

Time and Rebound Effects in the LCA of Electric Vehicles



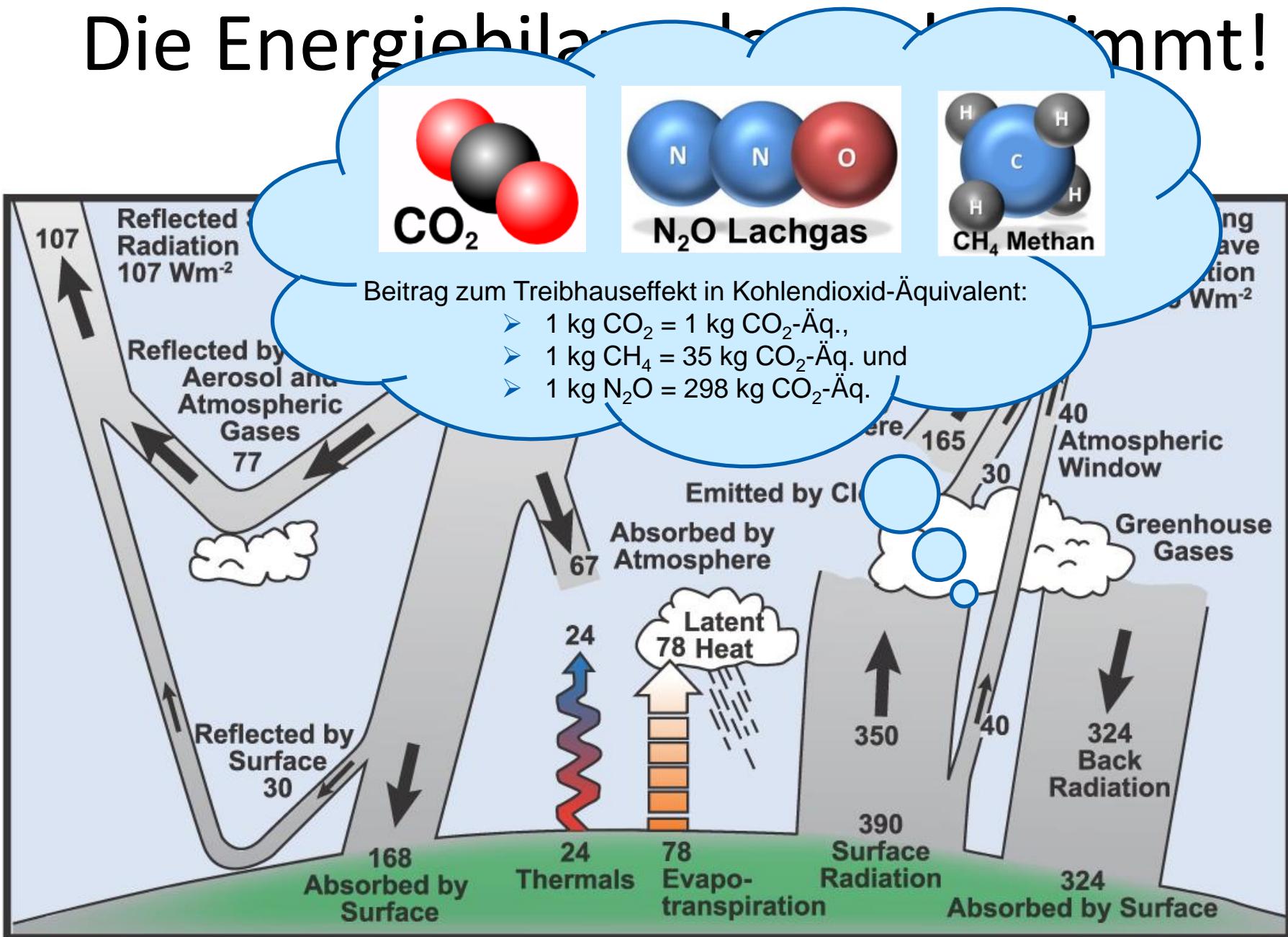
Methodological Approach and Examples

Gerfried Jungmeier

IEWT 2019

February 13 – 15, 2019, Vienna

Die Energiebilanz bestimmt!



Source: IPCC 2001

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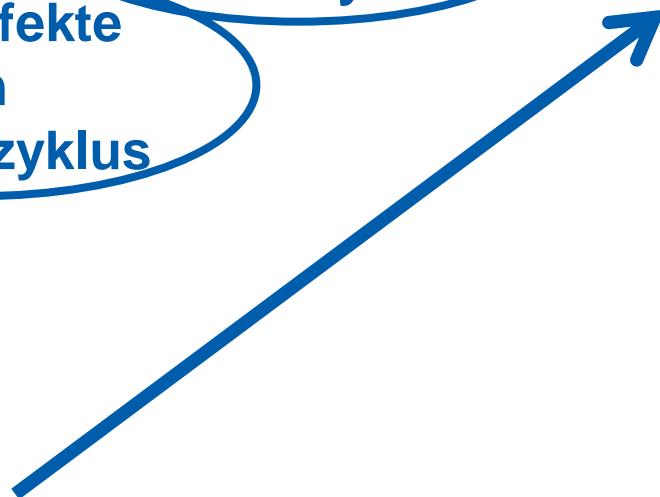
Die 4 großen
Irrtümer

