

Alternative Antriebe

Dekarbonisierung des Schwerlastverkehrs - Stand der Entwicklung im LKW - Markt



Hochschule Fulda
University of Applied Sciences



Fachbereich
Wirtschaft



Vorstellung

Agenda



1.

Langjährige Kompetenz in
der Forschung zur
nachhaltigen Mobilität im
Straßengüterverkehr



2.

Potentiale der
Dekarbonisierung des
Güterverkehrs



3.

Realisierung der
Potentiale durch eine
effiziente Strategie für
den Baustoffhandel

Alternative Antriebe

Langjährige Kompetenz in der Forschung zur nachhaltigen Mobilität im
Straßengüterverkehr

Fachbereich
Wirtschaft



Prof. Dr. Boris Zimmermann

Studiengangsleiter Logistik
Projektleitung



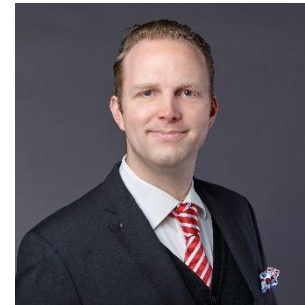
Dominik Käufer

Wissenschaftlicher Mitarbeiter
Systemadministration, Datenanalyse
und -aufbereitung



Kai Weber

Wissenschaftlicher Mitarbeiter
Softwareentwicklung, Datenanalyse
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Philipp Knauf

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Wissenschaftliche Mitarbeiterin
Technische- und Datenanalyse



Luisa Werner

Studentische Mitarbeiterin
Datenvisualisierung, Grafikdesign



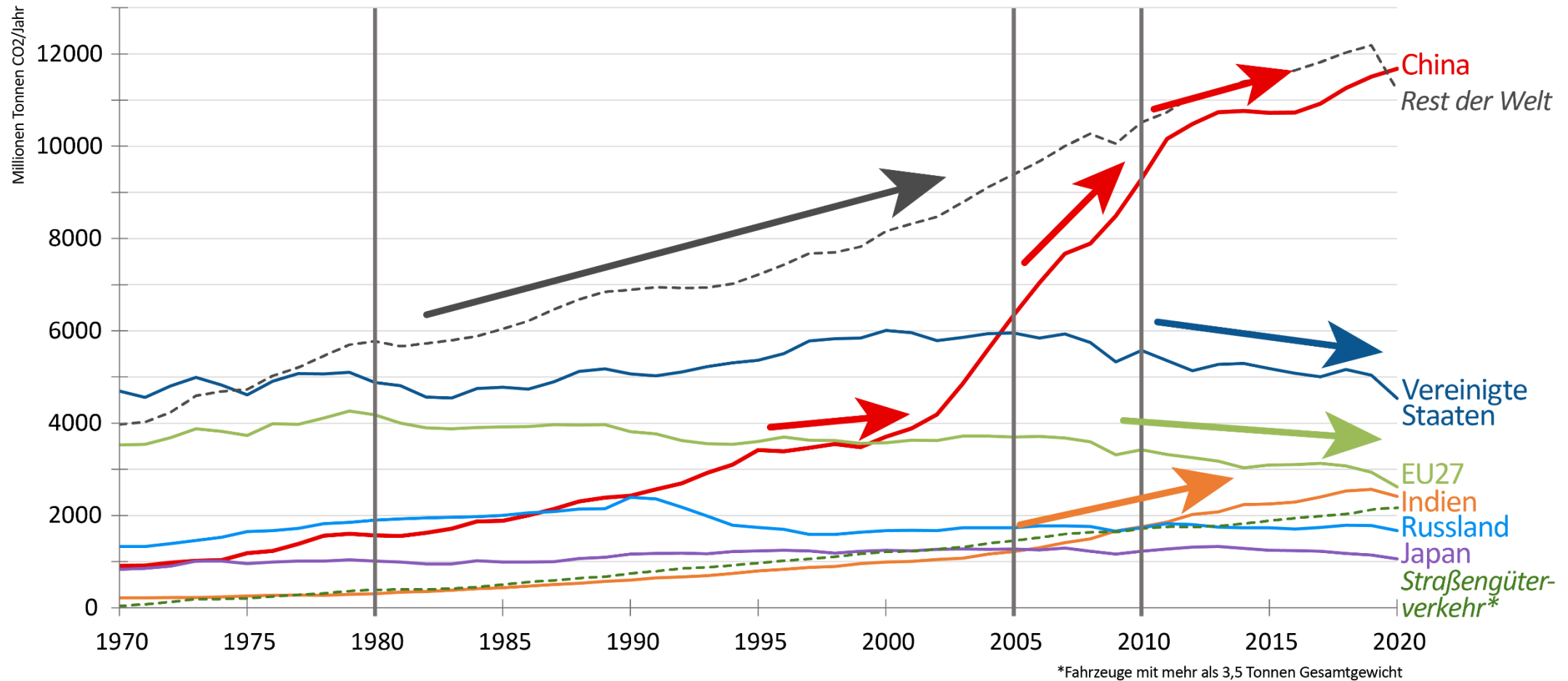
Alternative Antriebe

Langjährige Kompetenz in der Forschung zur nachhaltigen Mobilität im Straßengüterverkehr

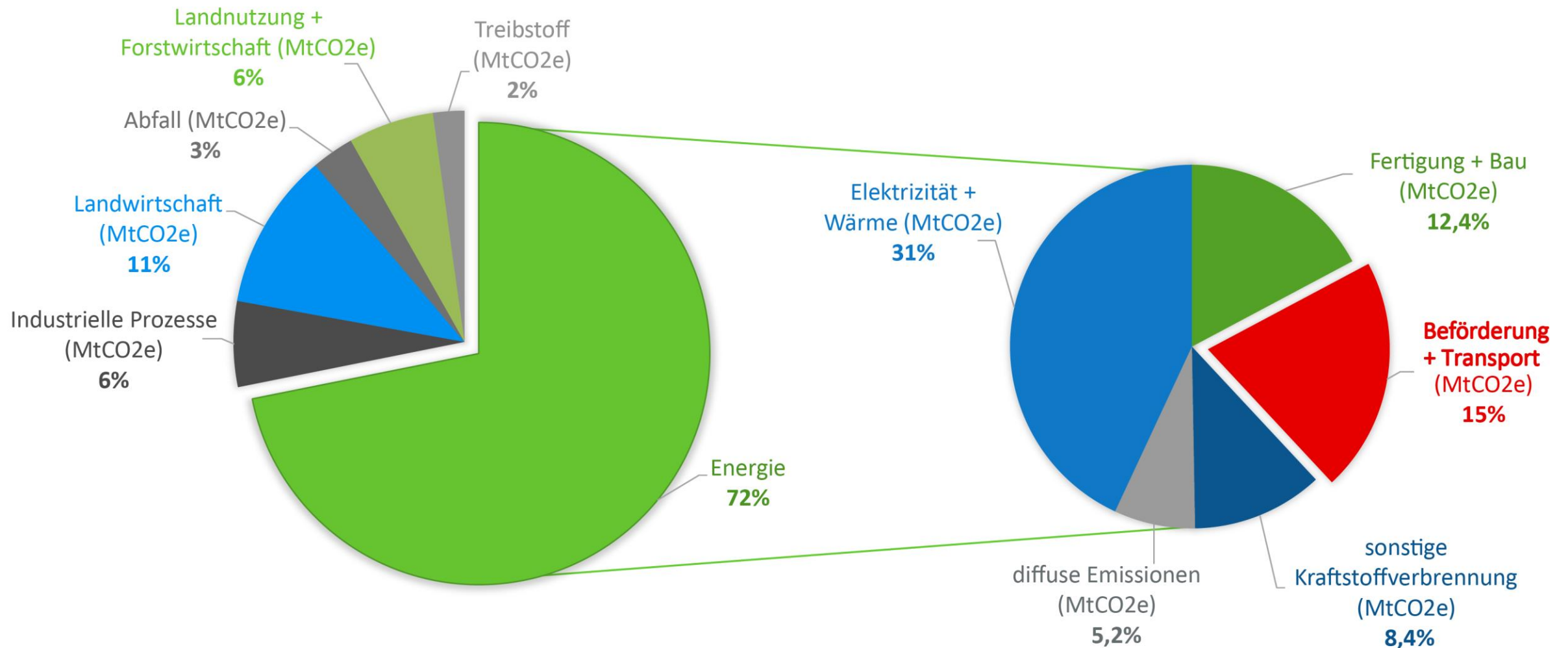
- Seit 2016 insgesamt 6 Jahre Erfahrung:
- 4 Förderprojekte
- 17 Unternehmen
- 10 Mitarbeiter*innen
- 45 Student*innen
- 21 Fachvorträge in 4 Jahren
- 35 Medienauftritte
- 10 Fachartikel zum Thema
- 1,7 Mio. € Volumen
- 4 wissenschaftliche Einrichtungen
- 8 Mio. analysierte Kilometer: 20 Mal zum Mond
- 27.000 Touren
- 7 Terrabyte Daten
- Vom CAN BUS Reengineering zur Datenwolke
- Realdaten von E-Lkw generieren
- Auch im Bereich Wasserstoff



