The concept of efficiency in the German climate policy debate on road transport

Study for MWV and UNITI - results

26 October 2020

Translation of the German presentation delivered on 26.10.2020

Our goal: A comprehensive efficiency analysis of BEVs and ICEVs powered by green PtL/E-fuels

Background

- **The energy efficiency of technologies** is one of the key issues in the current energy policy debate and an **important guideline for political decisions**.
- **Conventional efficiency comparison** of electromobility and renewable fuels
  - **often identify battery electric vehicles as the single technology of choice** and refer to their efficiency
  - but **disregard important parameters for an appropriate comparison**

Study objective

- Against this background, MWV and UNITI commissioned Frontier to carry out a **comprehensive efficiency analysis**, **considering all stages of generation and energy conversion**.
- The focus is on
  - **battery electric passenger cars (BEVs)** and
  - **internal combustion-engined vehicles (ICEVs) powered by "green" PtL**

Our core results at a glance

1. **Conventional efficiency analyses** adopt a **more limited** and **national perspective**.
   In contrast, **comprehensive efficiency comparisons** take **all key parameters** into account.

2. When conducting a **comprehensive efficiency comparison** for production and use, **ICEVs** operated with green PtL show a **similar efficiency** to **BEVs**.

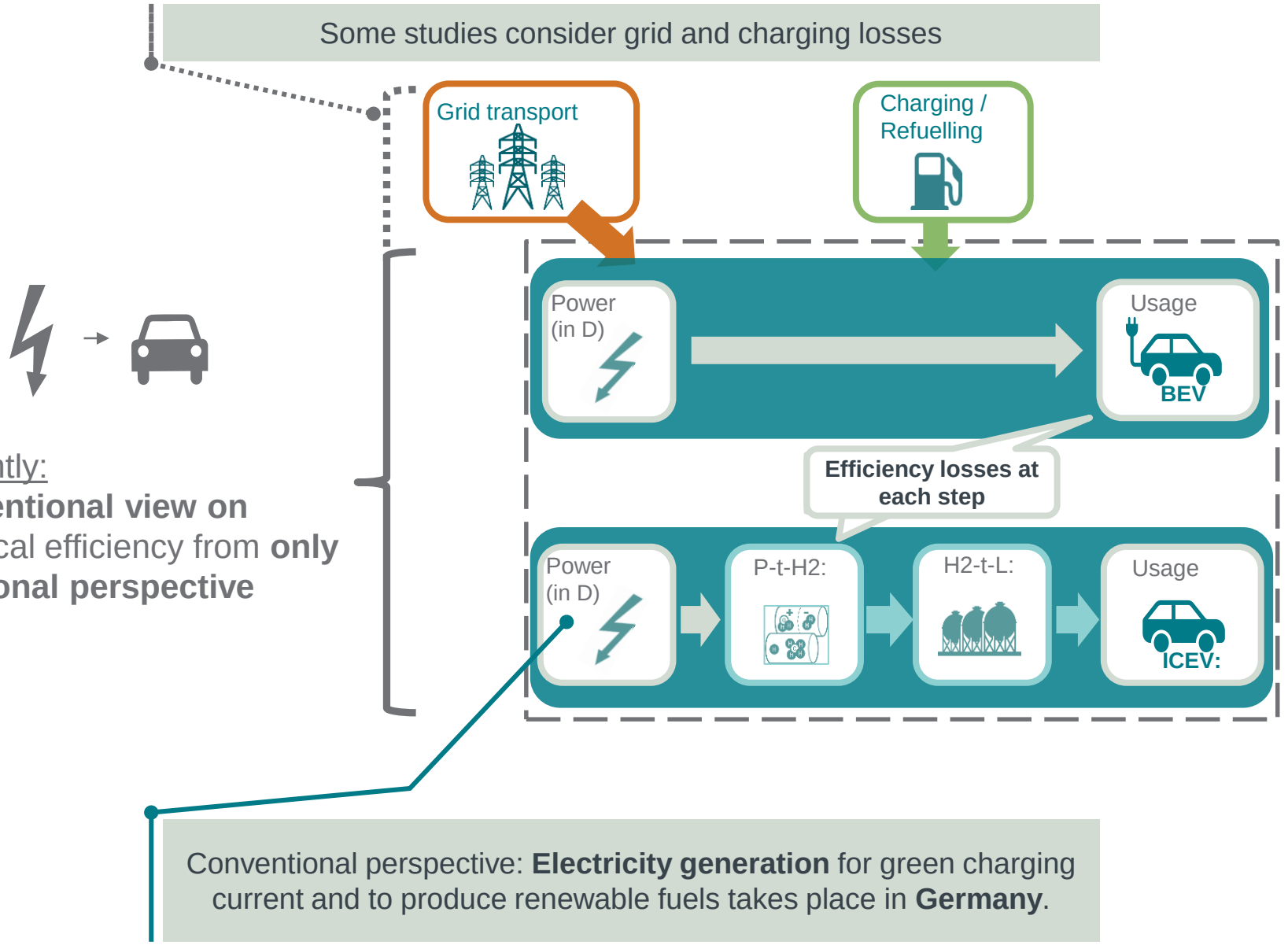
3. This is largely explained by the fact that **conventional efficiency analyses** often **take nationally isolated perspectives**; we take into account **international differences in the capacity factors of renewables**

