

# Der Antrieb der Zukunft braucht Vielfalt



**28. ZULIEFERFORUM DER  
ARBEITSGEMEINSCHAFT  
ZULIEFERINDUSTRIE**

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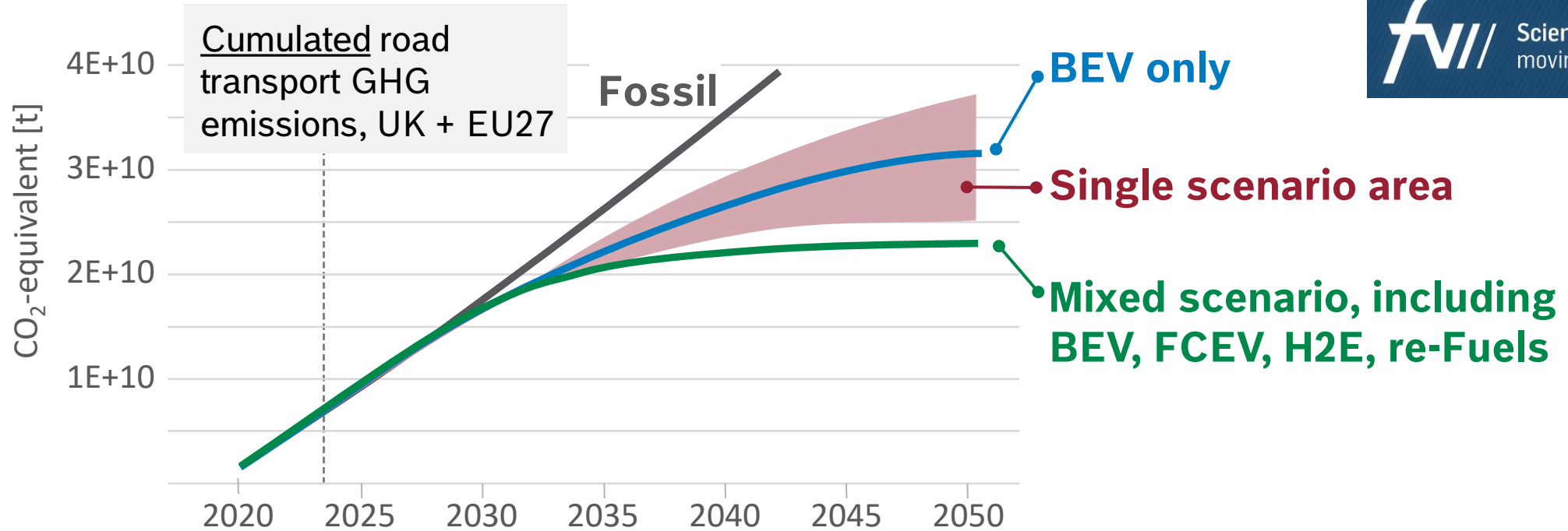
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# The powertrain of the future needs diversity

## Why do we need diversity from CO<sub>2</sub> perspective?

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To sustainably reduce cumulative CO<sub>2</sub> in earliest timeframe, a holistic approach is mandatory

# The powertrain of the future needs diversity

## Why do we need diversity from a technical point of view?

Goal

Fast, resilient and sustainable contribution to a holistic CO<sub>2</sub> reduction

