Charging Poland

Prospects for electrification of vans and trucks in Poland

Electric Vehicles Promotion Foundation

cambridge econometrics
clarity from complexity

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Prospects for electrification of light commercial vehicles and trucks in Poland

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Special thanks to the members of the Steering Committee

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- National Centre for Emissions Management, Robert Jeszke
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The report summarises the analytical task performed by Cambridge Econometrics entitled Potential Options and Technology Pathways for Delivering Zero-Carbon Freight in Poland. The full text of the technical report in English can be found at www.camecon.com

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Introduction

The aim of the „Charging Poland - prospects for electrification of vans and trucks in Poland" report is an attempt to answer the following questions concerning the prospects for electrification of freight road transport

1. How will the total cost of ownership of different technologies change over time and what impact will it have on Polish hauliers?
2. What environmental benefits will the transformation of the Polish road freight sector bring?
3. What are the investment requirements for infrastructure related to the electrification of Polish road freight transport?

By answering these research questions, decision-makers will be able to undertake better decisions in the area of decarbonisation of road freight transport. The analysis shows what costs and benefits are anticipated from selected zero-emission technologies in terms of vehicle purchase, fuel and operating costs, fuel infrastructure construction needs and costs as well as environmental benefits. Especially related to the potential reduction of CO_2 emissions. The analysis shall cover light commercial vehicles with a gross vehicle weight (GVW) <3.5 tonnes and truckstrucks with GVW >3.5 tonnes.

The road freight transport sector is extremely important for Poland. Transport and logistics is one of the most important segments of the Polish economy. Poland has the largest number of registered trucks in the European Union, and our transport companies have the highest share of international freight transport in the European Union, reaching 30%. The cost of electricity for electric cars is significantly lower than the cost of traditional fuel. At the same time, the cost of purchasing an electric vehicle is significantly higher than the cost of purchasing a combustion engine vehicle, which is why a proactive state policy on electrification of road freight transport is necessary to maintain Poland's current position in international transport, while significantly reducing greenhouse gas emissions. Light commercial vehicles and trucks have higher annual mileage and unit emissions than passenger cars. The electrification of the sector will allow a significant reduction in CO_2 transport emissions. The decarbonisation of road transport will also contribute to addressing the problem of high air pollution. Linear pollution generated by transport, especially in cities and built-up areas, has a negative impact on the health of citizens. Actions aiming at reducing emissions of both greenhouse gases and other pollutants are therefore of vital social interest.

Conclusions from the report

- In order to analyse the costs and benefits arising from developing zero-emission light commercial vehicle and truck technologies, three technology development scenarios were created:
  - TECH-BEV scenario which assumes the dominance of battery technology in both the light commercial vehicle and truck segment;
  - TECH-ERS scenario which assumes a wide use of electric road systems in the light commercial vehicle segment;
  - TECH-FCEV scenario where hydrogen domination is assumed for the truck segment and battery domination in the light commercial vehicles segment.

The three scenarios were used to compare the dynamics of replacing a fleet with zero-emission vehicles and the reduction rate in greenhouse gases emissions.

- Battery vehicle technology appears to be the cheapest available technology. For both light commercial vehicles and trucks the total cost of ownership (TCO) will be lower than TCO for conventional cars already in 2025.

- Despite the assumed decrease in the cost of purchasing fuel cells and the decrease in the cost of hydrogen production, hydrogen vehicles will not become more competitive than battery vehicles, no matter the segment.

- With regard to the expected costs of developing charging and refuelling infrastructure, battery technology also proves to be the most competitive technology. It offers lower costs of charging infrastructure construction than hydrogen technologies (hydrogen refuelling stations) and the lowest demand for energy.

- The accumulated investment costs in infrastructure by 2050 within the hydrogen technology domination scenario (TECH_FCEV) will amount to EUR 20 billion, in the battery technology dominance scenario (TECH-BEV) EUR 19 billion, and in the electric road system technology domination scenario (TECH-ERS) EUR 17.4 billion.

- The implementation of zero-emission vehicles in road freight transport will contribute both to a radical reduction of CO_2 emissions from this sector (up to 81% by 2050) and to emissions of other pollutants, notably nitrogen oxides and particulate matter.

- The biggest cumulative reduction in CO_2 emissions, counting throughout the well-to-wheel cycle, will be achieved in the battery technology domination scenario. Lower reductions are achieved in the electric road system technologies domination scenario, and the lowest in the hydrogen scenario. This is due to the fact that battery vehicles can be implemented on a large scale as soon as possible and that the total cost of vehicle ownership is the lowest of the three technology development scenarios examined.

- Even assuming accelerated fleet electrification, taking into account the withdrawal of combustion-engine light commercial vehicles from sales in 2035 and trucks in 2040, given the current average lifetime of trucks in Poland, the Polish road transport sector will not achieve the climate neutrality objective by 2050.

Recommendations

Currently Poland has the largest fleet of trucks and the sixth light commercial vehicles fleet throughout the European Union. Polish companies dominate international road transport in the EU, accounting for approx. 30% of transport. At the same time, the road freight transport share and the volume of transport are constantly increasing. As a result of the road transport growth, Polish transport emissions continue to increase. The increase of transport emissions in Poland in years 2005 - 2019 was almost 100%, and Poland's current target for reducing greenhouse gas emissions by 2030 from sectors not covered by the Emissions Trading Scheme (the so-called non-ETS), including transport, is -7% compared to 2005. It should be borne in mind that this target will be tightened up following the decision to increase the reduction target to 55% by 2030. Promotion of zero-emission road transport vehicles is necessary to achieve the CO_2 emission reduction target.

The main barriers for Polish carriers in purchasing zero-emission vehicles are their high price, lack of support in purchasing them and lack of charging infrastructure. The modest market offer within zero-emission light commercial vehicles as well as light and medium-duty trucks and the total lack of heavy-duty trucks on the electric market create a temporary barrier.

Key recommendations concerning support within the development of a low- and zero-emission fleet of trucks and light commercial vehicles in Poland are related to:

1. actions aimed at equalisation of the total cost of ownership (TCO) of low- and zero-emission vehicles and combustion-engine vehicles;
2. actions aimed at developing charging infrastructure;
3. actions aimed at industrial as well as research and development policies;
4. actions within the climate policy.

Recommendations within accelerating the equalisation of the total cost of ownership (TCO) of low- and zero-emission vehicles and combustion-engine vehicles.

