

Der Antrieb der Zukunft braucht Vielfalt



**28. ZULIEFERFORUM DER
ARBEITSGEMEINSCHAFT
ZULIEFERINDUSTRIE**

30. Januar 2025

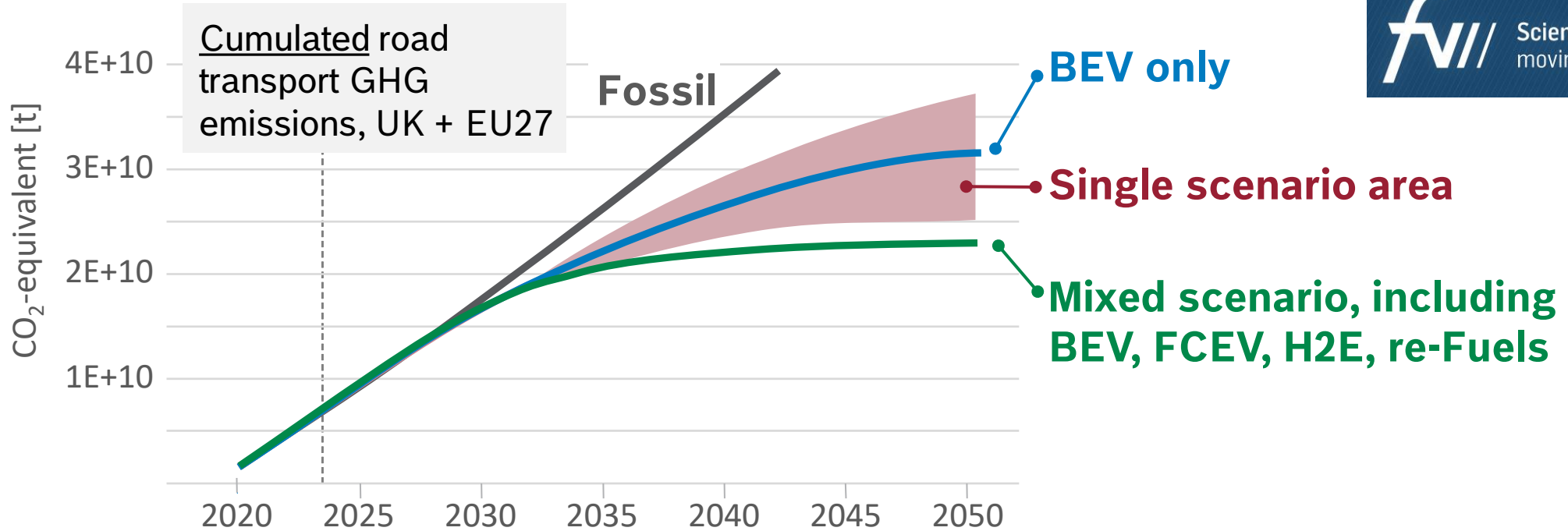
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The powertrain of the future needs diversity

Why do we need diversity from CO₂ perspective?

https://www.fvv-net.de/fileadmin/Stories/000.00_Wie_schnell_geht_nachhaltig/TB_R603_V1452_FVV_Fuels_Study_IVb_2022-10-06.pdf



To sustainably reduce cumulative CO₂ 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 CO₂ reduction

