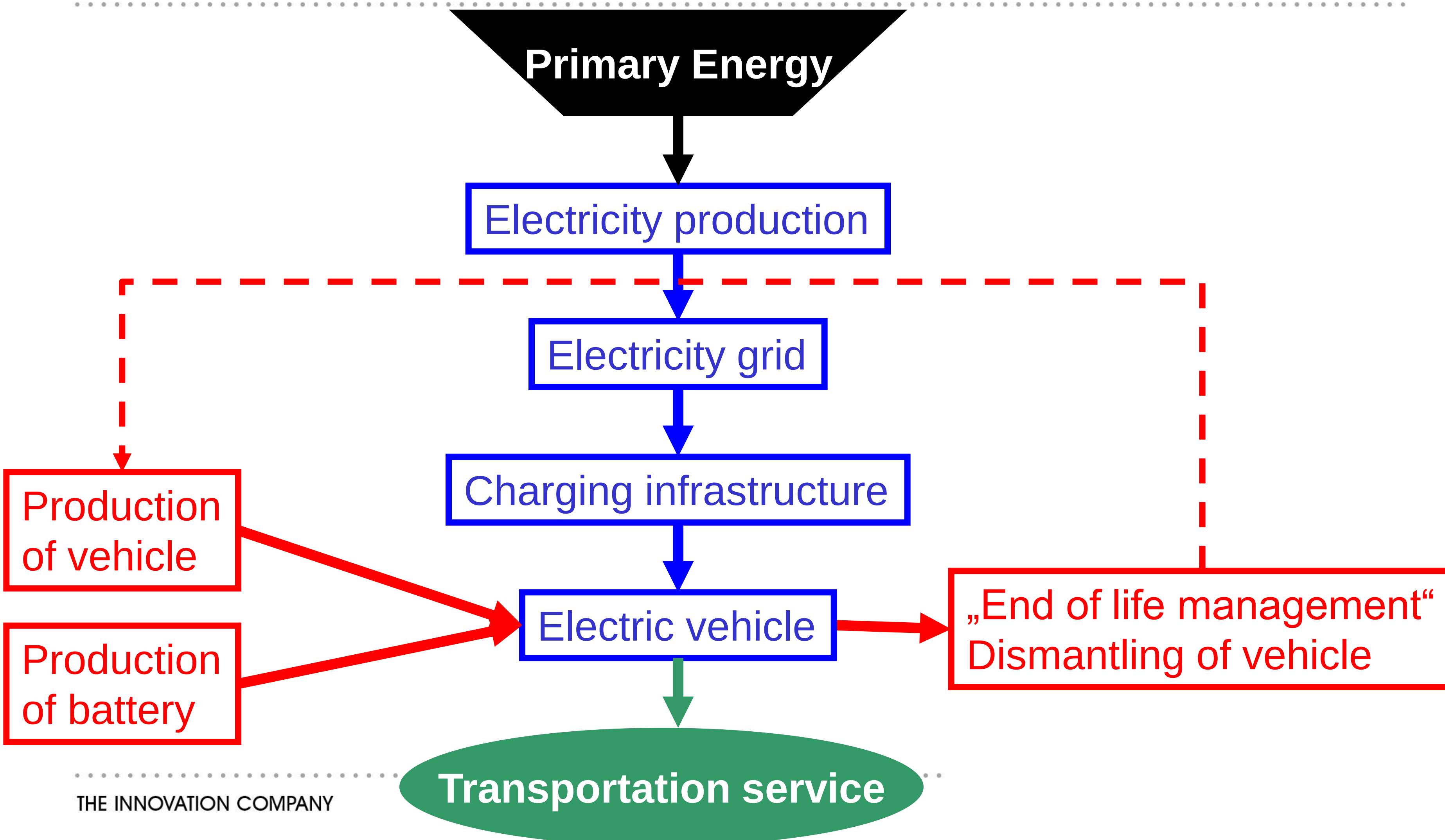
Assessment of LCA-Aspects over Full Value Chain



Example: 66,000 BEV in Norway (Norsk elbil forening 2015)

- **85% substitute „fossil driven“ ICE kilometres“**
- **15% substitute walking, bicycling, public transport and additional mobility**

→ 9,000 additional vehicles?

3) Ve... ...d of vehicle

4) **Fuel Cycle** (electricity productio... ...torage

5) **Inventory analysis**: CO_2, MJ, kg <-> CS... ...water, heavy metals

6) **Impact assessment**: GHG, primary energy <-> ...diversity, toxicity

7) **Reference system**: vehicle size, driving range, ≤ 100% substitution?

Source: G. Jungmeier, J. B. Dunn, A. Elgowainy, L. Gaines, S. Ehrenberger, E. D. Özdemir, H. J. Althaus, R. Widmer: ***Life cycle assessment of electric vehicles – Key issues of Task 19 of the International Energy Agency (IEA) on Hybrid and Electric Vehicles (HEV)***, *TRA 2014 – Transport Research Arena 2014, Paris, France, April 14-17, 2014.*

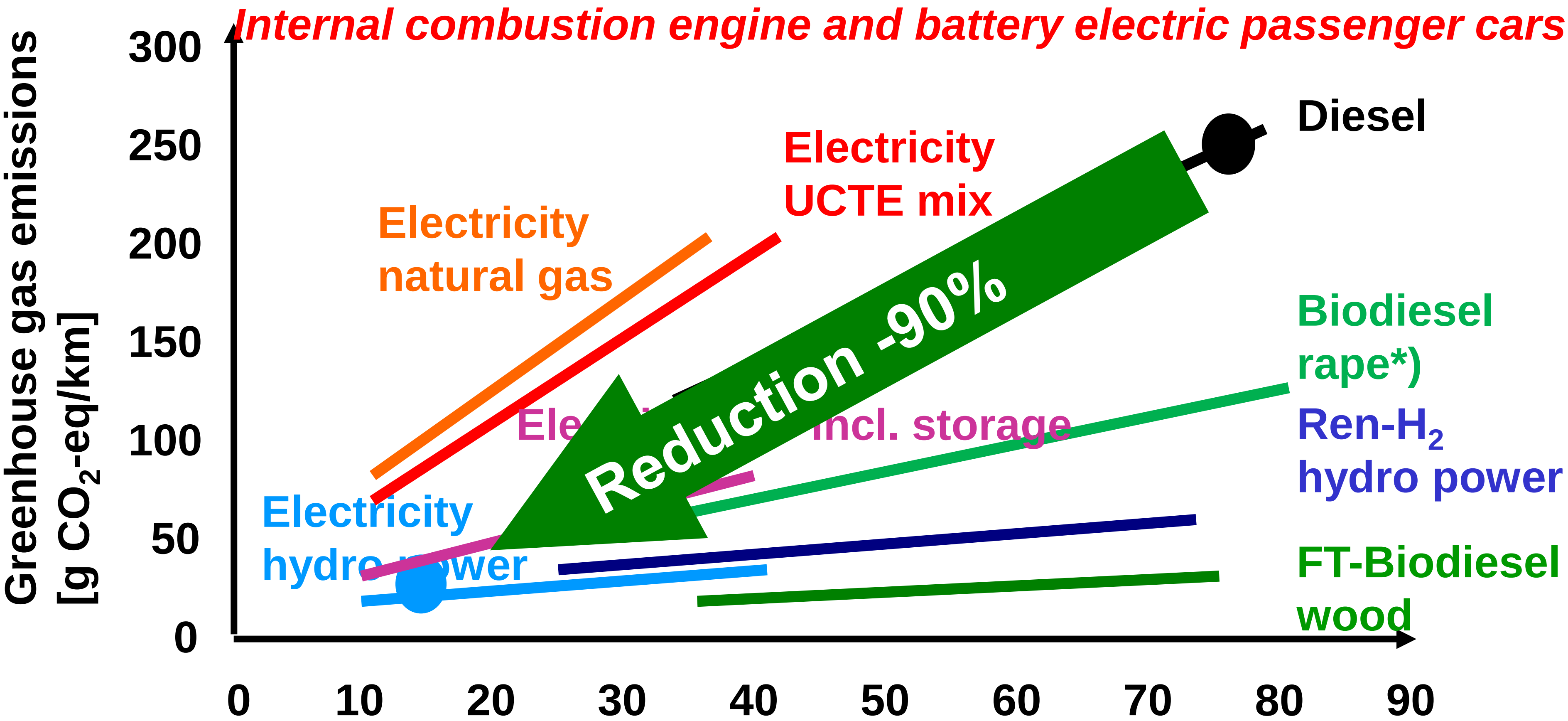
LIFE – Centre for Climate, Energy & Society