1. Introduction of a technologically neutral direct support system for the purchase or leasing of zero-emission light commercial vehicles and trucks for companies, financed from the state budget or from the National Fund for Environmental Protection. Such system should also cover second-hand zero-emission vehicles with a guarantee of origin.
2. Introduction of fiscal incentives to purchase zero-emission light commercial vehicles and trucks, while increasing taxation for combustion-engine vehicles, depending on their emissions. At the same time, we recommend reintroducing the excise duty on natural gas as a transport fuel.
3. Differentiation of tolls for the use of road infrastructure for light commercial vehicles and trucks depending on their emission and implementation of the lowest possible rate for zero-emission vehicles.
4. Adoption of legislation on clean transport zones allowing entry only of zero-emission vehicles, which will accelerate the transformation of light commercial vehicles and light duty vehicles fleet.

Recommendations within the development of charging infrastructure.

5. Development of a coherent plan for the construction of a backbone network of infrastructure for charging battery and hydrogen trucks along the main road routes throughout the country, along with allocation of necessary funds from national and EU sources. Inclusion of the plan in the investment plans of Distribution Network Operators (DNO) and Transmission Network Operators (TNO).
6. Charging infrastructure development support, both the infrastructure publicly available as well as privately available, combined with the support for investments in renewable energy sources and storage of energy generated from these sources.

7. Launch of research and development, along with pilot implementations, within development of electric road systems infrastructure, with particular emphasis on local supply chains on fixed routes, e.g. between handling terminals and logistics centres.

Recommendations within industrial as well as research and development policies

8. Pursuing a state policy conducive to investments in the production of zero-emission light commercial vehicles and trucks in Poland.
9. Analysis of the potential, technical capabilities, cost-effectiveness and prospects of implementing the conversion of the most popular models of light commercial vehicles and light duty vehicles into battery electric versions.

Recommendations within the climate policy

10. Implementation of the transport policy leading to the development of alternative zero-emission means of goods transport, mainly freight rail transport and promotion of hub-and-spoke logistics systems, which facilitates the optimal use of vehicles of different types of trucks.

European Union policy

Transport sector emissions

The electrification of heavy goods transport is another step towards the electrification of road transport, following the electrification of passenger cars. This technological change is supported politically, legally and financially in the European Union as one of the key elements necessary to achieve the objective of climate neutrality by 2050. The aim of these measures is primarily to reduce greenhouse gases emissions. According to the objectives of the Green New Deal, the European Union is to achieve the objective of climate neutrality by 2050, with expected reductions in greenhouse gases emissions from the transport sector of 90%. For the road transport sector, this means, in practice the need to almost completely abandon fossil fuels by that time.

EU policies on reducing CO_2 emissions from trucks

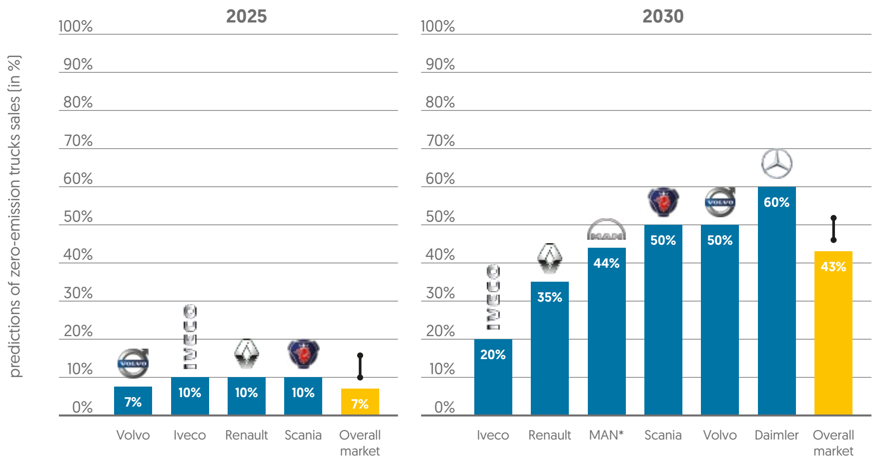
The transport sector remains the biggest source of greenhouse gases emissions in the EU, accounting for 29% of total emissions. 15% of emissions are generated by passenger cars as well as light commercial vehicles, and 5% by trucks. The European Union is already implementing specific policies and introducing regulations aimed at gradual decarbonisation of vehicle fleet and lowering the prices of zero-emission technologies. In 2019, the European Union adopted Regulation (EU) 2019/1242 which sets CO_2 emission performance standards for trucks by 2030. Compared to the average CO_2 emissions per kilometre for new vehicles sold between 1 July 2019 and 30 June 2020, new vehicles sold in 2025 and 2030 will have to emit on average 15% and 30% less CO_2 respectively. Initially, the standards apply only to larger commercial vehicles, but their scope may be extended as part of the standards' review to be carried out in 2022.

EU policies on reducing CO_2 emissions from light commercial vehicles

The CO_2 emission standards for light commercial vehicles (<3.5 tonnes) are regulated by Regulation 2019/631. It assumes that the reduction from light commercial vehicles will be 15% and 31% respectively compared to 2020. The new legislative proposals of the European Commission presented on 15 July 2021 under the Fit for 55 package assume that reductions in emissions from new light commercial vehicles are expected to accelerate. By 2030, the reduction in emissions is expected to be 50%, and by 2035, 100%. This means that in 2035 only zero-emission light commercial vehicles will be available for sale. The proposal to amend the regulation must be supported by the European Parliament and the Council. This will probably take place in 2022.

Electric trucks market

Predictions of manufacturers concerning the increase in sales of zero-emission trucks in 2025 and 2030



CO_2 standards are a key element of the broader objective, meaning reducing transport emissions in the EU by 90% by 2050, which is one of the overarching objectives of climate neutrality (i.e. net zero greenhouse gases emissions). Most truck manufacturers have already accepted voluntary commitments to increase the production of zero-emission vehicles. In theory, this would mean an increase in the sales of zero-emission trucks to 7% in 2025 and 43% in 2030. These commitments would exceed the current EU CO_2 targets (15% in 2025 and 30% in 2030).

