IN A NUTSHELL: HOW TO REDUCE CO_2 IN LINEHAUL

November 2023

DHL Group

We set an ambitious target for decarbonization until 2030 and committed to spending up to €7 billion into sustainable fuels and technologies

OVERVIEW DHL

Clean operations

We plan additional expenditures of up to **€7 billion until 2030 in Clean Operations** to reduce our emissions to under 29 million tonnes by 2030 and thereby **commit to Science Based Targets initiative** (SBTi)

Target **>30% Sustainable Aviation Fuels blending** by 2030 in our Air Freight business

Electrify 60% of **last-mile delivery vehicles**

Grow sustainable fuels and electrification share to >30% by 2030

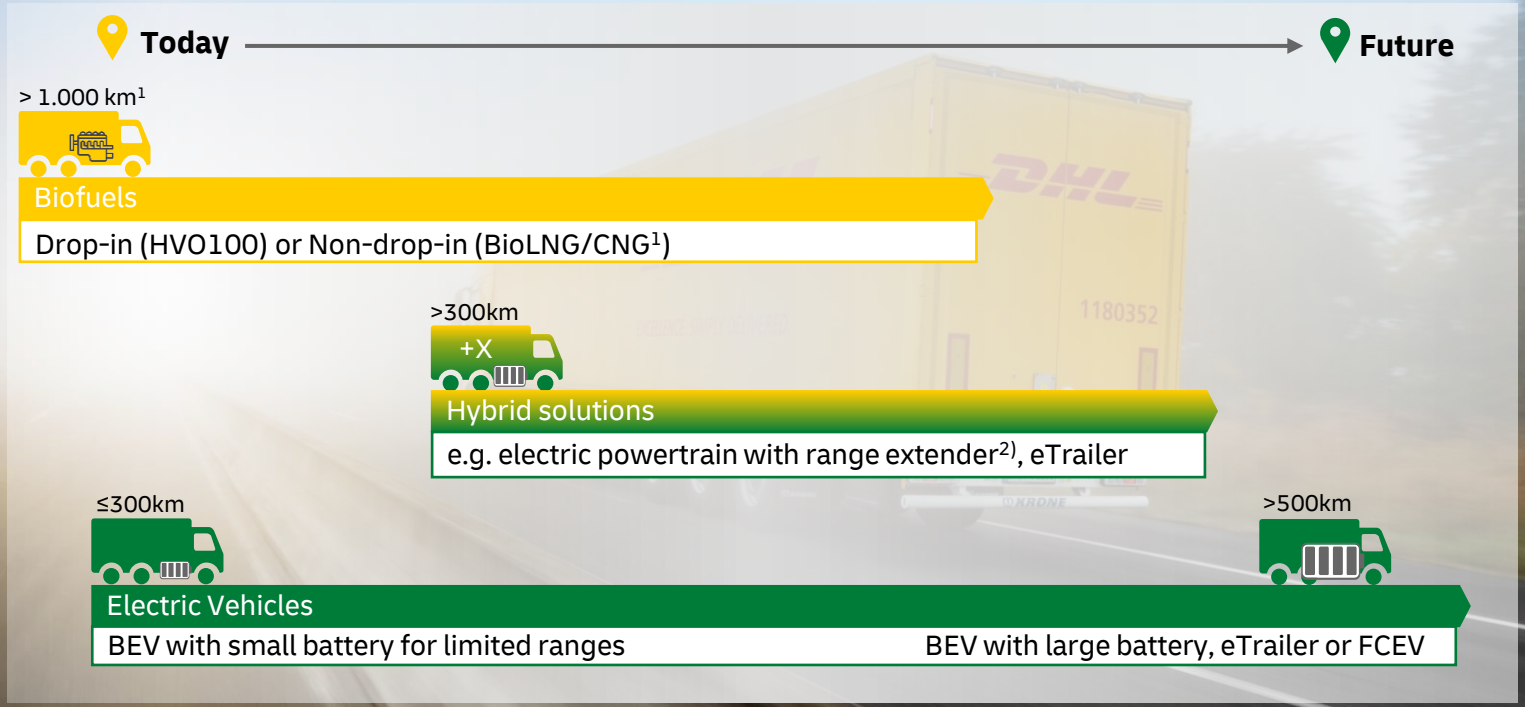
Focus

Increase the usage of **Sustainable Marine Fuel** for our FCL & LCL shipments

Carbon neutral design to be used for all new buildings

True „Zero emission technologies“ for trucks are not yet fully available; bridging technologies are unavoidable to reach short- to mid-term decarbonization targets