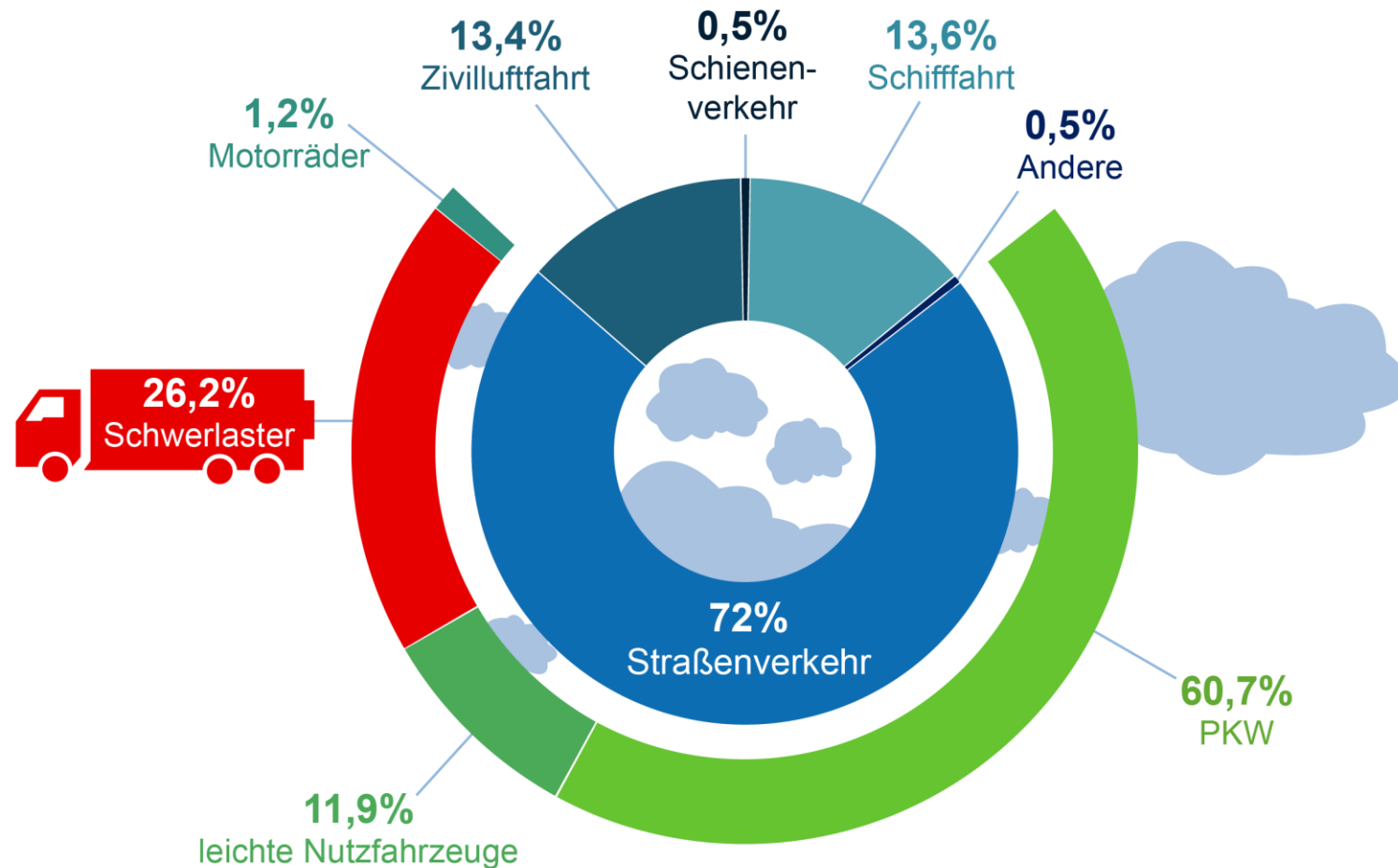
Weltweite fossile Kohlenstoffdioxidemissionen 1970 - 2018



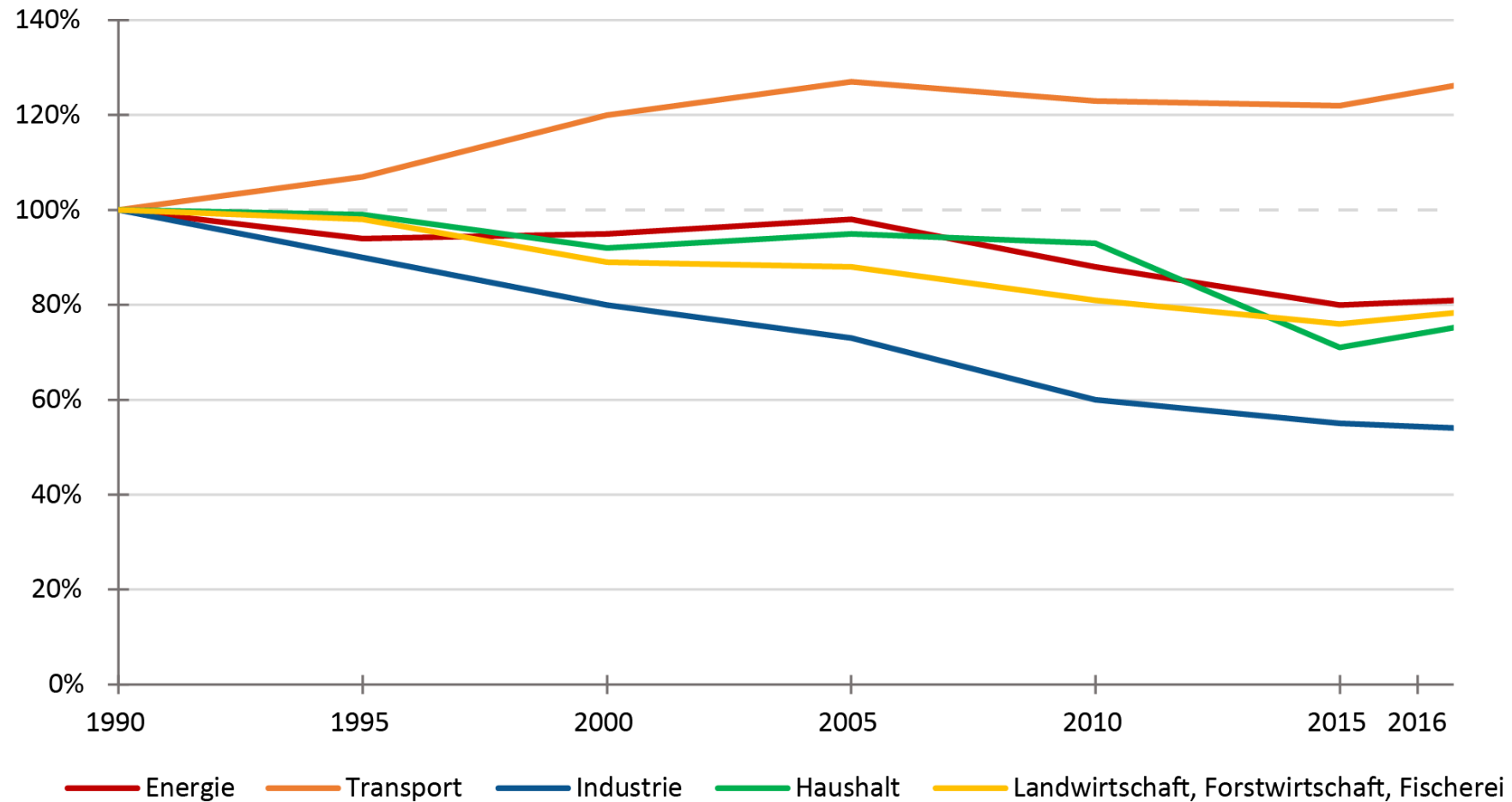
Potentiale der Dekarbonisierung des Güternahverkehrs



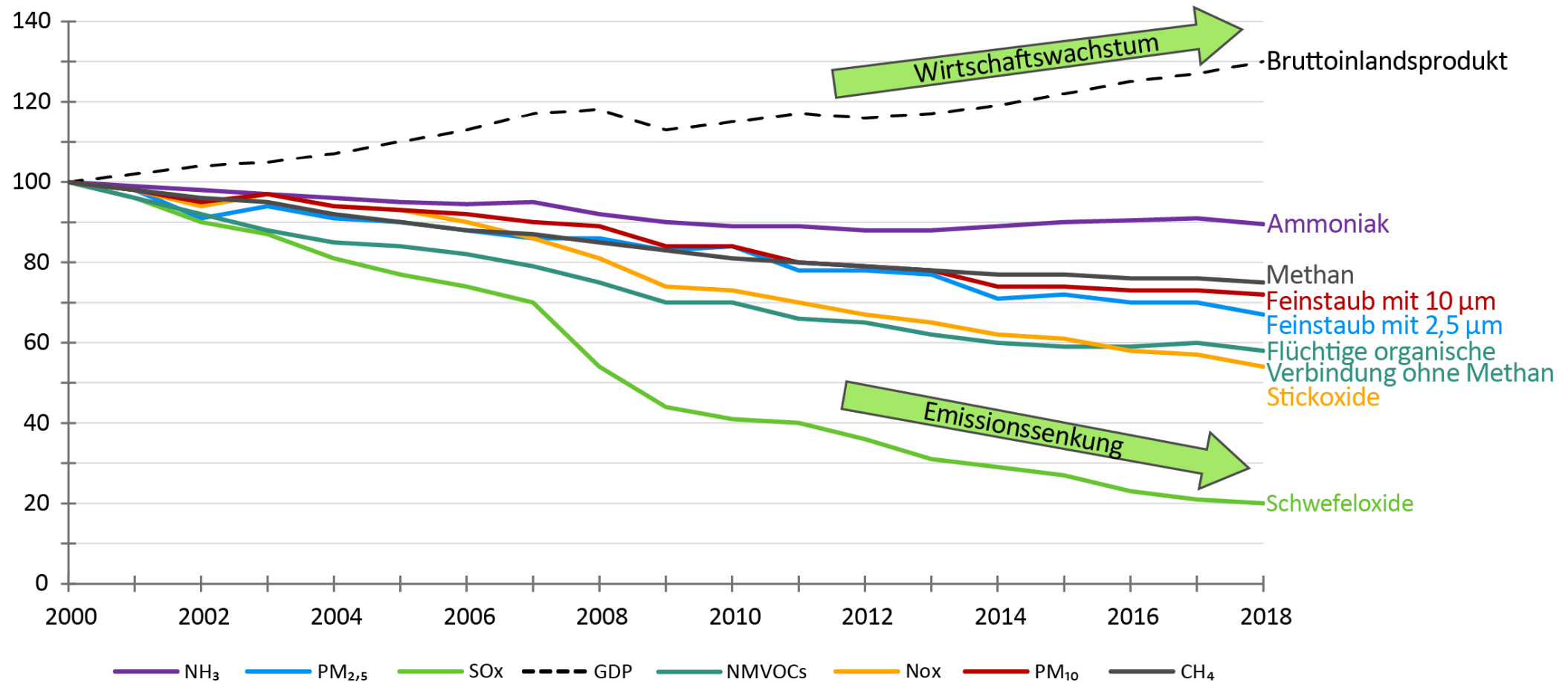
EU CO₂-Emissionen nach Verkehrsträgern (2016)



EU CO₂-Emissionen nach Sektor (1990 - 2016)