4. The **renewable energy capacity** to be installed to run a passenger car is similar - but with PtL, large **non-European renewable energy potentials** can be exploited.

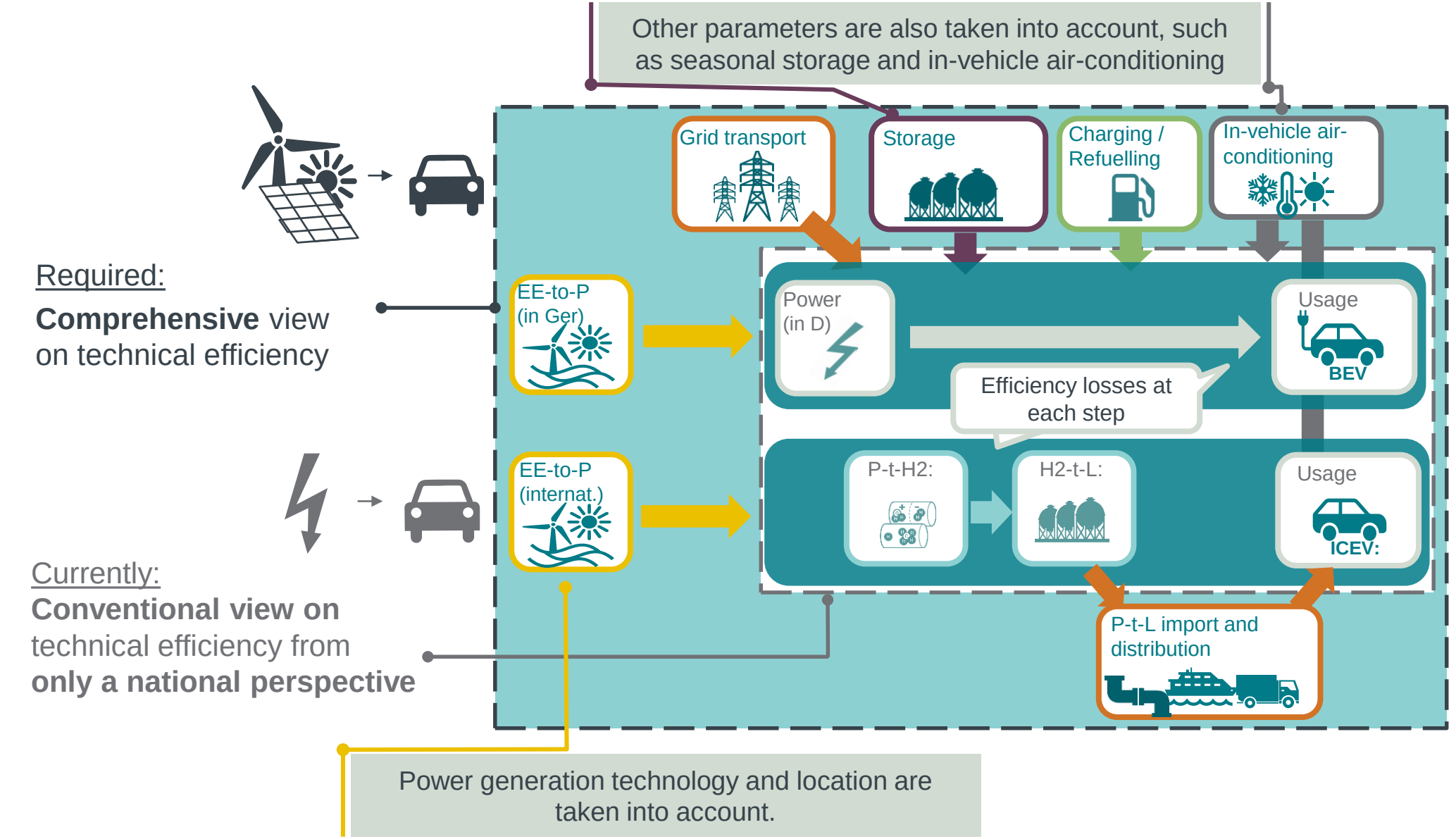
5. **Sensitivity analyses** confirm this result and depending on the configurations, ICEVs may even outperform BEVs in efficiency terms.

