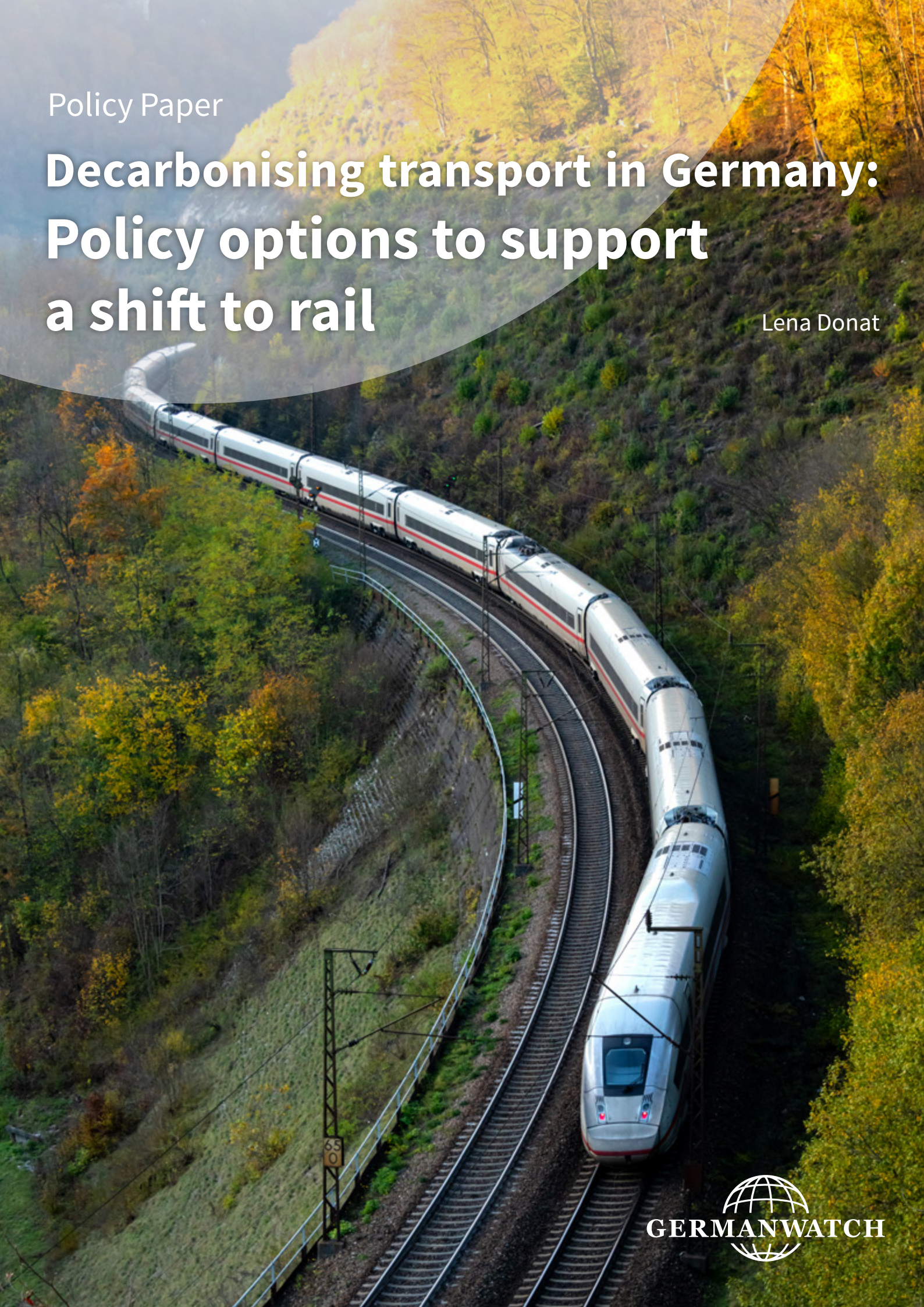
Policy Paper

Decarbonising transport in Germany: Policy options to support a shift to rail

Lena Donat



GERMANWATCH

The paper has been produced as part of the efforts of Climate Transparency, an international partnership of 14 research organisations and NGOs comparing G20 climate actions. It is part of series of efforts made by partners from Argentina, Brazil, Germany, Indonesia, Mexico and South Africa assessing the role that the transport sector can play in decarbonizing these economies.

All the papers and further information are available at www.climate-transparency.org

Climate Transparency

This project is part of the International Climate Initiative (IKI). The Federal Ministry for Environment, Nature Conservation and Nuclear Safety (BMU) support this initiative based on a decision by the German Bundestag.

Supported by

Federal Ministry
for the Environment, Nature Conservation
and Nuclear Safety

based on a decision of the German Bundestag.

Imprint

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Publisher: Germanwatch e.V.
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April 2020

Purchase order number: 20-3-04e

This publication can be downloaded at:
www.germanwatch.org/en/18573

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Executive Summary

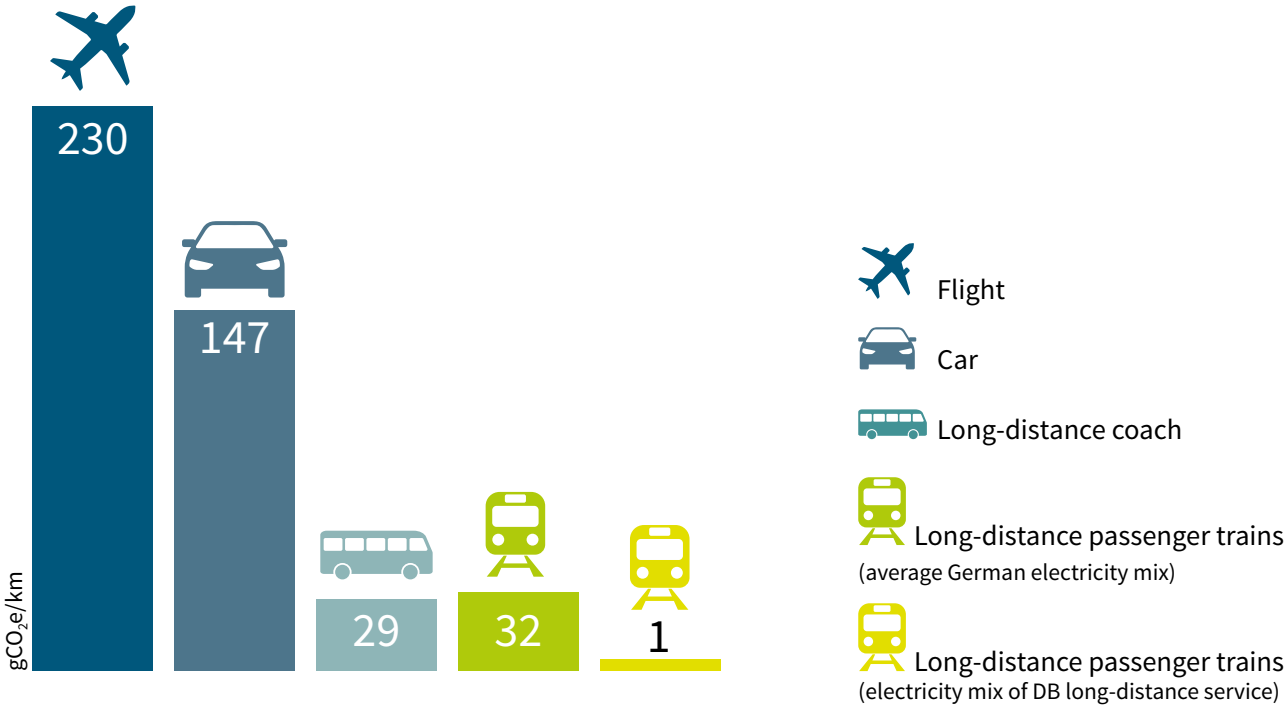
In order to become carbon-neutral before 2050, Germany urgently needs to tackle greenhouse gas emissions from the transport sector. Emissions from this sector are still rising, and measures currently in place are still far from putting the sector on track towards its 2030 target (40-42% reduction from 1990 levels).

Road transport is responsible for the lion's share of Germany's transport emissions. However, emission from aviation are also gaining importance. Aviation is by far the most emission-intensive means of travel, directly followed by fossil fuel-operated vehicles. Germany has made some policy attempts to make these transport modes cleaner, though only with limited success. Any efficiency improvements have been outweighed by an increase in road and air transport demand, as well as people's preference for ever-larger cars. Air passenger numbers have tripled since 1991. So far, the government has not made any major attempts to reduce the volume of road or air transport. On the contrary, the rapid growth in car and air passenger numbers over the last decades would not have been possible without large sums of public infrastructure investments, tax exemptions, research and development support and other subsidies.