Use Case - Technologies

Battery

Fuel-Cell

+ liquid renewable fuels

Hydrogen-Engine

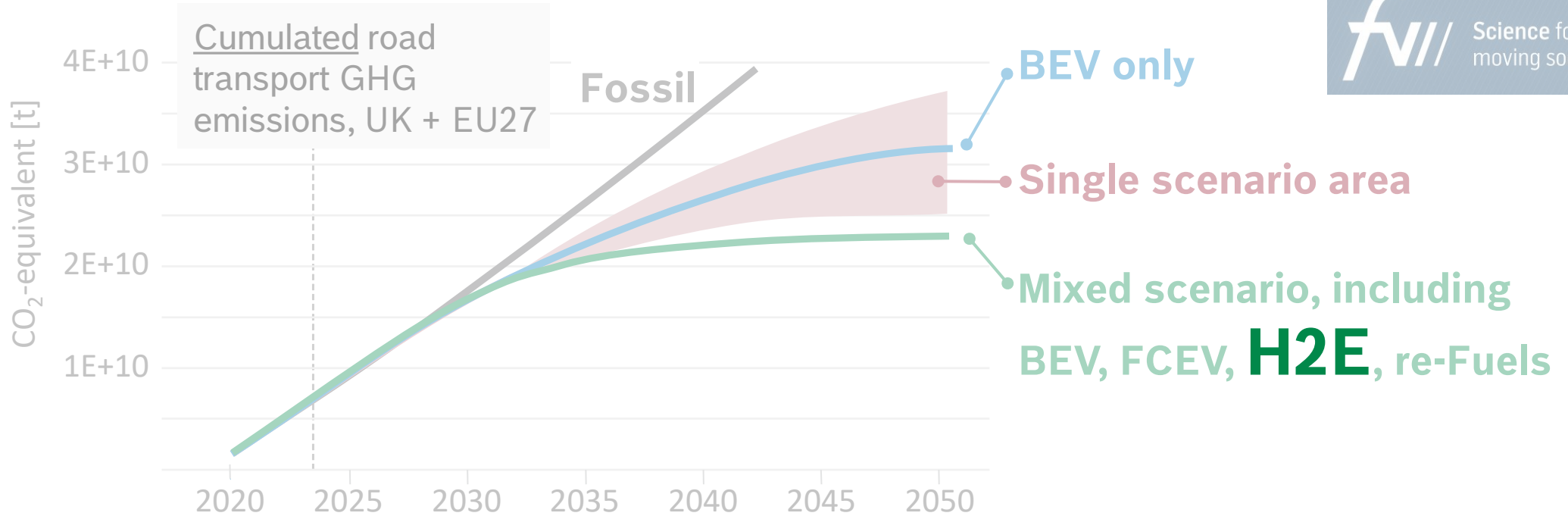


Commercial vehicle applications are highly heterogeneous (load, power, range, terrain, ...)  
We need all technologies, to meet customer and societal needs of all applications

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# The powertrain of the future needs diversity

## Arguments for the Hydrogen Engine



### CO<sub>2</sub> & Emissions

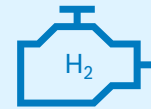


#### Direct CO<sub>2</sub> sources

~700 g/kWh



> 99%



≤ 2-5 g/kWh



Brussels 26. April 2024

#### HDV CO<sub>2</sub>-regulation

Definition of ZEV:

**BEV, FuelCell and H2E**



No relevant influence on air quality



Same order of magnitude as fuel-cell or battery electric driven powertrains



# The powertrain of the future needs diversity

## Arguments for the Hydrogen Engine



### Sustainability

#### Material exploitation & material processing



Mainly steel and aluminum

Small amounts of precious metal for exhaust gas aftertreatment



Use of rare earth materials not relevant

#### Recycling & disposal



No relevant critical substances regarding recycling and disposal

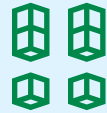


Use of established recycling and disposal processes



# The powertrain of the future needs diversity

## Arguments for the Hydrogen Engine



### Synergies

#### Production & assembling



Established development and production processes



Re-use of existing production facilities

Use of existing service concept



High resiliency against critical raw material- and global supply chain issues



Transformation speed



# The powertrain of the future needs diversity

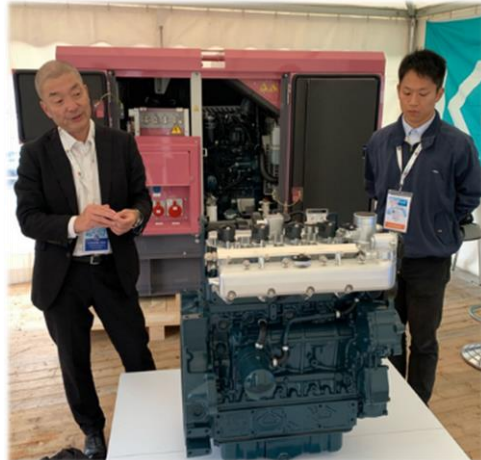
## Who is supporting the hydrogen engine?