6. **"Technical" efficiency** should also be interpreted in the context of **systemic** (including **economic** and **ecological**) **efficiency**.

Conventional efficiency analyses adopt a nationally isolated perspective and overlook important parameters

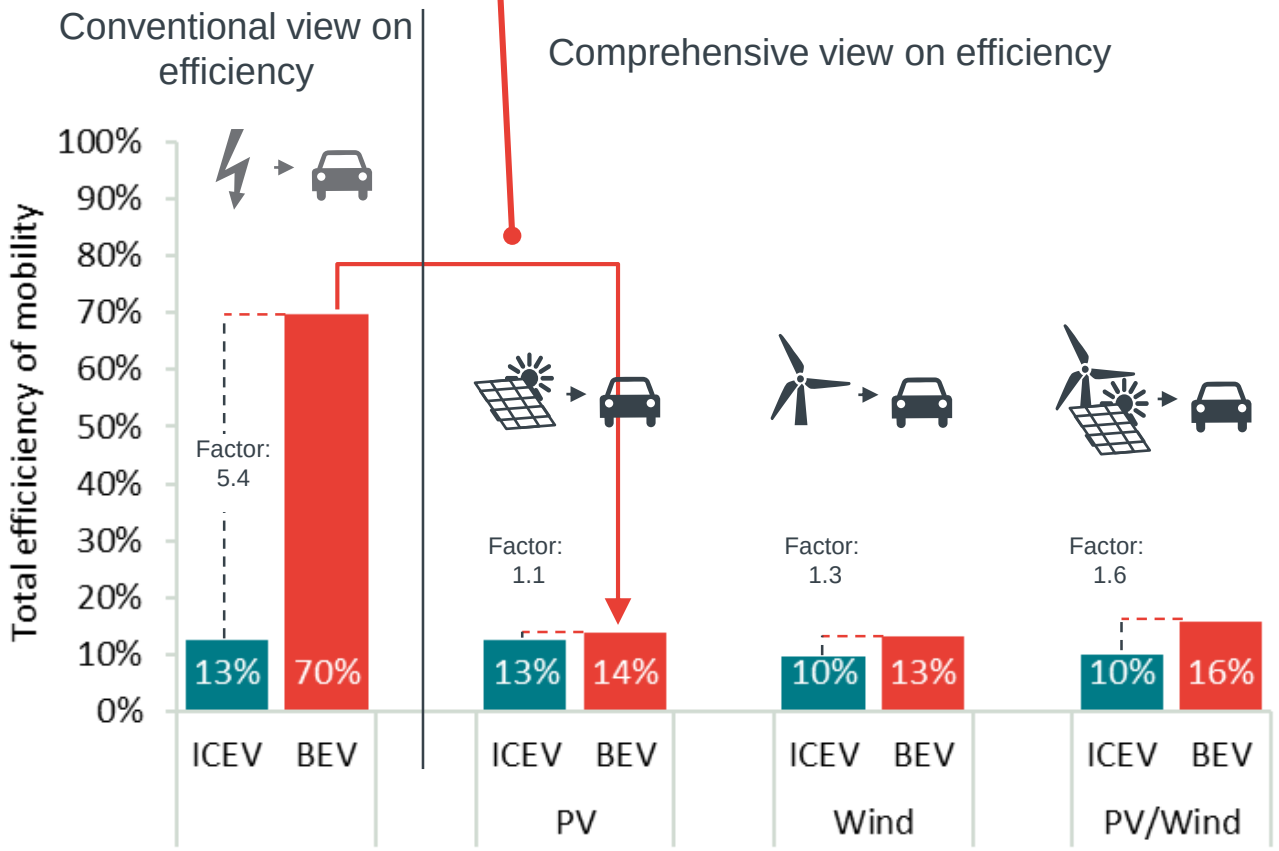


Conversely, an **comprehensive efficiency comparison** takes all key parameters into account, such as the scope to import PtL



A comprehensive efficiency comparison shows that the efficiency of ICEVs powered by green PtL is **similar in magnitude as of** BEVs

The efficiency with which green electricity is used in **BEVs**, which conventional analyses put at **around 70%,** declines in a comprehensive analysis **to between 13 and 16%**, which is comparable to that of ICEVs.