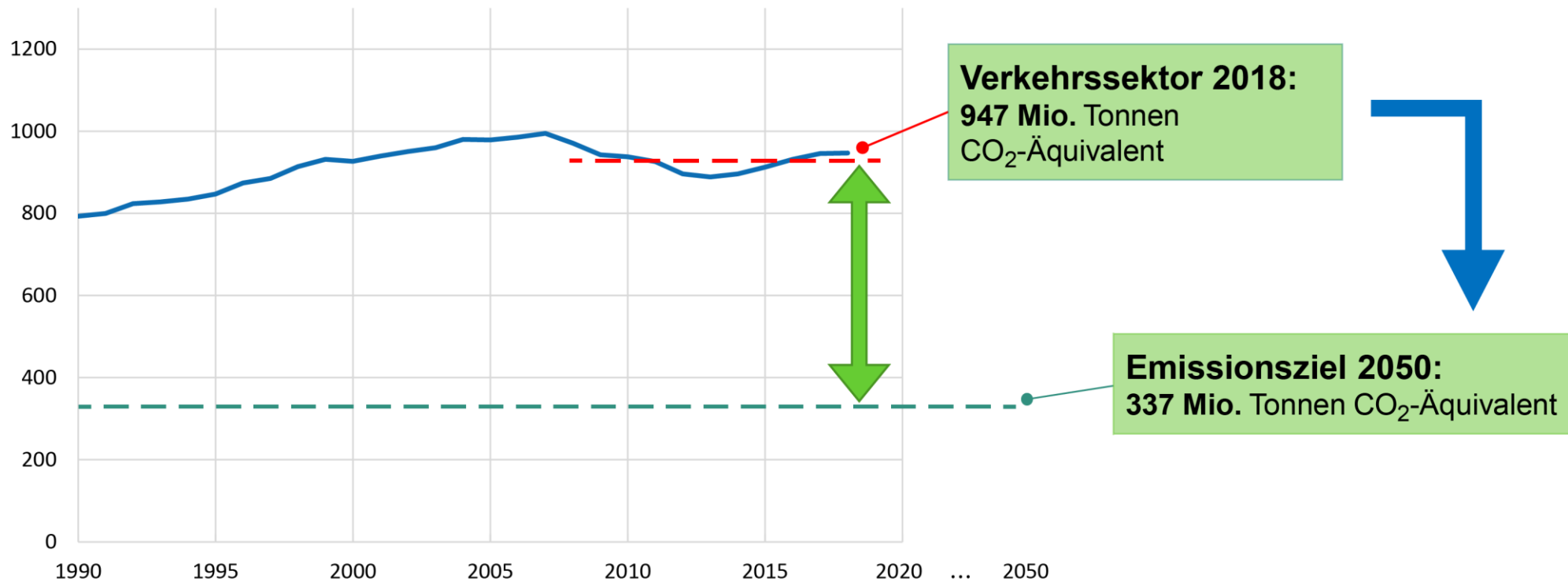


Potentiale der Dekarbonisierung des Güternahverkehrs

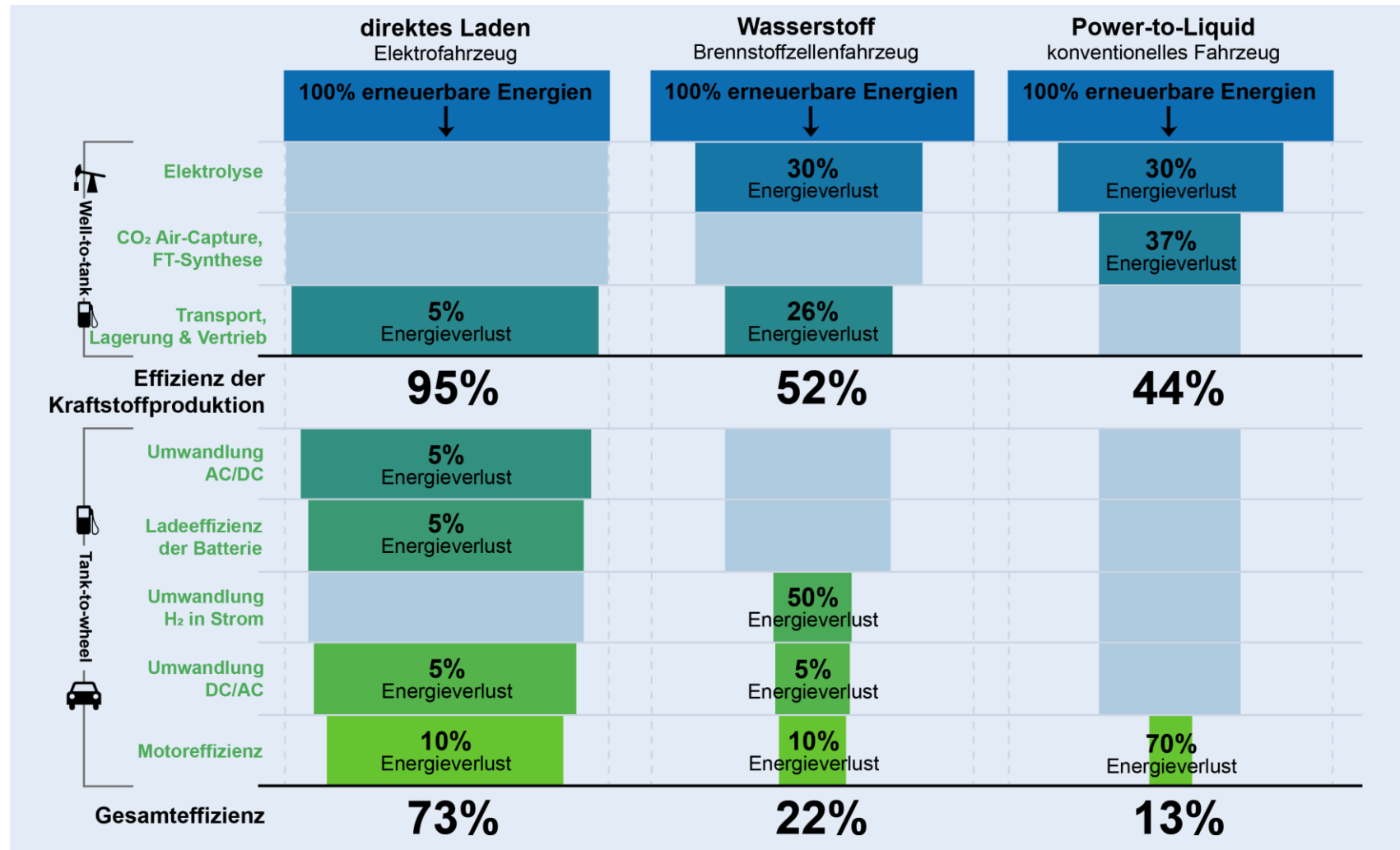


Potentiale der Dekarbonisierung des Güternahverkehrs

Entwicklung der CO₂-Emissionen in Europa im Verkehrssektor (nur Güter)
[in Mio. Tonnen CO₂-Äquivalent]



Potentiale der Dekarbonisierung des Güternahverkehrs





Folie 3:

Bilder: Prof. Dr. Boris Zimmermann Bildrechte bei den jeweils abgebildeten Personen

Folie 5:

Eigene Darstellung, in Anlehnung von <https://publications.jrc.ec.europa.eu/repository/handle/JRC117610>, sowie Wyatt, D., Electric Trucks 2020-2030, Analysis of the medium and heavy-duty truck markets; detailed production and market penetration forecasts at both global and regional levels, Key enabling technologies for battery electric trucks and fuel cell electric trucks, <http://www.IDTechEx.com/research>, 2020. S.22

Folie 6:

C2ES - Center for Climate and Energy Solutions: Global Manmade Greenhouse Gas Emissions;
<https://www.c2es.org/content/international-emissions/>; Letzter Zugriff: 19.11.2021

Folie 7:

In Anlehnung an https://www.destatis.de/Europa/DE/Thema/Umwelt-Energie/CO2_Strassenverkehr.html und Wyatt, D., Electric Trucks 2020-2030, Analysis of the medium and heavy-duty truck markets; detailed production and market penetration forecasts at both global and regional levels, Key enabling technologies for battery electric trucks and fuel cell electric trucks, <http://www.IDTechEx.com/research>, 2020. S.22

Folie 8:

Wyatt, D., Electric Trucks 2020-2030, Analysis of the medium and heavy-duty truck markets; detailed production and market penetration forecasts at both global and regional levels, Key enabling technologies for battery electric trucks and fuel cell electric trucks, <http://www.IDTechEx.com/research>, 2020. S.22

Folie 9:

EEA Report, No 09/2020 Air quality in Europe — 2020 report European Environment Agency, S.31, <https://www.eea.europa.eu/publications/air-quality-in-europe-2020-report> .

Folie 10:

Eigene Darstellung in Anlehnung an EEA (2019b)

Folie 11:

Grafische Darstellung in Anlehnung an: <https://www.transportenvironment.org/discover/roadmap-climate-friendly-land-freight-and-buses-europe/>

Folie 12:

Grafik: Fotolia 43211984; Green city and polluted (©Ella Sarkisyan)

Political initiatives

Government action to reduce CO2 emissions



“In 2020, China revised its fuel economy standards, aiming to reach a fleet-based average fuel economy of 4 litres of gasoline equivalent (Lge) /100 km for new vehicles by 2025. Average fuel economy is calculated using a credit system, in which EVs receive extra credits.”



“The EU directive 2019/631 revised the existing fleet-based average fuel economy standards for 2020-30 with the aim to reduce energy use of new cars by 37.5% and by 31% for new LCVs in this period.”



“In 2020 the United States revised its fuel economy standards to lower ambition of annual efficiency improvements of new light duty vehicles from previously 4.7% to approximately 1.5% between 2021 and 2026.”

Source: How Urban Delivery Vehicles can Boost Electric Mobility international Transport Forum 2 rue André Pascal F-75775 Paris Cedex 16, S.12.
<https://www.itf-oecd.org/sites/default/files/docs/urban-delivery-vehicles-boost-electric-mobility.pdf>

Political initiatives

Government action to reduce CO2 emissions

From 2025 on, manufacturers will have to meet the targets set for the fleet-wide average CO2 emissions of their new lorries registered in a given calendar year. Stricter targets will start applying from 2030 on.

The targets are expressed as a percentage reduction of emissions compared to EU average in the reference period (1 July 2019–30 June 2020):

from 2025 onwards: 15% reduction

from 2030 onwards: 30% reduction

The 2025 target can be achieved using technologies that are already available on the market. The 2030 target will be assessed in 2022 as part of the review of the regulation.

As a first step, the CO2 emission standards will cover large lorries, which account for 65% to 70% of all CO2 emissions from heavy-duty vehicles.