Use Case - Technologies

Battery

Fuel-Cell

+ liquid renewable fuels

Hydrogen-Engine

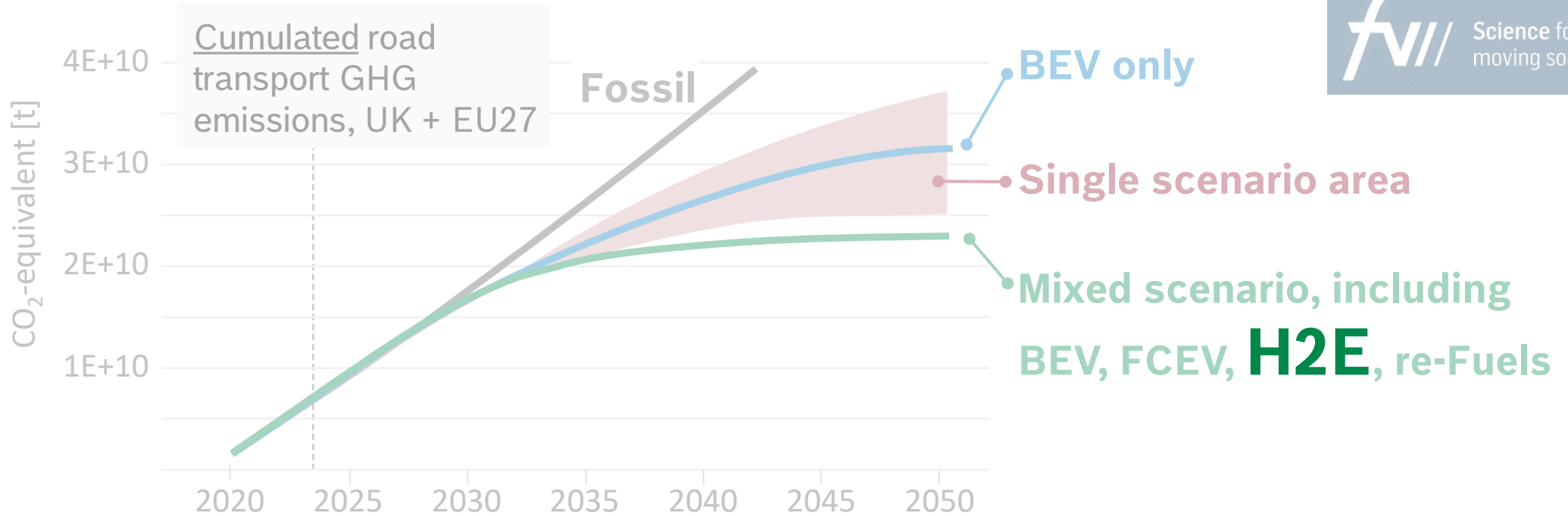


Commercial vehicle applications are highly heterogeneous (load, power, range, terrain, ...)
We need all technologies, to meet customer and societal needs of all applications

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Arguments for the Hydrogen Engine



CO₂ & Emissions

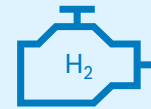


Direct CO₂ sources

~700 g/kWh



>
99%



≤ 2-5 g/kWh



Brussels 26. April 2024

HDV CO₂-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



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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

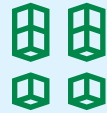


Use of established recycling and disposal processes



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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



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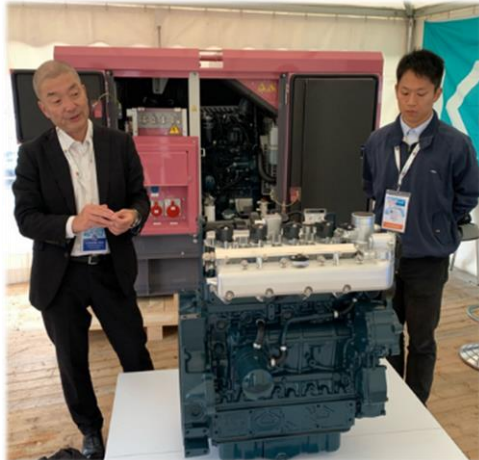
Who is supporting the hydrogen engine?



Die Techniktinitiative 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

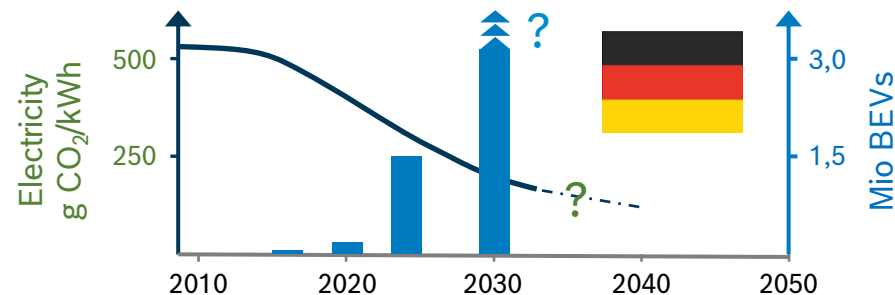
Net-Zero **2050**

CO₂ neutrality in road traffic passenger cars 2035

Political framework

Only in the longer term (2050) 100% green energy. Crediting e-mobility as CO₂-neutral mobility, even if the electricity is not yet green.