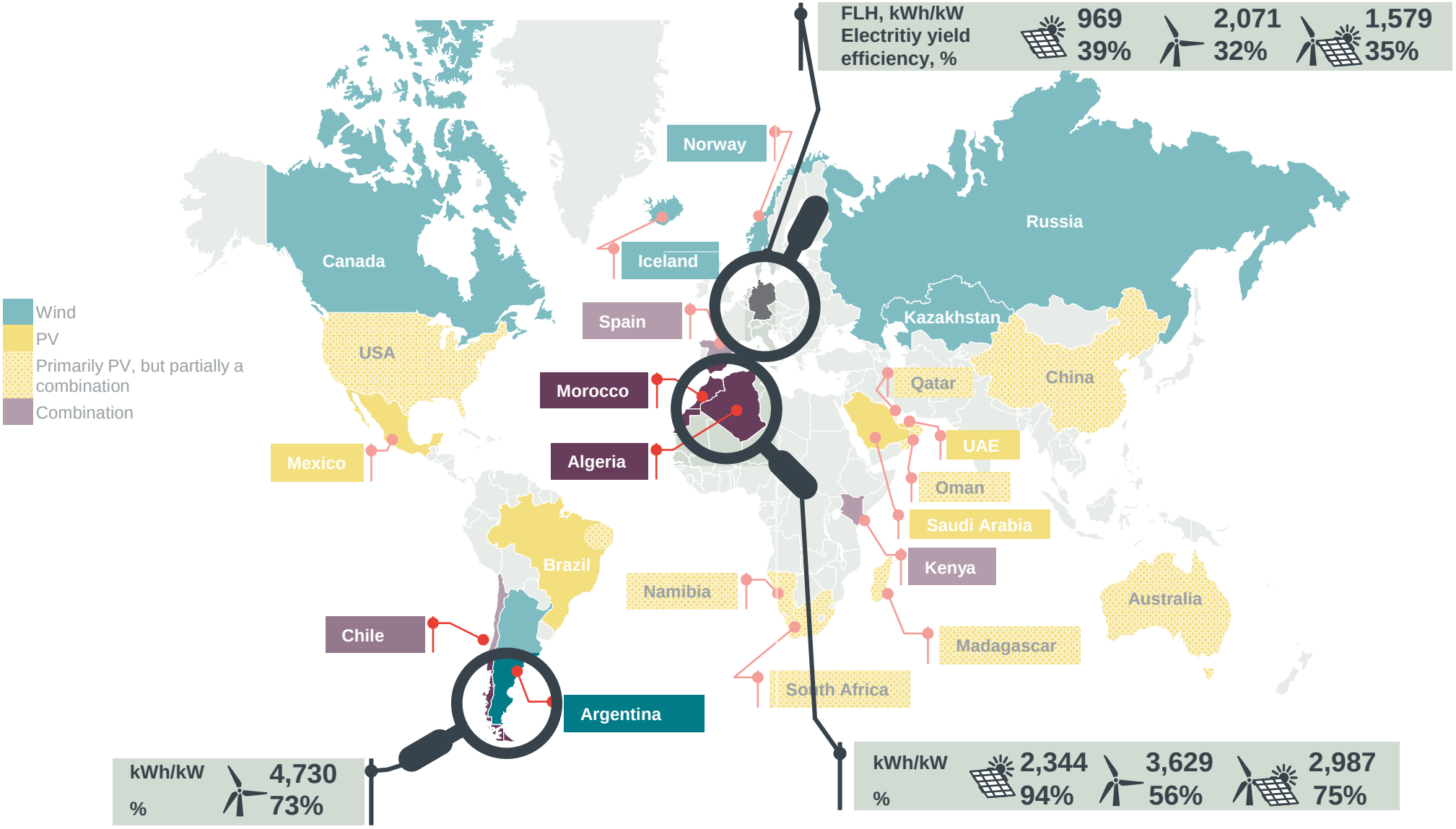


PV – BEV: Solar plants in Germany (D), ICEV: Solar plants in North Africa (NA) for the production of PtL.

Wind – BEV: Wind power plants in D (onshore / offshore); ICEV: Wind power plants in Argentina/Patagonia for producing PtL.