Source: https://ec.europa.eu/clima/policies/transport/vehicles/heavy_en

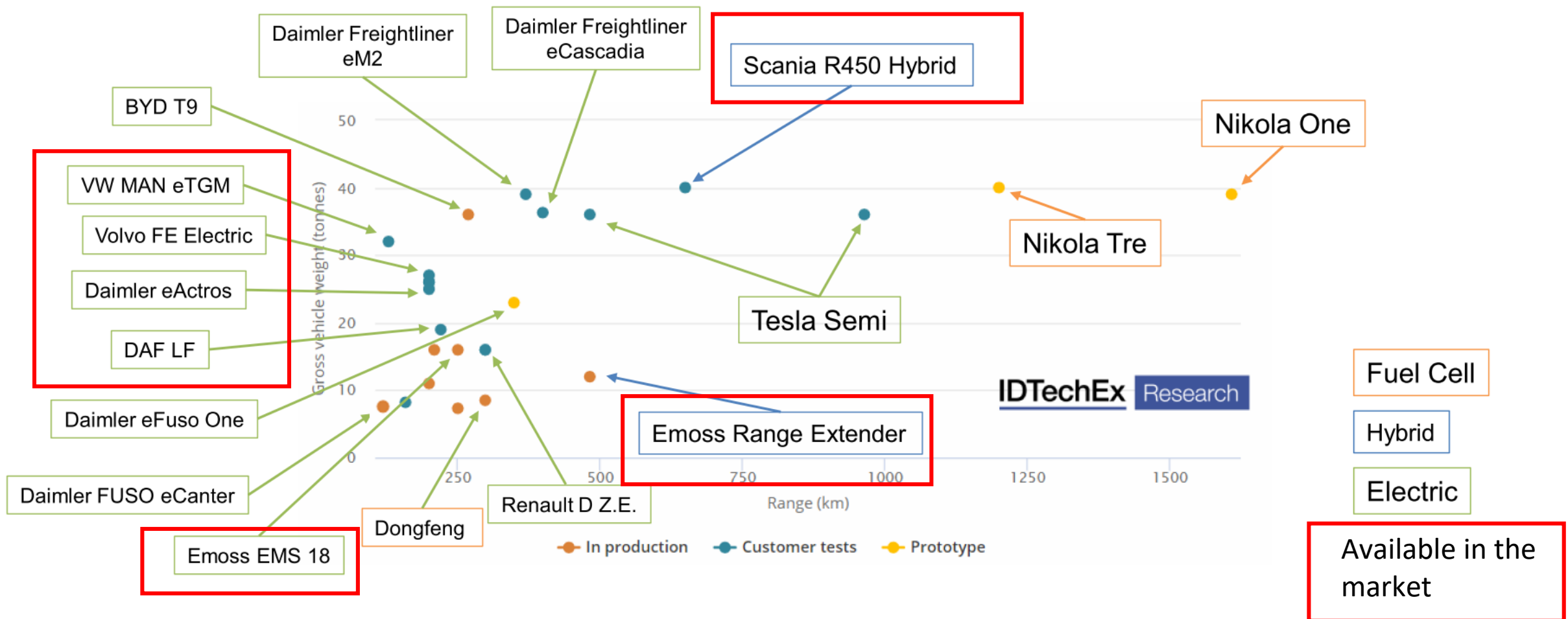
Solution to decarbonize trucks

New solutions?



Solution to decarbonize trucks

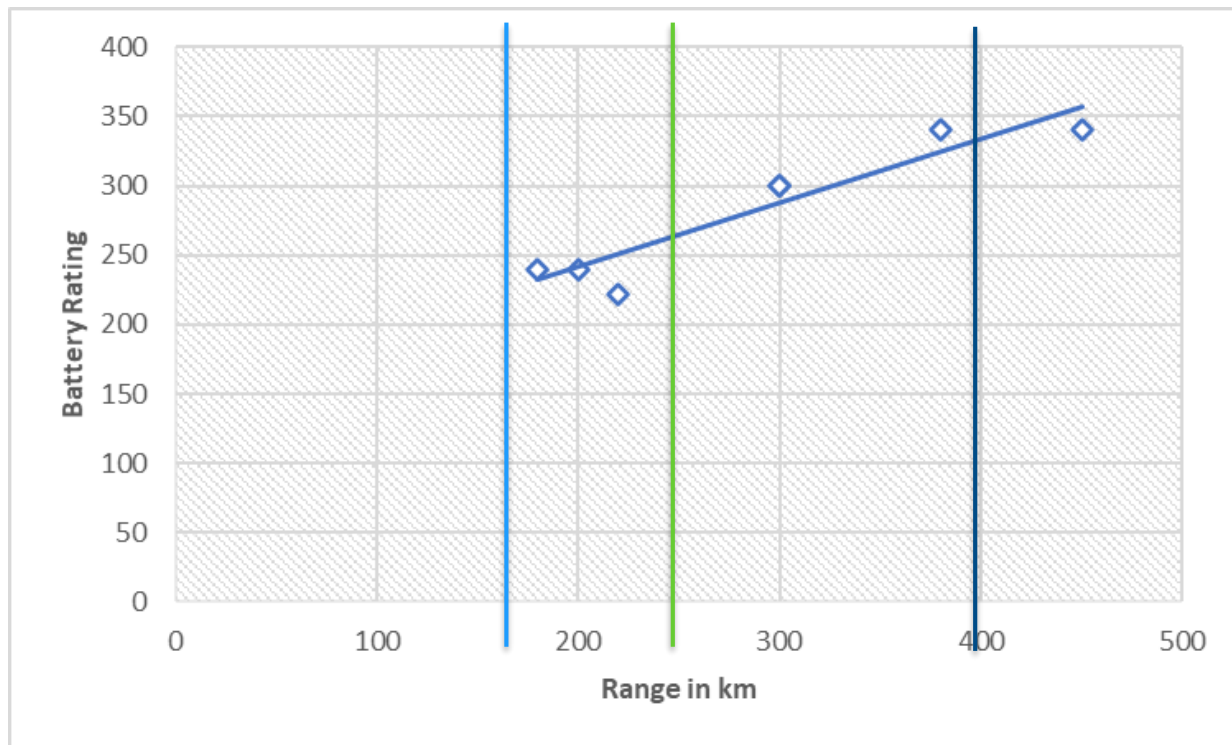
E-Trucks 2022



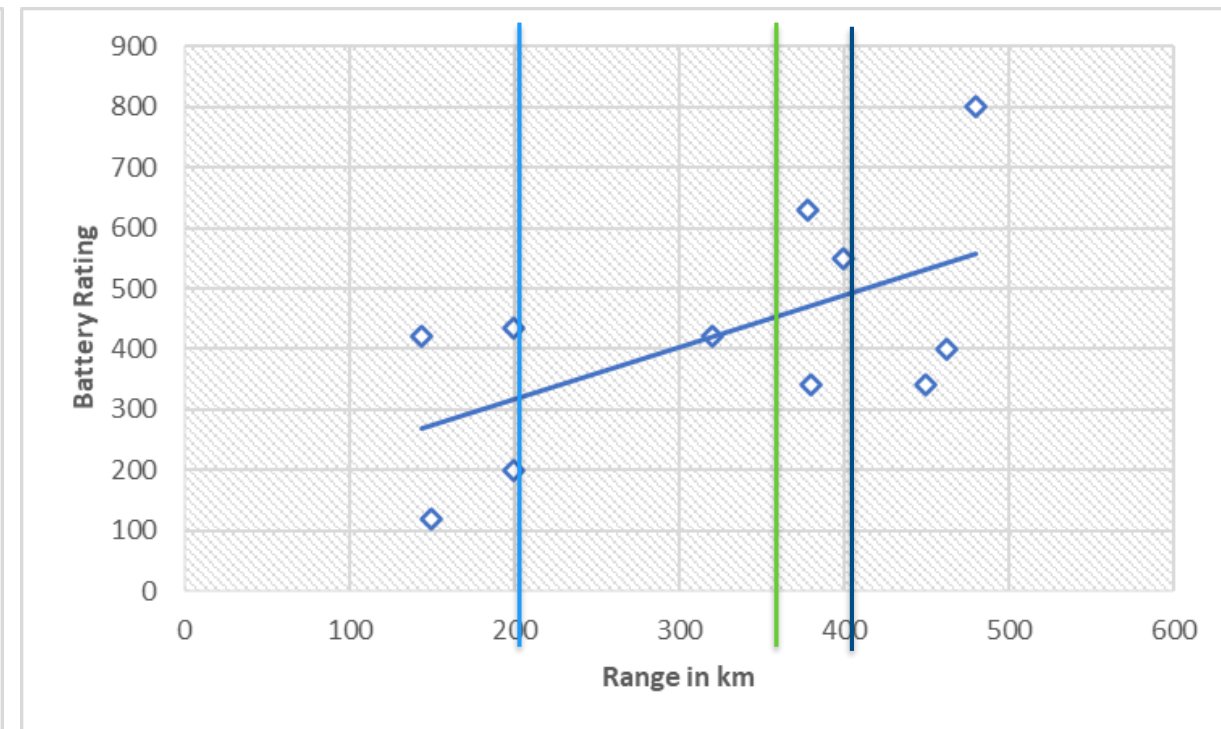
Source: Wyatt, D., Electric Trucks 2020-2030, Analysis of the medium and heavy-duty truck markets; detailed production and market penetration forecasts at both global and regional levels, Key enabling technologies for battery electric trucks and fuel cell electric trucks, www.IDTechEx.com/research, 2020. S.11