DECARBONIZATION TECHNOLOGY ROADMAP FOR LINEHAUL



Pathway to Zero

Less CO_2
-70-100%

Less emissions

No emissions

1) CNG rage appr. 600 km; CNG: Compressed Natural Gas, LNG: Liquified Natural Gas; HVO, Hydrotreated vegetable oils, BEV: Battery-electric vehicle, FCEV: Fuel-cell-electric vehicle; 2) e.g. generator or fuel cell

In many markets alternative fuels can already be used today at a large scale

OVERVIEW OF SUSTAINABLE FUELS

	HVO	BioLNG	BioCNG
Fuel feedstock & availability	● Used cooking oils ● Competition with other uses ● Available in various blends, 100% availability growing	● Different waste materials ● Limited production, but growing 100% availability	● Different waste materials ● Independent pricing ● 100% availability
Vehicle availability & range	● Drop-in Fuel, can be used in regular Diesel trucks ● >1,000 km	● Non-drop-in fuel, dedicated trucks required ● 1,200 – 1,400 km	● Non-drop-in fuel, dedicated trucks required ● <600 km
Infrastructure readiness	● Good network in selected countries[1] and growing, in some cases bunkers required	● Good LNG network in many countries[2], growing further	● Limited (not all stations are truck compatible)
Cost premium[3] & lead times	● Fuel: Price Premium[3,4] ● Truck lead time: 9-12 months	● Fuel : volatile +/- to Diesel[4] ● Truck: + 10,000 – 40,000 EUR ● 12 – 18 months	● Fuel: Below Diesel[4] ● Truck: + 10,000 – 40,000 EUR ● 12 – 18 months
	Easiest but costly option for short-term emission reductions	**In selected markets most cost-efficient for long distances**	**In selected markets most cost-efficient for short/medium distances**

1) NL, BE, IT, A, Nordics, Baltics; 2) DE, Nordics, UK, NL ; 3) compared to Diesel; 4) As of November 2023; prices vary significantly between countries; TCO depend on specific use case;

Though not in scope of current OEM activities, we also consider the use of modular range extender technologies

OVERVIEW OF HYBRID SOLUTIONS

eTrailer

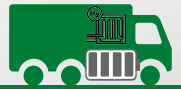
+ Independent from tractor unit
+ Compatible with any truck motorizations
+ External charging possible
- Additional energy load for local grids
- Additional weight and invest

Diesel generator

+ Drop-in fuel ready
+ Compatible with fueling and charging standards
+ Applicable for all truck use cases
+ Reduce energy load from local grid
- Remaining tailpipe emissions

Catenary

+ Motorway optimized
+ Local emissions free
+ Space for additional components available
- Challenging infrastructure rollout
- Low momentum from industry or legislation



Fuel cell

+ Long range solution
+ Local emissions free
- Less efficient than BEV
- Challenging transport and storage of hydrogen
- Highest cost

BEVs are the most energy efficient option amongst Zero Emission solutions. Grid capacity is the main hurdle while regular use of FCEVs is not in sight

OVERVIEW OF ZERO EMISSION TECHNOLOGIES

	BEV	FCEV
Energy features & availability	● Renewable electricity ● Relevant competition with other sectors ● Availability of renewable electricity differs between countries	● Hydrogen from renewable electricity ● High competition with other sectors ● Green Hydrogen only at high cost and not mature yet
Vehicle availa-bility & range	● Mature trucks for up to 300km ● As of 2024 Long haul trucks up to 500 km ● eTrailers expected end of 2024 (300-400km)	● As of now pilot vehicles only ● First series vehicles expected in 2026 (Range: > 500 km)
Infrastructure readiness	● Very limited public charging infrastructure ● High requirements regarding grid capacity for high-power charging (HPC)	● Very low number of fueling stations ● Existing and incumbent providers expand network
Cost premium & lead times	● Energy: -10-30% + charging infrastructure[1,2)] ● Truck: +150-350k EUR[2,3)] ● Lead time 6–12 months	● Energy: +200-400%[4)] ● Truck: only prototypes
	Very energy efficient, fast growing OEM portfolio, high invest	**Complementary to BEV, Very high invest, not yet available**

1) Assuming on-site charging; 2) Subsidies varying from country to country; 3) Depending on OEM and battery capacity 4) For green hydrogen

We already achieve short-term emission reductions for our customers with biofuels…