- addresses the key issues related to **climate change**:
  - How can society cope better with the risks of global warming and how can we **minimise** the associated **economic damage**?
  - Will climate change also bring **economic opportunities**?
  - How can these opportunities be realised?
  - What steps are necessary to guide our society towards a more **sustainable development** path in order to **slow down climate change**?
- **creating opportunities** from climate change
- establish a **centre of European dimensions** by pooling the scientific excellence of three research groups
- Our mission is:
  - **strengthen resilience** to climate and weather risks
  - promote the transition to a **low-carbon economy and society** by 2050

Research Groups

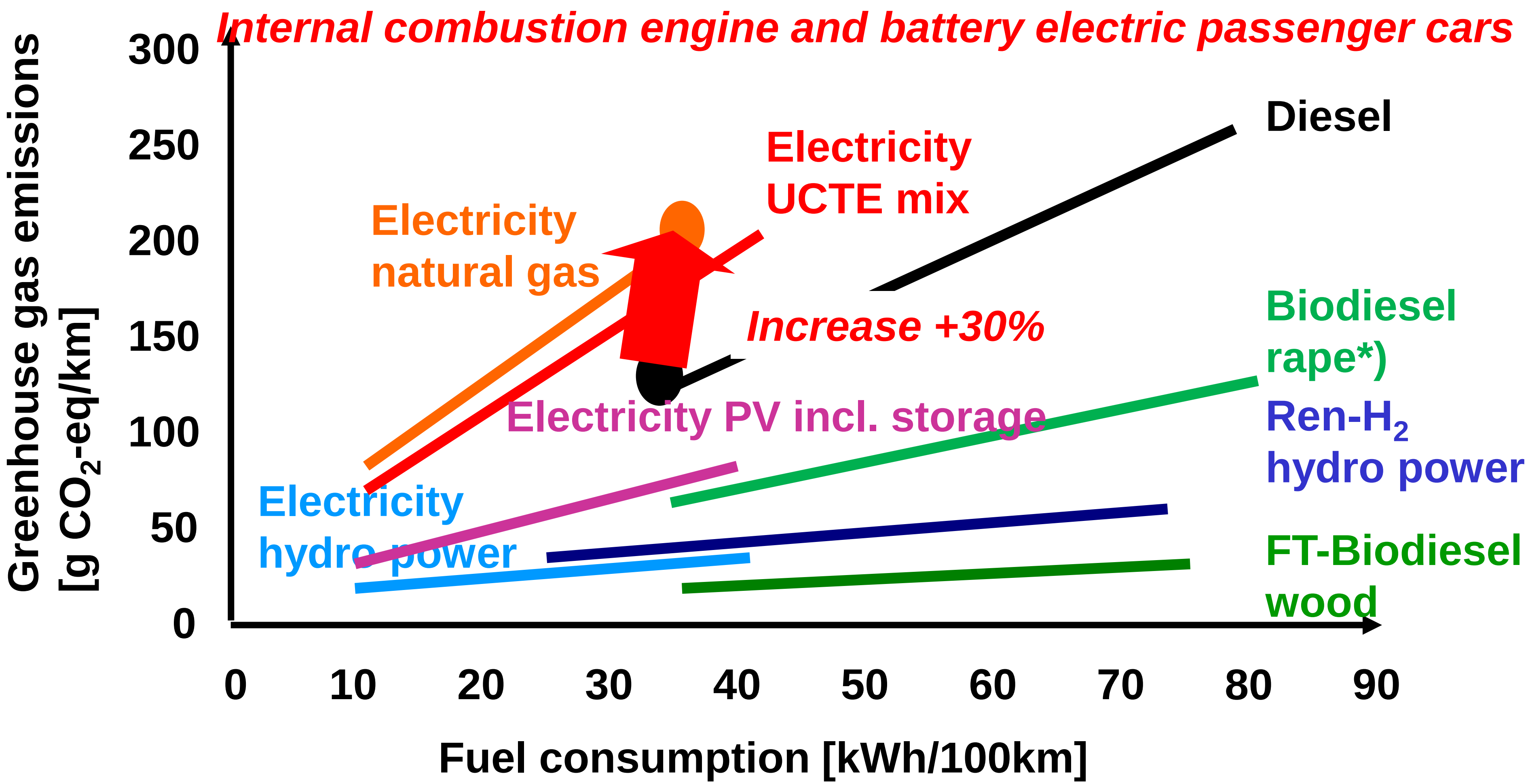
CRM Weather & Climate Risk Management	SYS Future Energy Systems & Lifestyle	CPE International Climate Policy & Economics
Risk Identification	Energy Systems Assessment	Macroeconomic Analysis
Impact Quantification	Best Technology Choice	Policy evaluation
Climate Solutions & Climate Services	Lifestyle Transformation Tools	Policy Design

The 2 Keys: Renewable Energy and Energy Efficiency



*Source: LCA of passenger vehicles, Joanneum Research, *) without iLUC*

The 2 Keys: Renewable Energy and Energy Efficiency



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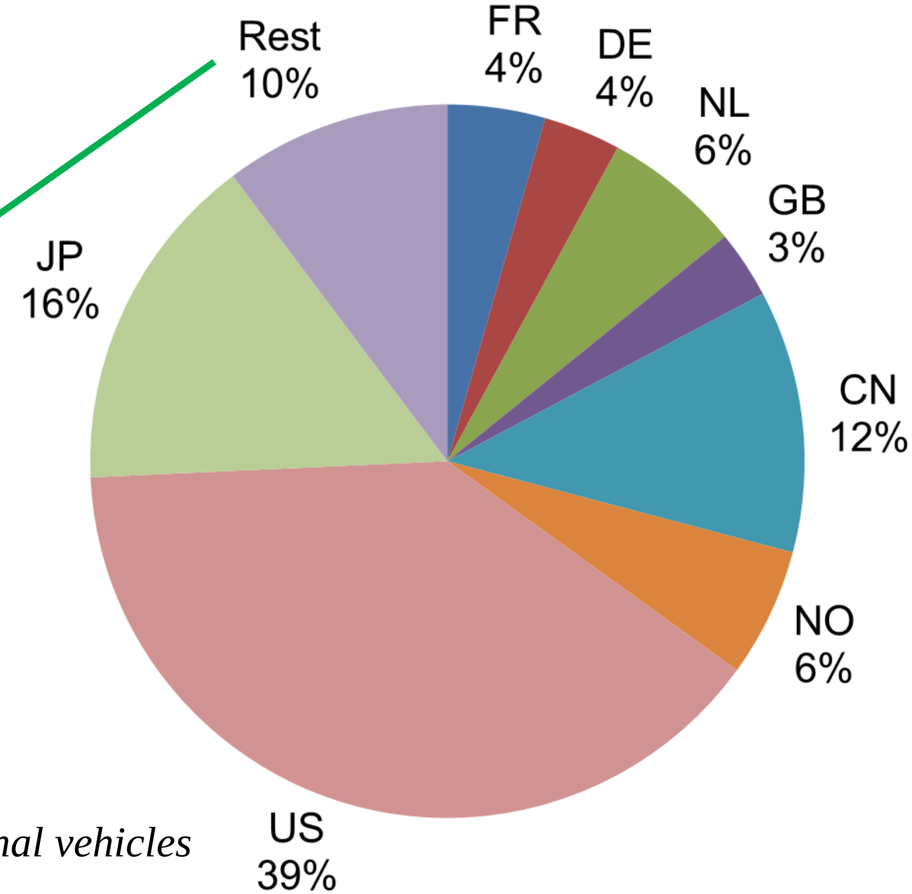
IEA INTERNATIONAL ENERGY AGENCY HYBRID & ELECTRIC VEHICLE IMPLEMENTING AGREEMENT