Result of the comparison of 35 battery electric truck concepts

Below 26 tons total gross weight



Tractor units

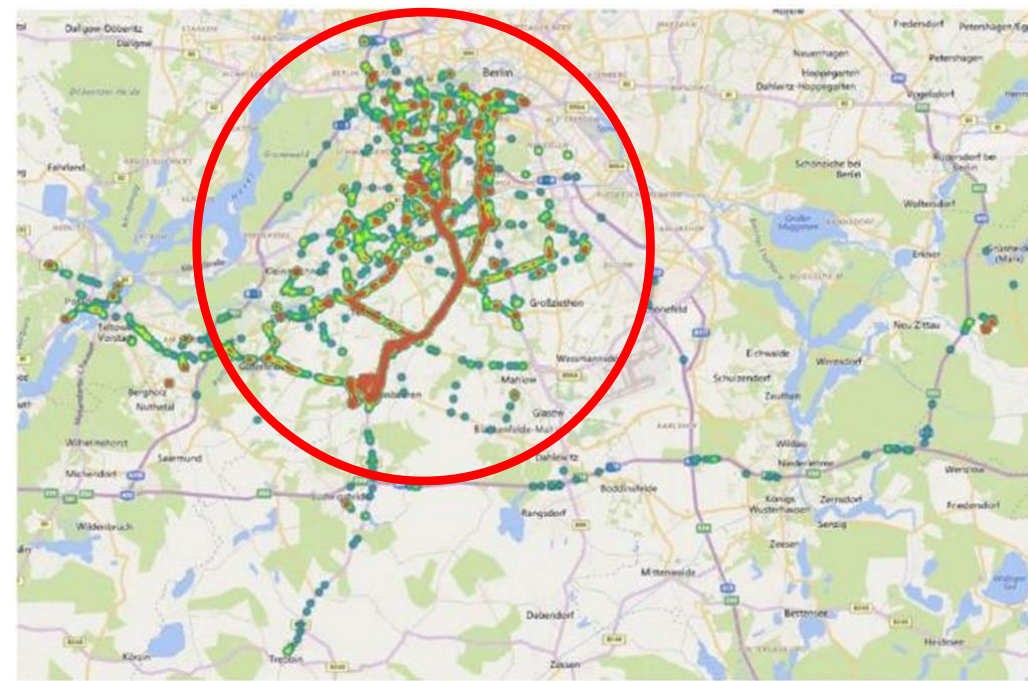
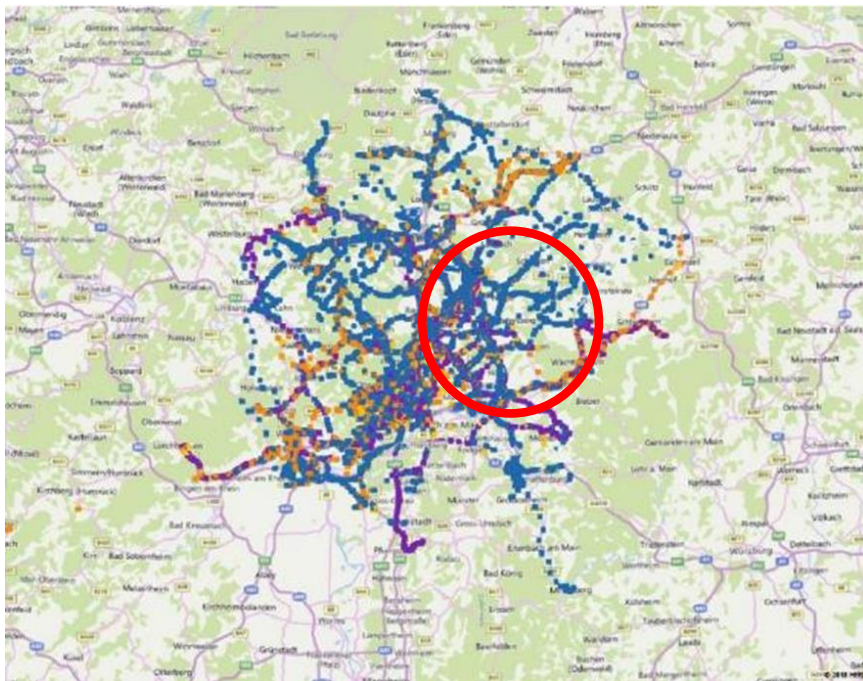


Source: Own Research 50 to 100 Webpages

Solution to decarbonize trucks

E-Trucks 2020

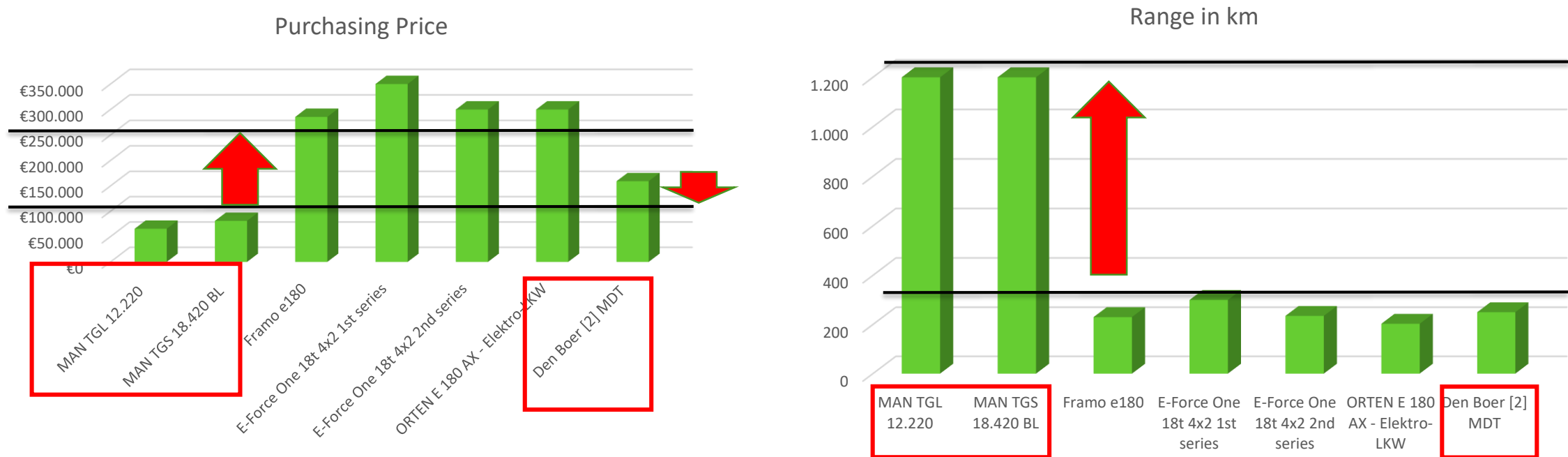
Typical driving range of a middle duty truck, compared to the driving range capacity of a battery electric truck.



Source: Own Research Analysis of six different data sheets and offers from manufactures and lastauto omnibus, Katalog 2018, EuroTransportMedia Verlags- und Veranstaltungs GmbH, Volume 47, Stuttgart, 2019. p.285-290

E-Trucks 2020

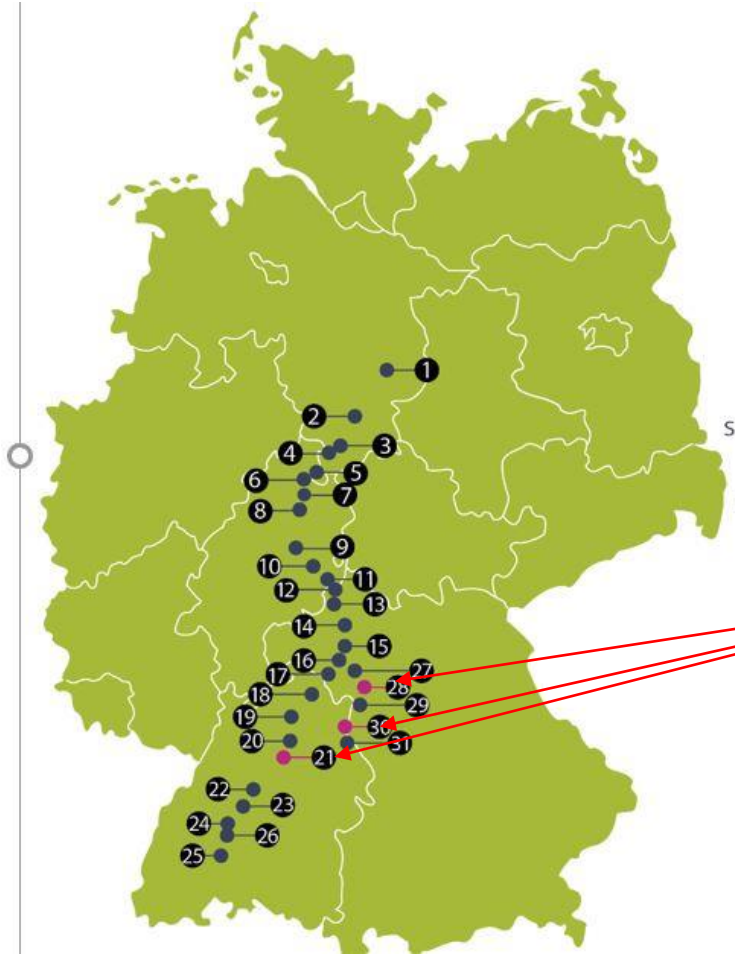
Result of the comparison of four datasheets from BET manufactures



80% of the cost increase is caused by the battery price.

Source: Own Research Analysis of six different data sheets and offers from manufactures and lastauto omnibus, Katalog 2018, EuroTransportMedia Verlags- und Veranstaltungs GmbH, Volume 47, Stuttgart, 2019. p.285-290

Infrastructure in Germany



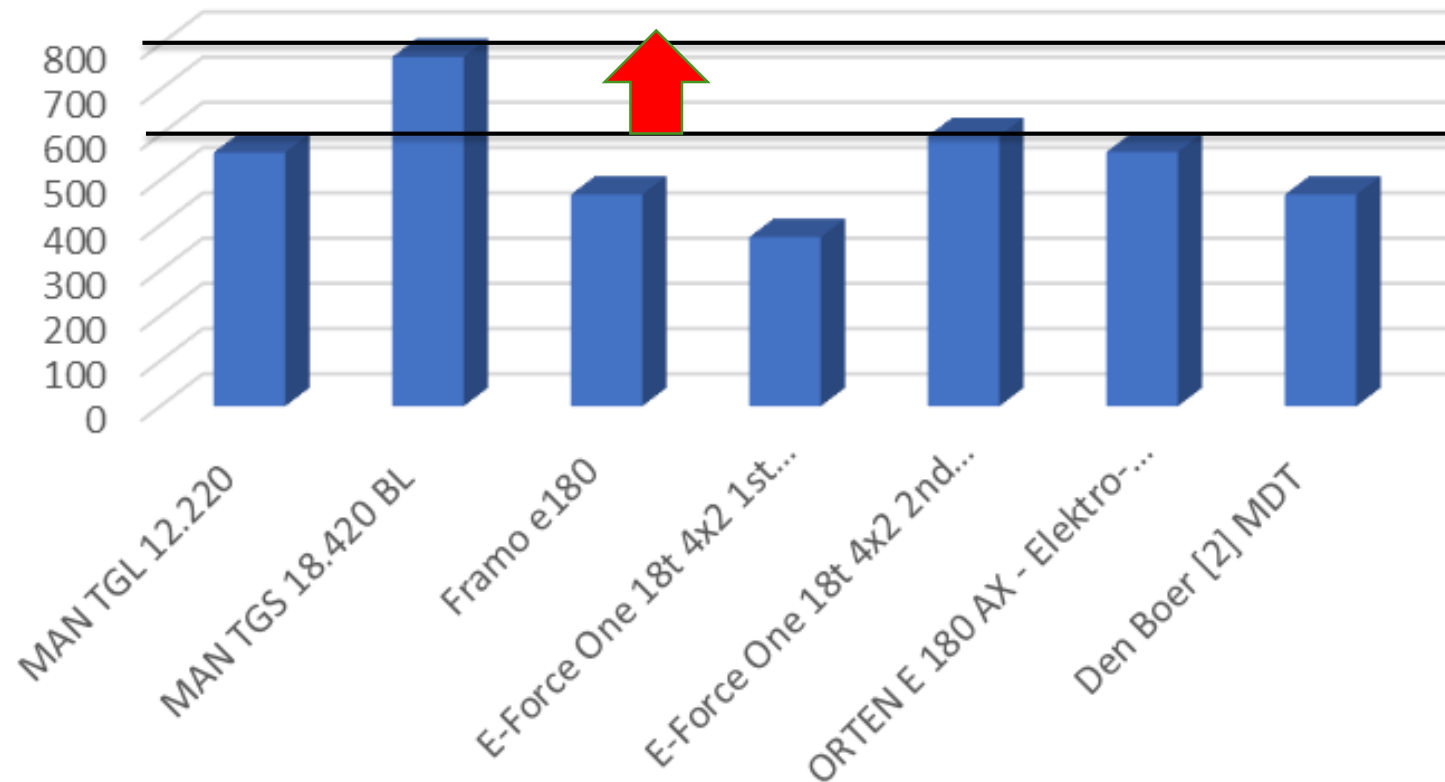
Out of thirty-one charging stations, only three are able to charge a battery electric truck. The capacity of these charging stations is 150 KW. It would take approx. two hours to charge a BET with a 300 kWh battery.