Die 4 großen
Fakten

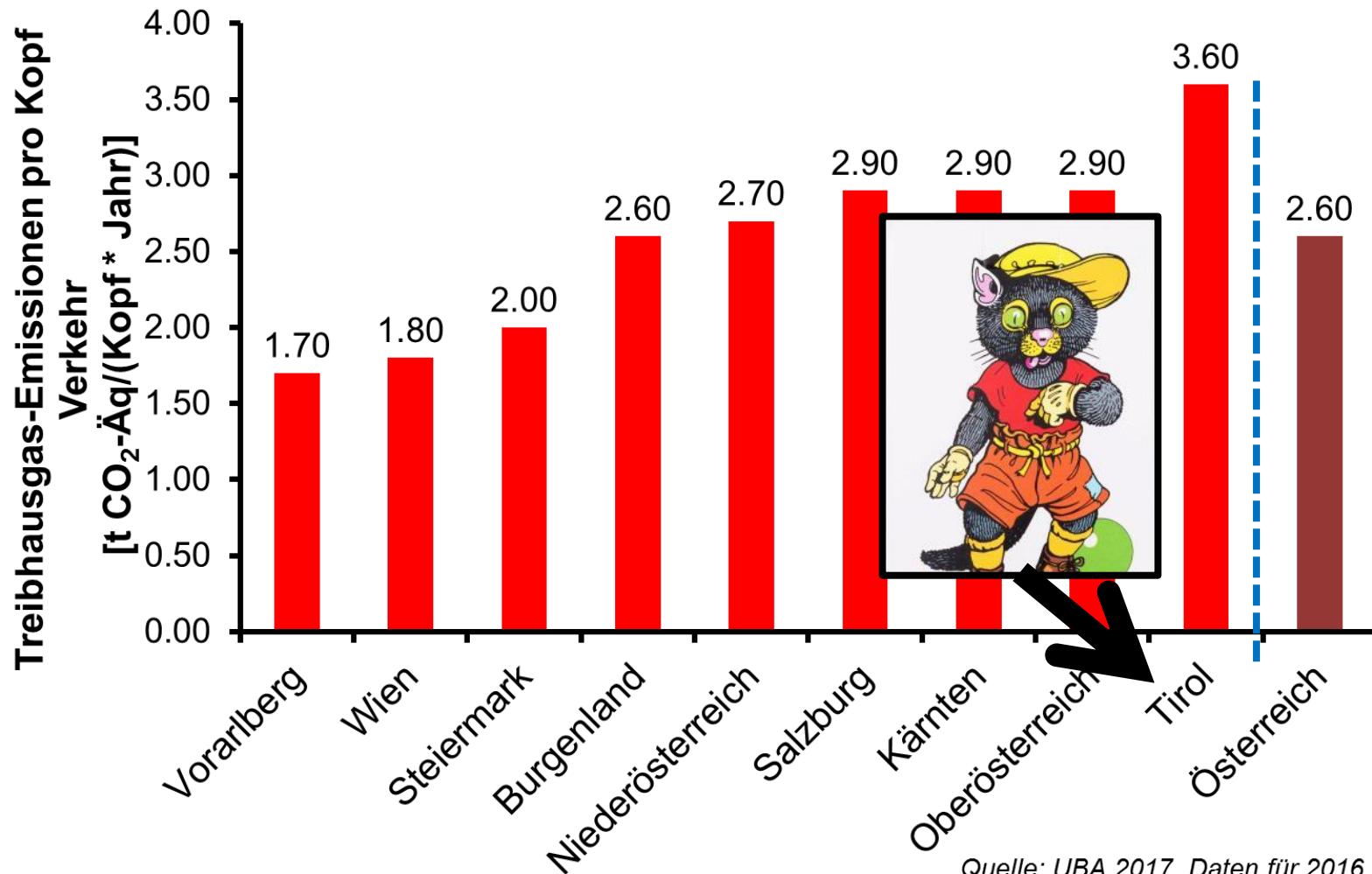
Zeit-Effekte
im
Lebenszyklus

Rebound-
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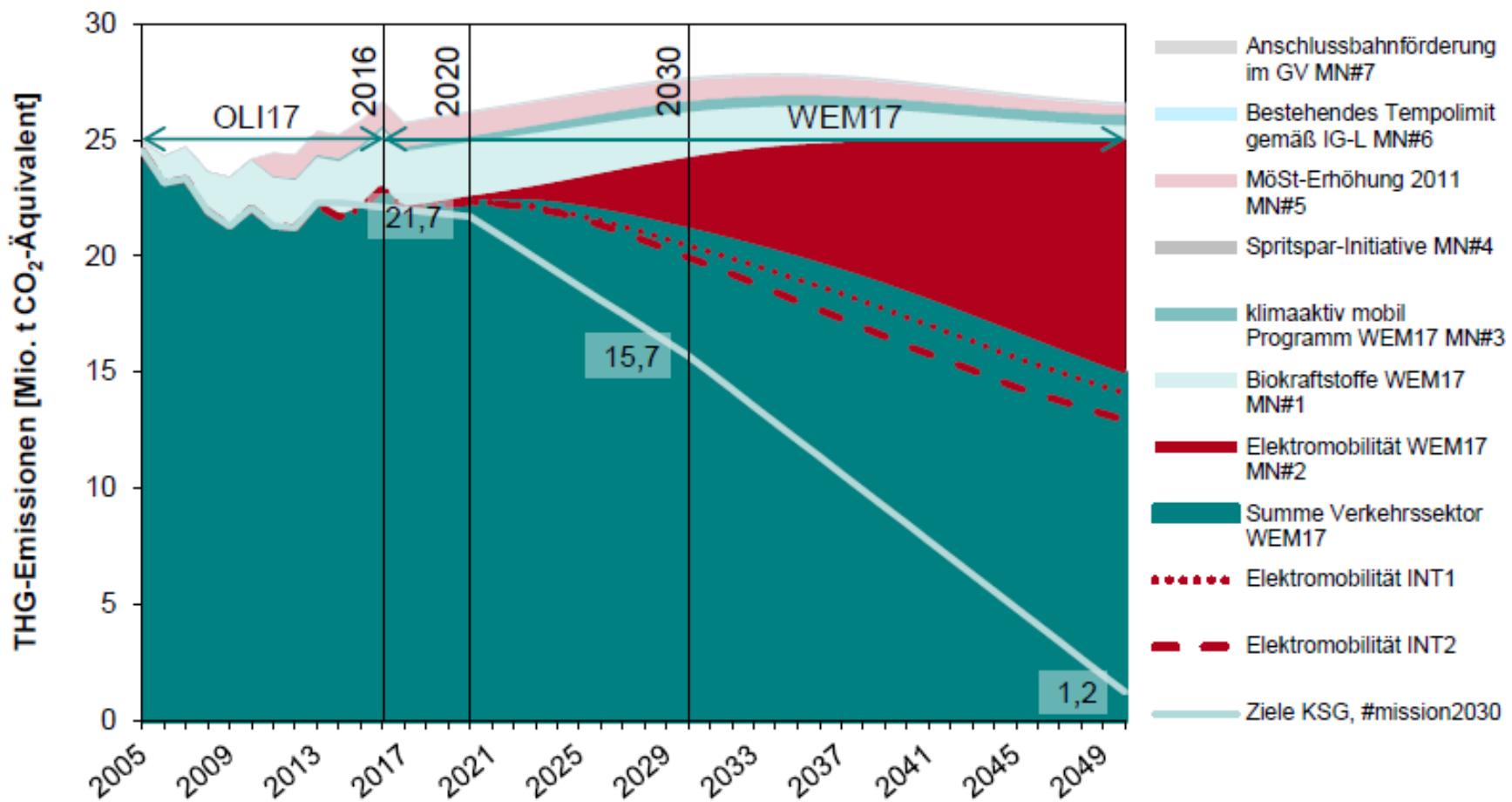
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Irrtum #1: Treibhausgas-Emissionen pro Kopf im österreichischen Verkehrssektor