Since 1994, Germany has constructed 247,000km of new roads. In the same time span, only 1,700km of railway network were constructed or upgraded. The German government currently provides more than twice the amount of public finance for road infrastructure (66% of total transport investment) as for rail infrastructure (27%). In contrast, the UK spends 55% of its transport investment in rail infrastructure, France 46%. In addition, Germany's taxation scheme favours road and air transport. Aviation is exempt from energy taxes, receives 85% of emission allowances under the EU Emissions Trading Scheme for free, and pays no VAT on international flights. Amongst other subsidies, road passenger transport

	Road	Rail	Aviation
Access charges	Only HGVs (above 7.5t) on around 6% of the road network; cars and coaches do not pay	Yes, full costs (fixed and marginal costs) for passenger transport. Half-price for freight.	Yes, for take-off and landing in airports, and for parking
Fuel taxes	Petrol/diesel taxes; diesel tax benefits and company car tax benefits	Full electricity tax rate for long-distance, reduced rate for regional trains	No kerosene tax
Renewables surcharge	No (only electric vehicles pay surcharge)	Yes (on around 90% of transport volume)	No
Emissions trading scheme	No	Yes (for electricity), all allowances under auctioning	Yes, but 85% of free allowances and extra-EU flights not covered
VAT on tickets	Full rate of 19% on coach/bus tickets, and on fuel for cars/HGVs	Reduced rate of 7%	Full rate of 19% on domestic flights; No VAT on cross-boundary flights
R&D resources 2009-2018	€ 363.9 million	€ 42.3 million	€ 60.8 million
Share of transport infrastructure investment (2016-17 average)	66%	27%	5%

Average GHG emissions of different long-distance transport modes



Source: Umweltbundesamt (2020); Allianz pro Schiene (2020)

does not pay for using infrastructure, and diesel cars benefit from reduced energy tax rates.

The growing awareness of the climate crisis and the rise of political movements such as Fridays for Future, increasing congestion in cities and air pollution and the Dieselgate crisis have started to raise serious doubts around Germany's car- and aviation-focused transport policy. There is growing public support for limiting the use of private fossil-fuel vehicles in cities, for taxing and reducing aviation, as well as for enabling a shift to cleaner transport modes such as walking, cycling and public transport.

Shifting passenger transport to rail is one key puzzle piece for decarbonising Germany's transport system. Rail is already one of the most climate-friendly modes of transport, emitting at least seven times less CO_2 than aviation, and almost five times less than cars.

With sufficient investment and political support, rail can become a real alternative to car and air travel. These decisions must be taken today to avoid a lock-in into a high-carbon transport system for the coming decades. There are clear indications that the German government is starting to pay more attention to improving its rail system. For example, a large infrastructure investment package was announced in early 2020, and the value-added tax (VAT) on rail tickets was decreased. However, these measures are still light touch, considering how public financial support and the taxation scheme have disadvantaged rail against road transport and aviation for decades. There is a real need for far more radical changes to overcome this discrimination and to turn rail transport into a cornerstone of Germany's future transport system.

Due to the COVID-19 crisis, 2020 annual transport emissions are likely to stay well below 2019 levels. However, it can be expected that once the crisis has passed transport demand will quickly return to pre-crisis levels, with similar GHG emission levels as in 2019. The planned economic recovery packages will have long-lasting effects on the future economic system and GHG emissions in Germany, as the measures will determine public spending and steer investments for the coming years – also in the transport sector. This enormous political lever can be used smartly for strengthening low-carbon transport modes, thus bringing Germany closer to reaching its transport emission targets. In addition, the recovery measures also need to be financed. A stimulus package should go hand in hand with tax reforms, which offers a good opportunity to revisit harmful subsidies currently in place.

	Problem	Solution
STRATEGY	Germany is lacking a coherent long-term mobility strategy that integrates all transport modes and their synergies, and is in line with the Paris climate targets	❱ Adopt a comprehensive long-term low-carbon mobility strategy, encompassing all transport modes and their synergies
INFRA-STRUCTURE FINANCE	Germany provides more than twice as much infrastructure finance for road as for rail. The Federal Transport Infrastructure Plan 2030 locks us into a high-carbon transport system for the coming decades	❱ Short term: Stop public investment on new federal highways, additional highway lanes, highway-like roads and bypasses ❱ Prioritise railway infrastructure, both regional and long-distance, especially projects that are key for implementing the nationwide integrated regular interval timetable ('Deutschland-Takt') and cross-boundary connections ❱ Revise Federal Transport Infrastructure Plan, and undertake a 1.5°C check. Include reduction of road passenger and freight transport as a strategic target in of the Plan ❱ Plan infrastructure based on coordinated timetable intervals ('fahrplanorientierte Infrastrukturplanung')
TAXATION	Taxes and charges do not reflect infrastructure costs and external costs: average taxes and charges per rail passenger-km are close to or even exceed average external and variable infrastructure costs, while not even half of these costs are covered for car transport. Aviation benefits from VAT and kerosene tax exemptions. Car users do not pay for infrastructure use and benefit from exemptions for company cars	❱ Introduce kerosene tax and full VAT for airlines, and work towards full auctioning of ETS allowances. As a first step, abolish € 1.75 billion cap on air ticket tax revenues ❱ Reduce track access charges for trains to the level of marginal costs ❱ Gradually introduce a comprehensive toll for the use of highways, starting before 2025 ❱ Increase (direct or indirect) CO_2 price to a level that has a real steering effect, while using the revenues for decreasing social and rural-urban fairness gaps ❱ Relate company car tax benefit to CO_2 emissions and limit deductibility
AIRPORT OPERATION	Federal and regional governments subsidise the construction and operation of airports and create an unfair advantage for aviation	❱ Phase-out direct subsidies for airport operation
R&D, TRAINING	The government provides eight times as much R&D funding for road (€ 71 million) as for rail (€ 9 million) and supports vocational education and training for road, but not for rail	❱ Support education and training in the rail sector to help overcome shortage of skilled workers and ❱ Support R&D in the rail sector to improve rail performance
SAFETY COSTS	The risk of an accident when travelling by road is 113 times as high than by train, also due to strict (and expensive) rail safety regulations	❱ Provide financial support to rail operators to cover safety costs, so as to create a level playing field across transport modes