CUSTOMER PROJECTS WITH BIOFUELS (EXCERPT)

Customer:	JAGUAR / LAND ROVER	MARKS & SPENCER	VOLVO	GRUNDFOS	Intergamma
Country:	UK	UK	SE	DK	NL
Technology:	BioCNG	BioLNG	HVO	HVO	HVO
Scope:	transition of entire UK core fleet by 2024	35 trucks	Domestic FTL + different LTL flows	2 trucks	3 trucks

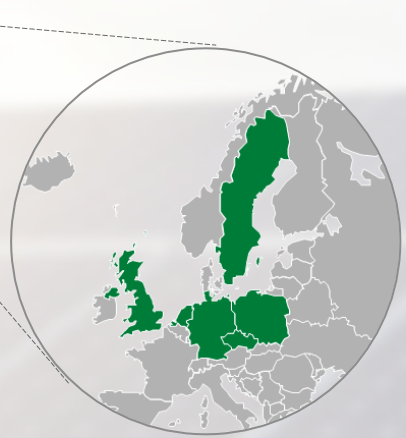
LNG: Liquified natural gas, CNG: Compressed natural gas, HVO: Hydrotreated vegetable oils, BEV: Battery-electric vehicle

...while promoting and piloting long-term zero emission technologies (1/2)

ELECTRIC TRUCKS AT DHL GROUP

Already **more than 50 electric trucks** in use in DHL Group operations, ranging from

- **Europe**
  USA
- **7,5-60t**
- **Deployment in**
  - **PuD**
  - **linehaul**
  - **regional traffic**
  - **yard operations**



Volvo FL Electric 16t

Delivering to Fashion retailers in the City of London

(100km/day)

Volvo FH Electric 60t

High utilization in combined linehaul and regional traffic in Sweden

(300 km/day)

Terberg E-Yard Truck BC-182

Used for more than three years at two German parcel centers.

(21 hrs/day)

...while promoting and piloting long-term zero emission technologies (2/2)

PILOT PROJECTS HYDROGEN TRUCKS

- First hydrogen **pilot successfully completed** (27t Box Body Rigid with mobile H2 refueler)
- **Two Fuel Cell Electric trucks** will be deployed **in 2023/24** in cooperation with Paul Nutzfahrzeuge and Shell
- We will be testing two **hydrogen combustion engine trucks** within the HYCET project in cooperation with BMW (40t, 400km range)
- Further pilots in development (e.g. H_2Haul in cooperation with Iveco and BMW)

Vehicle Specs

- 2 year pilot
- 15t box body rigid with trailer use
- Range 450km
- Fueling at H_2mobility station in cooperation with Shell
- Deployment in regional transport in Cologne area, Germany

With the majority of our road emissions in Scope 3, activation of our road transport partners for decarbonization is a major focus

DHL GROUP GREEN CARRIER CERTIFICATION PROGRAM (GCC)

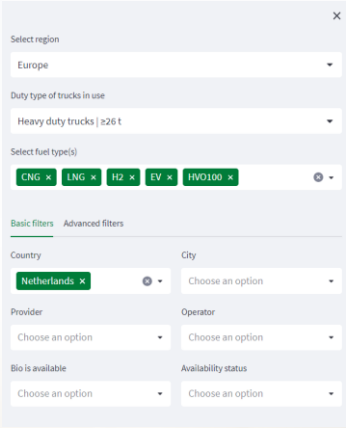
- The business areas focus on reducing emissions in the management of road subcontractors
- Depending on the subcontractor's CO_2e performance, fleet profile and investments in alternative fuels, the subcontractor receives certificates
- Vehicle and fuel consumption data of subcontractors are collected through the GCC program and the integrated online platform
- The ranking helps to select subcontractors in a targeted manner and also to develop them further, if necessary

Our goal:
CO_2e reduction in scope 3

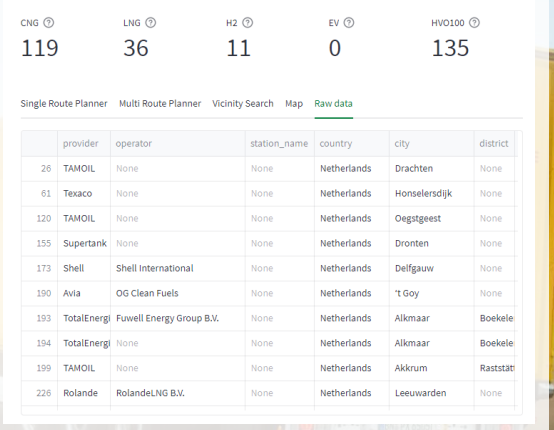
The Green Fuels Route Planner helps identify customer routes with existing infrastructure for sustainable fuels and technologies