Irrtum #2: Zero-Emission von E-Fahrzeugen

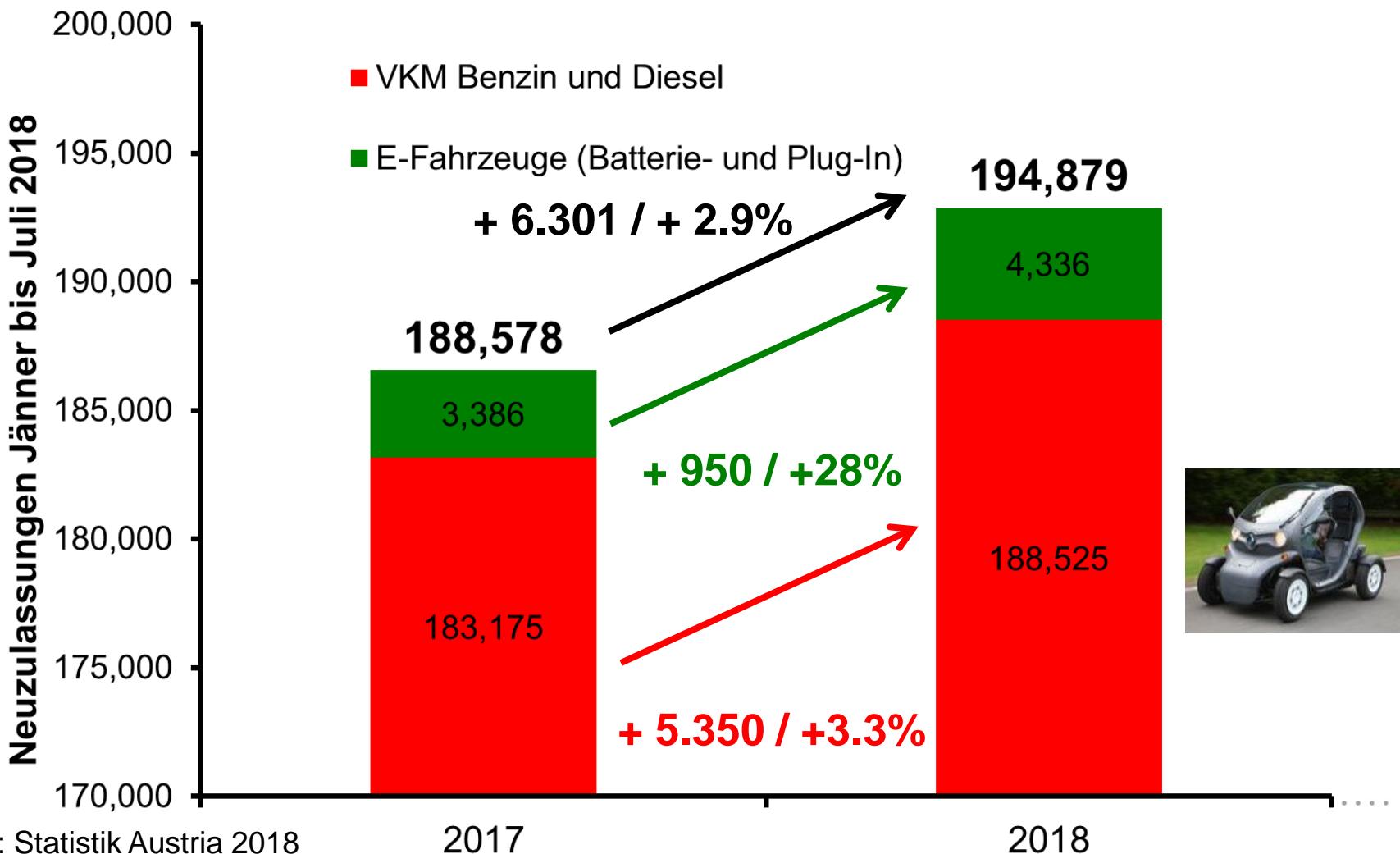


Datenquellen: 2005–2016: Ergebnisse der Österreichischen Luftschaadstoffinventur (OLI17)
2017–2050: WEM17

Irrtum #3: Technologie-Entwicklung bewirkt Umweltverbesserung



Irrtum #4: E-Autos ersetzen konventionelle Fahrzeuge



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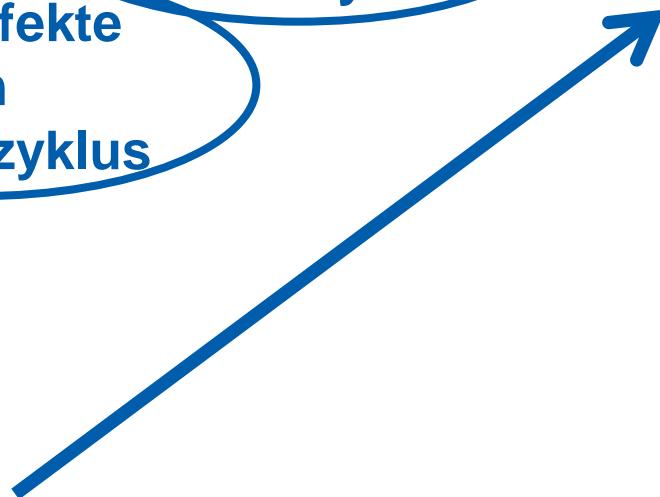
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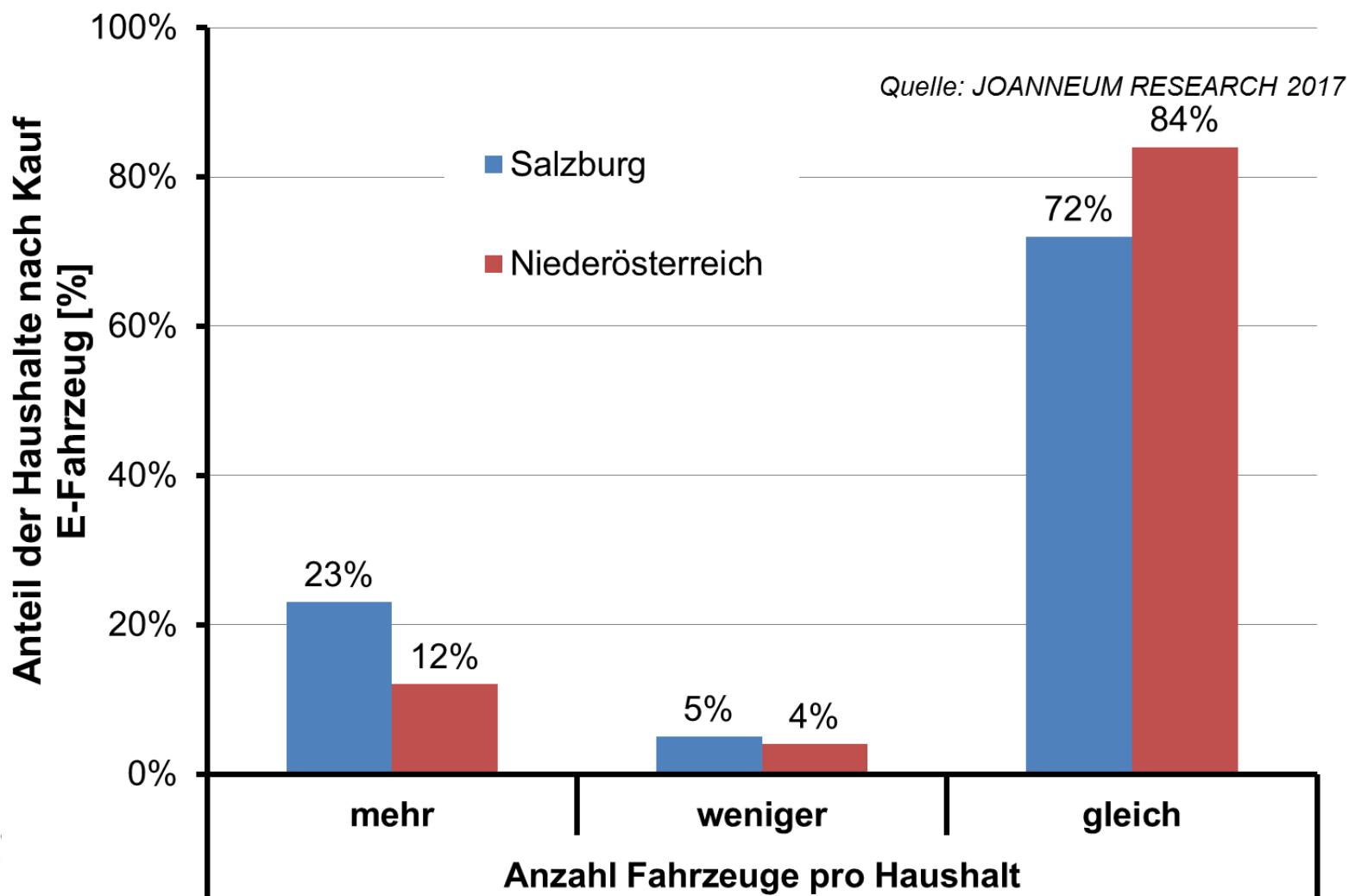
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Faktum #1: E-Fahrzeuge erhöhen Anzahl an Fahrzeugen pro Haushalt



Faktum #2: Die E-Mobilität gibt es schon lange.....



..und ist
„Shared Mobility“ und
“Autonomes Fahren“

Faktum #3: Mobilität beginnt im Kopf

Warum muss ich woanders hin?

Welche Wahl-Möglichkeiten gibt es?

Wie wird entschieden?



Faktum #4: Umweltbewertung NUR mit Lebenszyklusanalyse möglich

“Es besteht internationaler Konsens,

dass die Umweltwirkungen von

Produkten und Dienstleistungen nur auf

Basis von Lebenszyklusanalysen

Produktion - **Life Cycle Assessment (LCA)** - Anwendung

bewertet werden können.

Rohstoff-
(Produktion–Nutzung–Entsorgung/Verwertung)
Produktion Nutzung Entsorgung Verwertung

“....und im Vergleich zu anderen Produkten
und Dienstleistungen”



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Key Questions for Further Developing LCA Methodology

- How does rapidly changing electricity mix affect the LCA results?
- How to apply LCA for Electric Vehicles in scenario analyses adequately?
- Does each electric driven kilometer really substitute a fossil driven kilometer? Do we need an appropriate new functional unit?
- And how do these aspects effect the application of LCA to whole current or future vehicle fleets?