Source: Own Research Analysis of six different data sheets and offers from manufactures

Solution to decarbonize trucks

E-Trucks 2020

CO2 Emissions g/km

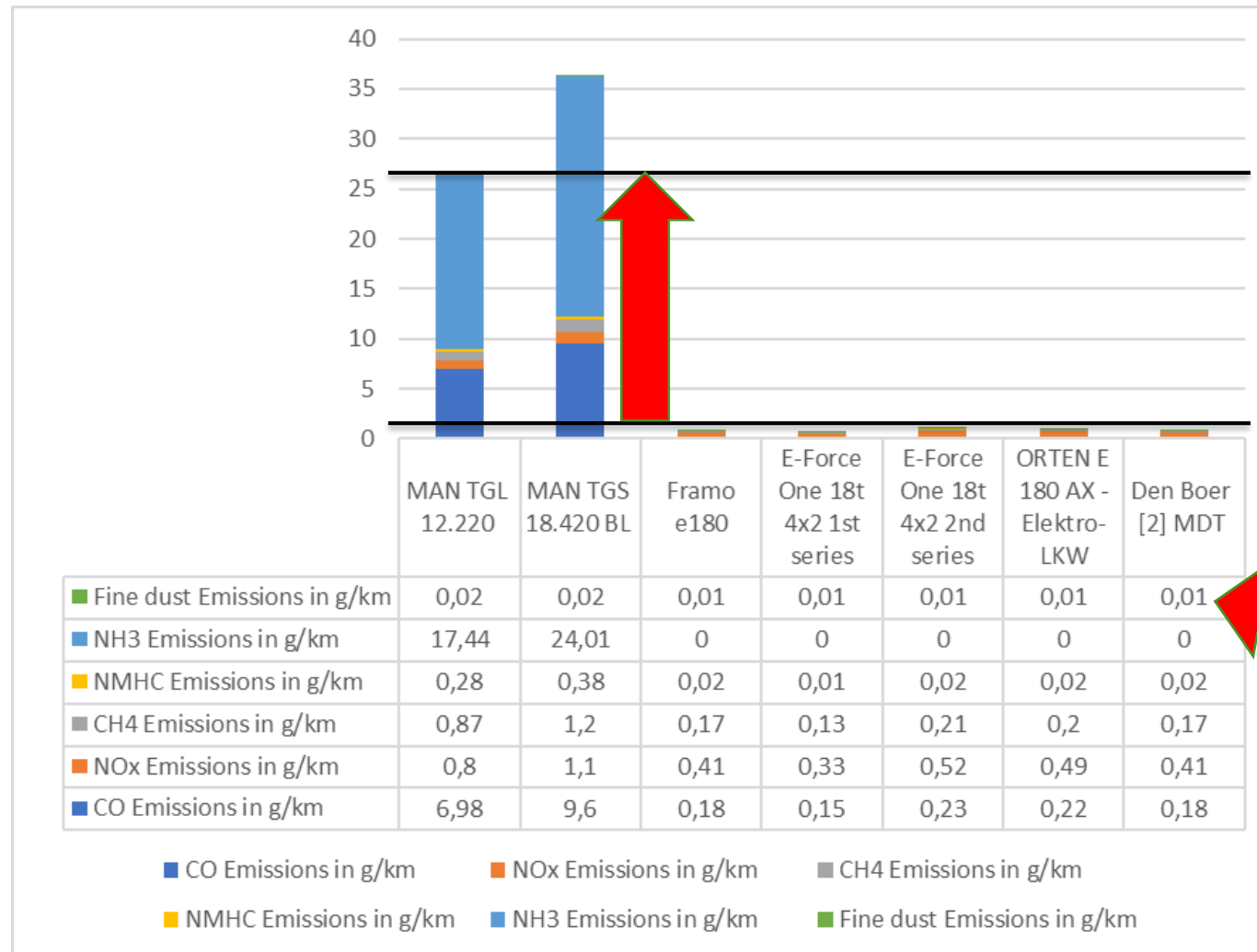


CO2 emissions are reduced by only 200g/km, because of the energy mix.

Source: Own Research Analysis of six different data sheets and offers from manufactures and lastauto omnibus, Katalog 2018, EuroTransportMedia Verlags- und Veranstaltungs GmbH, Volume 47, Stuttgart, 2019. p.285-290

Solution to decarbonize trucks

E-Trucks 2020



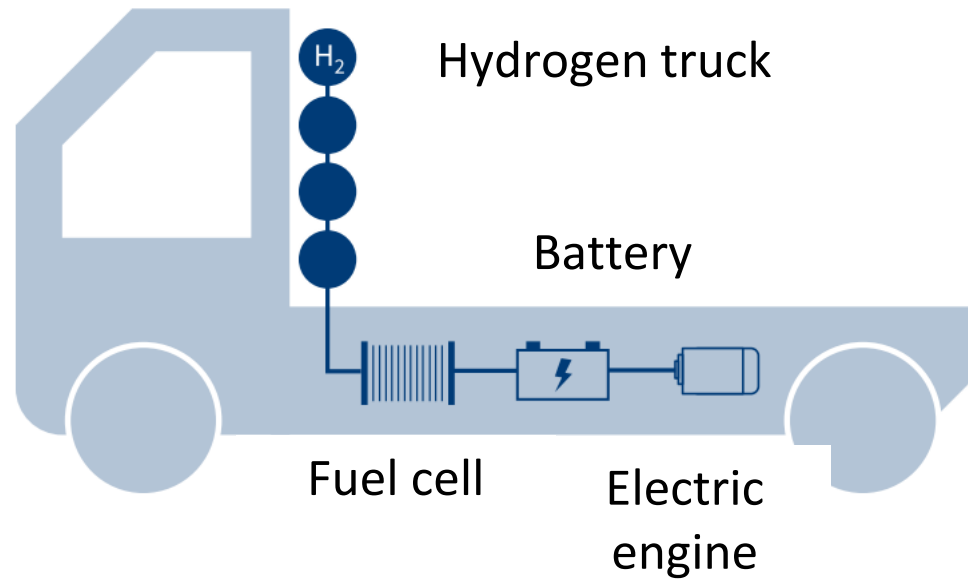
Other emissions
are reduced
more than 20
times

Primary fine dust reduced by 50%.
The other 50% is caused by the wheels!

Source: Own Research Analysis of six different data sheets and offers from manufactures and lastauto omnibus, Katalog 2018, EuroTransportMedia Verlags- und Veranstaltungs GmbH, Volume 47, Stuttgart, 2019. p.285-290

Solution to decarbonize trucks

Hydrogen trucks



Source: Kickoff Workshop – HYWHEELS Wasserstoffbasierter (HY) Wirtschaftsverkehr in Osthessen zur Einsparung von Emissionen in der Logistik und im Straßenverkehr 26.11.2020

Solution to decarbonize trucks

Hydrogen trucks



Water power station



Production
36 kg H₂/h



Filling station for
containers



Container
max. 350 kg H₂ with 350
bar (pressure)

Source: Kickoff Workshop – HYWHEELS Wasserstoffbasierter (HY) Wirtschaftsverkehr in Osthessen zur Einsparung von Emissionen in der Logistik und im Straßenverkehr 26.11.2020

Solution to decarbonize trucks

Hydrogen trucks

Data sheets of hydrogen vehicles



	Car	Bus	Heavy duty truck
Range in km	400 to 650	400	400 to 1200
pressure level in bar	700	350	350 to 700
tank volume in kg	4 to 6	45 to 40	more than 35
charging time in min.	3 to 5	10	10
energie consumption kg/100 km	1	6 to 10	7 to 10

