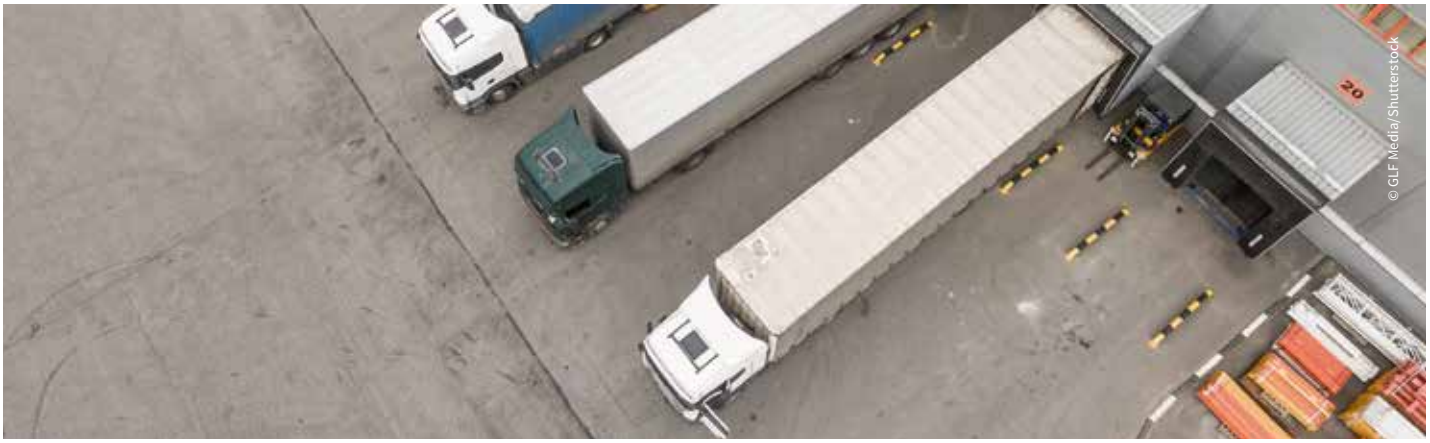
Global Alliance
*Powerfuels*

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# Powerfuels in Heavy Transport

**Powerfuels can play a major role in reaching the decarbonisation goals of heavy road transportation.**

Road freight transport in the European Union has increased by 25 per cent since 1990. In 2016, heavy duty vehicles were responsible for 27 per cent of road transport $CO_2$ emissions and almost 5 per cent of total EU green-house gas (GHG) emissions. And EU freight transport is greatly dependent on road transport: 70 per cent of European freight is being transported by trucks, most of them being driven by diesel engines. As there is no major efficiency increase predicted for heavy duty vehicles, alternative propulsion systems and renewable fuels have to play a major role for the mitigation of GHG gases in the transport sector[1]. These include natural gas, hybrid-systems, battery electric vehicles, trolley-trucks and the usage of powerfuels.

Heavy duty transport is characterised by high transport capacity combined with long distances, this makes the direct use of electric energy difficult as battery driven trucks are lacking in range. The direct electrification by overhead lines comes with high infrastructural costs and is not cost-effective for less frequented routes.

Powerfuels offer a sustainable alternative to these challenges. Since they can be chemically identical to their fossil fuel alternatives, they could be used with existing infrastructure.

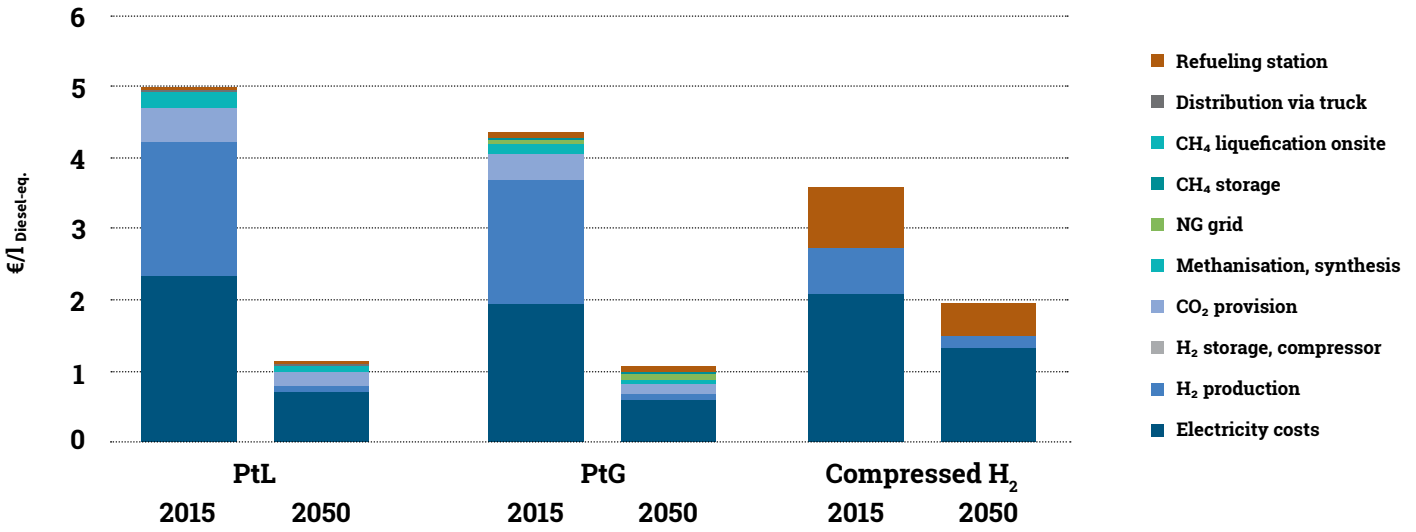
**27 % of GHG emissions in the European traffic sector are emitted by heavy duty vehicles[1]**