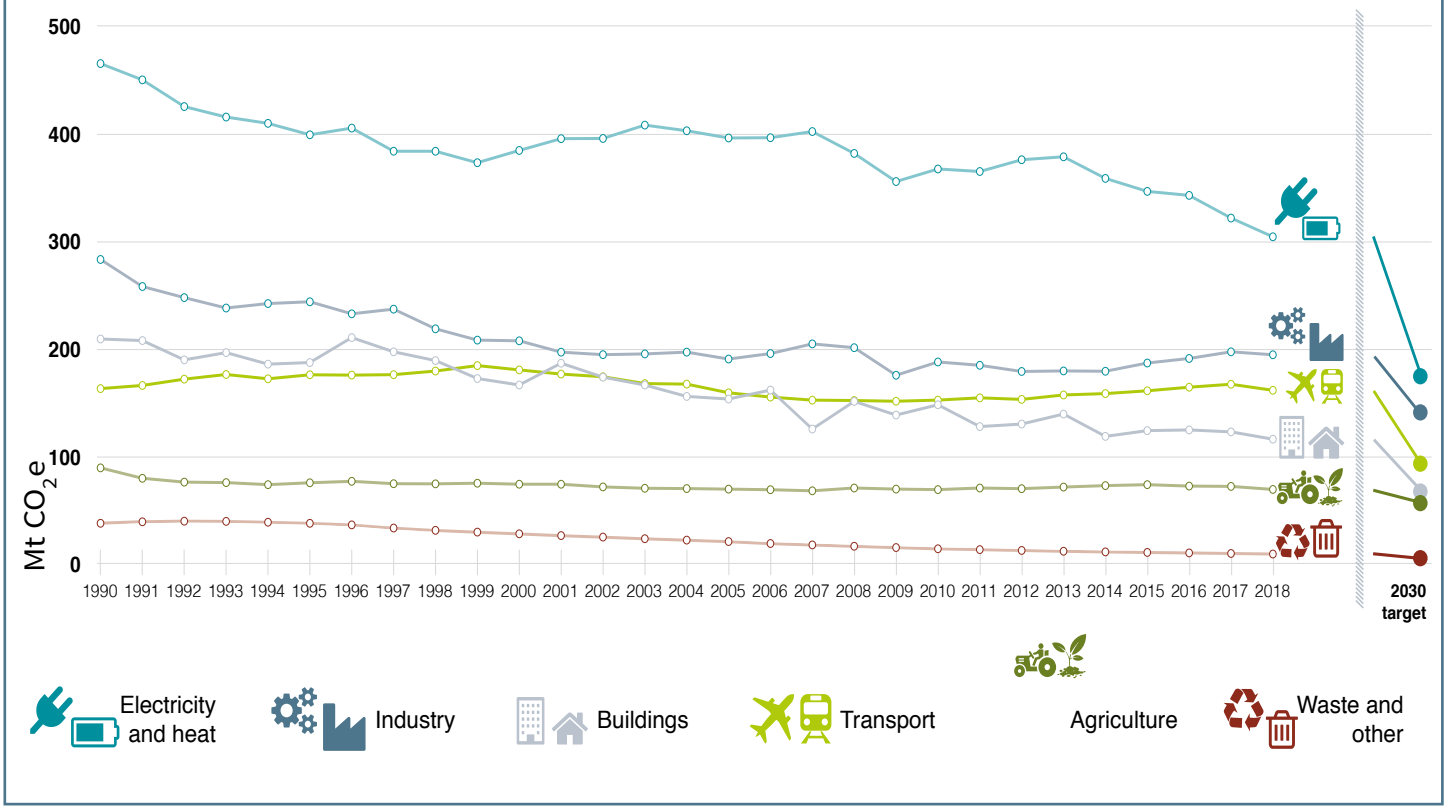
Transport emissions in Germany

Germany has committed to achieving greenhouse gas (GHG) neutrality by mid-century, and to reducing GHG emission by 55% by 2030 (measured from 1990 levels. The policy measures currently in place are not sufficient for achieving these targets, irrespective of the fact that the targets themselves are not in line with 1.5°C. With current efforts, projections say that Germany would only be able to reduce emissions by 51-52% until 2030[1]. In order to get in line with the 1.5°C temperature limit, Germany would need to set more ambitious emission targets.

Germany's biggest headache in this respect is the transport sector. The sector is responsible for almost one fifth of total national GHG emissions.[2] In all other sectors, GHG emissions have dropped since 1990. Emissions from electricity and industry, for example, were reduced by almost one third. These achievements can mainly be attributed to the breakdown of emission-intensive industry in Eastern Germany after 1990 and the renewable energy boom in the electricity sector. In contrast, the transport sector currently still emits 163 Mt CO_2e/year (2019), the same level as in 1990.[3]

The government has set a target for the transport sector of cutting emissions to a level of 95-98 Mt CO_2e by 2030. This is equivalent to a 40-42% reduction from 1990 levels. However, it is clear that the measures currently in place will not get Germany anywhere near that target. Recent studies estimate that current policies will reduce transport emissions down to 125-128 Mt CO_2e – this would result in an emission gap of at least 27 Mt CO_2e in 2030.[4]

Greenhouse gas emissions in Germany by sector



Source: Umweltbundesamt (2020)[5]

Due to the COVID-19 crisis, 2020 annual transport emissions are likely to stay well below 2019 levels. Transport demand across all modes has dropped to a minimum since the start of the crisis. However, it can be expected that this will only be a temporary phenomenon. Transport demand will quickly return to pre-crisis levels, and – if the government does not support significant structural changes – this will result in GHG emission levels to 2019. Germany has already approved a € 750 billion emergency aid package, and further measures are expected for an economic recovery programme after the crisis. The aid now planned will have long-lasting effects on the future economic system and GHG emissions in Germany, as the measures will determine public spending and steer investments for the coming years – also in the transport sector.

This enormous political lever can be used smartly for strengthening low-carbon transport modes, thus bringing Germany closer to reaching its transport emission targets. The recovery measures also need to be financed. A stimulus package thus should go hand in hand with tax reforms, which offers a good opportunity to revisit harmful subsidies currently in place.

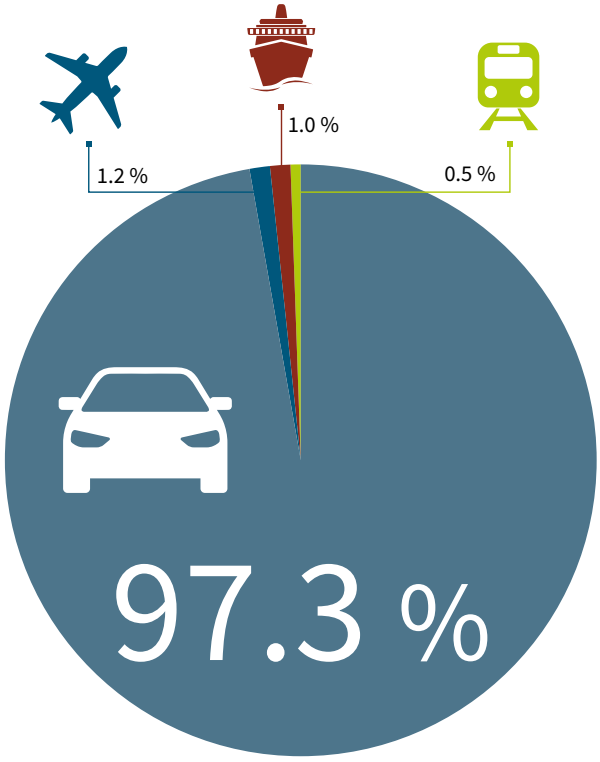
This paper shows how Germany has favoured road and air transport over rail transport for decades. A shift to rail – as one of the cleanest transport modes – could be a key contribution to decarbonising the transport sector. This paper points out opportunities for creating more favourable policy conditions for rail transport, with a focus on long-distance passenger transport.

Past strategies for decarbonising the transport sector

Road transport (private cars, motorcycles, buses, vans, and trucks) is currently responsible for the lion's share (97%) of total transport emissions in Germany, amounting to 159 Mt CO_2e. In 1990, total emissions were 155 Mt CO_2e.[6] Roughly two thirds of road transport emissions are currently caused by cars. [7]

According to the Federal Environment Agency (Umweltbundesamt, UBA), domestic flights currently only make up 1.2% (2 Mt CO_2e) of transport emissions.[9] However, this number has two serious omissions. First, the calculation does not include non-CO_2 climate impacts of aviation from contrails and cirrus clouds, which would increase the figure for longer flights (distances exceeding 600 km) by a factor of 2-4. Second, international flights are not counted, i.e. flights coming from or landing abroad. Factoring in the fuel used for these flights ('international bunker fuels') would add another 30 Mt CO_2 to the calculation – or even 60-120 Mt CO_2 if non-CO_2 impacts are counted. Furthermore, the number of flight passengers boarding or disembarking at German airports is growing rapidly. Since 1991, this figure has more than tripled from 77 million to 244 million in 2018, and this trend is expected to continue after the Corona crisis.[10]

Transport emissions by source in 2019



Source: Own calculations based on Umweltbundesamt (2020)[8]