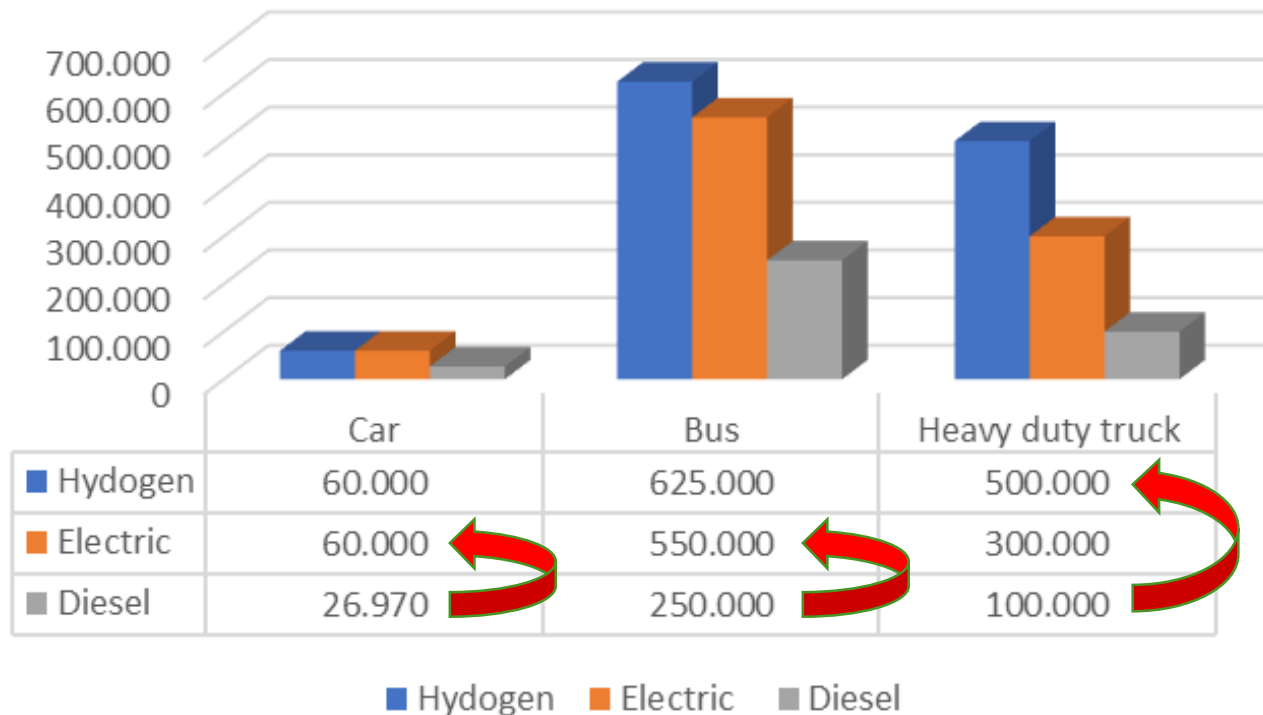
Range and charging time are equal to what users know from diesel vehicles.
Acceptance of the vehicles will be higher.

Source: Kickoff Workshop – HYWHEELS Wasserstoffbasierter (HY) Wirtschaftsverkehr in Ostthessen zur Einsparung von Emissionen in der Logistik und im Straßenverkehr 26.11.2020

Solution to decarbonize trucks

Hydrogen trucks

Purchasing price



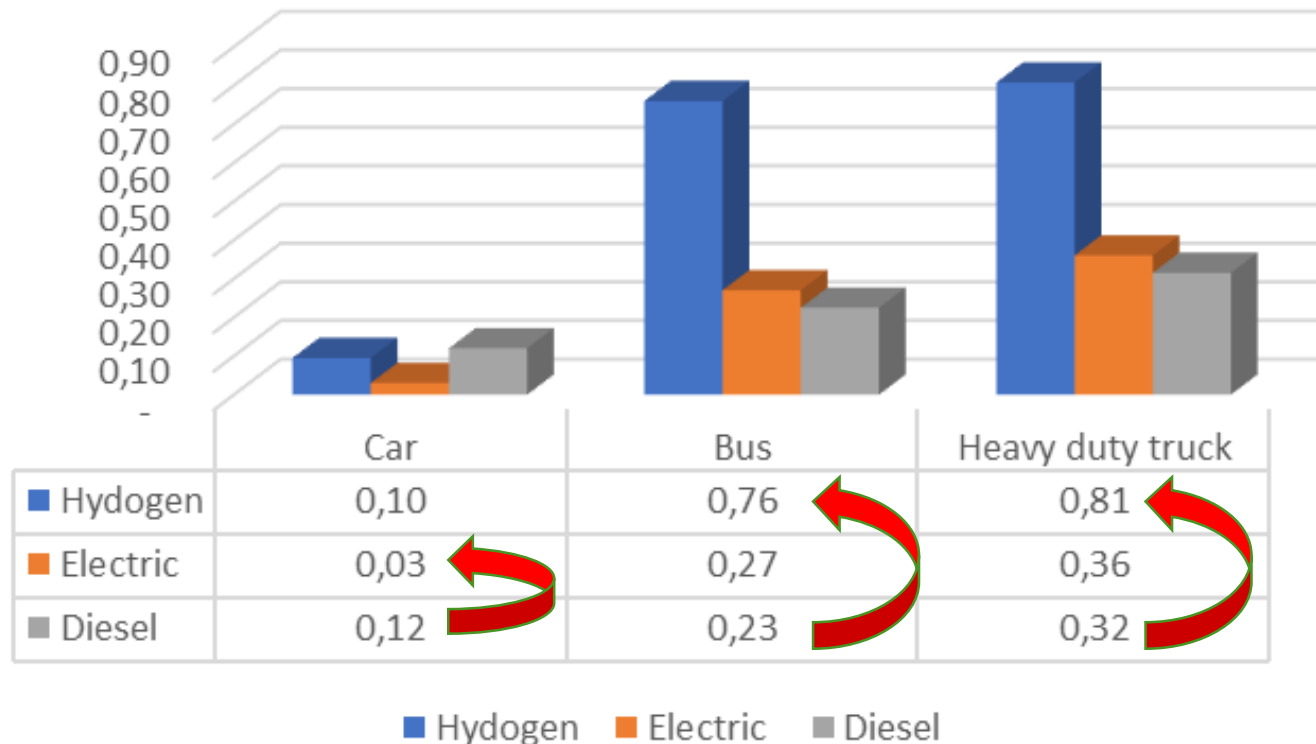
Cars and busses are two time more expensive. Trucks at least three times, or more.

Sources: Own Research and <https://www.auto-motor-und-sport.de/news/nikola-one-wasserstoff-truck-1000-ps/> <https://infoportal.mobil.nrw/technik/busse-mit-elektrischem-antrieb/brennstoffzellen-linienbus.html> <https://www.elektroauto-news.net/2020/wie-viel-kostet-ein-kilo-wasserstoff-basics> <https://www.adac.de/rund-ums-fahrzeug/autokatalog/marken-modelle/toyota/toyota-mirai/> Einführung von Wasserstoff-bussen im ÖPNV Fahrzeuge, Infrastruktur und betriebliche Aspekte now GmbH https://www.starterset-elektromobilität.de/content/1-Bausteine/5-OEPNV/now_leitfaden_einfuehrung-wasserstoffbusse.pdf

Solution to decarbonize trucks

Hydrogen trucks

Comparison costs per km

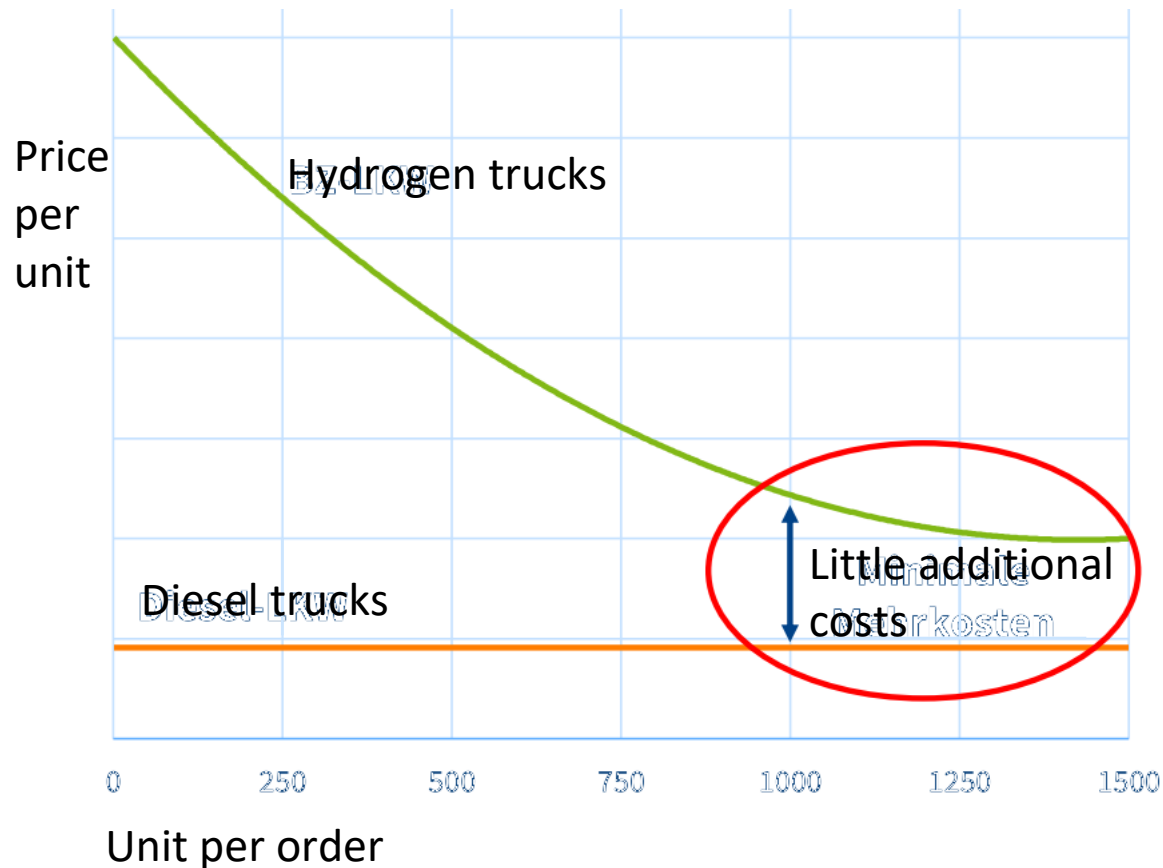


Battery electric cars might compensate their higher price through lower operating costs.