DHL GROUP GREEN FUELS ROUTE PLANNER (GFRP)

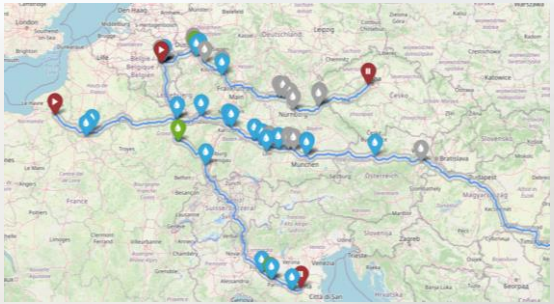
1 Search criteria



2 Process results



3 Show locations and details



Green Fuels Route Planner

- Enter customer lane Information (e.g., Tender Information) via standardized Excel template

Analysis

- Automatic processing and verification of lane information with daily updated fuel provider data

Visualization

- Feasibility route check for alternative fuels via Excel & Map
- Detailed lane and routing data

There are many solutions for decarbonizing your linehaul transport now

let‘s start!

BACK UP

Our roadmap identifies five levers for achieving our climate targets in linehaul transport

DECARBONIZATION LEVERS FOR LINEHAUL

1 SUSTAINABLE FUELS & TECHNOLOGIES IN LINEHAUL
Grow sustainable fuels and electrification share to >30% by 2030

2 DRIVE INNOVATION
Support development and market availability of **hydrogen and electric trucks**

3 TRANSPORT PARTNER ACTIVATION
Foster green transport of our subcontractors through **standards, education and incentives** to invest in green transport solutions

4 NETWORK OPTIMIZATION
Reduce fuel consumption through **network improvements**

5 DRIVER TRAINING
Enable employee contribution through **ecofriendly driving training programs**

SUSTAINABLE FUELS suitable for road transportation

CLASSIFICATION OF SUSTAINABLE FUELS

Sustainable fuels come from renewable energy sources and cause no or very low greenhouse gas emissions. The spectrum ranges from biodiesel to power-to-liquids.

The fuels differ

- according to the utilized raw materials, e.g. waste, used cooking oil, water and CO_2, electricity from renewable energies
- by the type of use; drop-in or non-drop-in fuels
- by state of aggregation; gaseous fuels are easier to produce than liquid fuels, but storage and transportation are more complex.

DROP-IN FUELS

... can be blended with conventional diesel, engines and infrastructure do not need to be retrofitted. Drop-in include

- HVO
- E-Fuels (e.g. PTL)[1]

NON-DROP-IN FUELS

... cannot be blended in diesel engine. Specific vehicles and dedicated infrastructure are necessary. They include

- Hydrogen
- BioLNG/BioCNG
- E-LNG/E-CNG[2]
- Electric energy

[1] Used mainly for flight operations [2] Gas from renewable energies

BioLNG and BioCNG – the bridging technology for linehaul

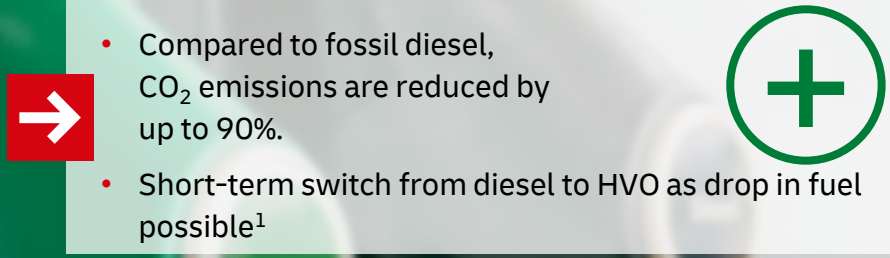
INTRODUCTION TO BIOLNG AND BIOCNG

- Natural Gas has long been used as a vehicle fuel, being stored either liquid (LNG) or in gaseous (CNG) state.
- If coming from fossil sources, LNG and CNG do not offer significant carbon improvements against Diesel.
- However, natural gas **can also be produced from renewable sources** – e.g. household waste, liquid manure, food or straw. The fuel is then called BioLNG or BioCNG and offering **very high CO_2e reductions between 80 and >90%**.
- Fossil and biological LNG and CNG are chemically identical and **can** therefore **be used in all blend ratios from 0 to 100%.**