PV/Wind – BEV: Solar and wind power plants in D, of which 50%; ICEV: Solar and wind power plants in NA.

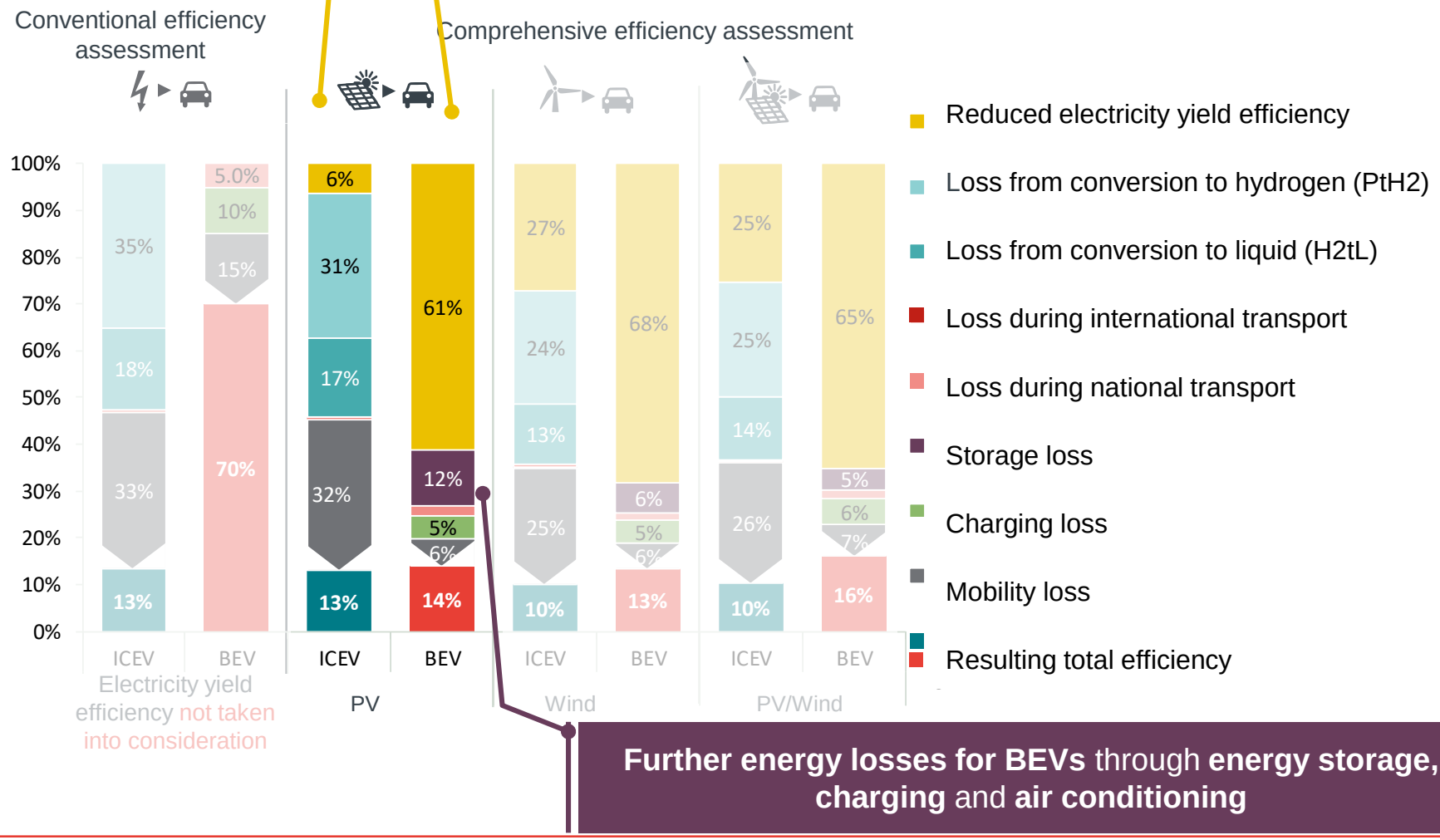
Primary reason: Conventional efficiency analyses often take a national perspective, we consider **renewable electricity yield efficiency**