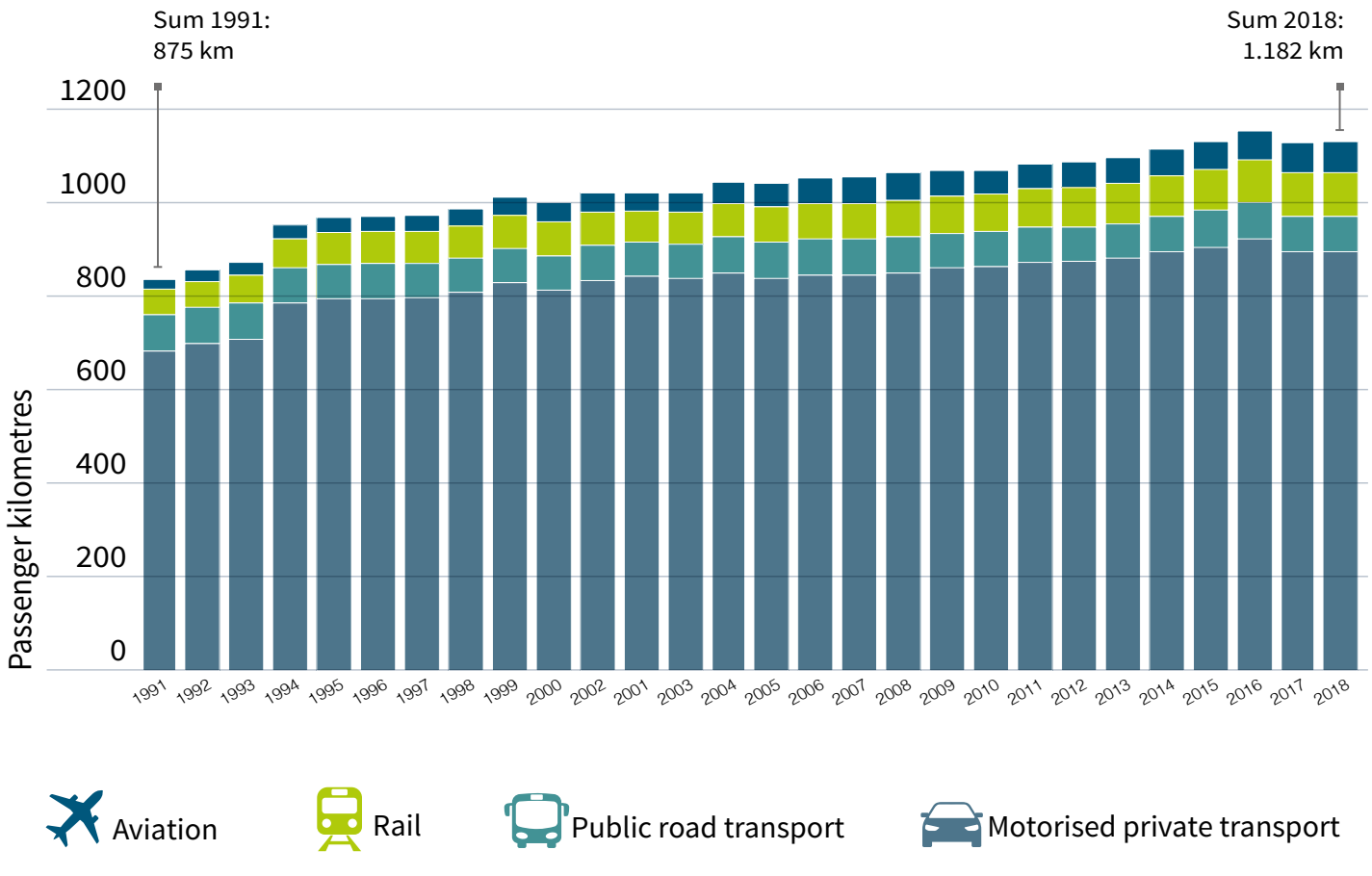
Germany has focussed on making cars cleaner…

Transport has long been treated as a Cinderella issue in German climate policies. In 2000, Germany kick-started the famous Energiewende (energy transition) with strong support programmes for renewables in the power sector. For the transport sector, a voluntary agreement between the car industry and the European Commission was adopted in 1998, setting a voluntary CO_2 emission target of 140 g/km for fleets for 2008. It was only after the car industry failed to meet the target in 2008 – the average emissions of new cars were measured at 154 g CO_2/km[11]– that more attention was given to GHG emissions from transport. In 2009, the EU adopted a Directive with binding, but not very ambitious, fleet targets of 130 g CO_2/km for 2015. Germany's 2010 Energy Concept aimed to reduce energy use from transport by 10% until 2020 (compared to 2005 levels), and spelled out numerous measures supporting the uptake of electric vehicles and biofuels.[12] The 2013 Mobility Strategy set out a vision for diversifying the fuel mix.[13]

These policies have resulted in some technological improvements – for example, the average CO_2 emissions of passenger cars per kilometre has dropped by 9% since 1995.[14] However, two factors have completely outweighed these positive developments:

First, people and goods travel more and for longer distances, usually via road transport. The number of kilometres people travel has increased by 37% since 1991.[15] Over the same time period, the number of cars registered in Germany increased by 28%, from 36.8 million in 1991[16] to 47.1 million cars in 2019 – for 83 million people[17]. The government expects that the number of passenger-kilometres (pkm) travelled by car will keep increasing by 1.2% annually.[18] This development completely outweighs any efficiency improvements.[19]

Passenger transport volume by mode



Source: Umweltbundesamt (2020)[20]

Second, people buy heavier cars with higher engine power, which outweighs any technological improvements. The average engine power of new cars increased from 87 kW in 2009 to 112 kW in 2018 (+29%), and the average weight from 1296 kg to 1515 kg (+16%).[21] In 2019, SUVs made up almost a third of new car registrations in Germany.[22] A SUV emits more than twice as much CO_2 per km as an average small car.[23]

Contrary to expectations, the emissions and efficiency standards for vehicles have not induced a real uptake of electric vehicles. EVs still made up less than 2% of new registrations in 2018. In this regard, China (4.5%) and the US (2.5%) have long bypassed Germany. The main reason for the slow uptake are a short range, a lack of charging infrastructure and high purchase prices. In 2020, Germany introduced a bonus of € 6,000 on the purchase of EVs, which has considerably reduced but not eliminated the price gap. A small electric Volkswagen model is still € 2,500 more expensive than a comparable engine-powered model, even after the bonus.[24]

However, one cannot assume that simply shifting all cars to electric power would solve all problems. Electric vehicles are more resource- and energy-intensive to produce than conventional cars. A study by Fraunhofer-ISI estimates that the production of an EV currently causes 70-130% more CO_2 emissions.[25] Also, electric vehicles are only as clean in operation as the electricity mix, which is not yet fossil-free in Germany. With the current electricity mix and high production emissions, an EV needs to drive 150,000 km before having a CO_2 advantage compared to a conventional car. With the consumption of 100% solar energy, and assuming the same production emissions, this break-even point would be reached after 60,000-80,000 km.[26] Lastly, electric vehicles can only make a real contribution to decarbonisation if additional electricity demand is kept at a minimum.[27] If all 47 million cars in Germany were suddenly replaced by electric vehicles, this would increase electricity demand by 20%.[28] If the number of cars and kilometres travelled, vehicle weight and engine power keep increasing, electricity demand would increase further. Due to their heavy batteries, electric vehicles are already heavier than conventional cars, and the current trend is heading towards electric SUVs models instead of smaller models.

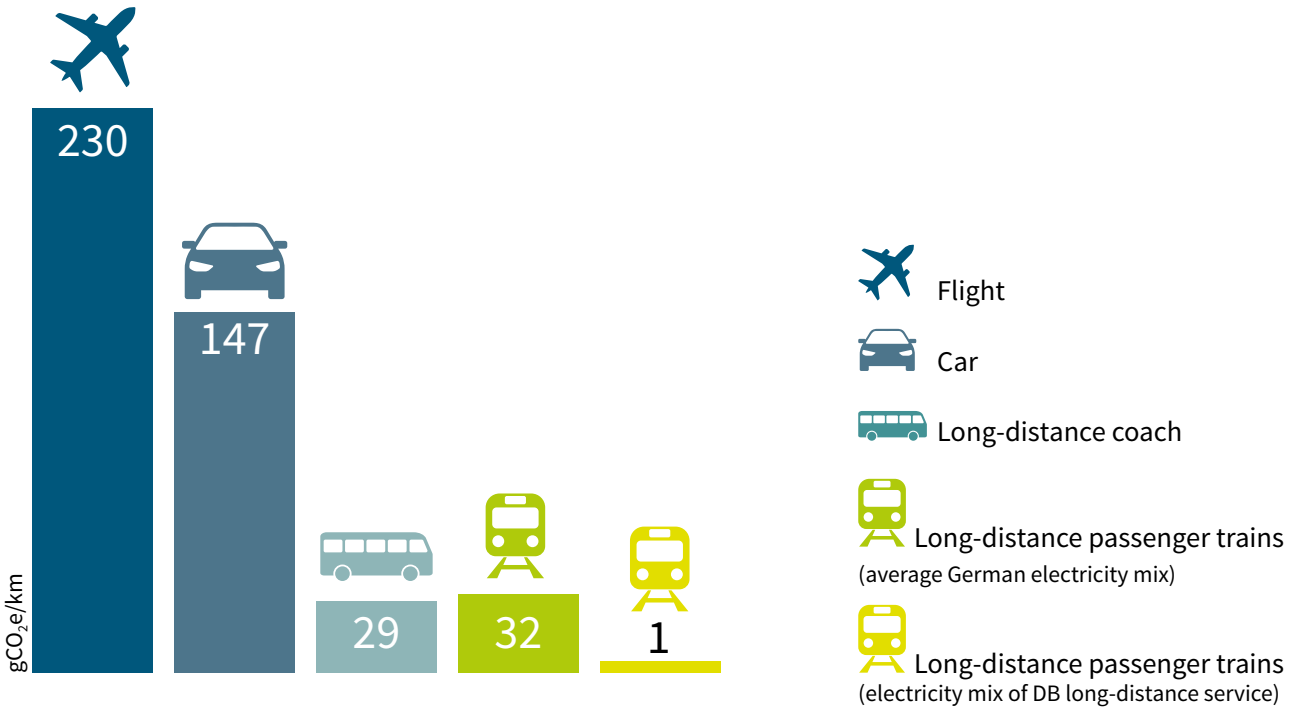
Another problem is the growing demand for minerals used for the production of EVs, such as lithium, cobalt, copper, or iron. The extraction of these resources causes environmental problems and is often connected to serious human rights violations. Lithium mining, for example, requires vast amounts of water and deepens existing water shortages in the production areas. Cobalt is mainly extracted in DR Congo, often using child labour. If the complete global car fleet simply switched to electric power, this would increase demand for lithium by almost 3,000%, and cobalt demand by almost 2,000%.[29] These numbers show that simply switching to electric but not reducing the number of private cars is not a sustainable option.