JOANNEUM RESEARCH LIFE

Vehicle Fleet Worldwide 2014

About 700,000 electric vehicles

Rest: AT, BE, BG, CZ, DK, FI, GR, HU, IE, IT, LU, PL, PT, RO, SK, SI, ES, SE, AU, CA, CH, KR, TR, ID, SA

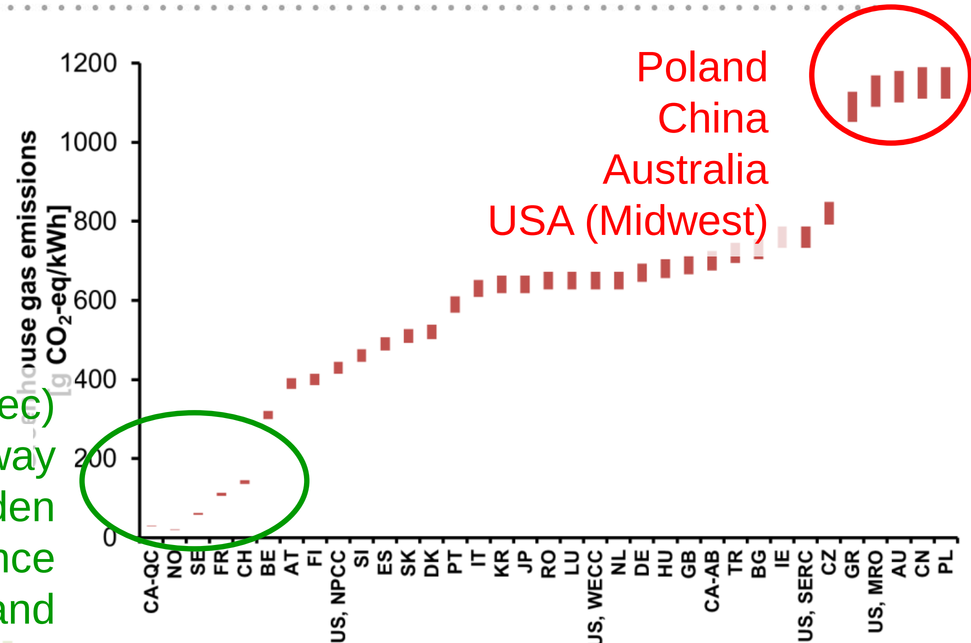


Assumption:
- *BEV 65%, PHEV 35%*
- *BEV: 14,000 km/a*
- *PHEV 8,000 km/a (electric)*
- *EVs substitute 95% of km driven by conventional vehicles*

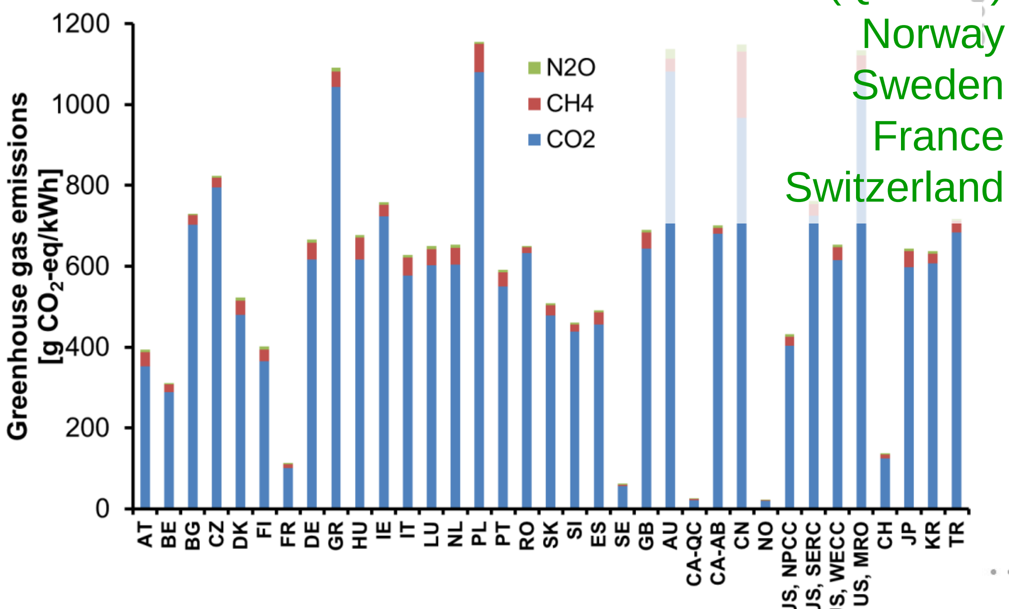
Source: EVI 2015, IEA-HEV, own assumptions