Note: Converting the full-load hours (VLS) into an efficiency score (electricity yield efficiency) requires a benchmark, which compares the respective VLS achieved. As a benchmark for 100% efficiency of PV and wind systems, we use the maximum respective VLS currently achievable worldwide with the respective technology. For PV systems this is 2,500 hours (e.g. in the South American Atacama Desert) and for wind systems 6,500 hours (e.g. Patagonia, Tibet).

An important factor is **renewable electricity yield efficiency** – but it is not the only factor

PV example: RES-E electricity yield efficiency much higher in countries, from which PtL imports are possible, than for electricity generation in Germany



Further energy losses for BEVs through **energy storage, charging** and **air conditioning**

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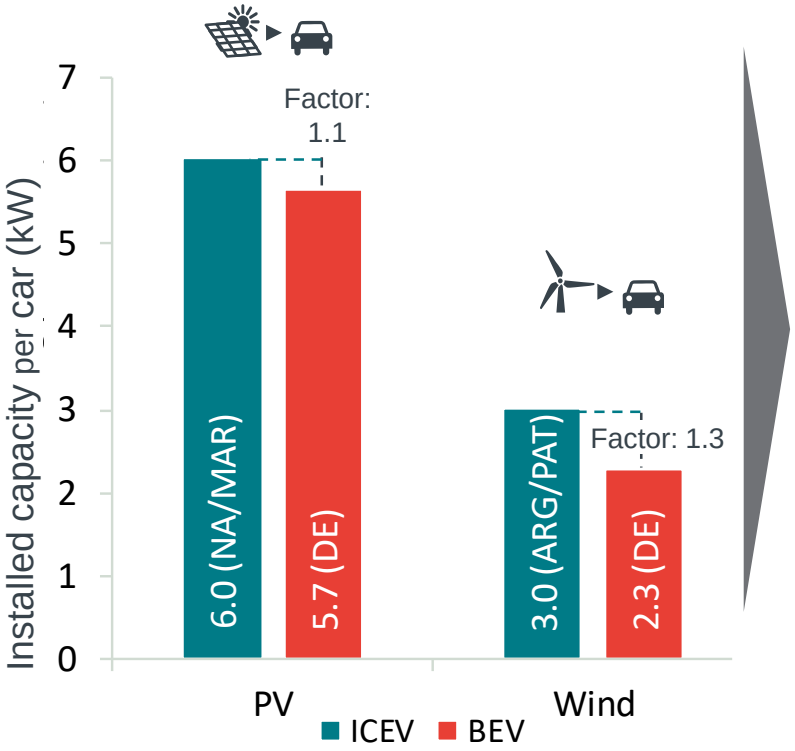
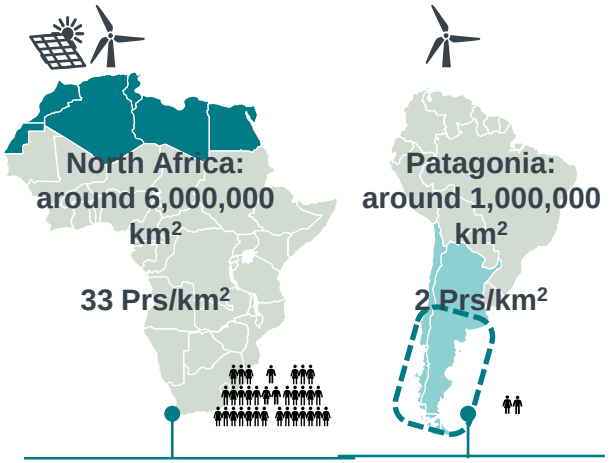
The **capacity** to be installed for running a car is similar - but PtL allows **supply of abundant non-European RE potentials**