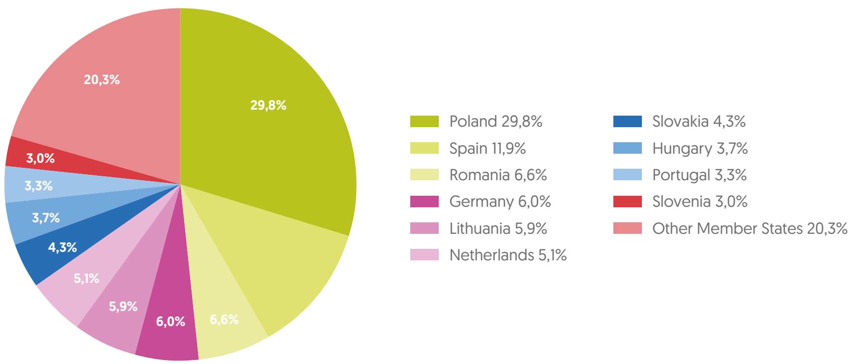
The electrification of light commercial vehicles and trucks is only one of a wide range of potential measures that will lead to the achievement of the zero-emission goods transport system. Similarly to the modal shift (for example, from trucks to trains) or improvement of logistics (for example, the use of hub-and-spoke logistics systems to ensure that vehicles of optimal size for specific purposes are used instead of using trucks for supply along the entire route).

Road transport sector in Poland

The road transport sector is crucial for the Polish economy. With over one million medium and heavy commercial vehicles registered in Poland, the country has the largest truck fleet among all EU countries. Almost 20% of all medium and heavy commercial vehicles in the EU are registered in Poland.

At the same time, Polish transport companies have the largest share of almost 30% in international road transport in the EU. If Polish carriers do not follow the trend of transport electrification, they may lose competitiveness in the medium term compared to carriers from other countries that will offer their customers the transport of goods at lower costs and lower carbon footprint. In the coming years, the carbon footprint, apart from the price, can become one of the main factors that affect the competitiveness of road transport operators. On the other hand, the Polish Government could lobby for the development of zero-emission truck infrastructure in Poland, arguing that the electrification of heavy goods transport will not only have a lasting impact on the reduction of greenhouse gases emissions in the country, but will also affect the emissions of the entire European transport sector.

International goods road transport, 2018



Source: Eurostat

Number of registered commercial vehicles in the EU

	2015	2016	2017	2018	2019	%change 19/18
Austria	68 860	69 428	70 791	72 486	73 336	1,2
Belgium	143 697	142 744	144 293	146 081	147 756	1,1
Croatia	42 119	43 806	45 210	45 720	47 300	3,5
Czech Republic	180 435	183 560	186 004	187 483	186 881	-0,3
Denmark	41 529	42 066	42 489	42 751	42 586	-0,4
Estonia	35 783	36 781	37 644	37 911	39 848	5,1
Finland	95 250	94 780	95 948	96 169	95 141	-1,1
France	582 500	587 190	594 100	602 410	601 040	-0,2
Germany	950 054	966 972	963 972	1 001 073	1 010 742	1,0
Greece	230 910	227 990	223 680	229 776	226 913	-1,2
Hungary	87 666	88 592	91 760	94 966	96 109	1,2
Ireland	46 168	46 423	46 677	47 259	48 311	2,2
Italy	918 258	923 655	933 311	941 994	946 393	0,5
Latvia	26 743	26 981	27 905	27 710	27 852	0,5
Lithuania	54 003	57 901	61 465	65 996	67 111	1,7
Luxemburg	11 437	11 633	11 778	12 055	12 300	2,0
Netherlands	158 973	161 672	164 317	168 453	170 640	1,3
Poland	980 201	1 025 585	1 064 671	1 108 975	1 150 493	3,7
Portugal	119 000	119 700	125 600	130 000	132 500	1,9
Romania	239 851	255 297	281 708	288 309	296 489	2,8
Slovakia	85 577	85 277	85 654	85 241	81 083	-4,9
Slovenia	29 648	31 667	33 572	35 864	37 285	4,0
Spain	556 310	570 315	584 733	590 674	607 020	2,8
Sweden	80 046	81 430	83 025	83 977	84 153	0,2
EUROPEAN UNION	**5 765 018**	**5 881 455**	**6 020 307**	**5 143 333**	**6 229 282**	**1,4**

Research methodology

The research was divided into following stages:

- Consultation with members of the Steering Committee to define scenarios and agree on key modelling assumptions.

- Conducting economic modelling in the scope of:
  I] Estimating the impact of different scenarios of market penetration of low-carbon vehicles on energy demand, CO_2 emissions and technology costs using the vehicle fleet model developed by Cambridge Econometrics [CE];
  II] Simulation of the total cost of ownership [TCO] in the scope of vehicle purchase and operation costs.

A detailed description of the methodology, modelling assumptions and source data is contained in the technical report.

Technology implementation scenarios

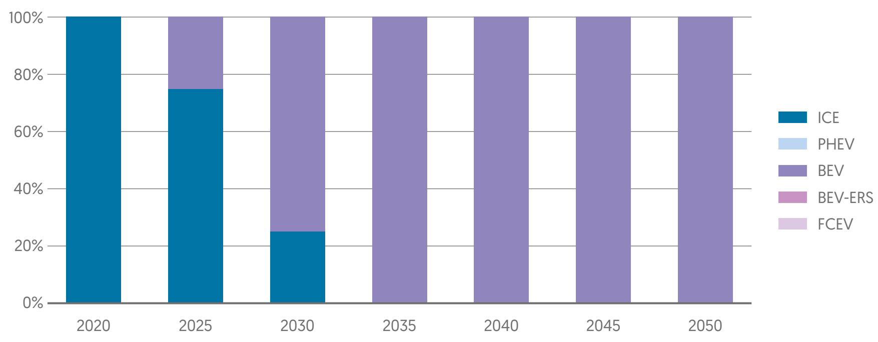
Scenariusz	Opis scenariusza
REF scenario (reference)	No changes in drive technologies assumed after 2020. A slight improvement in fleet energy efficiency is related to the replacement of old vehicles with new ones.
CPI scenario (Current Policy Initiatives)	Projected implementation of solutions to increase the energy efficiency of vehicles (e.g. reduction of vehicle weight) and new drive technologies due to the necessity of meeting CO_2 emission standards in 2025 and 2030. No further changes after 2030.
TECH BEV scenario (battery electric vehicles dominate)	Assumed ambitious implementation of technologies aimed at increasing the energy efficiency of vehicles by 2030. Expected dynamic development, mainly within battery technologies (BEV) for both light commercial vehicles and trucks. The scenario assumes the exclusion of combustion-engine light commercial vehicles from sales in 2035 and trucks in 2040.
TECH ERS scenario (electric road system dominates)	Assumed ambitious implementation of technologies aimed at increasing the energy efficiency of vehicles by 2030. Expected development, mainly within battery technologies (BEV) for light commercial vehicles and electric road systems (ERS) for trucks. The scenario assumes the exclusion of combustion-engine light commercial vehicles from sales in 2035 and trucks in 2040.
TECH FCEV scenario (fuel cell vehicles dominate)	Assumed ambitious implementation of technologies aimed at increasing the energy efficiency of vehicles by 2030. Expected development, mainly within battery technologies (BEV) for light commercial vehicles and hydrogen technology (FCEV) for trucks. The scenario assumes the exclusion of combustion-engine light commercial vehicles from sales in 2035 and trucks in 2040.