Estimated GHG (CO_2, CH_4, N_2O) Emissions of National Electricity Productions

From primary resource extraction to charging point



National electricity production

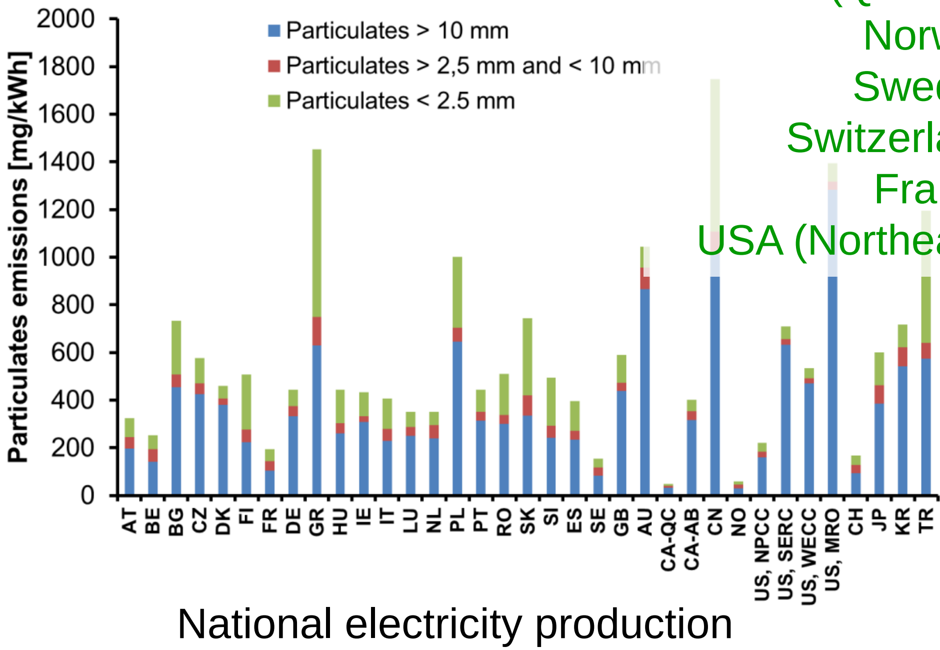


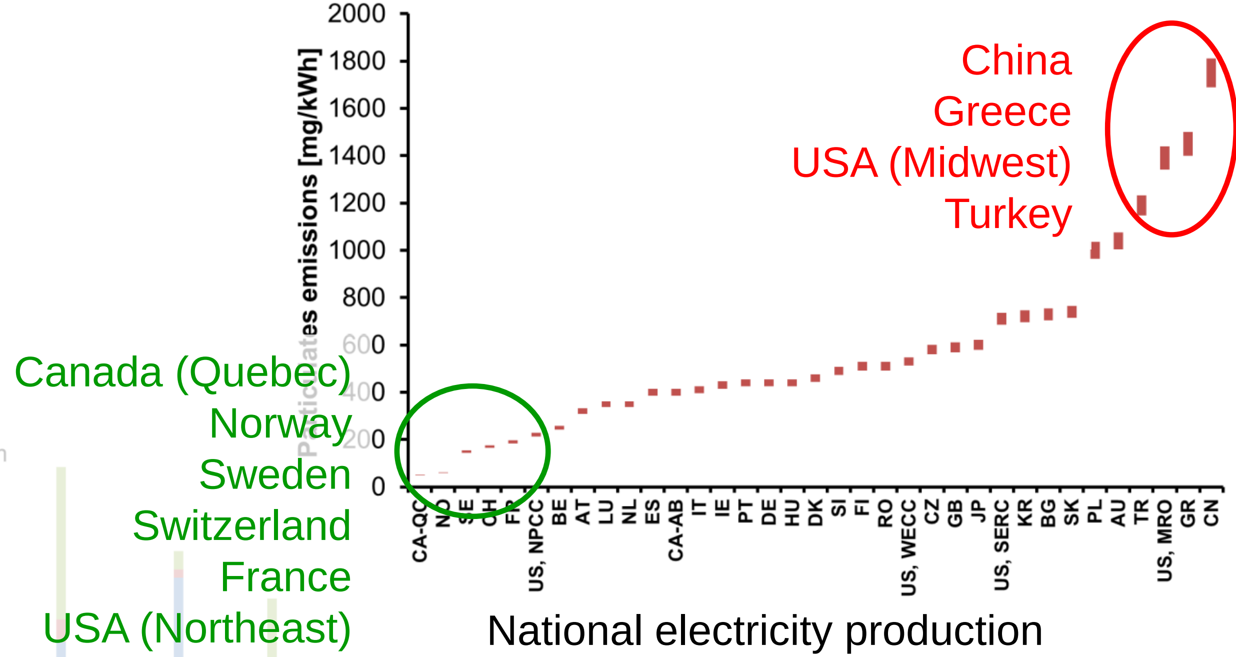
National electricity production

Source:
own calculations using data of ecoinvent

Estimated PM-Emissions of National Electricity Productions

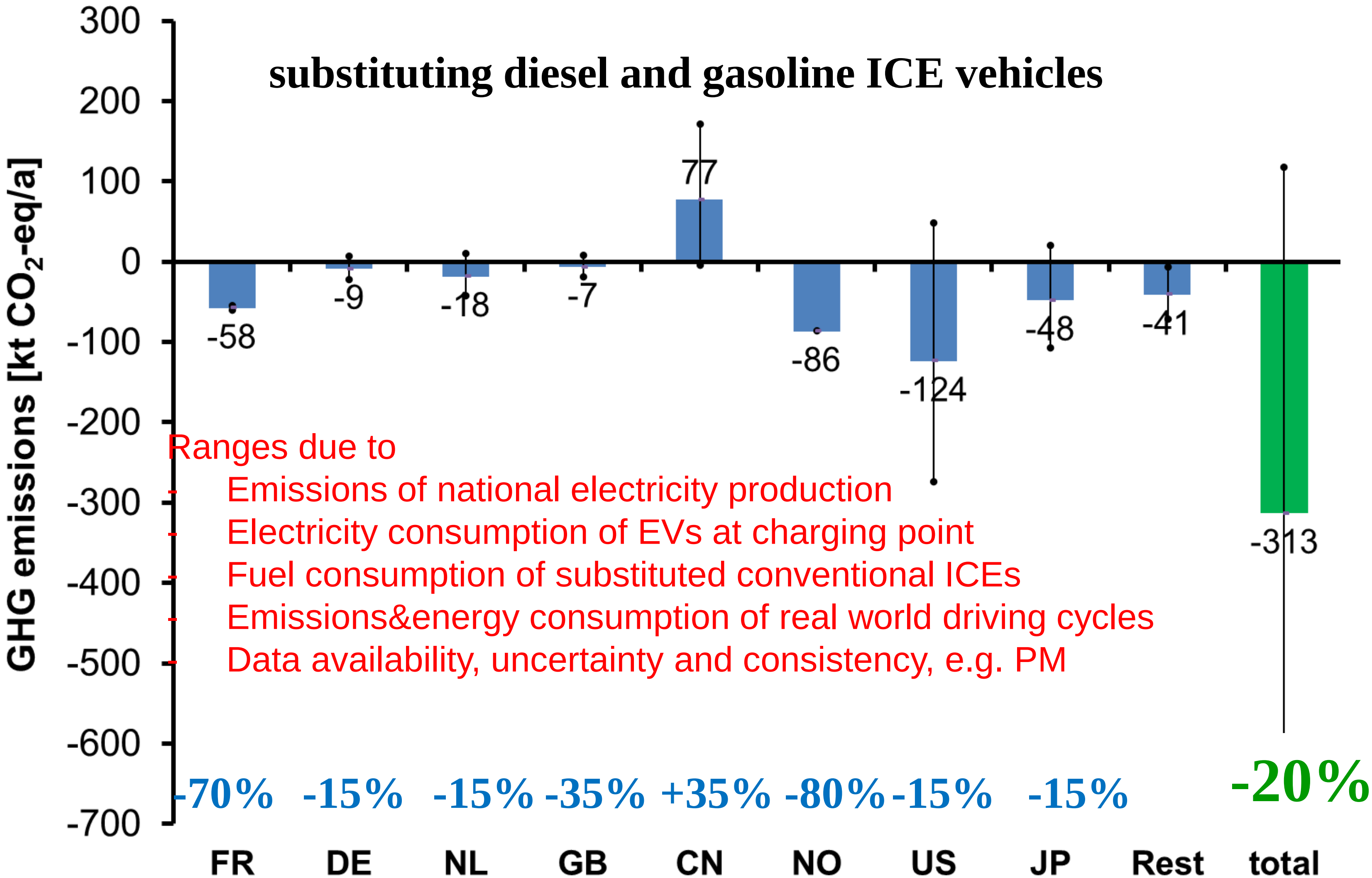
From primary resource extraction to charging point