Areas and RE potentials **limited** or land development linked to **high costs** (on-roof PV) and **acceptance problems** (wind onshore)



Areas around 3 - 16x larger than Germany

- Significant renewables potential,
- High space availability,
- Low costs

Population density about 9 to 140 times lower than in Germany

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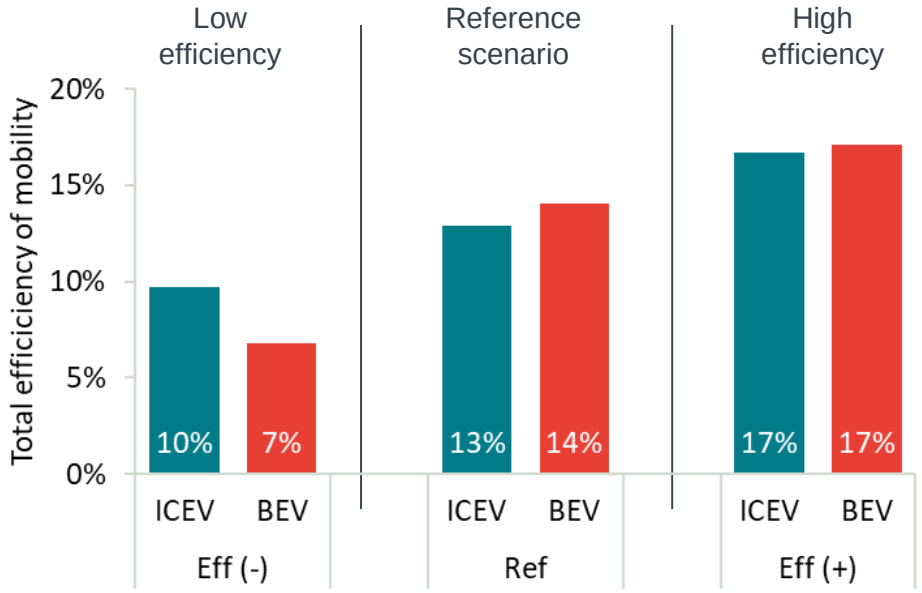
Sensitivity analyses **confirm this result** and depending on the configurations, ICEVs may even outperform BEVs in efficiency terms



- Low electricity yields
- Cold winter day
- Urban traffic

- Low electricity yields
- Cold winter day
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- High charging losses