Die Technikiinitiative zur nachhaltigen Transformation




# Activities Alliance Hydrogen Engine Exhibition Hydrogen Engine LIVE at Karlsruhe 2024



# The powertrain of the future needs diversity

## The hydrogen engine has arrived on the road; outside Europe?

### India's commitment to a sustainable future

#### Clear objectives

Net-Zero **2070**

Energy Independence **2047**

#### Political framework

Clear vision, mission and ministerial structure under the leadership of the MNR.

Using grey hydrogen for pilot and infrastructure development to build supply chains and develop applications.

#### Useful funding example

Government-funded (\$59 million) pilot project (MNR), 5 freight routes, infrastructure to launch via trailer.



### e-Mobility in the EU, a meaningful start

#### Clear objectives

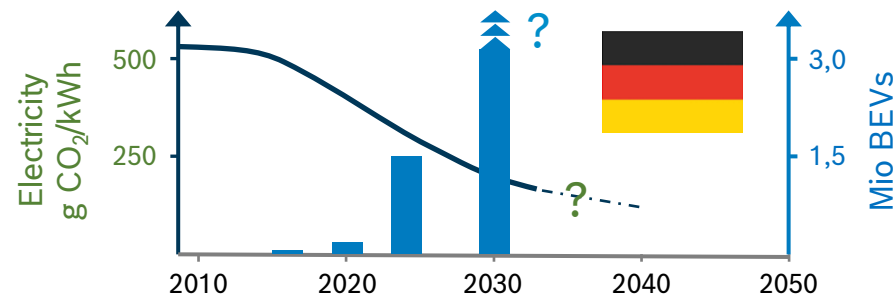
Net-Zero **2050**

CO<sub>2</sub> neutrality in road traffic passenger cars 2035

#### Political framework

Only in the longer term (2050) 100% green energy. Crediting e-mobility as CO<sub>2</sub>-neutral mobility, even if the electricity is not yet green.