For the purposes of the analysis, five scenarios were adopted showing possible pathways of development of light commercial vehicle and truck fleets in Poland. The aim of these scenarios is not to predict the future composition of the Polish truck fleet, but to present possible costs and benefits arising from various types of technologies.

Change within the fleet of light commercial vehicles <3.5 tonnes

In the technology scenarios, where new internal combustion-engine (ICE) vans are phased out of sales from 2035 and an active public policy on the promotion of zero emission vehicles is assumed, the share of battery vehicles in sales increases from 25% in 2025, through 75% in 2030 to 100% in 2035. Other drive technologies such as hybrid plug-in vehicles or FCEVs will not be competitive, therefore it was assumed that this will be a dominant zero-emission technology in the market. This translates into 37% of battery light commercial vehicles in 2040 and 70% in 2050. However, if the current average age of cars used is maintained, despite the ambitious target of terminating the sales of light commercial vehicles after 2035, we will not achieve zero emissions in this vehicle segment by 2050.

Sales structure of light commercial vehicles in TECH scenario

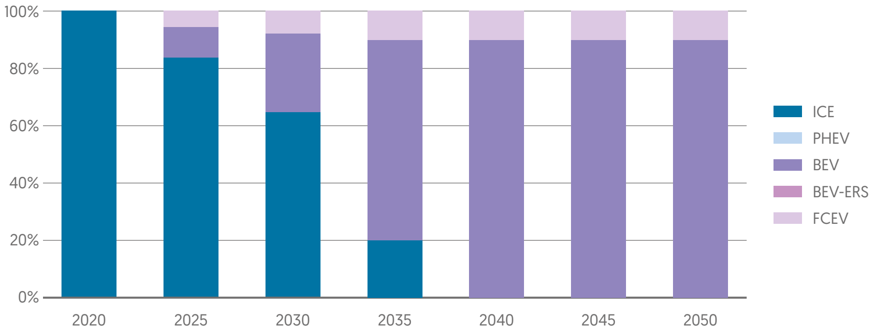


Change within the fleet of heavy goods vehicles >3.5 tonnes

In case of heavy goods vehicles (HGVs) with GVW >3.5 tonnes, the development of three zero-emission technologies was compared: battery, hydrogen and pantograph vehicles using electric road systems. Each scenario assumes the dominance of one of the technologies.

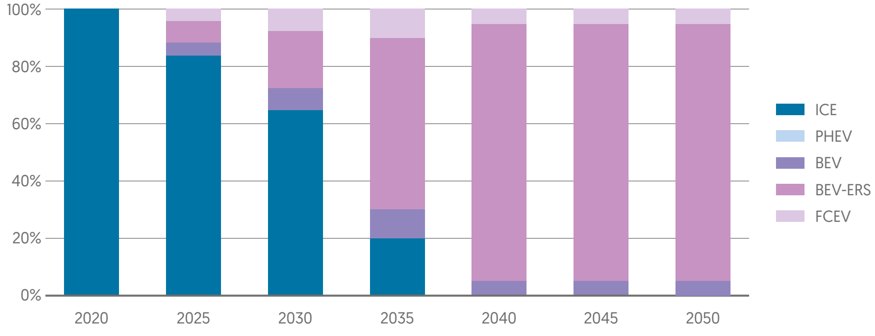
In the TECH BEV battery scenario, the share of registered vehicles in 2025 is 10% and 5.5% within hydrogen cars. Buyers choose to use battery technology if it corresponds to their business profile, in particular with regard to vehicle range on a single charge. In the following years, the share of sold hydrogen cars remains at 10%. Such vehicles are used for transport of the heaviest goods at long distances. The sales of battery cars increase to 35% in 2030, 70% in 2035 and 90% in 2040. In this scenario, zero-emission cars account for 61% of the truck fleet in Poland (53% of battery vehicles and 8% of hydrogen vehicles) in 2050 (see Chapter 4 of Technical Report).

HGVs sales structure in TECH BEV scenario



In the TECH ERS scenario, due to the slow development of infrastructure for this technology, the increase in the number of zero-emission vehicles is the slowest. In 2040, only 25% of registered vehicles use ERS and 50% in 2050. At the same time, 40% of vehicles still use combustion engines in 2050. Due to the slow development of infrastructure, this technology requires the most time to achieve a full decarbonisation of the fleet.