…but not on shifting to cleaner modes

After walking and cycling (which are only an option for short distances), trains are the transport mode with the lowest level of GHG emissions per person-km. The exact numbers depend, of course, on the fuel mix used for rail transport. In Germany, long-distance passenger trains of the main train company Deutsche Bahn (DB) are fuelled with 100% renewable electricity. In regional transport, some trains still operate with diesel or other electricity mixes.[30] Assuming the average German electricity mix, cars emit 4.5 times, and planes 7 times, as much GHG emissions as long-distance trains. Since Deutsche Bahn operates with 100% renewables in long-distance trains, the real factor is even higher.[31] These calculations are based on the average utilisation rate (e.g. 1.49 people per car; 276 people in a long-distance train); flight emissions are weighted with a factor of two to take into account non-CO_2 climate impacts of aviation from contrails and cirrus clouds.[32] Some studies suggest that the factor should be even higher, up to four.

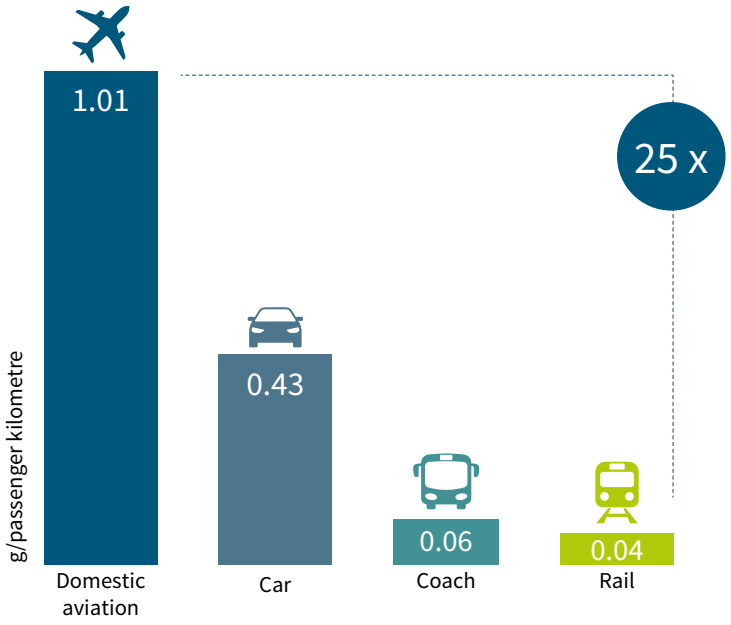
Long-distance trains also produce less air pollution and are the securest form of travel. Nitrogen oxide emissions of planes are 25 times as high as emissions from trains – measured per passenger-km. The risk of injury is 137 times as high driving a car as travelling by train.[34]

Average GHG emissions of different long-distance transport modes

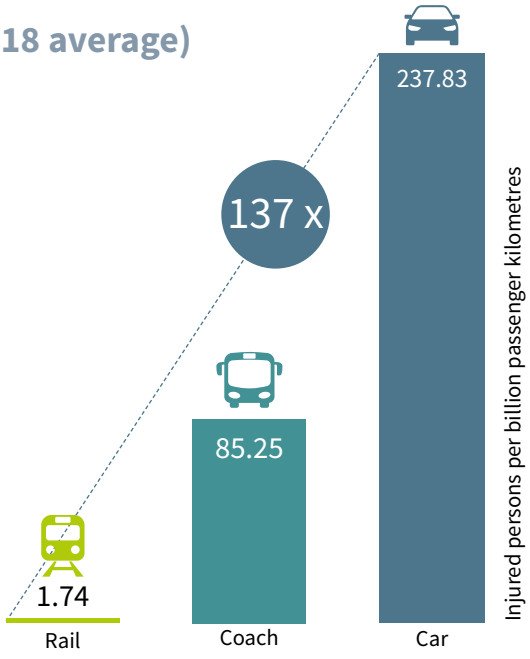


Source: Umweltbundesamt (2020); Allianz pro Schiene (2020)[33]

Nitrogen oxide emissions

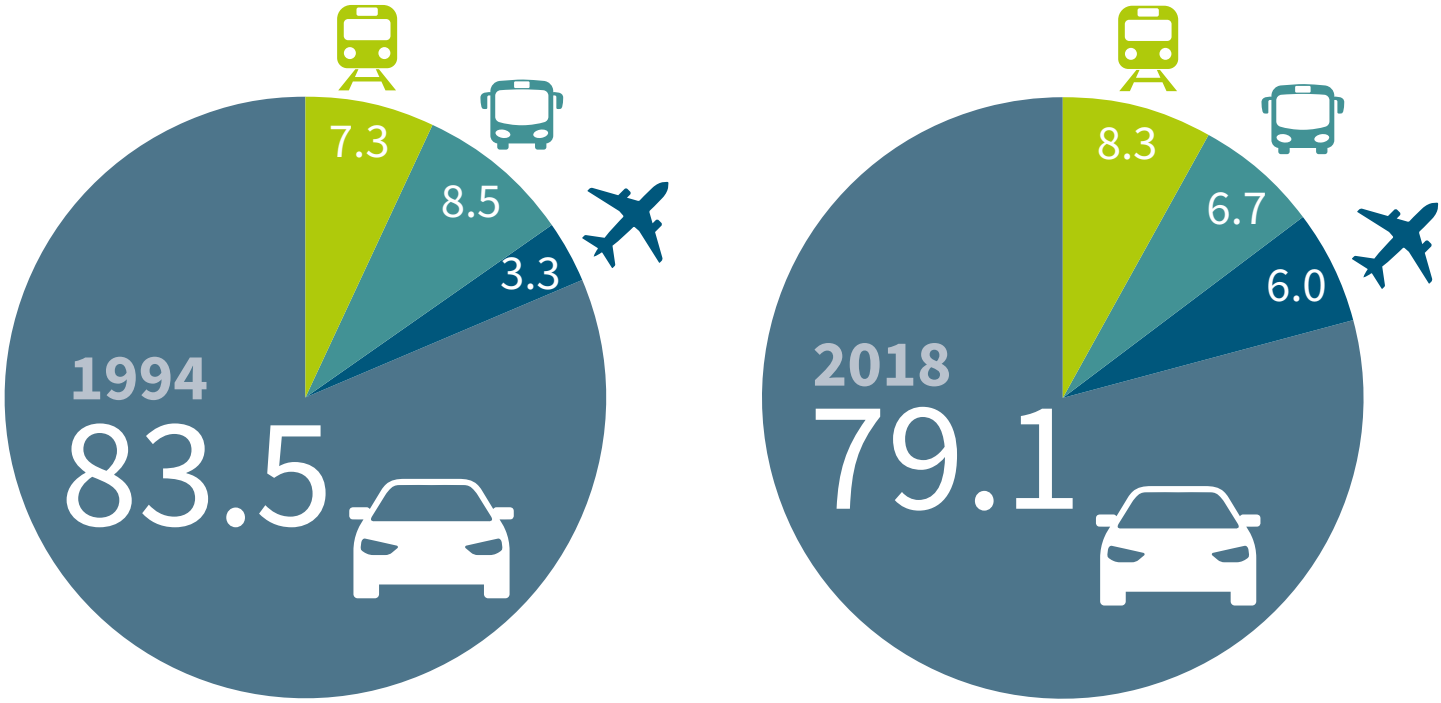


Injuries (2009-2018 average)