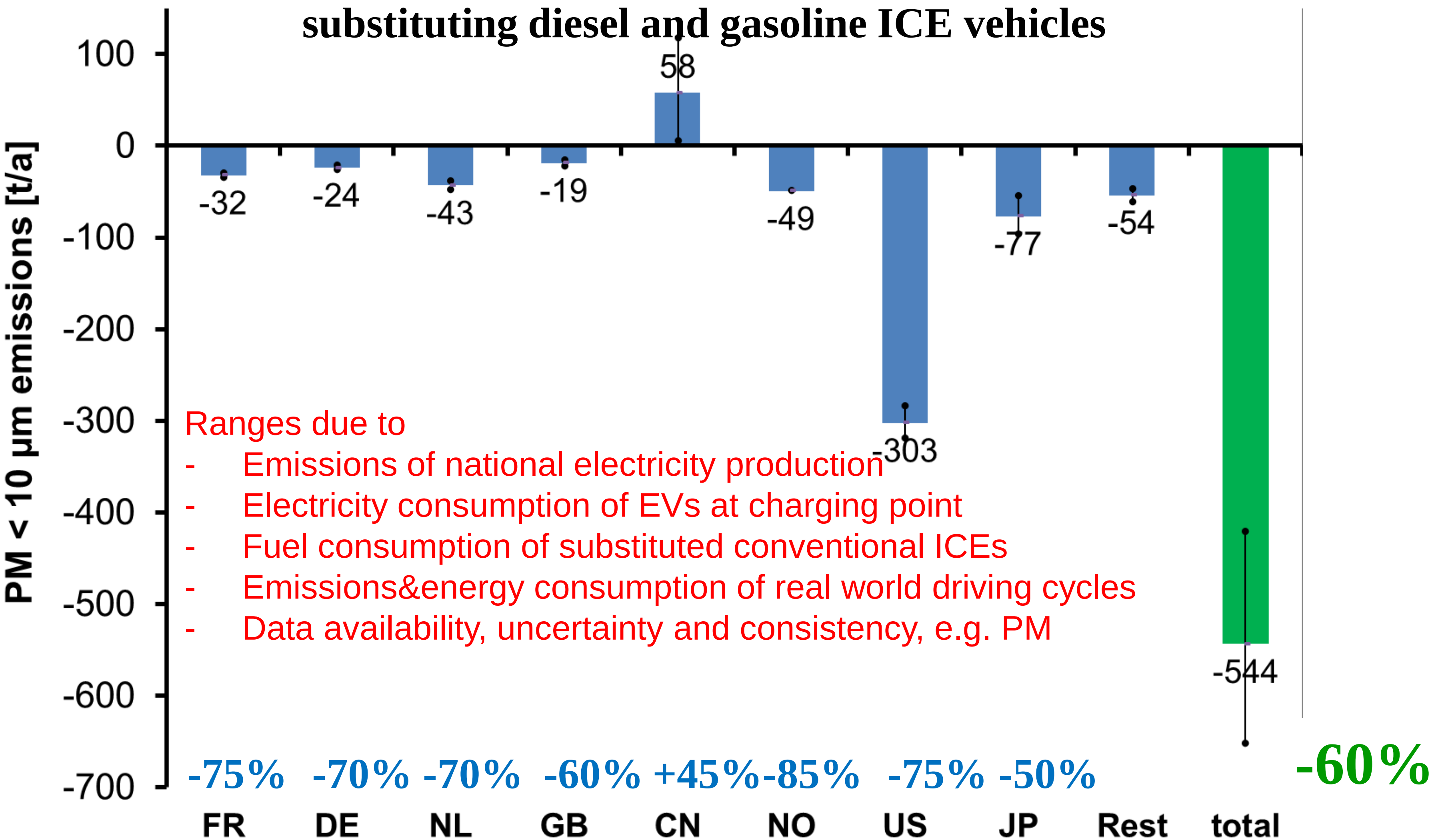


Source:
own calculations using data of ecoinvent

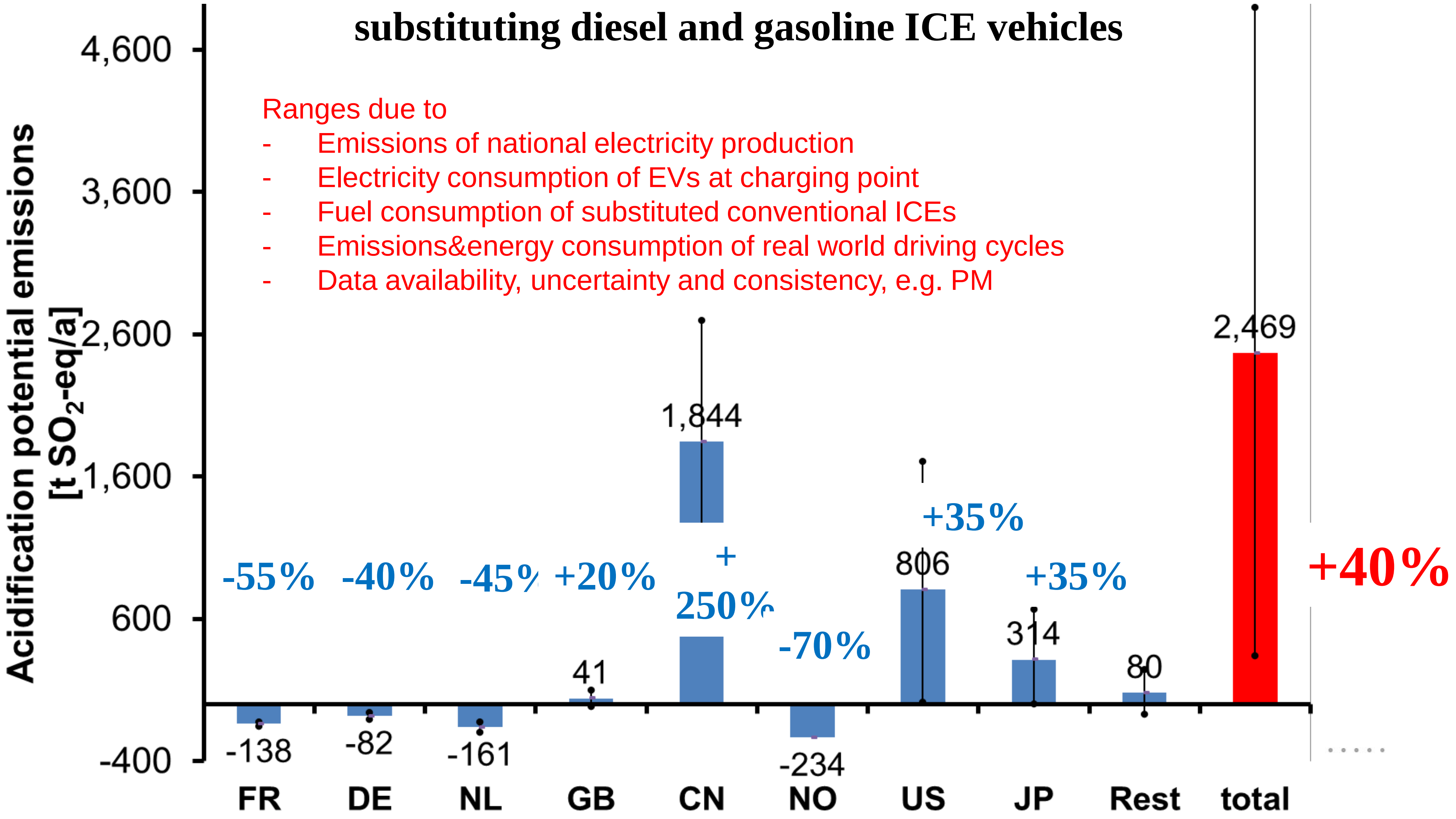
Estimated GHG-Emissions of Electric Vehicles Worldwide (2014)