HGVs sales structure in TECH ERS scenario

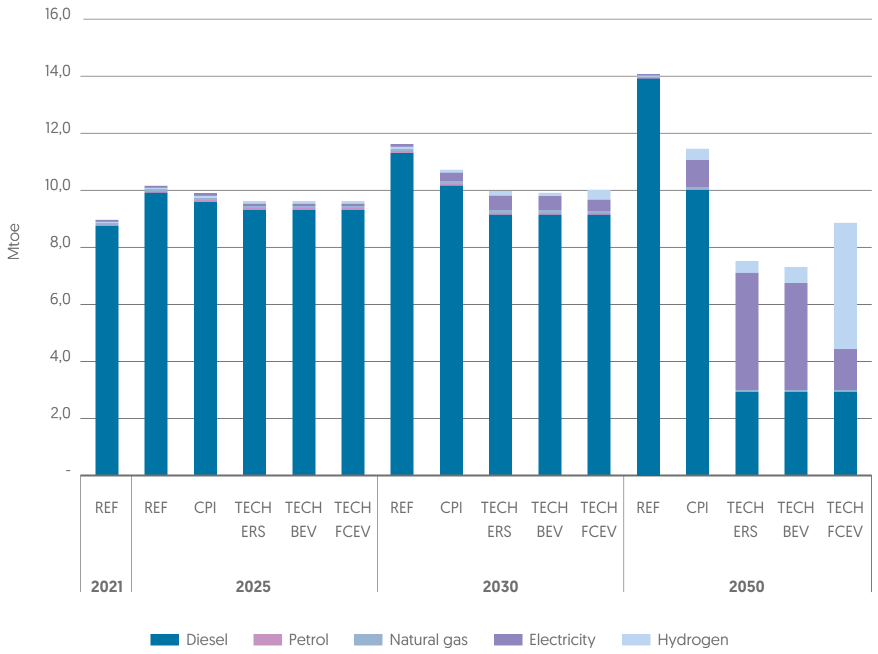


In the TECH FCEV scenario, the number of hydrogen cars registered increases at the same pace as electric cars in the TECH ERS scenario. Due to the current high entry barrier resulting from the high purchase cost, hydrogen vehicles only become popular in 2035, with a 25% share in the number of registered vehicles and a 50% share in 2050.

The development of zero-emission technologies will reduce energy demand by more than half in 2050. This is due to the much lower energy efficiency of combustion engines compared to the electric engine. A significant difference in energy consumption for transport purposes is already visible in 2030, where using zero-emission technologies reduces its consumption by more than 10% compared to the reference scenario. In 2050, energy savings in each technological scenario range from 50% for the battery scenario (TECH BEV) to 39%

for the hydrogen scenario (TECH FCEV). This difference is due to the lower energy efficiency of hydrogen technology.

Annual fuel consumption for each scenario [Mtoe]

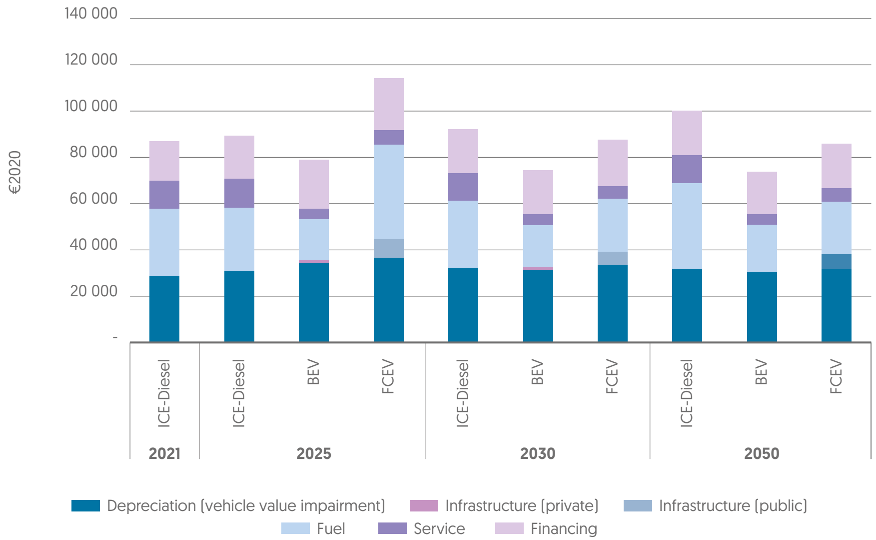


REF (Reference Scenario), CPI (CPI scenario), TECH ERS (Electric Road Systems Scenario)
TECH BEV (Battery scenario), TECH FCEV (Hydrogen scenario)

Total cost of ownership analysis (TCO)

The total cost of owning electric light commercial vehicles (TCO) will already be lower in 2025 than TCO for Diesel-engine vehicles. This is due to lower fuel costs and lower maintenance costs compared to combustion-engine vehicles. In 2025, in terms of the total cost of ownership, pantograph trucks > 16 tonnes (for electric road systems) will be the cheapest, on the other hand, battery vehicles will be a little more expensive. Due to relatively high purchase costs and fuel costs, hydrogen trucks will be much more expensive. In terms of TCO, hydrogen vehicles will be equal to combustion-engine only in 2030. By 2050, the lowest TCO will have battery and pantograph vehicles, and hydrogen vehicles will still have the highest TCO due to higher fuel costs and vehicle purchases.

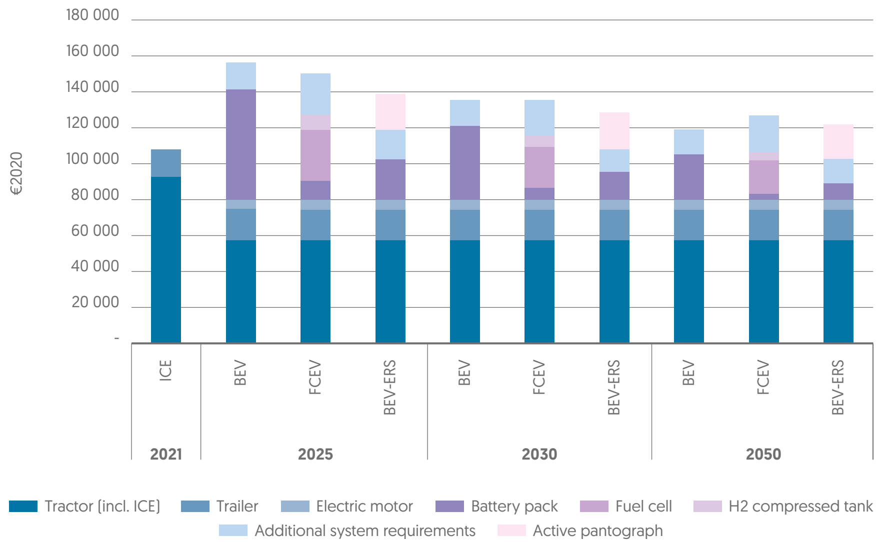
Total cost of ownership of commercial vehicles over a period of 14 years [€2020]



ICE-Diesel - Diesel-engine truck, BEV - Battery truck, BEV ERS - Pantograph truck, FCEV -Hydrogen truck

For the purpose of analysing the total cost of ownership, it was assumed that both battery and hydrogen cell prices would gradually decrease. As a result, the purchase costs of all types of vehicles will also decrease, but will not reach the purchase price of combustion-engine vehicles. In case of trucks >16 tonnes, three types of technologies were compared: battery, hydrogen and pantograph trucks. By 2050, the cheapest zero-emission truck will be a battery vehicle, but in 2025 and 2030 pantograph vehicles will be the cheapest.