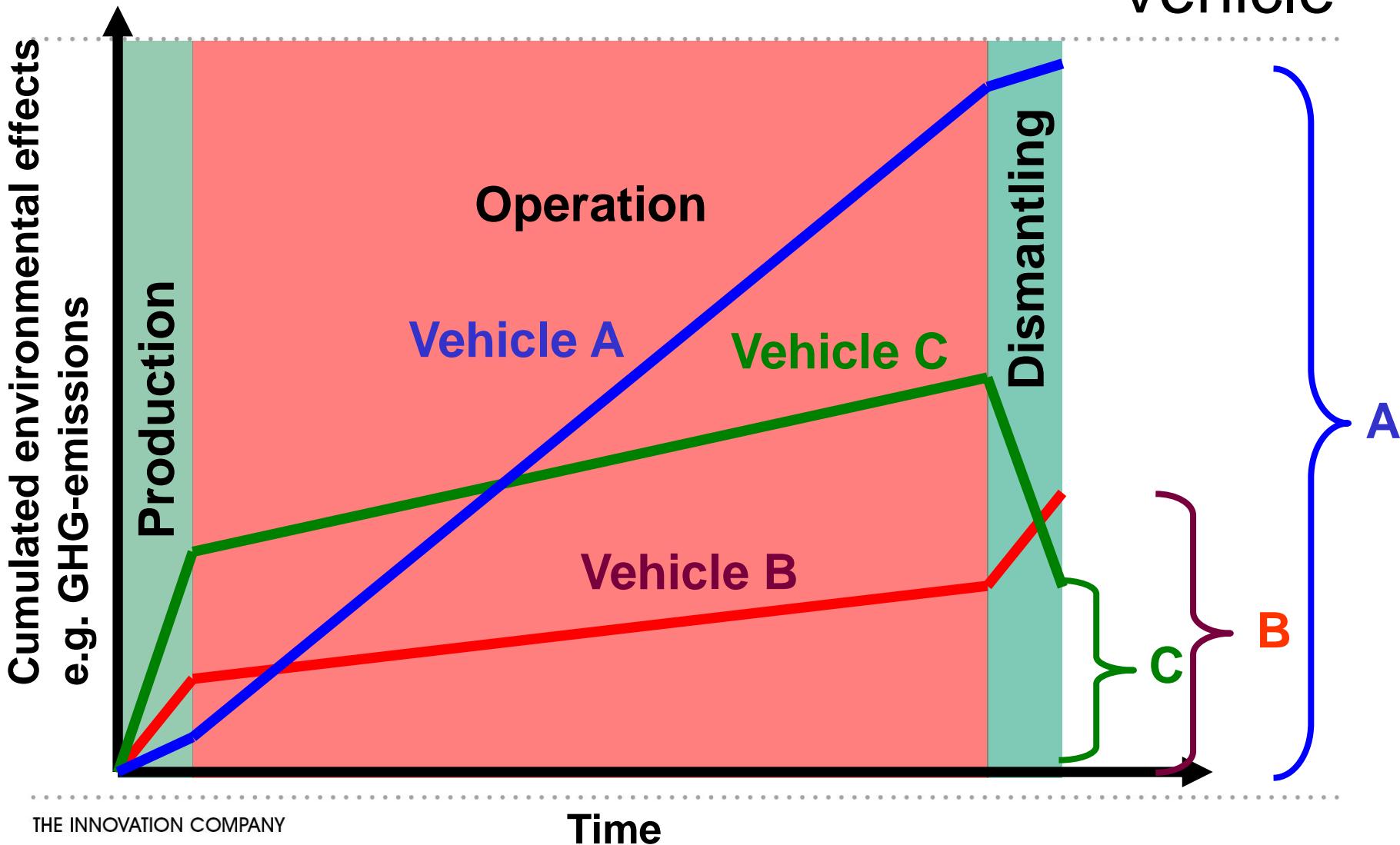
Activity in

IEA HEV Task 30
„Environmental Effects of Electric Vehicles“

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The Three Phases in the Life Cycle of A Vehicle



Time Effects in LCA

■ Standard LCA:

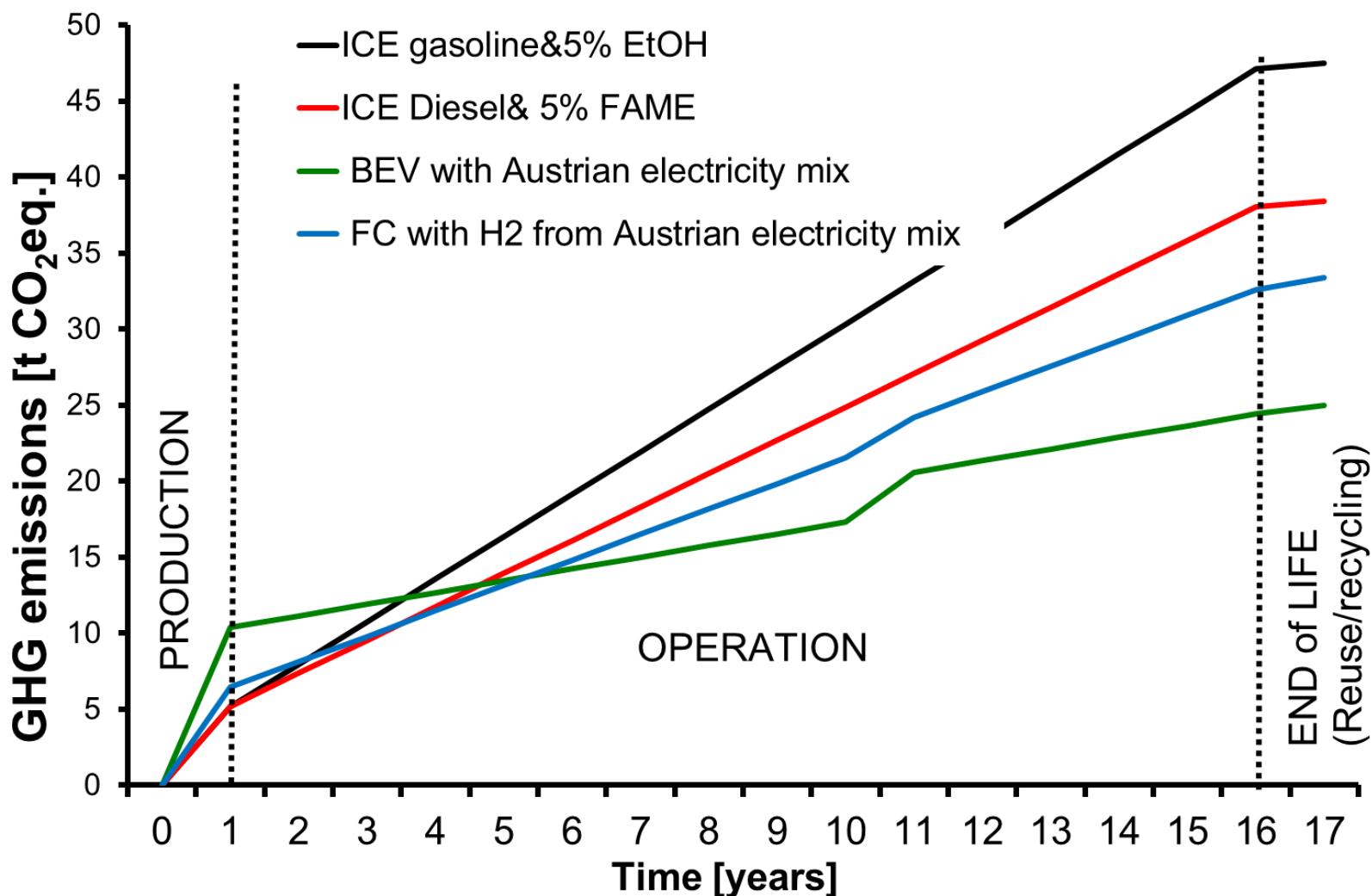
- constant conditions over lifetime of vehicles
- Results: average over lifetime of vehicle

■ Time effects in LCA: changing conditions during life time e.g.