**40 % of the oil demand growth and 15 per cent of the increase in global energy-sector $CO_2$ from 2015 until 2050 will be accountable to trucks without further policy efforts[2]**

| | | | |
|---|---|---|---|
| **$H_2$ Hydrogen** | ✓ No local pollutant and $CO_2$ emissions | ✓ High efficiency of the fuel cell | ! Hardly any supply and refuelling infrastructure |
| **Synthetic Methane** | ✓ Significantly lower $CO_2$ and local pollutant emissions | ✓ Usage of existing vehicles and refuelling infrastructure for RE-CNG | ! No existing refuelling infrastructure for LNG |
| **Synthetic Diesel** | ✓ Possible usage of existing refuelling infrastructure and vehicles | ✓ “Drop-in” character makes it able to gradually substitute conventional Diesel | ! No substantial efficiency increase predicted for Diesel engines |

## Actual and projected cost structure of relevant powerfuels for public transport

Actual (2015) and predicted (2050) prices for different powerfuels in €/l Diesel-eq.




Hydrogen is provided by high temperature electrolysis for PtG and PtL, Hydrogen for compressed hydrogen is provided by low temperature electrolysis, Powerfuels are produced with EU domestic energy in 2015 and are imported for the year 2050, Carbondioxide is provided by direct air capture technology Source: "e-fuels" study (LBST and dena)[3]

## Comparison of technology and infrastructure for different propulsion types

| | Technology readiness level | Infrastructure |
|---|---|---|
| **FCEV-truck** Hydrogen | First fuel cell trucks (FCEV) are already been produced; high tank capacities needed; high overall efficiency of the fuel cell; high cost reduction possible | Almost no existing infrastructure; Development of modern logistic procedures, like liquid organic hydrogen carriers (LOHC) and liquefaction of hydrogen |
| **CNG/LNG-truck** Synth. Methane | High technology readiness level of the whole powertrain; Usage of CNG rather in the light vehicle area; LNG for trucks not yet widespread | CNG-infrastructure available widespread; LNG not yet disseminated |
| **Diesel-truck** Synth. Diesel | Further use of existing and disseminated technology | Further use of existing and disseminated infrastructure |
| **BEV-truck** Renewable electricity | BEV-trucks are yet in prototype stage; not yet suitable for long distances; high weight of the battery | Recharging infrastructure in under construction |
| **Trolley-truck** Renewable electricity | Overhead line hybrid trucks are yet in prototype stage | Capital-intensive construction of infrastructure needed; disseminated usage and border-crossing traffic problematic |

## Existing political instruments can foster powerfuels ramp-up

The admission of powerfuels to the national implementations of the EU RED-II (Renewable Energy Directive) as carbon-neutral variant of alternative fuels could draw more attention to powerfuels. Instruments on national or local level like road tolls or congestion charges, as well as existing taxes and duties like energy taxes or vehicle taxes can be further evolved to take GHG emissions into account. Another possibility is allowing powerfuels to count towards achieving EU fleet average emission targets for heavy duty vehicles. These are amongst others promising possibilities for policy makers to boost the market ramp-up of powerfuels.

**1** Carbon dioxide emissions from Europe's heavy-duty vehicles, European Environment Agency. **2** $CO_2$ emission standards for heavy-duty vehicles, European Parliament. **3** The future of trucks – Implications for energy & the environment, IEA. **References:** The potential of electricity-based fuels for low-emission transport in the EU, dena and Ludwig Bölkow Systemtechnik.

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