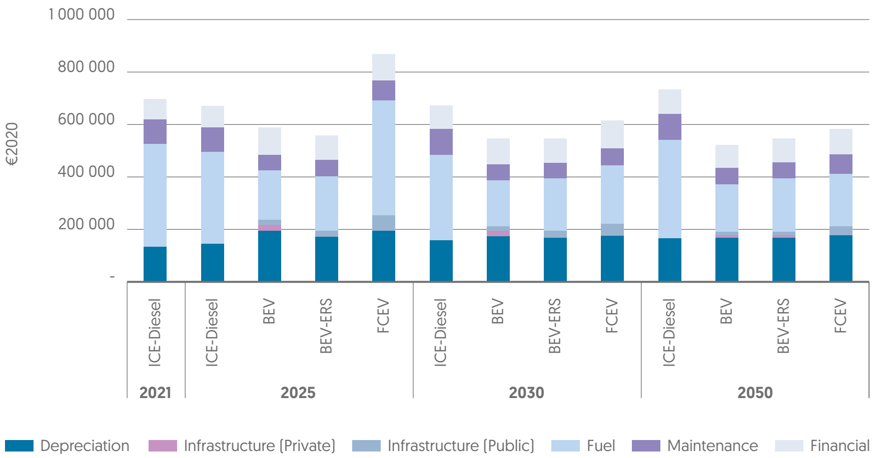
Costs of purchasing trucks with GVW > 16 tonnes in years 2025 - 2050 [€2020]



ICE-Diesel - Diesel-engine truck, BEV - Battery truck, BEV ERS - Pantograph truck, FCEV -Hydrogen truck

Despite the high purchase costs, battery trucks will already in 2025 be economically competitive compared to vehicles with a conventional drive. The dynamics of changes in total ownership costs is similar to light commercial vehicles. Initially, trucks with pantographs using electric road system technology are cheaper than battery trucks, but already in 2030, along with a drop in battery prices, TCO of battery vehicles is more beneficial than in the case of pantograph vehicles. There is no period where hydrogen trucks outprice the battery vehicles.

Total cost of ownership of vehicles with GVW > 16 tonnes [€2020]



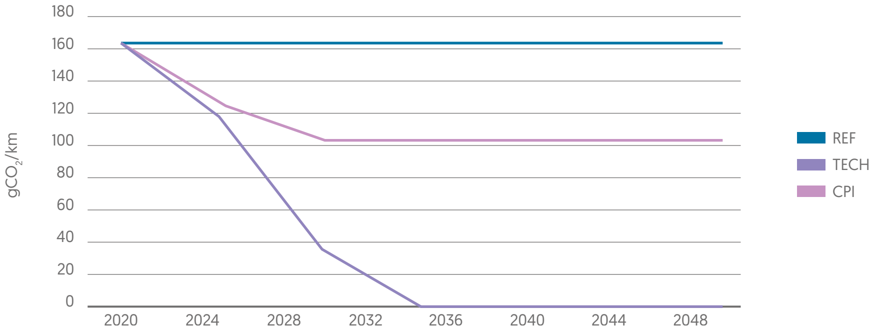
ICE-Diesel - Diesel-engine truck, BEV - Battery truck
BEV ERS - Pantograph truck, FCEV - Hydrogen truck

The analysis of the total cost of ownership shows that the low cost of electricity compensates for the high cost of purchasing battery vehicles and that this technology will soon be the most cost-effective for carriers. Hydrogen vehicles, due to high fuel costs and purchase costs, will not be competitive compared to battery vehicles, which does not mean that they will not be used in specific cases where travel time is involved or there is no access to charging infrastructure. Pantograph technology is cost-competitive compared to hydrogen technology, but requires extensive infrastructure. This is not only an investment challenge, but also a political challenge as it requires international coordination.

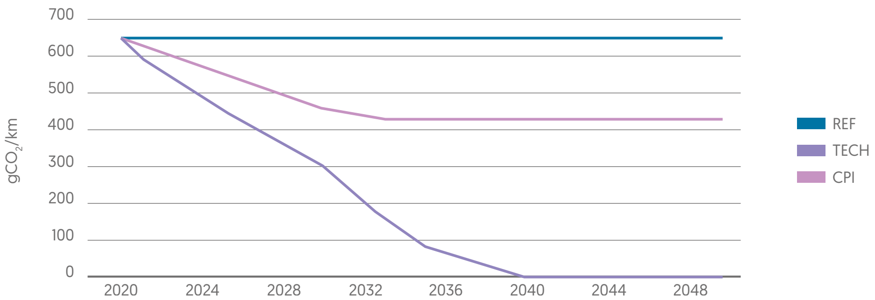
Environmental benefits

The development of each of the analysed zero-emission drive technologies will lead to a reduction in greenhouse gases emissions. The challenge will be to increase the production of hydrogen and electricity from emission-free energy sources. In each of the scenarios analysed, the decrease in average emissions from new light commercial vehicles and trucks by 2030 exceeds the European Union's targets for 2025 and 2030.

Emissions from exhaust pipes of new light commercial vehicles [gCO2/km]

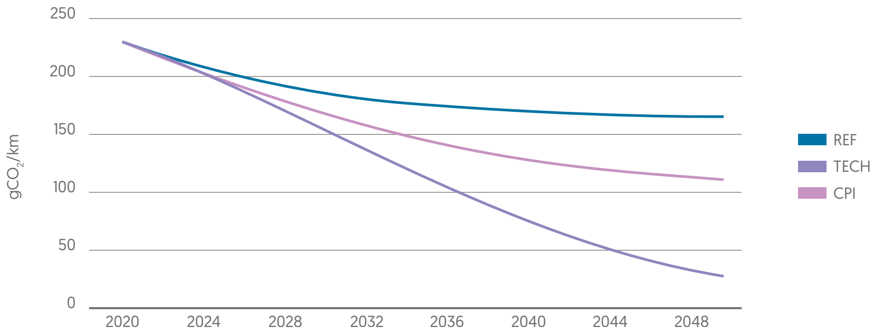


Emissions from exhaust pipes of new HGVs [gCO2/km]