- Production: new battery if lifetime of battery shorter than of vehicle
- Operation: changing of electricity mix
- End of Life: credits from recycling/reuse

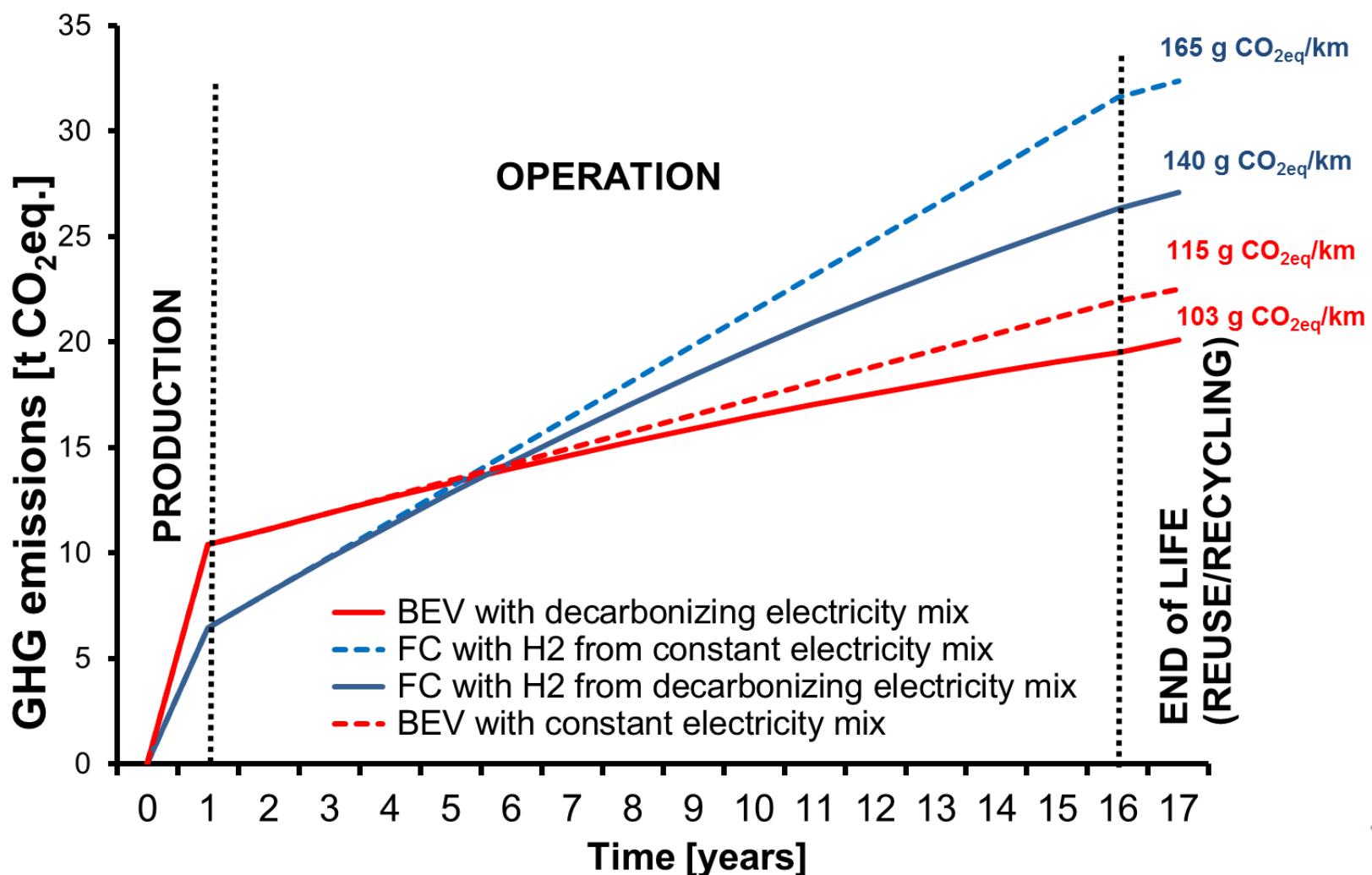
Example #1: New Battery and Fuel Cell after 10 Years

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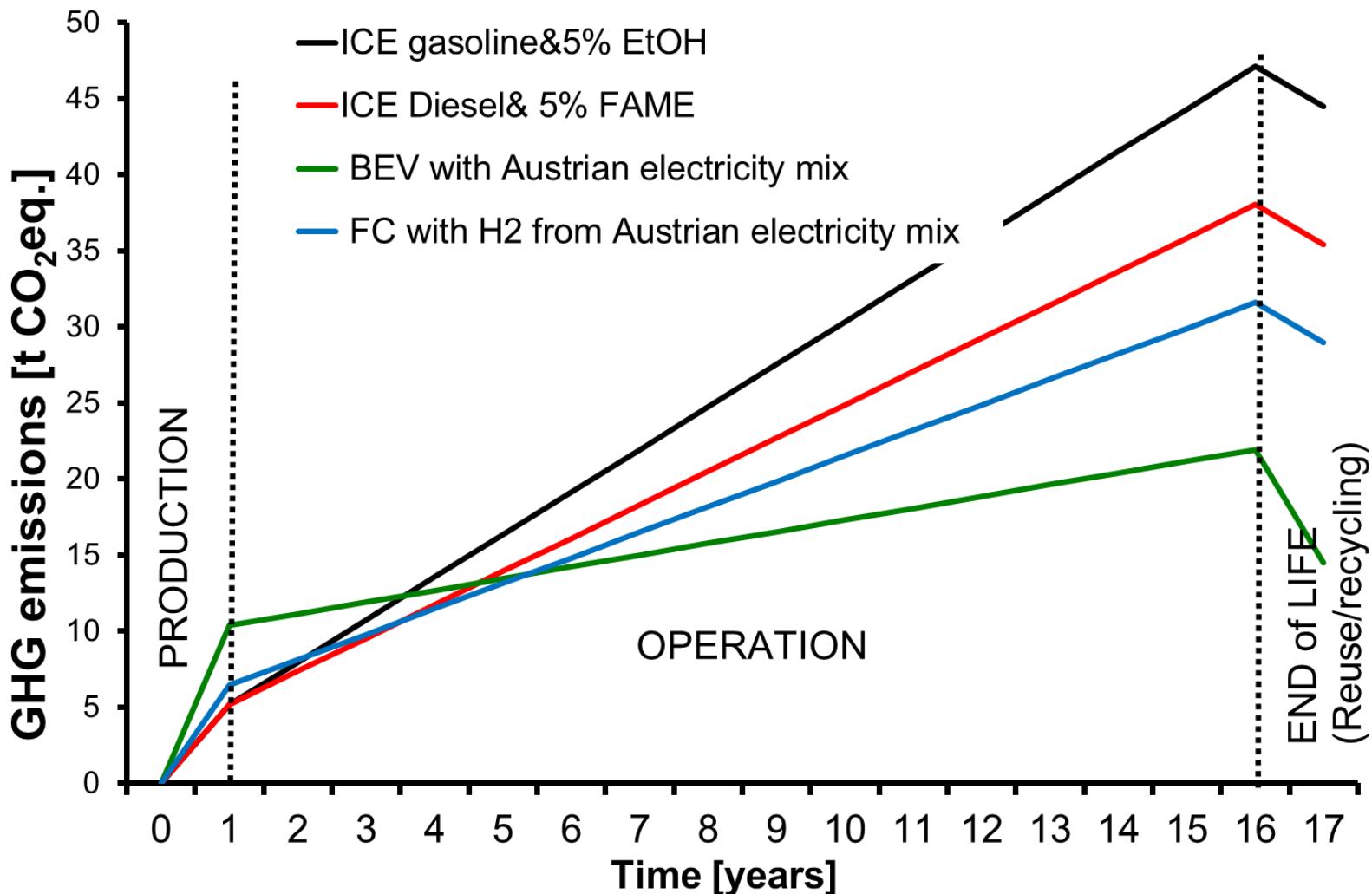