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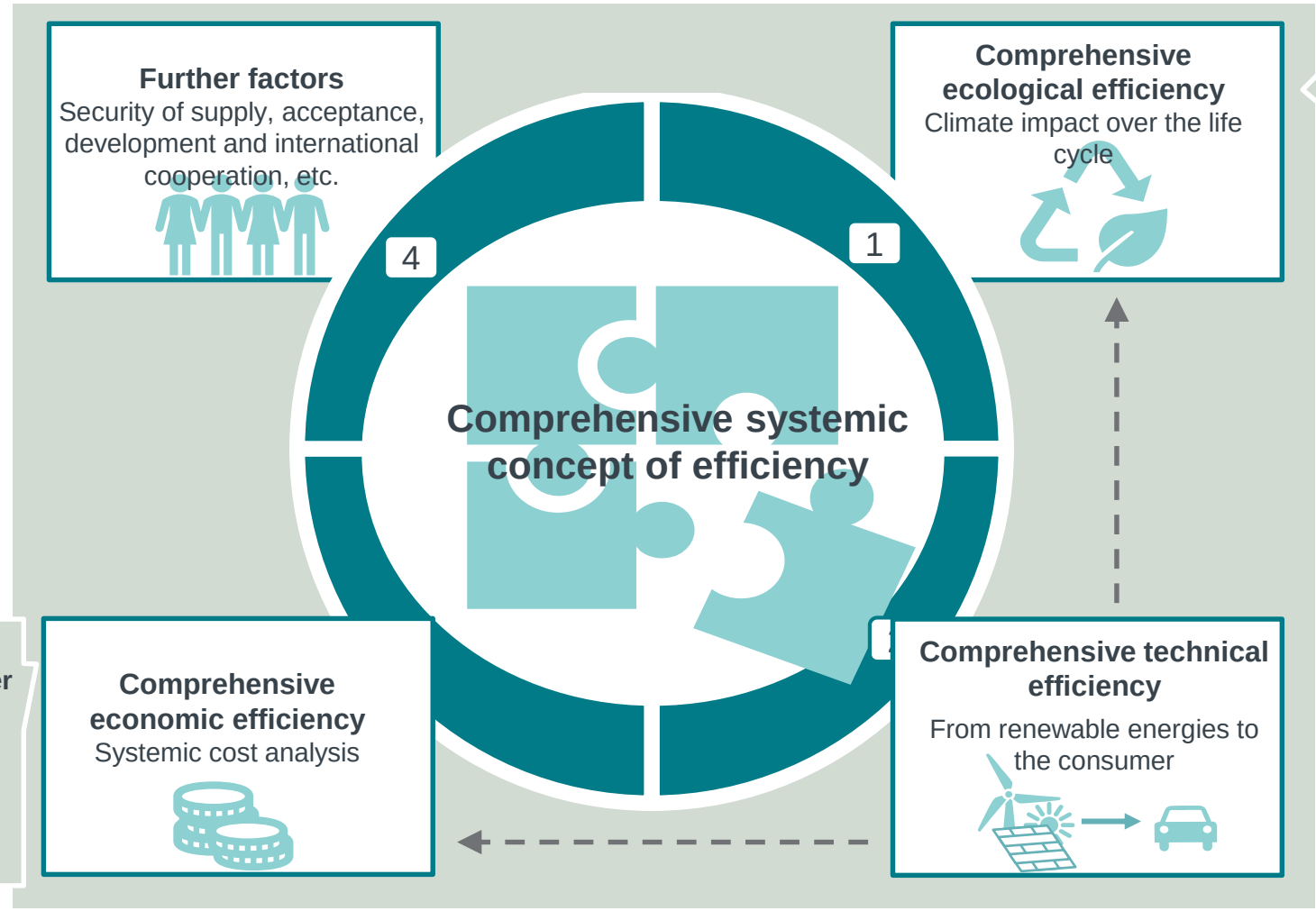
- HT electrolysis

- High electricity yields
- Low charging losses

Technical efficiency should be interpreted in the context of **systemic** (including **economic** and **ecological**) **efficiency**

Comprehensive technical efficiency is only a single component of wider systemic efficiency



Measure of the contribution and stability of **climate change measures**

Measure for achievable **climate protection effects per monetary unit used**

- E.g. development of renewable energies;
- Usability of existing infrastructures

Conclusion: All technological ways forward to defossilise road traffic should be pursued with an open mind ...

The conventional technical efficiency approach is misleading

- The political focus on a single technology based on a perspective of conventional efficiency is misleading because it ignores key influencing parameters

Comprehensive technical efficiency offers a more suitable basis to evaluate efficiency

- It considers all significant influencing parameters and,
- in the context of this investigation, shows that there is no substance to pursue climate protection targets with only BEVs or only ICEVs

It is important to capitalise on the potential for **international cooperation**

- Defining system boundaries nationally as a basis for justifying a technology focus is inappropriate.
- Going forward, imports and exports of renewables will be considered part of the international energy landscape.

Technical efficiency should be interpreted in the context of **systemic efficiency**

- Systemic efficiency also includes economic and ecological efficiency.
- Technical efficiencies receive an economic and ecological value and the scope goes beyond kilowatt-hours

Forward-looking climate policy in the transport sector should aim to **use and keep open all technologies that meet the climate target**

- There is a need **to revise the legislative framework**, both at European and national level.
- **Action is urgently needed** to pursue an energy system of renewable energies given ongoing climate change.

... using all future procurement options for RES

Thank you very much!

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