#### Useful funding example

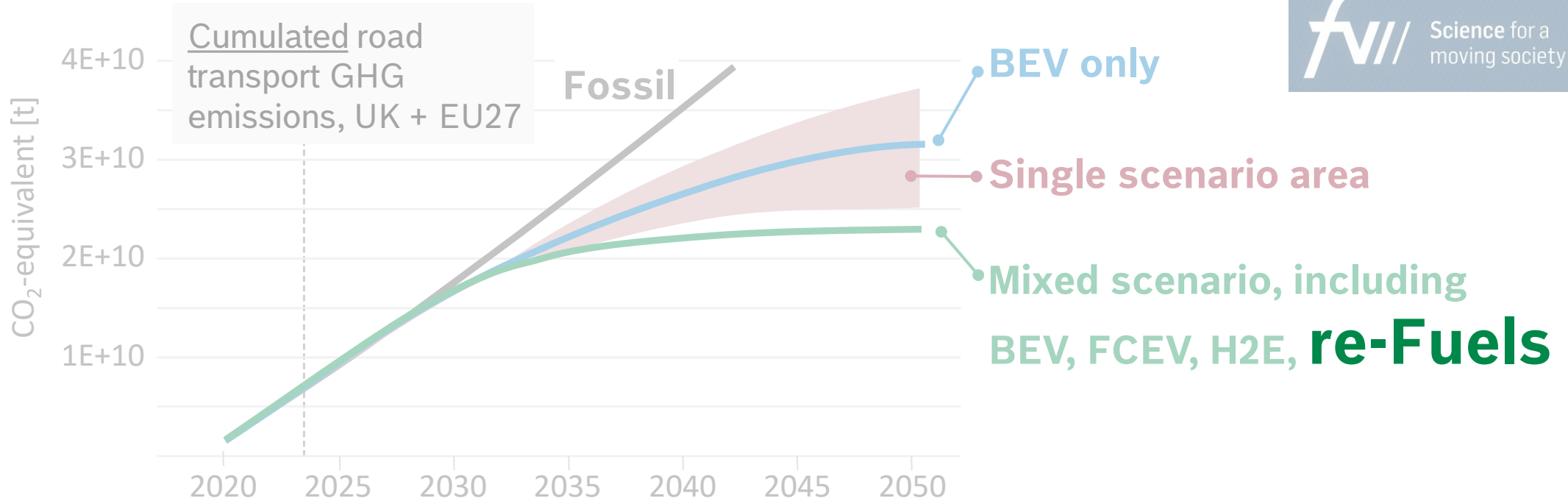


As with e-mobility, the H<sub>2</sub>-engine also needs a transition from gray to green hydrogen

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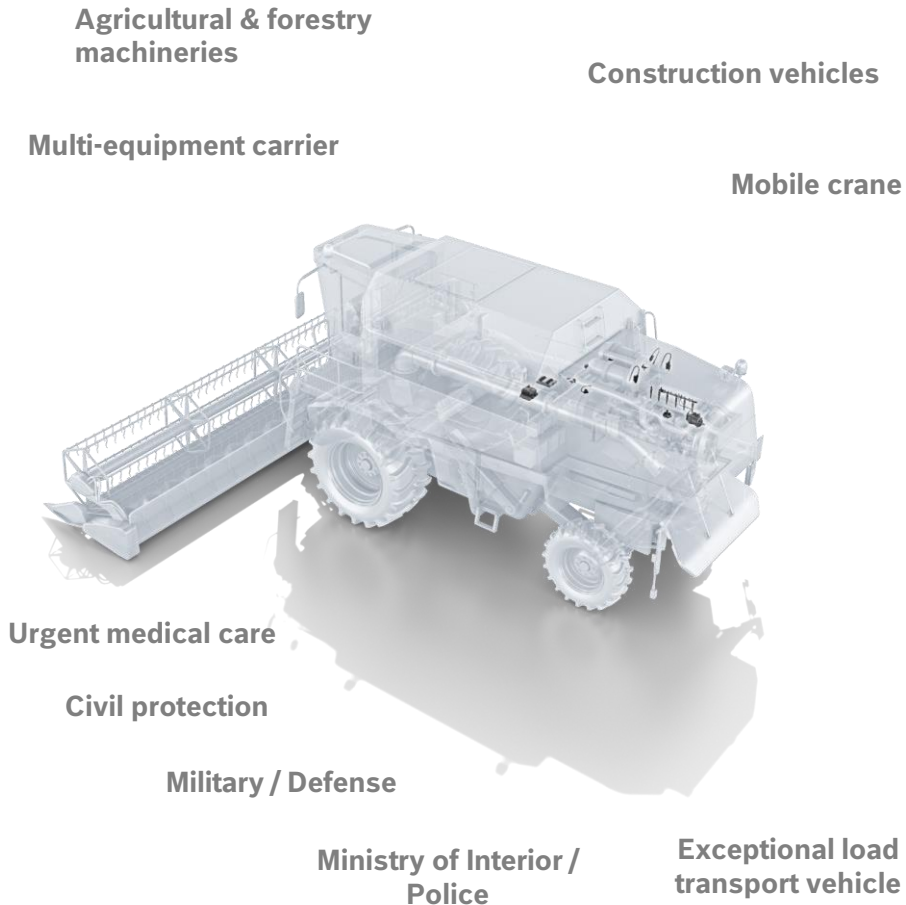
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# The powertrain of the future needs diversity

## Liquid renewable, necessary fuels for special applications and...



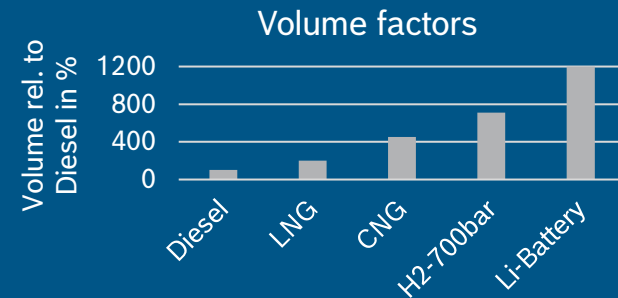
### Utilization: short but intensive and...