Example #2: Changing Electricity Mix Over Lifetime of BEV

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Example #3: Credits for Recycling



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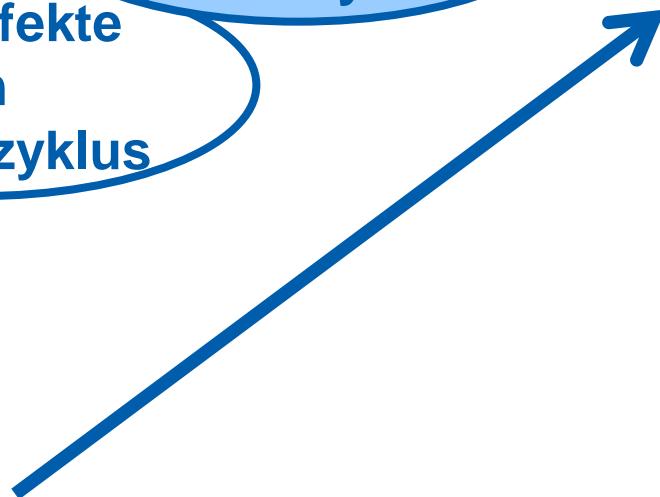
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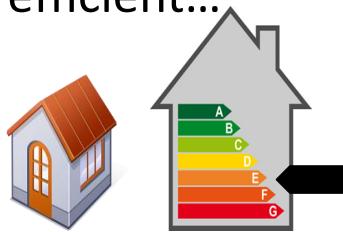
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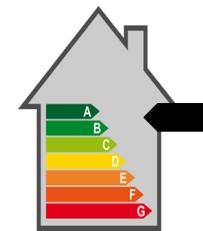
What is rebound?

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As heating becomes more efficient...



... we live in bigger houses.



... and we spend the savings in other consumption domains.

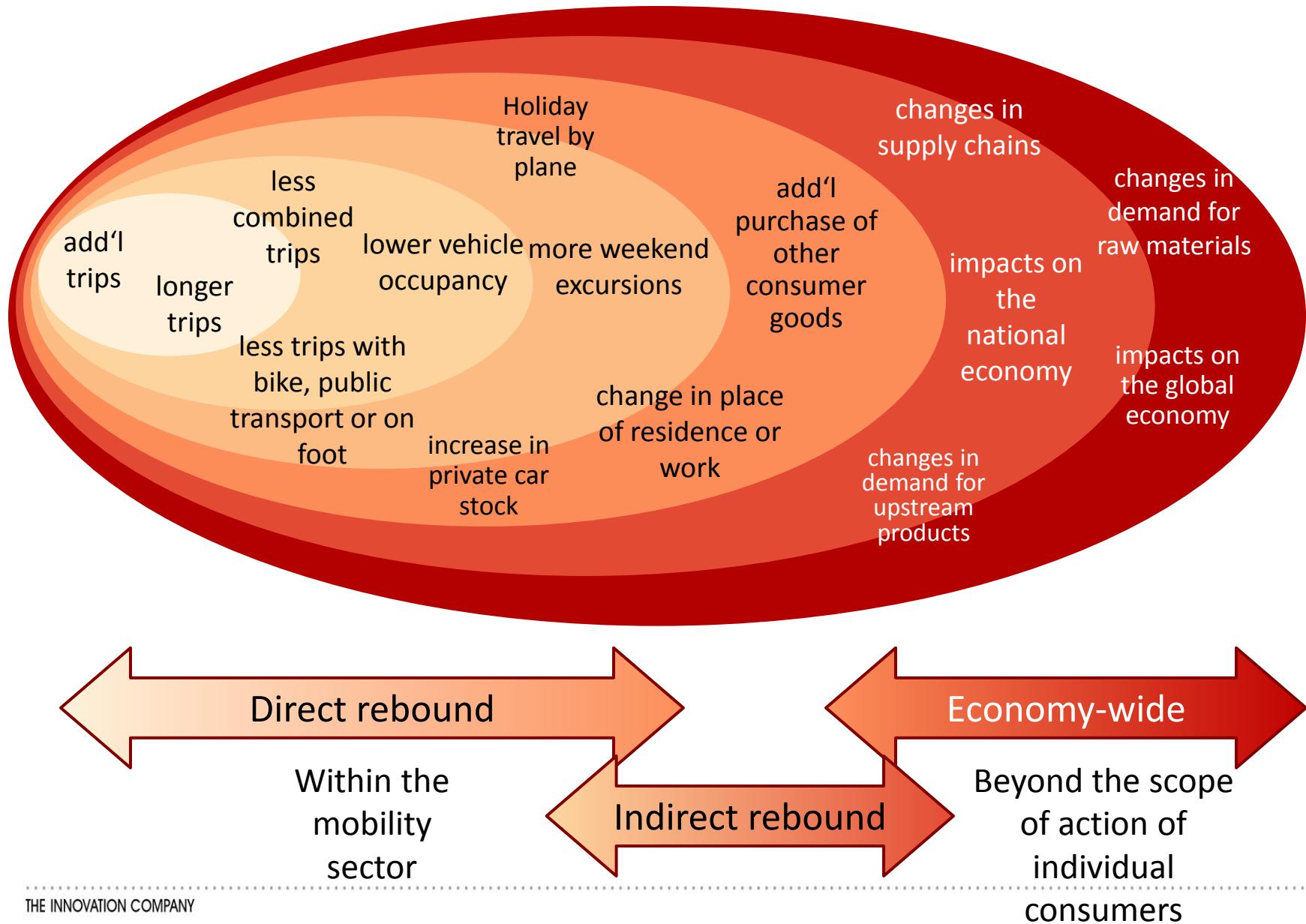
As cars consume less fuel...



... we drive more.