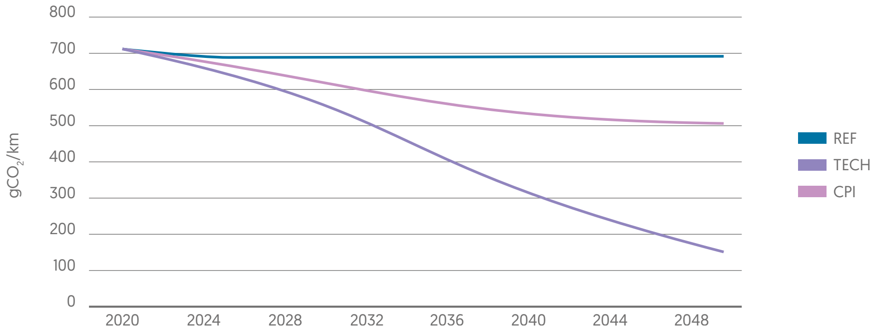


The CO_2 exhaust pipe emissions from new vehicles will be at the zero level as early as 2040, however, in 2050 the average emissions from all registered light commercial vehicles and trucks will not reach zero as the cars sold in previous years will continue to be in use.

Average light commercial vehicle fleet CO_2 emissions [gCO2/km]

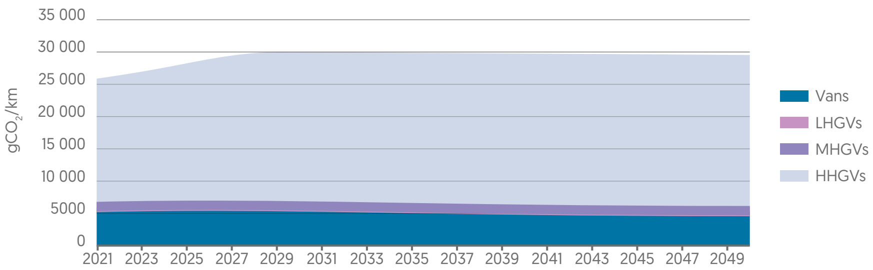


Average truck fleet CO_2 emissions [gCO2/km]

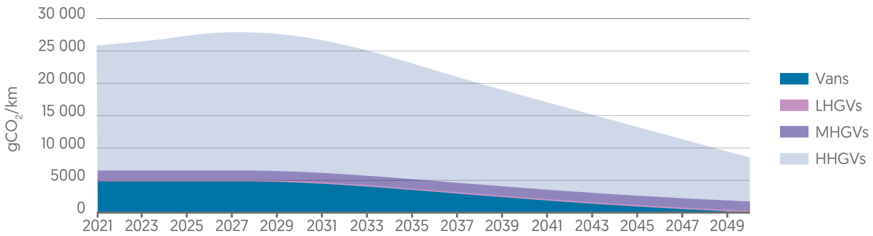


Regardless of which truck and light commercial vehicles decarbonisation technology we choose, the reduction in exhaust pipe CO_2 emissions from the entire fleet of registered vehicles will decrease by about 60% in 2050 compared to 2020. This is due to the fact that combustion-engine vehicles will still be in use. Compared to the scenario where we do not implement any new drive technologies (REF scenario), emissions gradually increase by 2050, and in the scenario where we limit ourselves to already agreed changes for 2030 (CPI scenario), emissions remain at the same level.

Total CO_2 emissions of the light commercial vehicle and truck fleet (CPI scenario) without emissions in relation to hydrogen and electricity production [ktCO2]

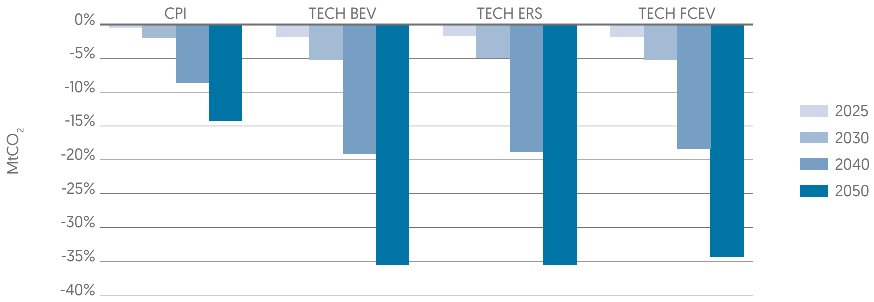


Total CO_2 emissions of the light commercial vehicle and truck fleet (TECH scenario) without emissions in relation to hydrogen and electricity production [ktCO2]

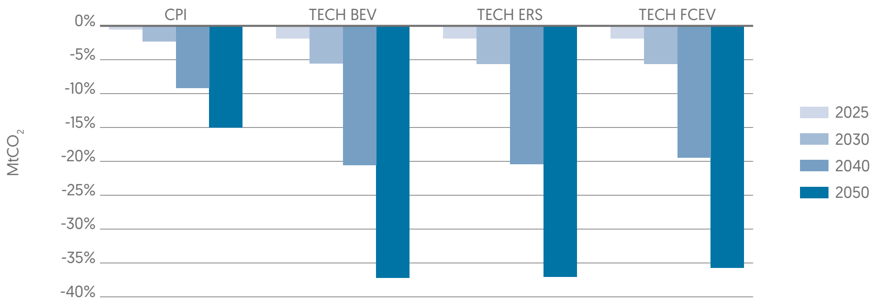


The biggest reduction in total carbon dioxide (CO_2) emissions, also taking into account the well to wheel cycle, will be achieved using the battery technology. The least effective form of reducing transport emissions from the tested zero-emission technologies is the hydrogen technology.