Source: Umweltbundesamt (2020); Allianz pro Schiene (2020)[35]

Modal split of passenger transport in Germany 1994 and 2018



Source: BMVi (2020); BMVi (2000)[38]

Rail | Public road passenger transport | Air | Car

Since the reform of Germany's railway system in 1994, rail passenger transport volume has increased by 40%.[36] However, this mainly mirrors the overall increase in passenger transport across modes. The share of rail in the modal split has only increased by a small margin, and now lies at 8.3%. As a comparison, in 1950 rail had a share of 37% in the modal split of passenger transport in West Germany.[37]

Over the same period, the total length of the railway network decreased from 44,600 km to 38,500 km.[39]

Only around 60% of the network is currently electrified. Compared to 57% in 2007, this equals a progress of only approximately 70km of raid electrification per year. The government aims to achieve 70% electrification by 2025 – this would require around 500 km per year.[40] Between 1994 and 2011, the number of DB employees was cut by 35%, with 117,000 jobs lost.[41] Luckily, recent developments point in an opposite direction: in 2019, Deutsche Bahn hired 24,000 new employees.[42]

Window of opportunity

It is symptomatic that Germany's transport strategies are largely silent on avoiding traffic or shifting traffic away from road. For decades, cars have been a powerful symbol for Germany's postwar 'Wirtschaftswunder' (economic boom). The automotive industry, which has specialised on large cars with high engine power, has benefited from quite favourable political circumstances. The government has pampered the industry and protected it from stricter EU regulations. It is thus not surprising that opportunities to shift transport to cleaner modes, such as walking, cycling, public transport and - first and foremost - rail transport, have long been neglected.

The German government's long-standing focus on road and air transport could now experience a turnaround. The growing awareness of the climate crisis and the rise of political movements such as Fridays for Future has placed the transport sector under political pressure. Increasing congestion in cities and air pollution are putting the current car-focused transport policy in question, and the diesel crisis has shaken public confidence in the car industry's ability to find appropriate answers to these challenges. Shifting passenger transport to rail could be one key puzzle piece for decarbonising Germany's transport system.

Germany aims to reduce emissions from the transport sector to 95-98 $MtCO_2e$ by 2030. In 2018, the sector emitted 167 $MtCO_2e$.[43] The Ministry for Economy has estimated that a partial shift from passenger and freight transport to rail could reduce emissions by 18 Mt CO_2.[44]

While the current CDU/CSU-SPD government still places much emphasis on road transport, there are clear signs that the government is also paying more attention to improving the rail system. According to the 2018 coalition agreement, the government aims at doubling the number of railway passengers, inter alia by

- Introduction of an integrated regular interval timetable for Germany (Deutschland-Takt)
- Electrifying 70% of the railway network by 2030
- Increasing rail infrastructure investment
- Reducing track access charges

With the 2019 Climate Package, the government has promised to introduce a CO_2 price for transport, reduce the VAT on rail tickets and increase aviation taxes. Within the next ten years, the government plans to support railways with around € 150 billion.[45] For a higher modal split of rail in the freight sector the Government has launched a masterplan for rail freight (Masterplan Schienengüterverkehr).[46]

However, the announced measures still remain rather 'light touch' and do not yet make up for the long-standing discrimination of rail transport. In order to turn rail into a real alternative to road and air transport, the transport policy mix requires a complete overhaul.

Obstacles and solutions for a shift to rail

Lack of political vision and long-term strategy

Germany is lacking a coherent long-term mobility strategy that integrates all transport modes and is in line with the Paris climate targets. Currently, there are many different contradicting policy instruments and infrastructure plans in place.[47] Although the Federal Infrastructure Plan gives a broad idea for infrastructure priorities, it neither provides a holistic concept for future mobility, nor guarantees respective financial resources.[48]

SOLUTIONS:

- Adopt a comprehensive low-carbon long-term mobility strategy, encompassing all transport modes and their synergies.

Infrastructure public finance favours road

Infrastructure is key for the functioning, and therefore the attractiveness, of different transport modes. Due to the high capital costs and the long lifetime of transport infrastructure, decisions taken today have the potential to lock us into a high-carbon transport system. Infrastructure also needs to be maintained: roads and highways constructed today will lock-in future funds that could otherwise be used for alternative transport modes.

Since 1994, Germany has constructed 247,000 km of new road network, not counting the addition of driving lanes to existing roads. In the same period, only 1,700 km of railway network were constructed or upgraded. This equals 150 times as much new road km as rail km.[49] The length of the total railway network has even decreased, as many railway tracks, especially for regional transport, were abandoned – 6,100 km have been closed since 1994, which constitutes 13% of the network.[50] Since the early 1990s, Germany has also opened 10 new airports.

The government has supported this development with public finance. Due to the high capital costs of new infrastructure and infrastructure maintenance, public finance is crucial for transport infrastructure. According to the OECD, Germany currently provides more than twice the amount of public finance for road infrastructure (66% of total transport investment) as for rail infrastructure (27%). In contrast, the UK spends 55% of transport investment in rail infrastructure, France 46%.

Investment and maintenance spending by transport mode (2016-17 average)

Country	Road	Rail	Maritime port	Airport
Argentina	83 %	7 %	7 %	3 %
Australia	73 %	18 %	4 %	4 %
Brazil	65 %	20 %	10 %	6 %
Canada	70 %	9 %	9 %	12 %
China	76 %	16 %	3 %	5 %
France	48 %	46 %	2 %	4 %
Germany	**66 %**	**27 %**	**2 %**	**5 %**
India	54 %	44 %	0 %	1 %
Indonesia	95 %	1 %	1 %	3 %
Italy	45 %	46 %	8 %	1 %
Japan	71 %	20 %	5 %	4 %
Mexico	43 %	24 %	9 %	24 %
South Korea	56 %	37 %	6 %	2 %
Russia	62 %	33 %	1 %	4 %
Saudi Arabia	78 %	5 %	10 %	6 %
South Africa	72 %	18 %	4 %	6 %
Turkey	62 %	16 %	1 %	22 %
United Kingdom	35 %	55 %	2 %	8 %
United States	68 %	10 %	5 %	17 %

Source: Overseas Development Institute (forthcoming)[51]

In Germany, the main instrument for steering transport infrastructure investment is the Federal Transport Infrastructure Plan (Bundesverkehrswegeplan, BVWP). This plan sets out priority projects for public infrastructure investments over a period of 15 years. The latest BVWP (2015-2030) foresees a total investment volume of € 270 billion until 2030, with 49.3% of investment allocated to road infrastructure, 41.6% to rail, and 9.1% to waterways. It needs to be highlighted that the underlying transport scenario does not envisage a modal shift to rail: rail is projected to only cover 8% of passenger transport in 2030. An alternative scenario calculated for the Federal Environment Agency estimates that emission reductions could reach 1 Mt CO_2e per year if only 30% of investments was channelled into road infrastructure, rather than the 49.3% currently foreseen.[52]

The list of projects in the BVWP exceeds available funds by far, meaning that not all projects will be implemented. Every five years, the Transport Ministry checks which projects should be prioritised, and whether adjustments are needed in accordance with recent transport developments. This provides an opportunity for re-evaluating priorities in accordance with emission reduction objectives.