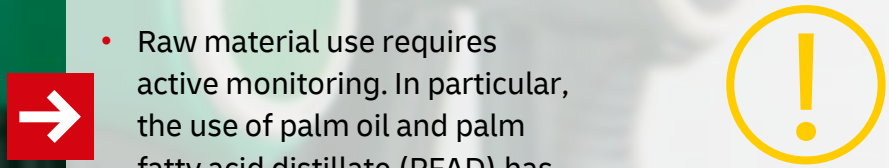
HVO is a backup option – most simple in implementation but only available in select markets such as Sweden, Netherlands, US and the UK

INTRODUCTION TO HVO

- Belongs to the biodiesel group, is **produced from waste raw materials**, and can be blended and used as a pure fuel in selected countries.
- HVO is used heavily, especially at DHL Sweden, due to tax incentives; its share of fuel consumption there is expected to rise to around 86% by 2030, compared with only 56% in Mainland Europe.
- In US HVO is cheaper than fossil diesel due to subsidies.
- In Germany, HVO may currently be added to diesel fuel at a rate of up to 26%. Approval of using HVO100 in Germany expected in Q2/ 2024; major suppliers are planning to integrate HVO100 on existing fueling stations.



- Compared to fossil diesel, CO_2 emissions are reduced by up to 90%.
- Short-term switch from diesel to HVO as drop in fuel possible[1]



- Raw material use requires active monitoring. In particular, the use of palm oil and palm fatty acid distillate (PFAD) has been criticized.
- Feedstock in competition with other uses, e.g., SAF
- The availability of HVO is correspondingly limited if high sustainability standards are met.

SAF: Sustainable Aviation Fuel; 1) Usage of HVO cleared by OEMs for most vehicles

The DHL Group Biofuels Policy ensures, that only sustainably produced fuels will be used in the Group

DHL GROUP BIOFUELS POLICY

- Certified by the Roundtable of Sustainable Biomaterials (RSB) or International Sustainability & Carbon Certification (ISCC).
- With certified LCA GHG[(1)] emission reduction of > 60% for all biofuels based on the EU Renewable Energy Directive II (RED II) and other certification schemes.
- NO fuels from feedstocks with a high risk of unsustainable production, e.g. grain-based SAF; currently banning palm oil and palm fatty acid distillate (PFAD) as feedstocks.
- Feedstocks such as UCO (used cooking oil) and tallow are officially defined as municipal waste.

[(1)] Life Cycle Assessment of Greenhouse Gas

There are various options for charging electrified trucks in the future, although there is no "one size fits all" solution here

ELECTRIC TRUCK CHARGING OPTIONS

Charge @Logistics sites

Further development of **own charging infrastructure** at DHL / customer sites

Charge @Semi-public sites

Destination charging on **semi-public** infrastructure being provided by **3rd party business partners**

Charge @Road

Use of **publicly available** charging infrastructure along the route

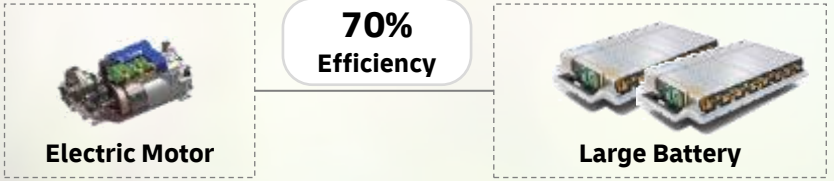
Charge @ e-highways

Charging on **"e-highways"** while on the move and refueling with electricity on demand along the way

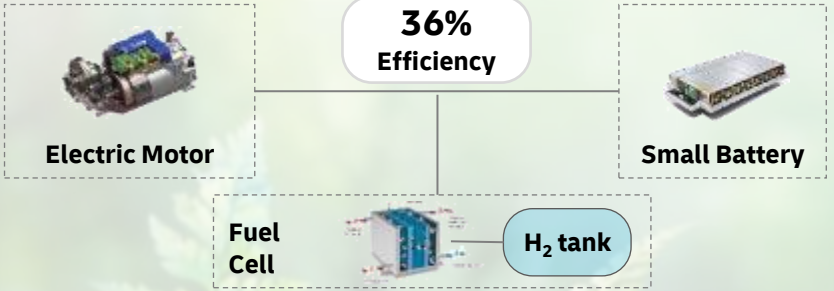
BEV are FCEV are two variants of the same powertrain, just differing in energy provision