System Boundaries of Rebound Effects

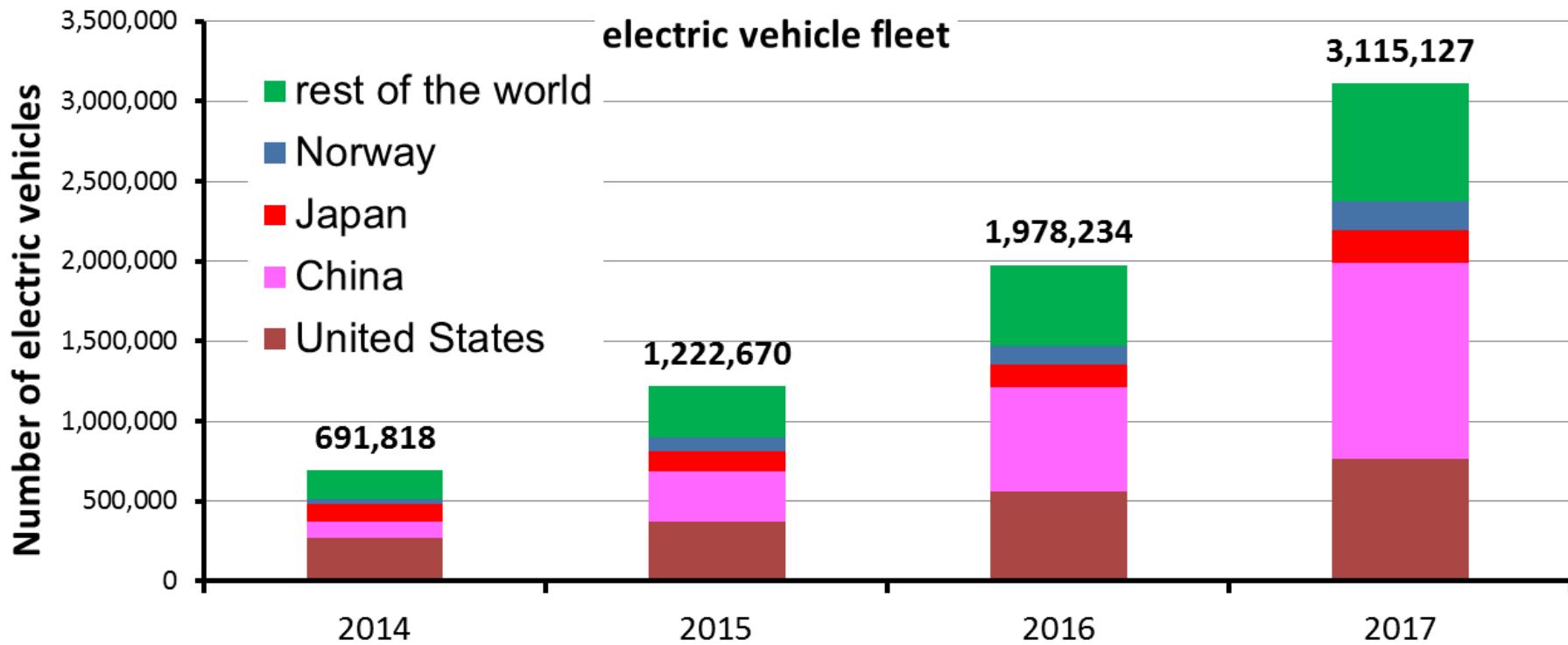


Potential Rebound Effects of EVs

- Energy costs for electricity lower compared to fossil fuels because of taxation
 - Direct rebound effect: drive more because of lower energy cost
 - Indirect rebound effect: consume more because money is saved
- Higher investment costs might lead to more driving to be more economic
- EVs are seen to be „green“
 - Germany: EVs drive 2 – 3 times more than average ICE
 - Austria: EVs drive 30% more than average ICEs
 - Use EV instead of walking, biking and public transport
- EVs become 2nd or 3rd car in household

LCA for Growing Number of Electric Vehicles Fleet Worldwide

BEV (60%) and PHEV (40%)



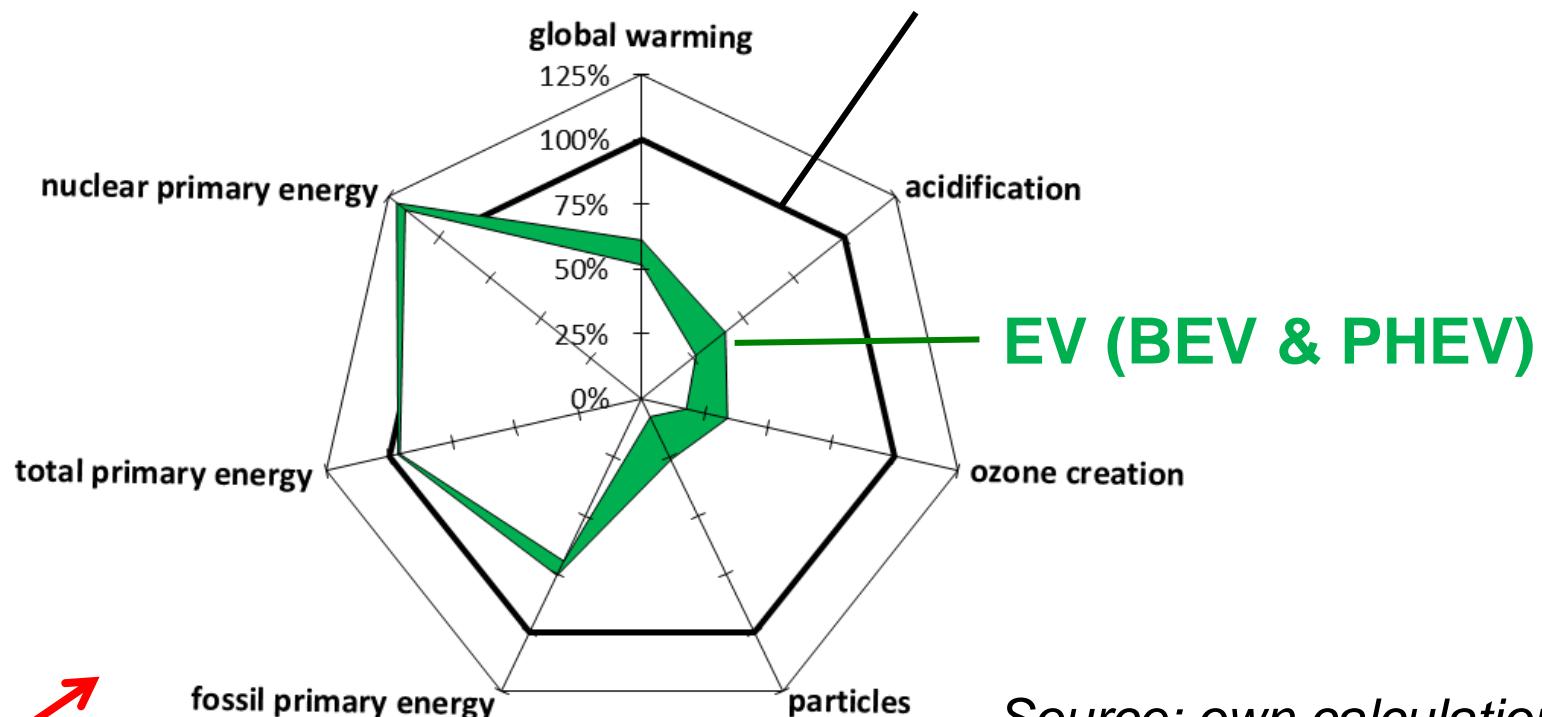
Sources: IEA HEV annual report, EVI, ExCo members