Useful funding example

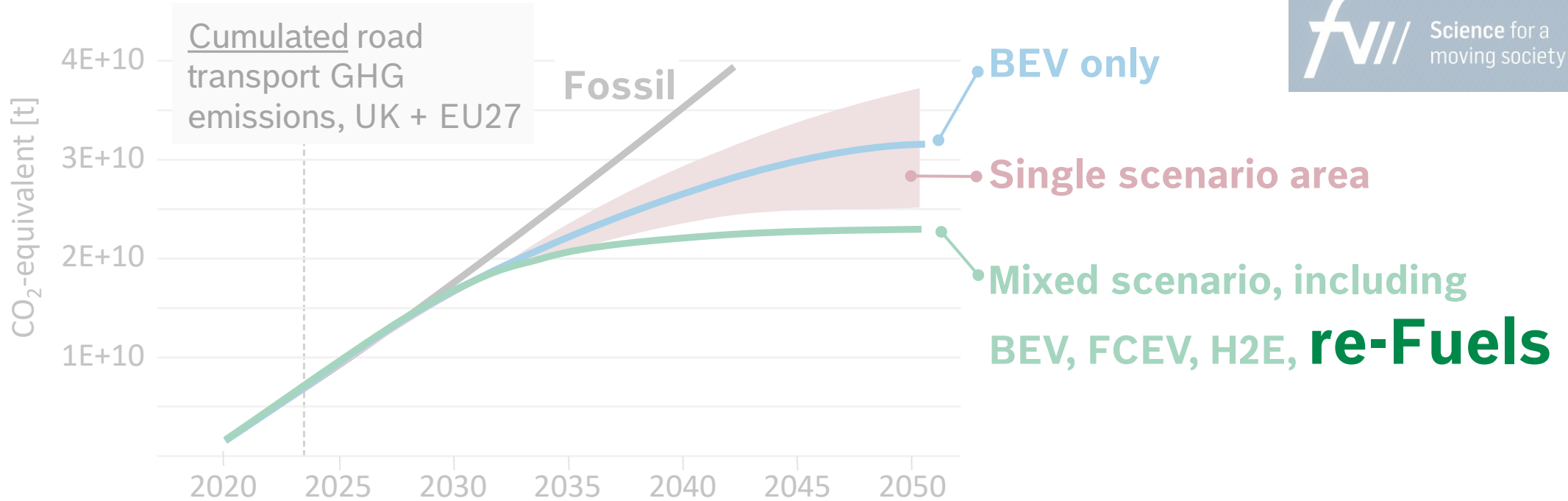


As with e-mobility, the H₂-engine also needs a transition from gray to green hydrogen

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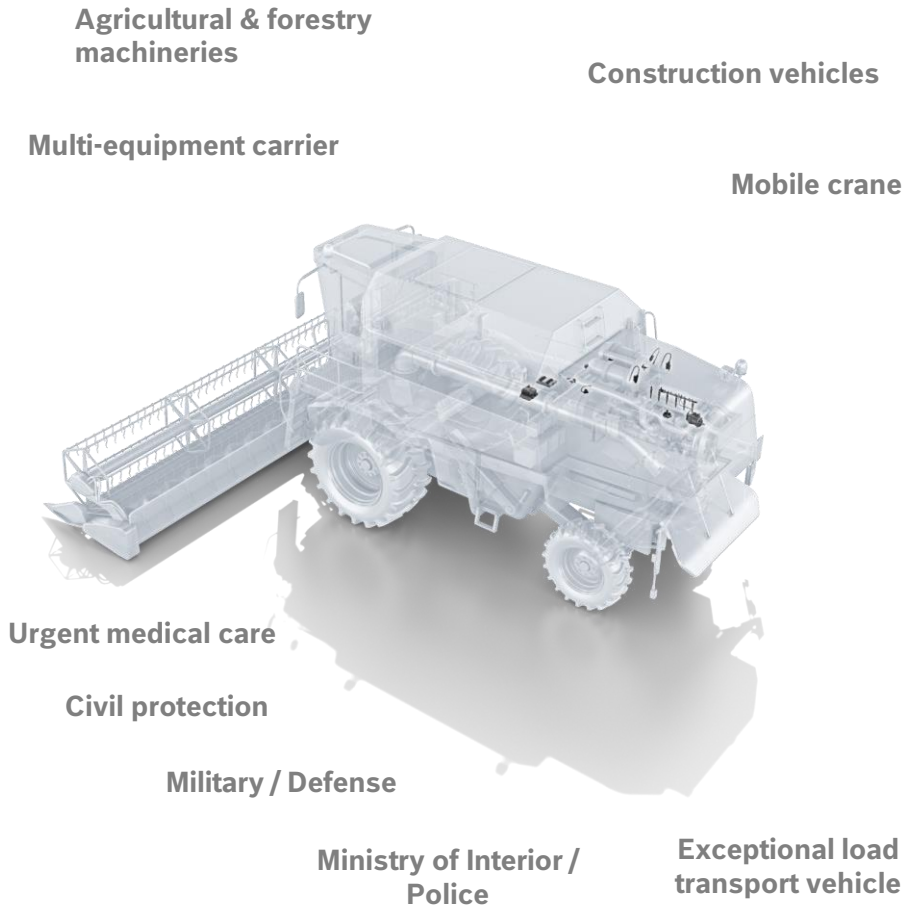
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Liquid renewable, necessary fuels for special applications and...