Total CO_2 emissions of light commercial vehicles and trucks considering the well to wheel cycle (blue hydrogen scenario) [MtCO2]



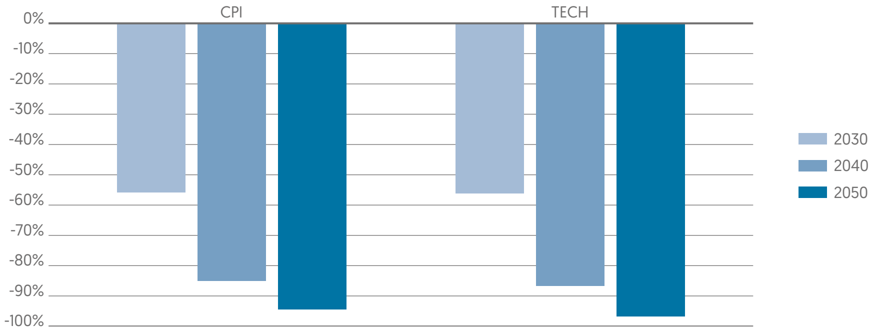
Total CO_2 emissions of light commercial vehicles and trucks considering the well to wheel cycle (green hydrogen scenario) [MtCO2]



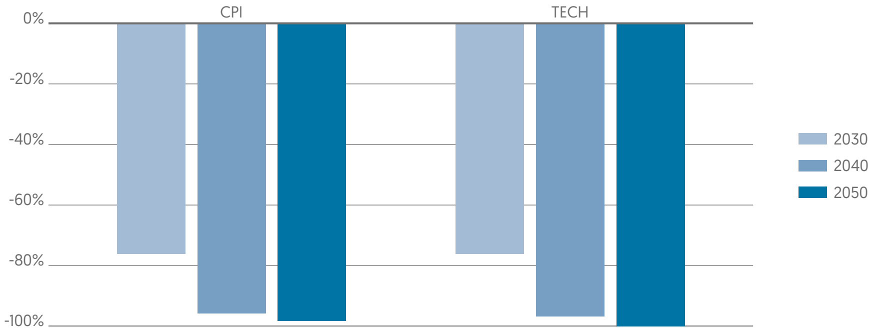
The implementation of zero-emission technologies and the modernisation of zero-emission vehicle fleets will contribute almost to the total reduction of particulate matter (PM10) and nitrogen oxide (NOx) emissions from exhaust pipes of light commercial vehicles and trucks. The CPI scenario (current policy initiatives) assumes that PM10 emissions will drop by 98% by 2050, and NOx emissions by 95% compared to 2020. The technological scenarios assume that PM10 emissions by 2050 will decrease by almost 100%, and nitrogen oxide emissions by 97%.

In the short term, meaning until 2030, the reduction of air pollution will take place primarily with the replacement of older combustion engines with newer engines which meet Euro 5, Euro 6 and Euro 7 standards and emit significantly less pollutants than previous models. However, after 2030, the reduction of pollution in technological scenarios, where zero-emission technologies are developed, is much faster than in the CPI scenario (current policy initiatives) where combustion-engine vehicles are still sold. It should be noted that more than half of the emissions of particulate matter from transport do not come from exhaust pipes, but from the abrasion of tyres, road surfaces and brake blocks.

NOx emissions from exhaust pipes of light commercial vehicles and trucks compared to 2020 [%]



PM10 emissions from exhaust pipes of light commercial vehicles and trucks compared to 2020 [%]



Infrastructure

Infrastructure for battery vehicles

The development of zero-emission vehicle fleets will be directly linked to the development of infrastructure for specific technologies. In the case of battery vehicles, the most important element of the infrastructure will be ultra-fast chargers with an output of 700 kW along motorways and main roads. Simultaneously to ultra-fast chargers, it is necessary to install fast chargers (90 kW) for charging during night stops. For the purposes of the analysis, one fast charger per a single truck was assumed and that the cost of its construction and installation would amount to approximately EUR 45 000. As far as ultra-fast chargers are concerned, they would handle 47 trucks, and their cost would amount to EUR 911 000.

Infrastructure for ERS vehicles

The electric roads system (TECH ERS) scenario assumes that the main source of electricity will be charging during driving. At the same time, slow chargers (22 kW) will be needed at stops for battery vehicles. With the development of infrastructure for electric road systems, the use of electricity infrastructure and dual-mode vehicles (combustion and electric) will gradually increase their operating time in the electric mode. The scenario assumes that the development of ERS infrastructure will outpace investments in a fleet of dual-mode vehicles. The target length of electric road systems is scheduled to be 2834 km (the length of all national roads in Poland is approx. 19400 km). The so-called electric roads are to be developed gradually. In 2030, 8.5% of the planned network is to be built, 38% in 2040 and 88% in 2050. The cost of infrastructure construction in 2020 was assumed to be EUR 2.41 million per km. The share of trucks equipped with a receiver drawing power from electric roads will gradually increase from 4.8% in 2033 to 72% in 2050.

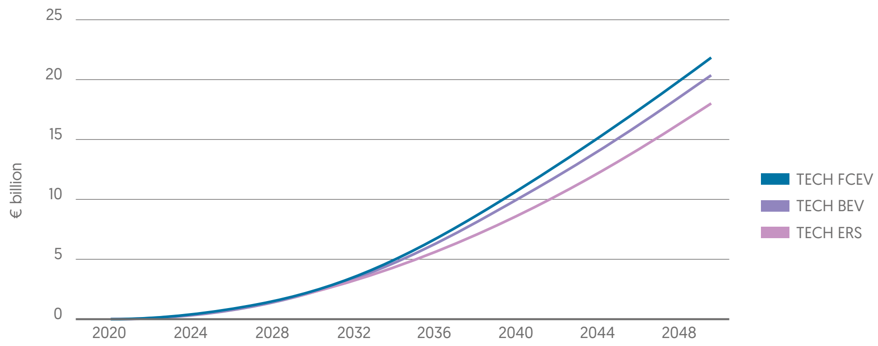
Infrastructure for hydrogen vehicles

The hydrogen vehicle infrastructure consists primarily of hydrogen refuelling stations. In order to develop this technology on a large scale, a support system will be needed for carriers to purchase relatively expensive vehicles, especially at the initial stage of hydrogen technology development. For the purpose of the analysis, the cost assumptions have been adopted for the two types of hydrogen charging stations: a station with a capacity of 10 000 kg of hydrogen per day means a cost of EUR 28 million and a station with a capacity of 25 000 kg hydrogen per day is EUR 48 million.

Total cost of infrastructure construction

The construction of infrastructure for zero-emission vehicles is an indispensable condition for the use of this technology on a mass scale. The infrastructure construction costs for each technological scenario differ only slightly. The biggest cost of investment in infrastructure occurs in the hydrogen scenario due to the high cost of building a hydrogen refuelling station. The total cost of investment in infrastructure of the hydrogen scenario (TECH FCEV) is EUR 20 billion by 2050, in the battery scenario (TECH BEV) it is EUR 19 billion, and in the electric road system (TECH ERS) scenario it equals to EUR 17.4 billion.

Total cost of infrastructure investments [€ billion]



TECH BEC – scenariusz bateryjny, TECH ERS – scenariusz dróg elektrycznych, TECH FCEV – scenariusz wodroowy