ENVIRONMENTAL EFFECTS: Comparison ICE and EVs

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Austria

Conventional ICE



FACT SHEET



NOVATION COMPANY

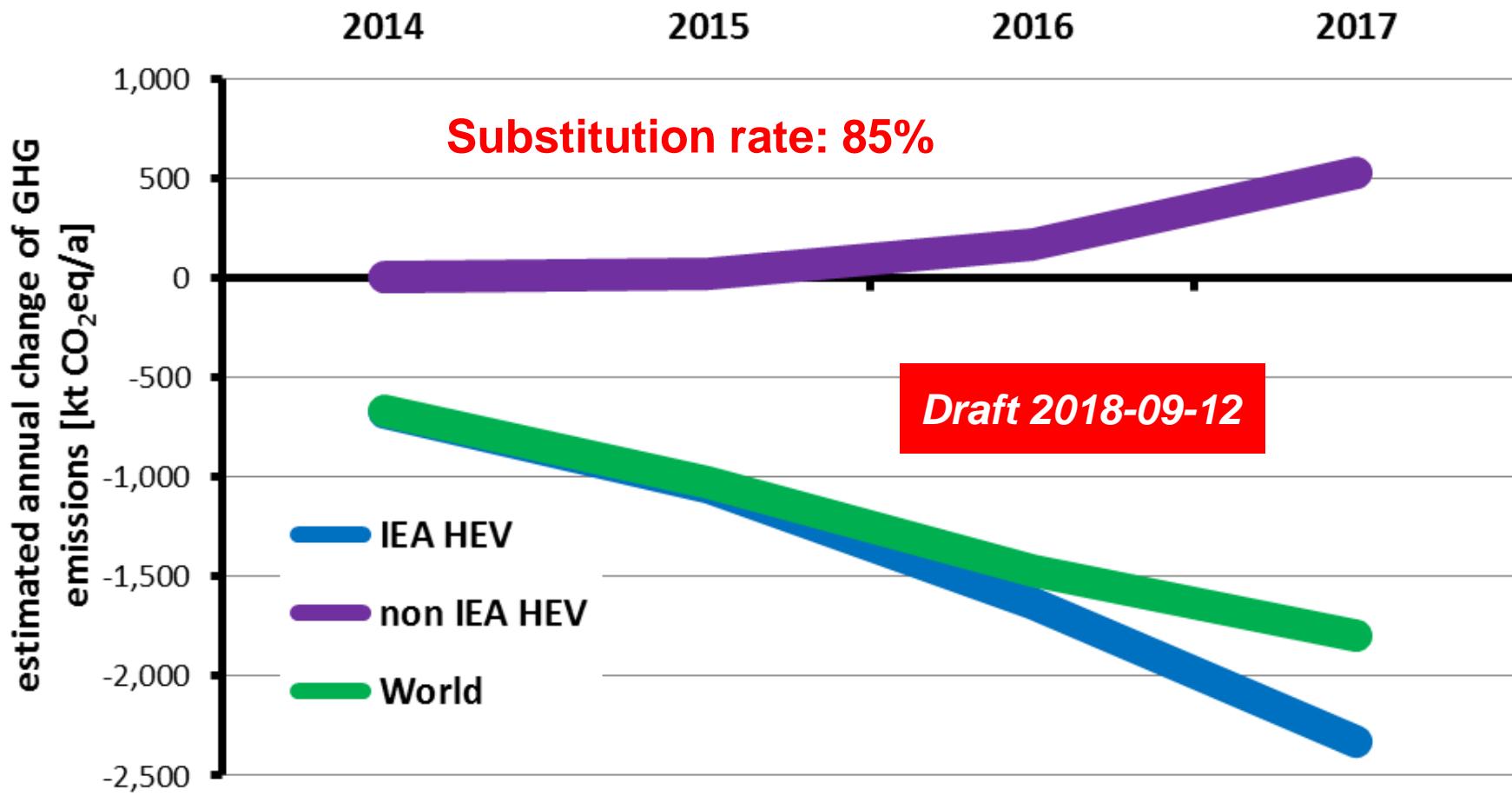
Source: own calculations

Substitution rate: 85%



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Estimated GHG Change of Global EV Fleet (I)



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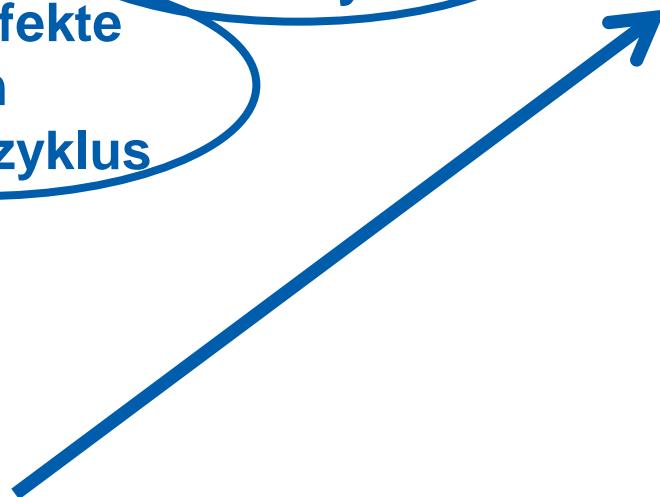
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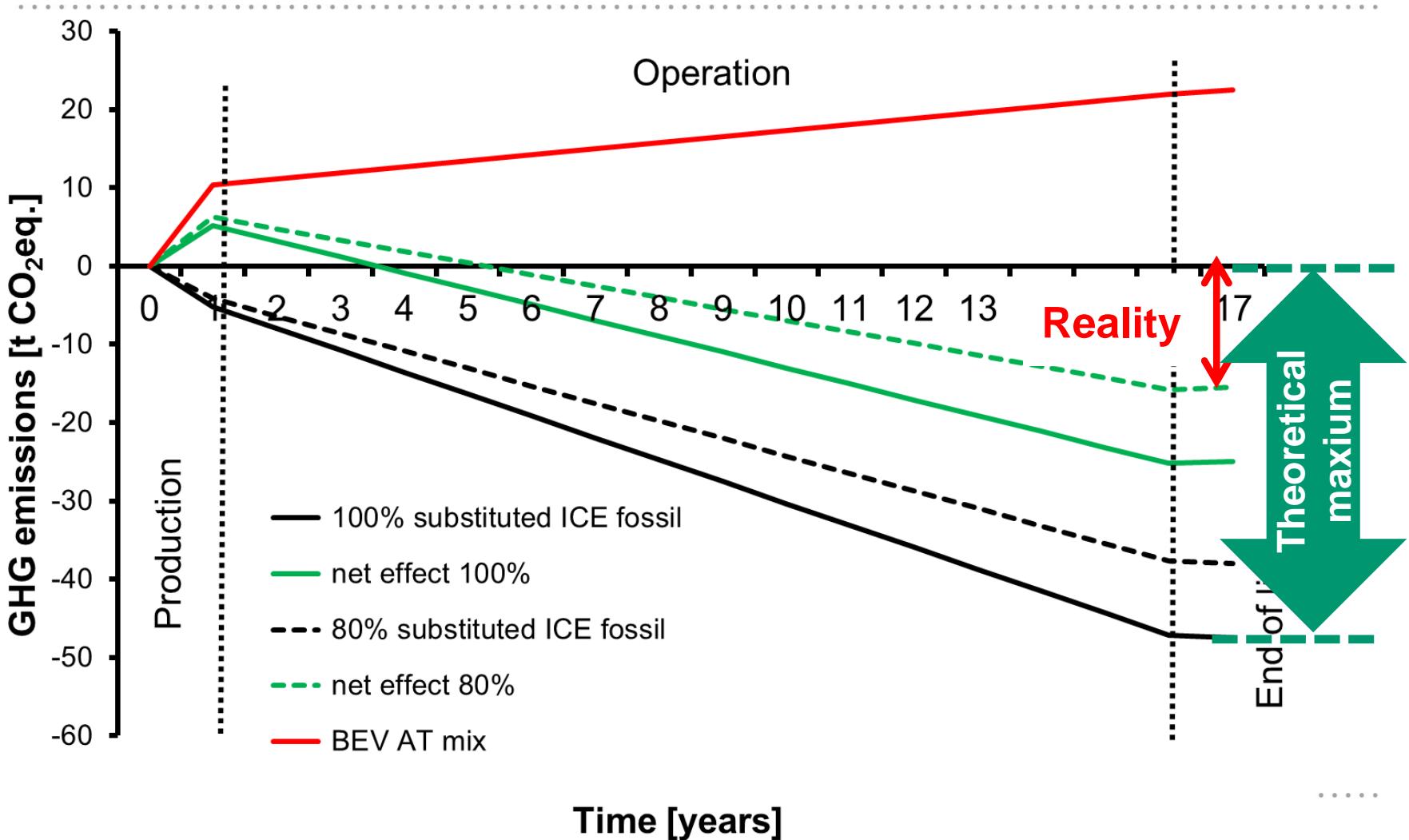
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GHG Emissions of EVs substituting ICEs



Summary

New developments in LCA methodology necessary done in IEA HEV Task 30

Future scenarios and LCA must include timing of environmental effects and rebound effects

Estimation of environmental effects substituting diesel/gasoline show positive environmental effects by 3.1 Mio. EVs in 2017

Electric vehicles **do not substitute ICE vehicles by 100%** and/or substitute e.g. public transport or create new mobility services

Considering **Time and rebound effects** are essential to avoid overestimation of environmental benefits e.g. Paris target

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

Your Contact

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LIFE – Centre for Climate, Energy and Society

Future Energy Systems and Lifestyles



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