Sources: Own Research and <https://www.auto-motor-und-sport.de/news/nikola-one-wasserstoff-truck-1000-ps/> <https://infoportal.mobil.nrw/technik/busse-mit-elektrischem-antrieb/brennstoffzellen-linienbus.html> <https://www.elektroauto-news.net/2020/wie-viel-kostet-ein-kilo-wasserstoff-basics> <https://www.adac.de/rund-ums-fahrzeug/autokatalog/marken-modelle/toyota/toyota-mirai/> Einführung von Wasserstoff-bussen im ÖPNV Fahrzeuge, Infrastruktur und betriebliche Aspekte now GmbH https://www.starterset-elektromobilität.de/content/1-Bausteine/5-OEPNV/now_leitfaden_einfuehrung-wasserstoffbusse.pdf

Solution to decarbonize trucks

Hydrogen trucks



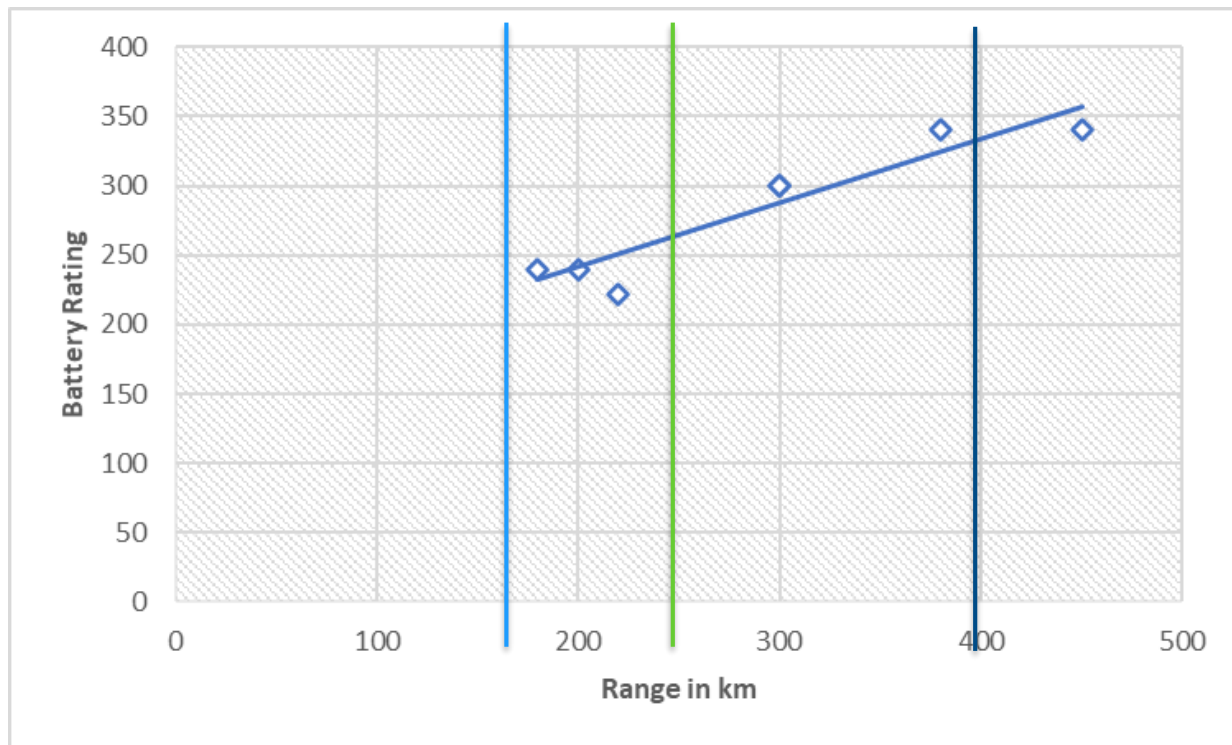
Hydrogen trucks:
Range: 400 to 1200 km
Charing time: 10 Minutes

E-trucks:
Range: 150 to 300 km
Charing time: 2 hours

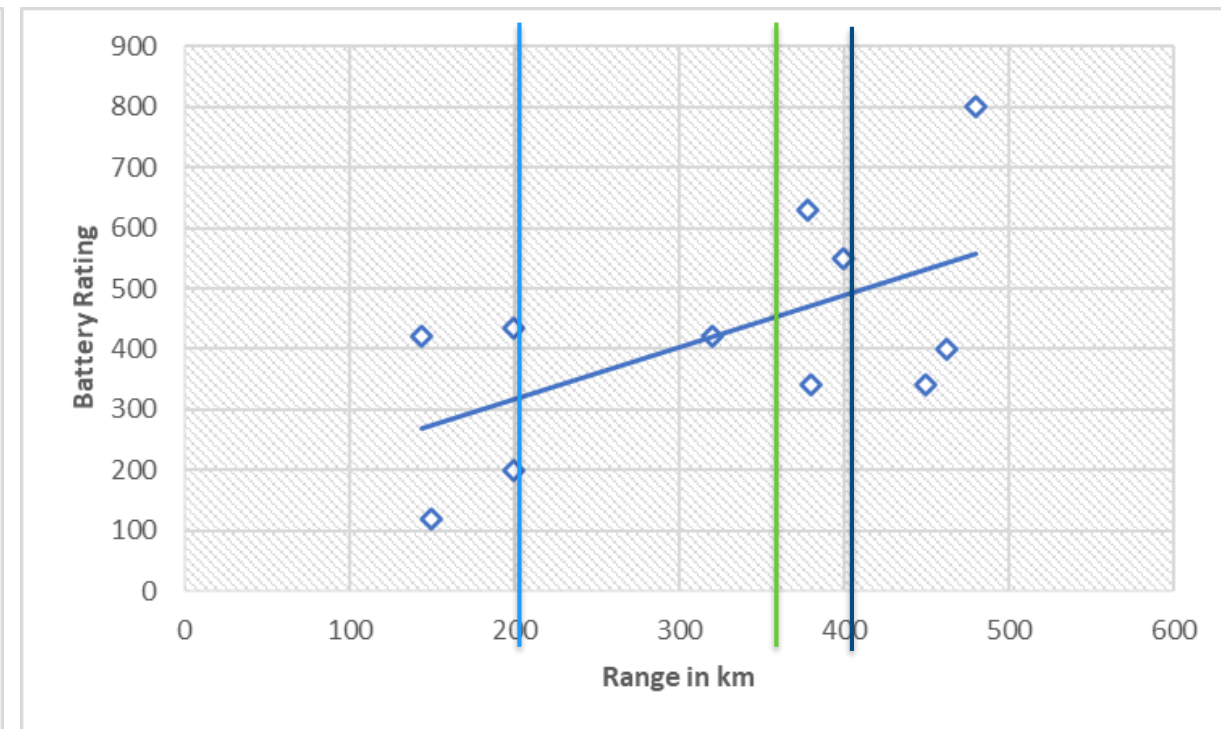
Source: Kickoff Workshop – HYWHEELS Wasserstoffbasierter (HY) Wirtschaftsverkehr in Ostthessen zur Einsparung von Emissionen in der Logistik und im Straßenverkehr 26.11.2020

Result of the comparison of 35 battery electric truck concepts

Blow 26 tons total gross weight



Tractor units

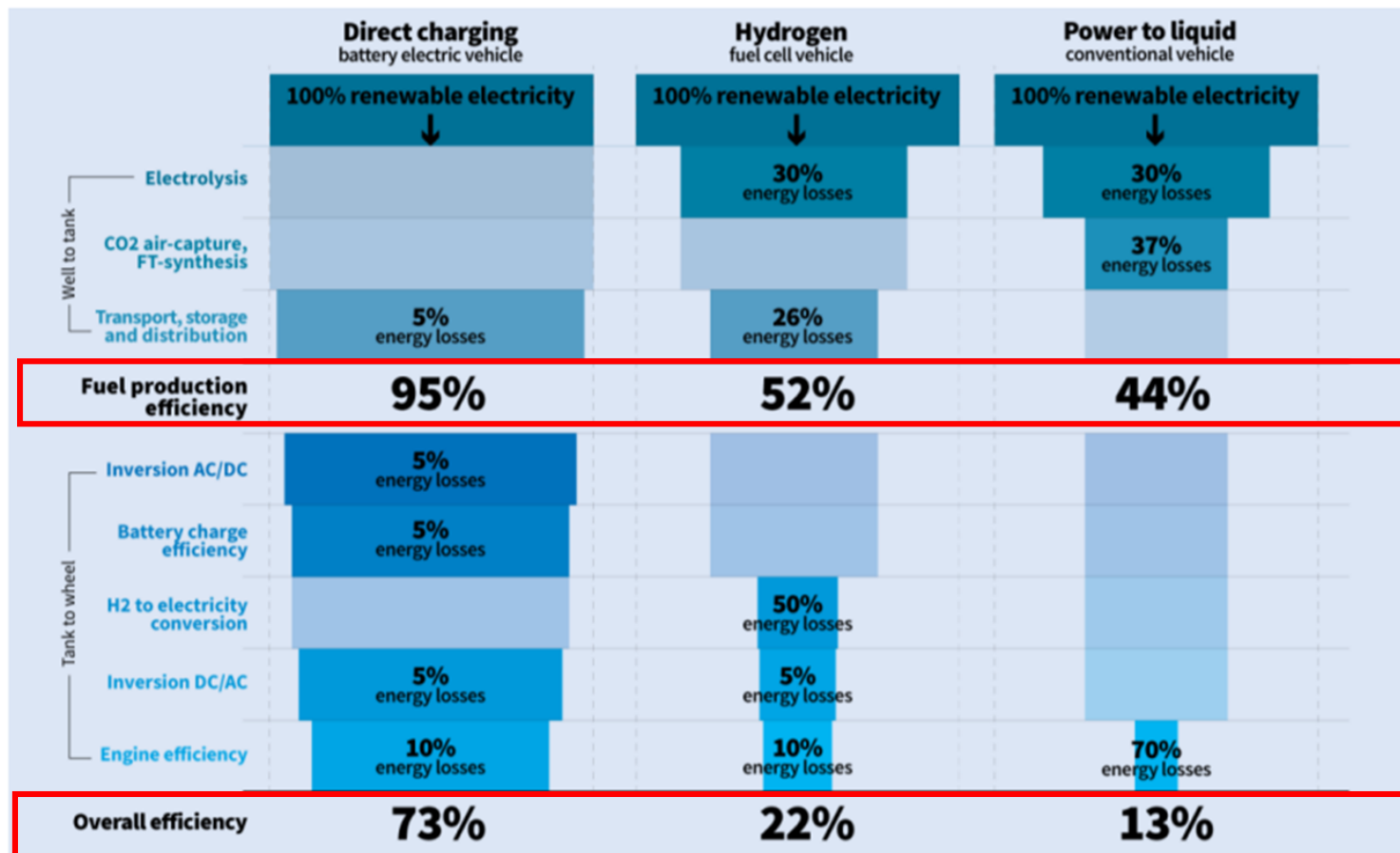


Source: Own Research 50 to 100 Webpages

Solution to decarbonize trucks

E-Trucks 2020

Comparison of the efficiency of different diesel alternatives



Efficiency of battery electric vehicles is 3,5 higher than hydrogen vehicles!

Ambel, C.C., Roadmap to climate-friendly land freight and buses in Europe, 2017, European Federation for Transport and Environment AISBL, zu finden unter https://www.transportenvironment.org/sites/te/files/publications/Full_%20Roadmap%20freight%20buses%20Europe_2050_FINAL%20VERSION_corrected%20%282%29.pdf