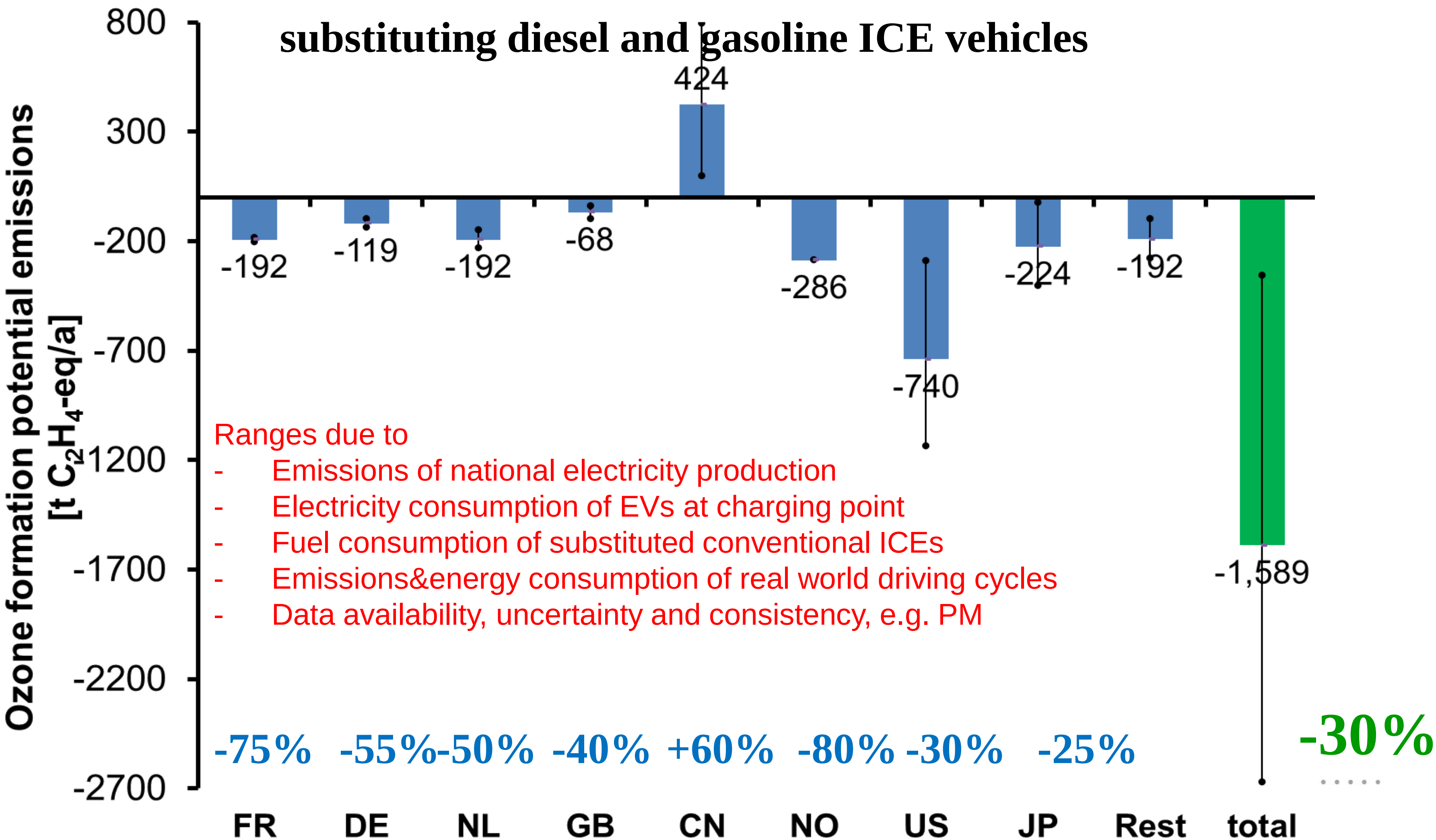
Estimated PM-Emissions of Electric Vehicles Worldwide (2014)



Estimated NO_x – and SO_2-Emissions of Electric Vehicles Worldwide (2014)

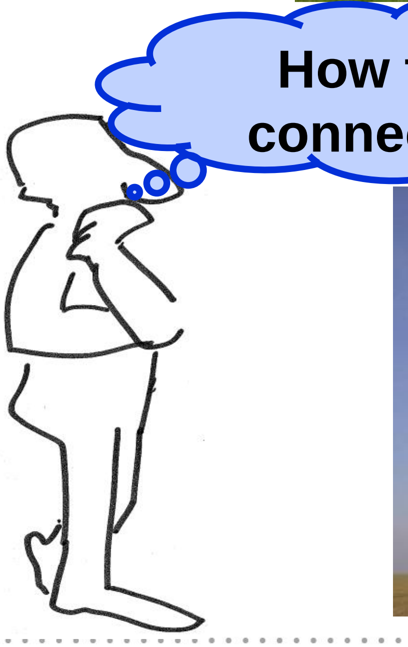


Estimated CH_4-, NMVOC-, NO_x- and CO-Emissions of EVs Worldwide (2014)



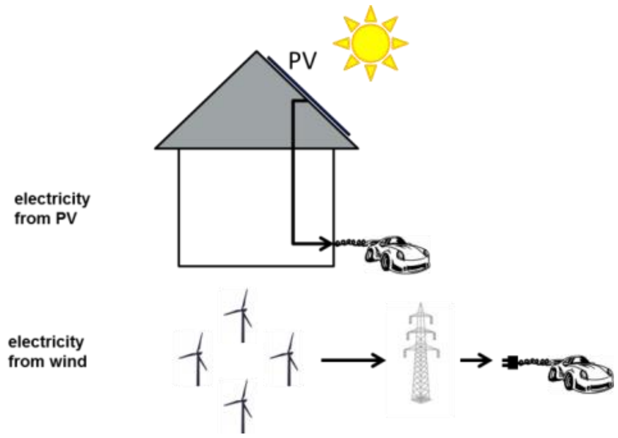
Additional Renewable Electricity Production and Electric Vehicles

1. „Direct connection“
2. „Via storage“
3. „Stored in Grid“
4. „Real time charging“

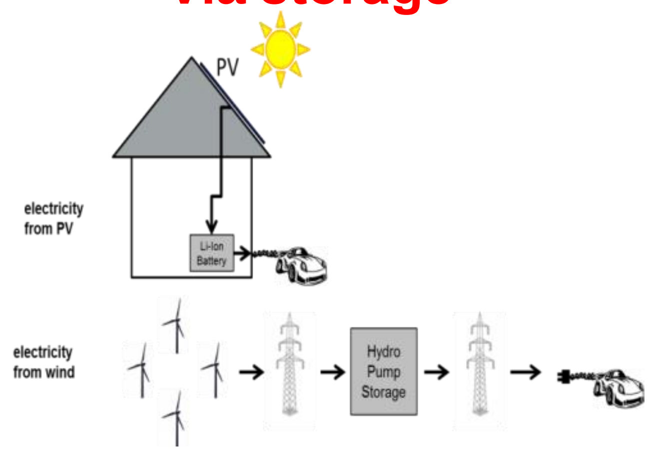


Charging of EVs with Additional Renewable Electricity

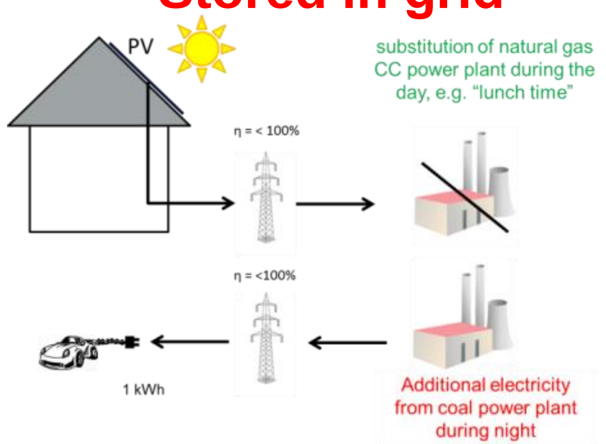
"Direct connection"