BEV AND FCEV OVERVIEW

Battery Electric Vehicles (BEV)



Fuel Cell Electric Vehicles (FCEV)

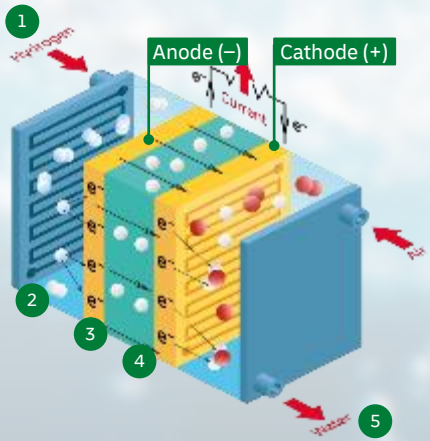


- BEV and FCEV share the identical electric powertrain, only that
  - BEVs store the energy directly electrically in large batteries
  - FCEVs store energy as hydrogen and transfer that into electricity on-board via a fuel cell
- **Advantage of BEVs** is the **higher energy efficiency** (70%) compared to FCEVs (36%)
- **Advantage of FCEVs** is the **higher driving range and shorter refuelling periods** due to their gaseous or liquid storage

Hydrogen – fuel of the future for linehaul

INTRODUCTION TO HYDROGEN

The fuel cell converts hydrogen into electricity.



Hydrogen is fed into the cell from a tank (1); on the anode side (negative pole) the hydrogen is split into protons (2); free electrons (e-) produce electricity for the engine (3);

The protons react with the oxygen fed in at the cathode side (positive pole) and the electrons to form water (4);

Clean water drips out from the exhaust (5).

- Efficient production of hydrogen from green electricity possible
- No limitation of raw materials
- Zero emissions
- The energy efficiency is 36 percent well-to-whell.

Blue hydrogen
Originally gray hydrogen in which the CO_2 is captured and stored (Carbon Capture and Storage). Production is therefore CO_2-neutral.

Gray hydrogen
Is produced from fossil fuels – especially natural gas.
Due to the high CO_2 emissions, it is not sustainable.

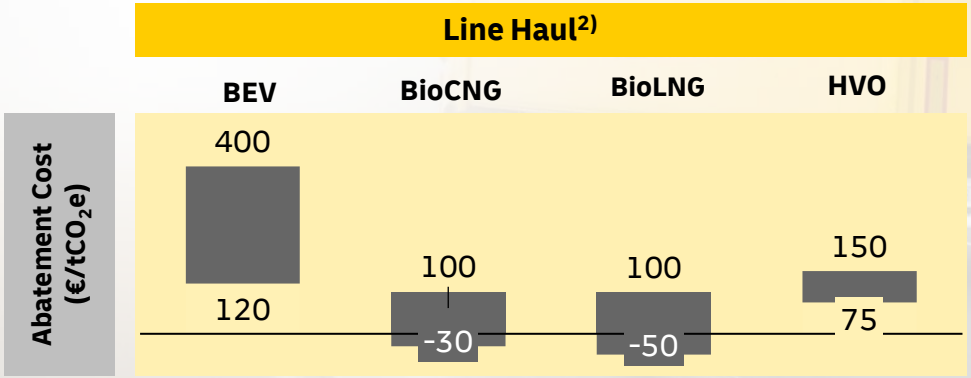
Green hydrogen
Is produced by the electrolysis of water. To ensure that the production is CO_2 free, only electricity from renewable sources may be used.

As the abatement cost for road decarbonization solutions largely vary depending on multiple factors, each case needs to be analysed individually

ABATEMENT COST OVERVIEW

Abatement Cost

"Estimates of the prospective annual abatement cost in **euros per ton of avoided emissions of greenhouse gases** […] ….understood as the **additional cost of producing** e.g. electricity **with this zero-emission technology** instead of the cheaper fossil fuel-based power production it would replace"[1)]



Abatement cost for road transport decarbonization vary widely, depending on multiple factors, such as:

- Country
- Local subsidies
- Specific vehicle(s)
- Yearly mileage
- …

1) https://www.mckinsey.com/capabilities/sustainability/our-insights/a-cost-curve-for-greenhouse-gas-reduction;
2) Exemplary Case, Assumptions: 100.000 annual mileage, 6 years, market standard prices for fuel and electricity