SOLUTIONS:

- Short term: Stop public investment on new federal highways, additional highway lanes, highway-like roads and bypasses
- Prioritise railway infrastructure, both regional and long-distance, especially projects that are key for implementing the nationwide integrated regular interval timetable (*'Deutschland-Takt'*) and cross-boundary connections
- Revise Federal Transport Infrastructure Plan, and undertake a 1.5°C check. Include reduction of road passenger and freight transport as a strategic target in of the Plan
- Plan infrastructure based on coordinated timetable intervals (*'fahrplanorientierte Infrastrukturplanung'*)

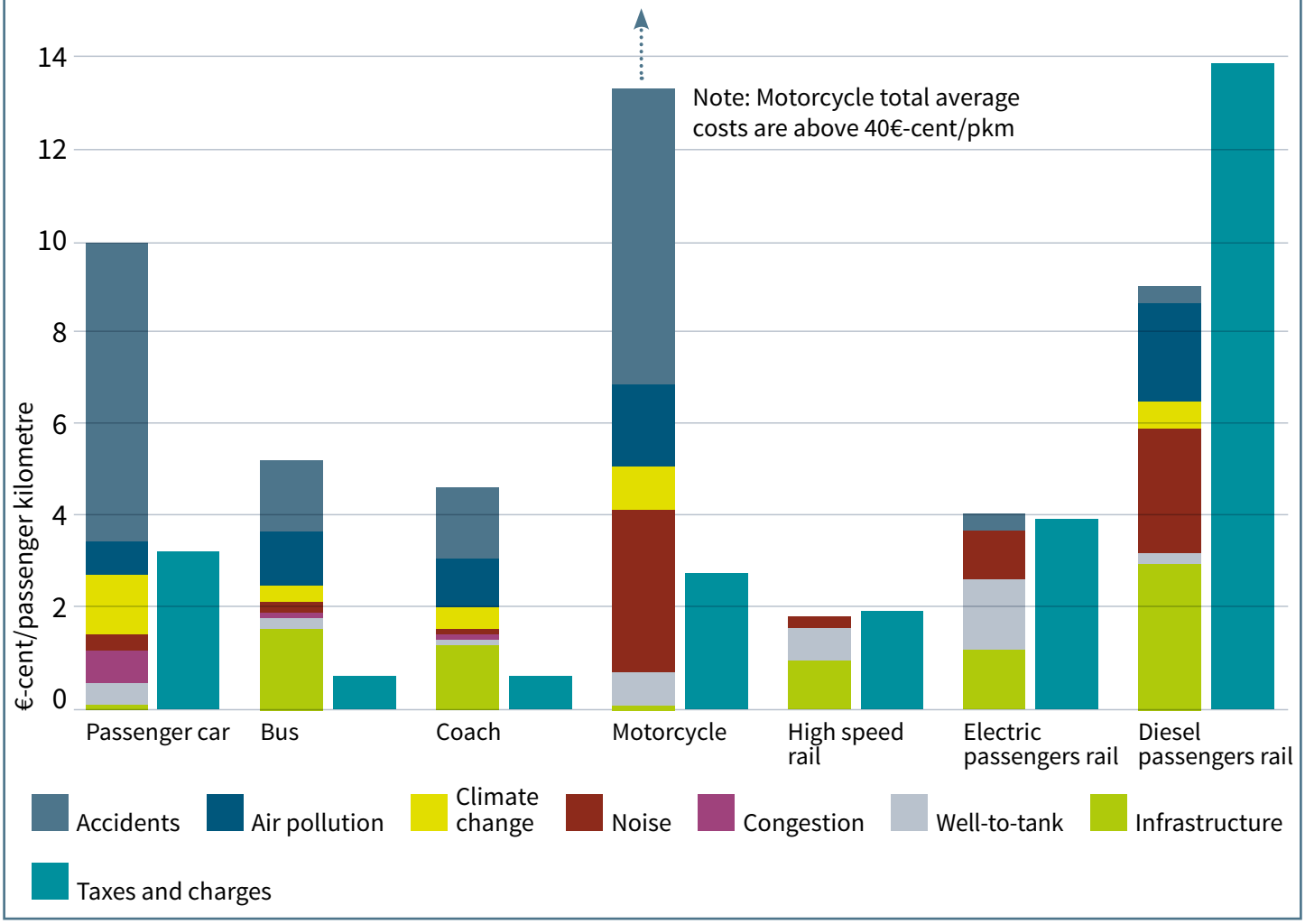
External costs are not equally internalised

The largest 'hidden subsidy' is usually caused by external costs which are not sufficiently internalised.[53] External costs are costs generated by the transport user but borne by the society as a whole (or by third parties), and hence not taken into account by the transport user. Such external costs can be accident costs, air pollution, climate change impacts, noise, congestion, destruction of habitat.

Taxes or user charges are an attempt to internalise external costs in the price of transport use, in order to make the polluter pay for the negative effects imposed on society, to influence behaviour, recover costs etc.[54] If external costs are not sufficiently reflected, the market sends wrong price signals to consumers. It is important to note that there are inherent uncertainties in putting a price on these external costs. Since the magnitude of current and future impacts cannot be determined with complete certainty, nor to which extent impacts are attributable to a specific activity, such calculations can always only be an approximation. For example, CE Delft calculates with a CO_2 price of 100 €/tCO_2e[55], the German Federal Environment Agency with 180 €/tCO_2e.[56] There are also different concepts of how best to internalise costs: e.g. should charges reflect only marginal costs or average costs, or be set at a sufficient level for achieving the environmental objectives?[57] While there is no complete certainty and no single best approach, external costs calculations nevertheless give a rough indication.

A recent CE Delft study commissioned by the European Commission analysed the external costs of road and rail passenger transport across EU member states, and contrasted these with the taxes and charges raised. These also included the variable infrastructure costs, i.e. maintenance ('wear and tear') costs.[58]

Average external costs and average variable infrastructure costs versus average taxes and charges in Germany (road and rail)



Source: Own calculations based on CE Delft (2019)[61]

For Germany, the results show that high-speed trains have the lowest level of average external costs per passenger-km (1.6 €-ct/pkm), and that trains in general have currently the highest 'cost coverage ratio': average taxes and charges per passenger-km are close to or even exceed average external and variable infrastructure costs. The different values for individual train types can mainly be explained by differences in energy taxations (diesel vs. electricity).[59] In contrast, charges and taxes for passenger cars only cover around 44% of these costs. The rate is even lower for buses, coaches and motorcycles. In other words, road passengers pay less of the external costs than train users per kilometre. Since road transport makes up 86% of total passenger transport, this has a large impact on total costs borne by society: road transport is the transport mode for which society pays the most in absolute terms.[60]

The following sections take a more detailed look at the tax and charges scheme for differing transport modes.

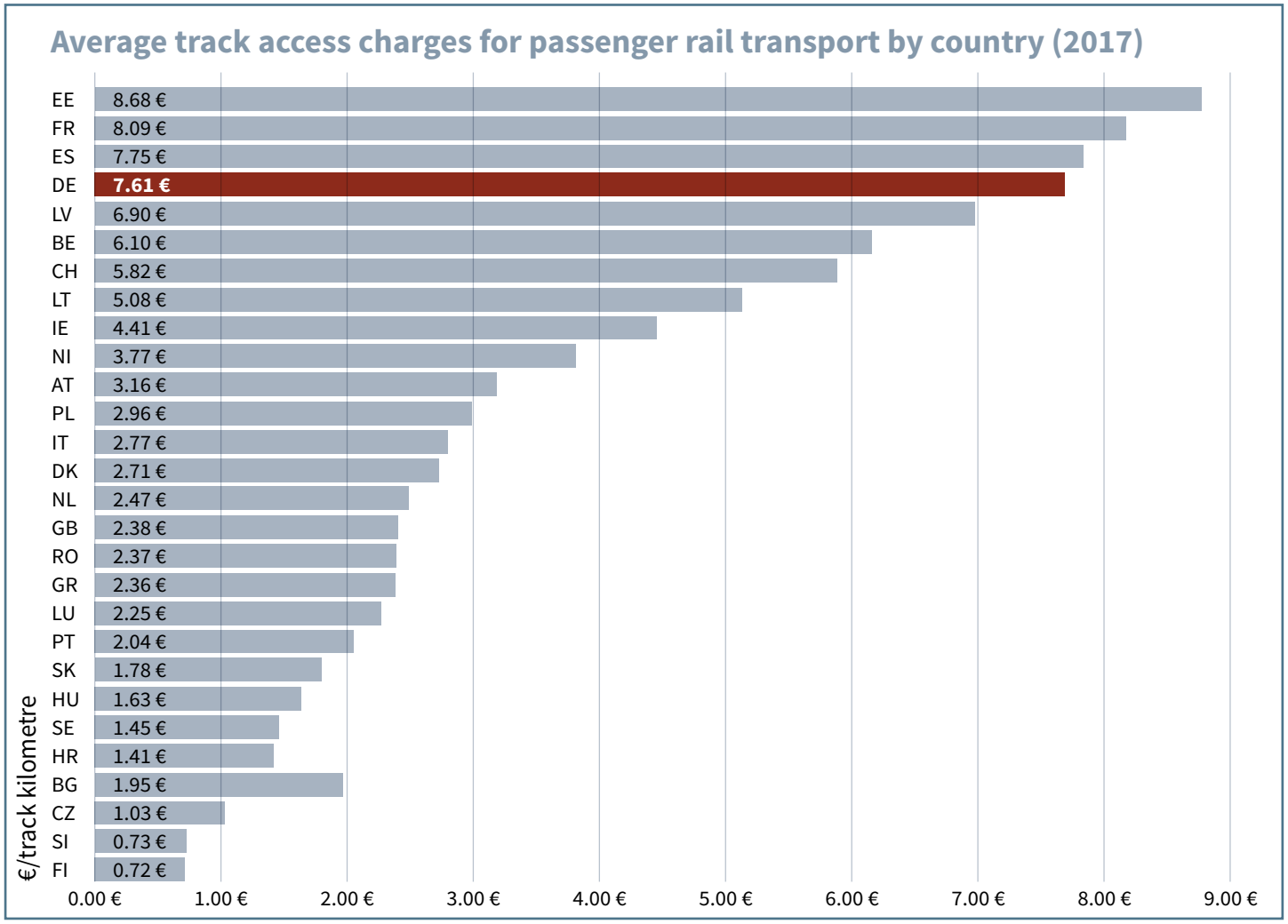
€-ct/pkm	Passenger car	Bus	Coach	Motorcycle	High speed rail	Electric passenger train	Diesel passenger train
Cost coverage ratio	0.44	0.16	0.17	0.93	0.79	0.44	1.30