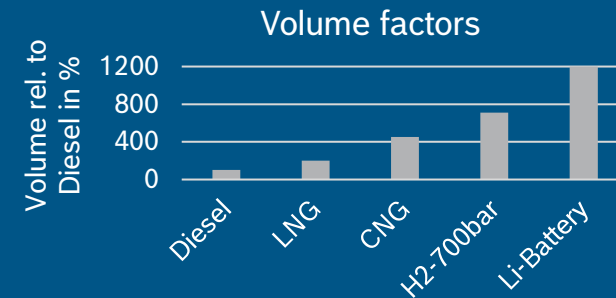
Utilization: short but intensive and...



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

Energy storage

- Volumetric integration/packaging challenging

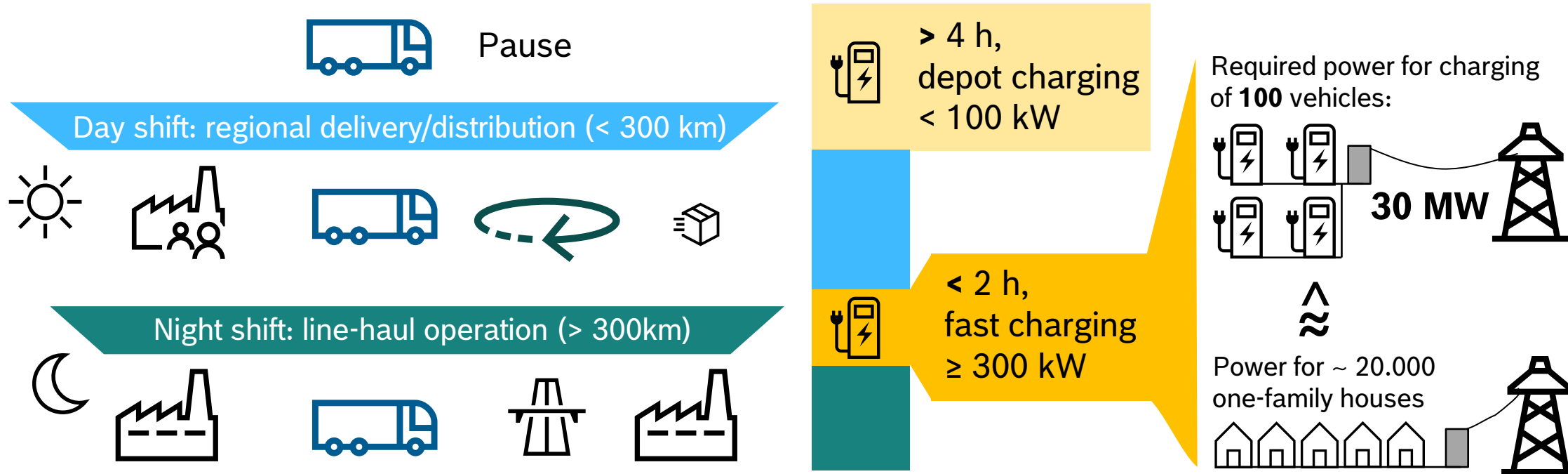


Sustainability

- Utilization scenario beneficial for liquid renewable fuels

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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 CO₂-Reduktionsziele (Batterie, Brennstoffzelle, H₂-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 H₂-Betankungsinfrastruktur (AFIR als Mindestmaß)
 - Deutliche Signale für die H₂-Mobilität (Brennstoffzelle und H₂-Motor):
Infrastruktur, Förderung, H₂-Versorgung und Pragmatismus bei der Farbenlehre
-
- Nutzung und Bewahrung des vorhandenen Knowhows für den klassischen Powertrain, auch für Zukunftstechnologien wie den H₂-Motor