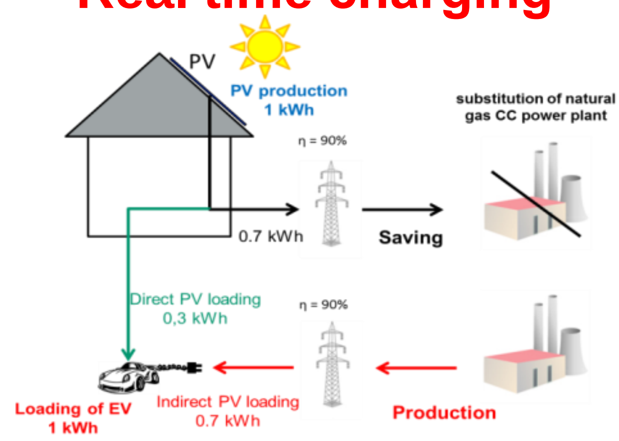
"Via storage"



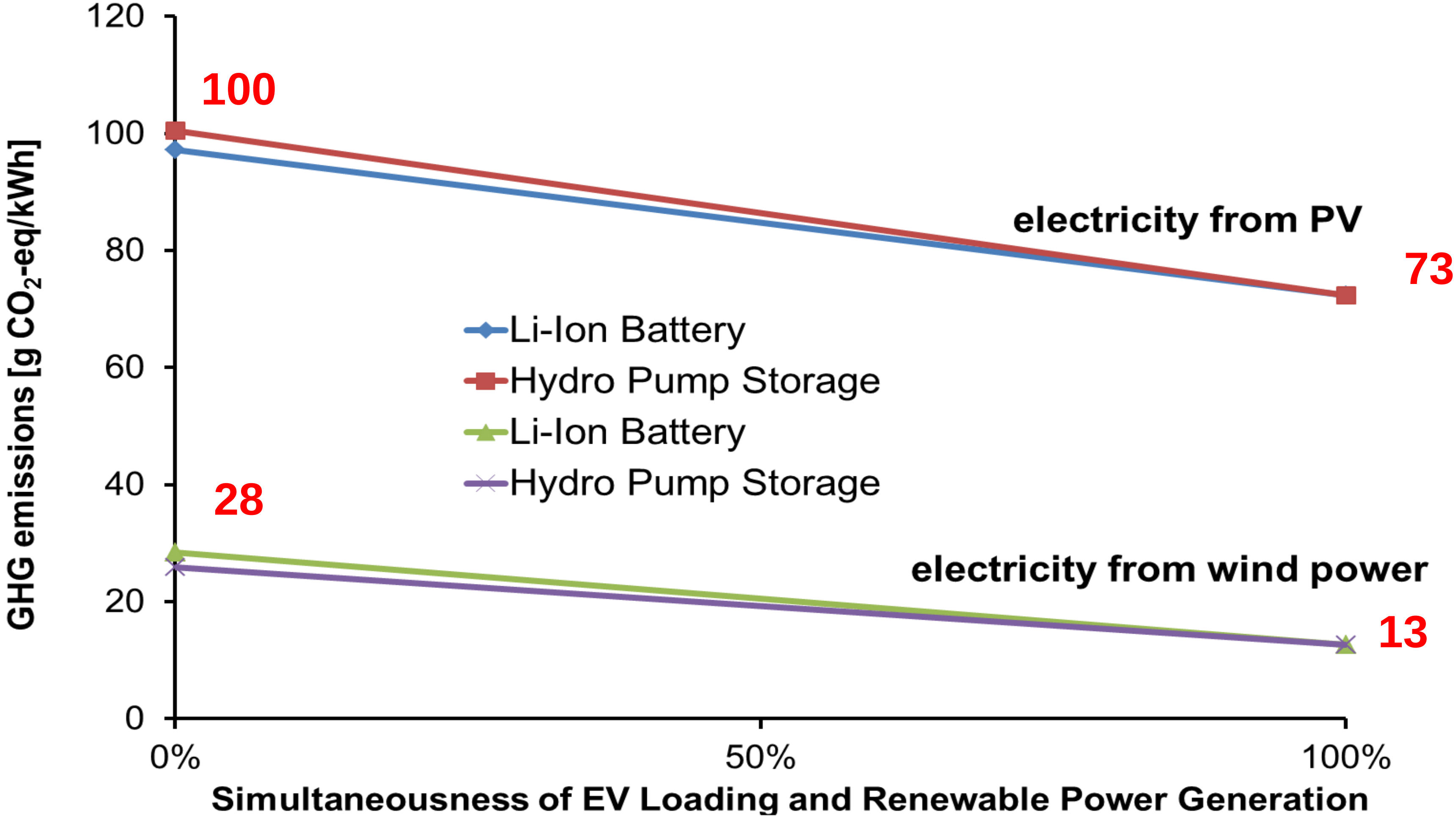
"Stored in grid"