- Short average annual utilization
- High energy throughput
- Significant energy storage volumes mandatory
- ...

### Energy storage

- Volumetric integration/packaging challenging



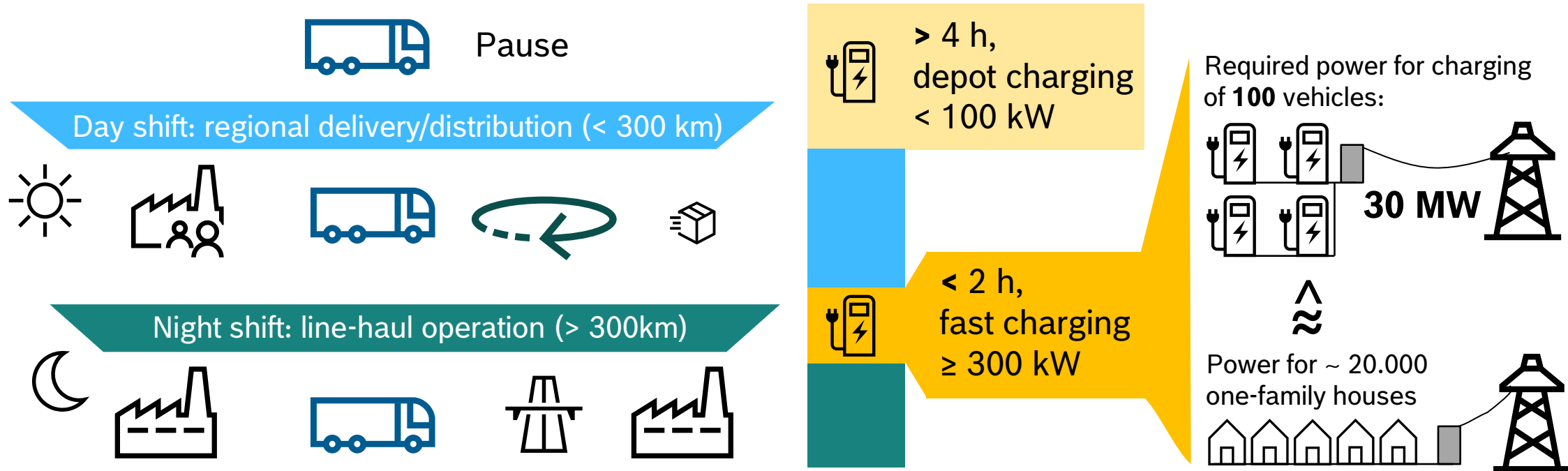
### Sustainability



- Utilization scenario beneficial for liquid renewable fuels

# The powertrain of the future needs diversity

## Powertrain- or infrastructure challenge, one logistic example



Electrification of logistic-centers huge challenge due to necessary high voltage supply.  
Fast refilling/charging crucial for business model

# Der Antrieb der Zukunft braucht Vielfalt ... und politische Unterstützung

- Einsatz aller klimafreundlichen Optionen zur Erreichung der europäischen CO<sub>2</sub>-Reduktionsziele (Batterie, Brennstoffzelle, H<sub>2</sub>-Motor, PHEVs, erneuerbare Kraftstoffe)
  - Gleichstellung aller klimafreundlichen Antriebe und Kraftstoffe bei Regulatorik, Besteuerung und Förderung
  - Ausbau der Ladeinfrastruktur für Pkw und Lkw sowie vorseilender Aufbau einer speziell für Nutzfahrzeuge geeigneten initialen H<sub>2</sub>-Betankungsinfrastruktur (AFIR als Mindestmaß)
  - Deutliche Signale für die H<sub>2</sub>-Mobilität (Brennstoffzelle und H<sub>2</sub>-Motor): Infrastruktur, Förderung, H<sub>2</sub>-Versorgung und Pragmatismus bei der Farbenlehre
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- Nutzung und Bewahrung des vorhandenen Knowhows für den klassischen Powertrain, auch für Zukunftstechnologien wie den H<sub>2</sub>-Motor