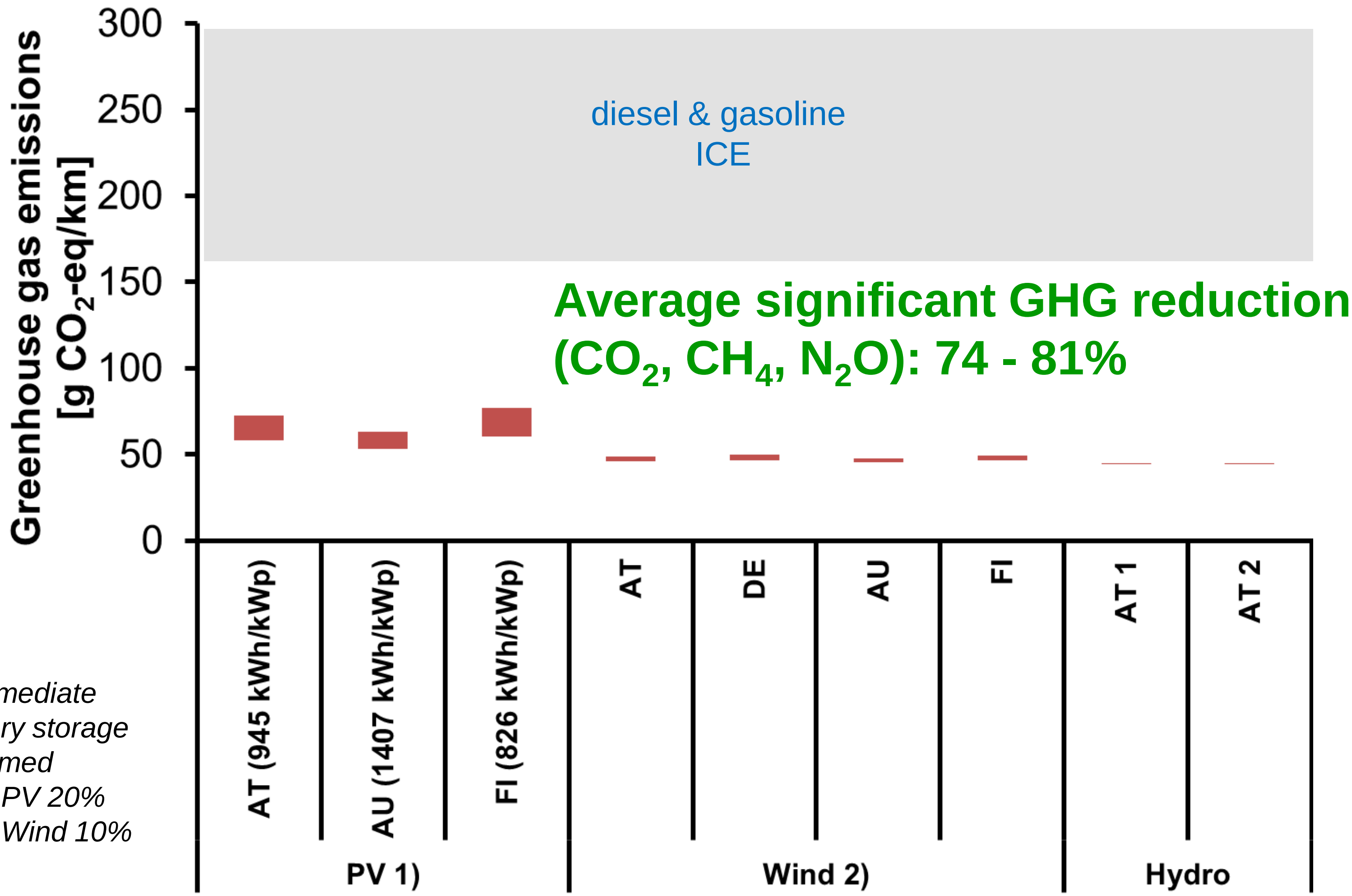
"Real time charging"



Emissions for Different Loading Strategies with Additional Renewable Electricity



GHG Emissions of Electric Vehicles - Renewable Electricity



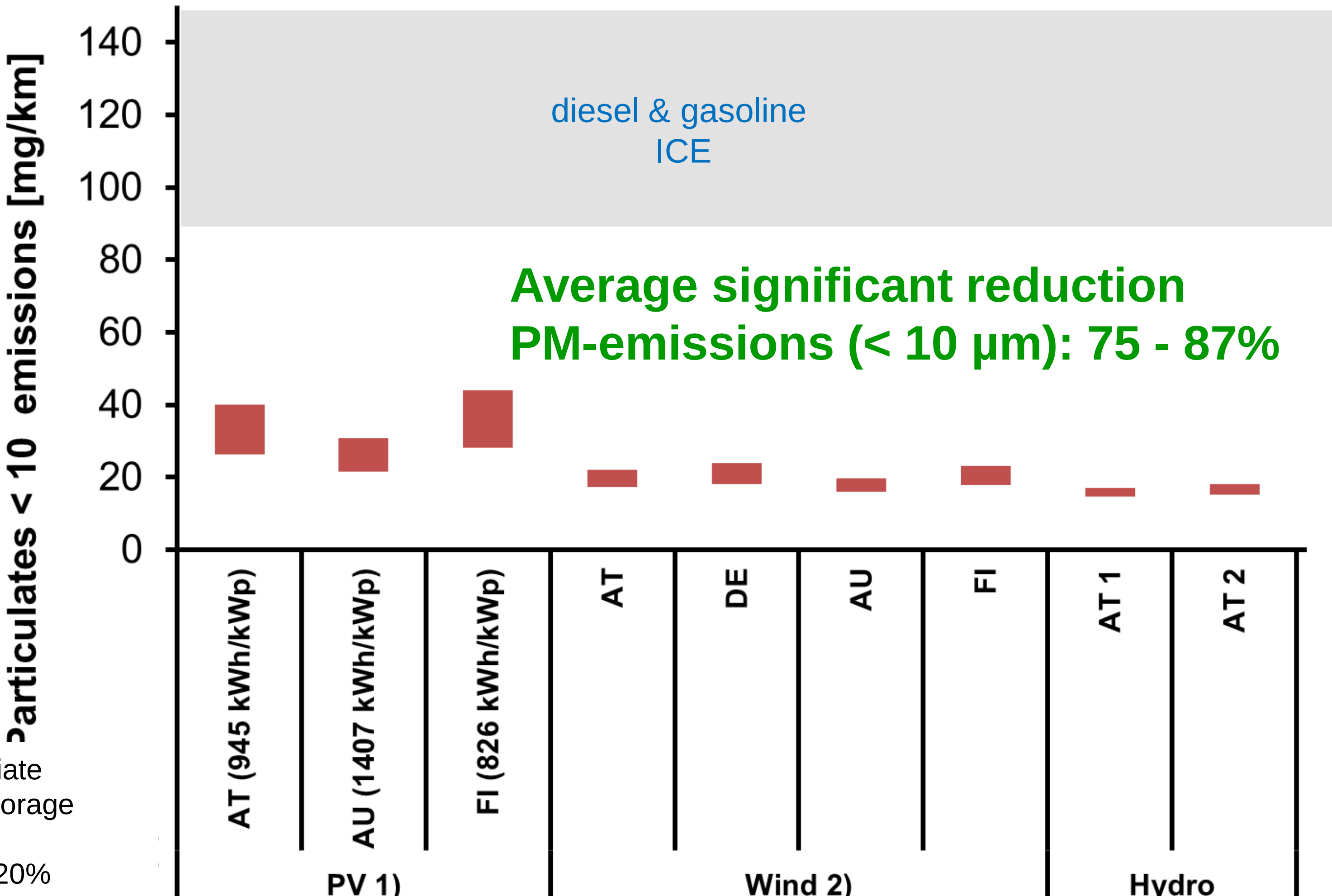
Intermediate battery storage assumed

1) *PV 20%*
2) *Wind 10%*

Electricity consumption EV at charging point for real driving cycle (e.g. heating/cooling): 15 – 30 kWh/100 km

Source: own calculations using data of ecoinvent

PM (< 10 µm)-Emissions of Electric Vehicles – Renewable Electricity



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ary

Additional renewable electricity with adequate charging strategies is essential for further significant reductions

Broad estimated ranges mainly due to

- Emissions of national electricity production
- Electricity consumption of EVs at charging point
- Fuel consumption of substituted conventional ICEs
- Data availability, uncertainty and consistency, e.g. PM

Estimation of environmental effects substituting diesel/gasoline

- GHG-reduction: - 20%
- PM < 10 reduction: - 60%
- Acidification increase: + 40%
- Ozone reduction: - 30%

about **700,000 EVs worldwide** (end of 2014):
Main countries US, JP, CN, F, DE, NO

Environmental Assessment of EVs only possible on **Life Cycle Assessment** compared to conventional vehicles

Your Contact

Gerfried Jungmeier

JOANNEUM RESEARCH Forschungsgesellschaft mbH.

LIFE – Centre for Climate, Energy and Society

Future Energy Systems and Lifestyles

Elisabethstraße 18
A-8010 Graz
AUSTRIA

+43 316 876-1313
www.joanneum.at/eng
gerfried.jungmeier@joanneum.at

www.ieahev.org/tasks/task-19-life-cycle-assessment-of-evs

www.ieahev.org/tasks/task-30-assessment-of-environmental-effects-of-electric-vehicles/