Infrastructure access charges

In Germany, train operators are charged for using the railway tracks, and airlines pay for take-off and landing, and for parking aeroplanes in the airport. In contrast, cars and buses do not pay for using road infrastructure, and heavy good vehicles (HGVs) pay charges only on limited number of roads (toll).

	Road	Rail	Aviation
Access charges	Only HGVs (above 7.5t) on around 6% of the road network; cars and coaches do not pay	Yes, full costs (fixed and marginal costs) for passenger transport. Half price for freight	Yes, for starting and landing on airports, and for parking

German rail track access charges are amongst the highest in the EU. While many countries only charge railway operators for the marginal costs ('wear and tear' costs), Germany applies a full cost coverage principle. A study by PwC found that passenger trains pay € 7.61 on average per track km – in Finland they only pay a tenth of this amount.[62] The Federal Network Agency reports that track access charges can reach up to 79 €/track km.[63] Additionally, train operators pay for accessing railway stations – for Berlin central station this currently amounts to € 49.92 per stop. Track access charges in Germany make up around a third of passenger rail operation costs (25-30%). Between 2013 and 2018, the level of rail track access charges for long-distance passenger transport has increased by 18%.[65]



Source: PwC (2018)[66]

Since 2018, the government subsidises freight railway transport by covering half of the track access charges. For local passenger rail transport, the government already pays a significant share through regionalisation funds (Regionalisierungsmittel). However, no Federal support is available for long-distance passenger transport.

The German Monopolies Commission (Monopolkommission) considers that lower charges for long-distance rail services would facilitate services by new entrants, and improve utilisation rates of tracks. This would allow full exploitation of existing track capacities, including those outside the main axis, e.g. tracks used for the former InterRegio network.[67] The Commission calculated that in 2017, long-distance rail services were charged € 918 million for track access.[68]

In contrast to rail, only a small share of road transport pays for infrastructure use. Only HGVs above 7.5 tons pay for using infrastructure, and only for federal roads and highways (around 50,000 km).[69] Currently, the toll varies between 9 and 27 €-ct/km, depending on emission class, weight and noise.[70] Passenger transport (cars, coaches etc.) does not pay for road use at all.

Uneven fuel taxation

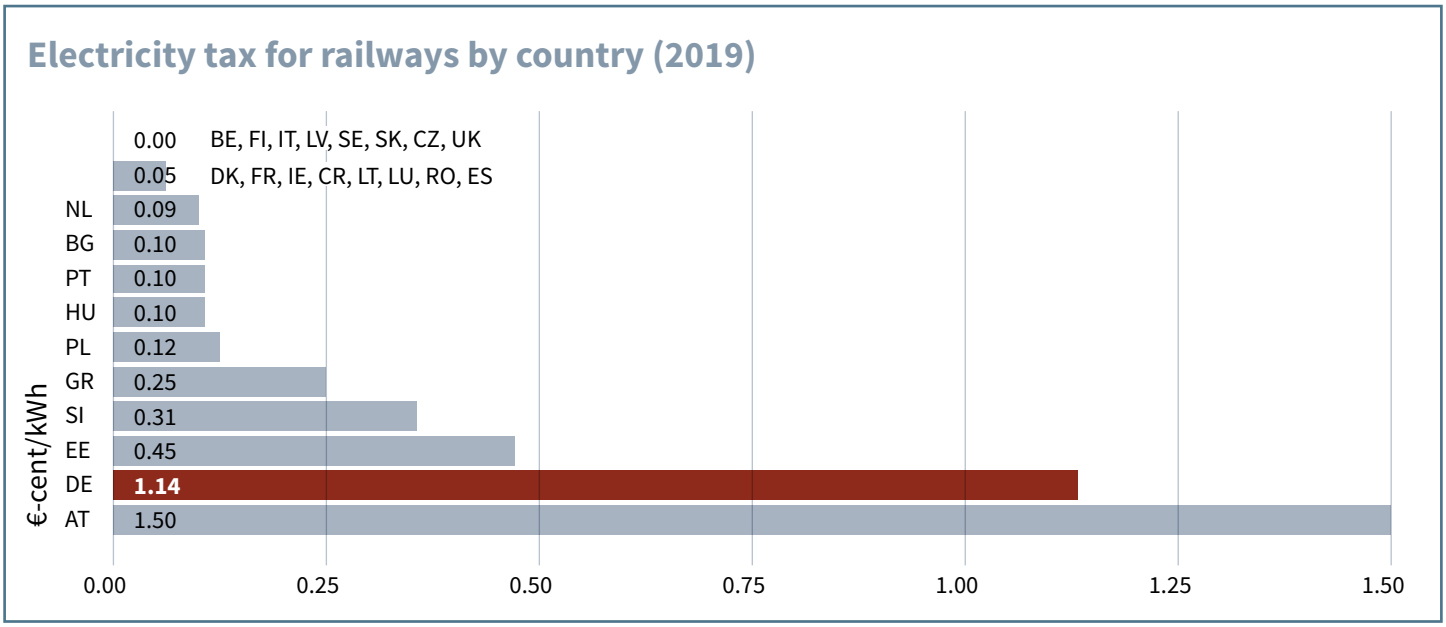
The different transport modes use different fuels. Cars, buses and trucks are largely fuelled by petrol and diesel. Electricity still makes up only a negligible share. Aeroplanes use kerosene. In contrast, 90% of rail transport volume is already electric – only some regional trains and some freight trains still operate on diesel.[71]

Fuel taxation is an important tool for factoring in external costs. However, the German fuel tax regime currently favours the most emission-intensive transport modes: road and air transport. Airlines are completely exempt from fuel taxes and are only covered to a limited extent by the European Union Emissions Trading Scheme. Flights that leave the EU are not included, not even for the section of the journey in European air space. For intra-EU flights, 85% of emissions allowances are granted for free. One additional loophole is that the EU ETS only covers CO_2 emissions and ignores other emissions. The climate impact of aviation is 2-4 times higher than the mere CO_2 emissions, especially in high altitudes, due to water vapour, aerosols and nitrogen oxides.

Road transport pays taxes on petrol of 65 €-ct/litre, and a reduced rate of 47 €-ct/litre for diesel. The Federal Environment Agency estimates that this diesel tax benefit results in lost revenues of around € 7.3 billion annually.[72] This tax benefit is only partly outweighed by a higher vehicle tax for diesel cars, which does not, however, depend on distance or fuel consumption. With its 2019 Climate Package, the government has decided to introduce a CO_2 price of 25 €/t CO_2, starting in 2021. This would increase the price of petrol and diesel, but only by around 7.5 €-ct/litre.[73] The CO_2 price is set to rise to 65 €/t CO_2 in 2026.

	Road	Rail	Aviation
Fuel taxes	Petrol/diesel taxes diesel tax benefits	Electricity tax, full rate for long-distance, reduced rate for regional trains	No kerosene tax
Renewables surcharge	No (only electric vehicles pay surcharge)	Yes (on around 90% of transport volume)	No
Emissions trading scheme	No	Yes (for electricity), all allowances under auctioning	Yes, but 85% of free allowances and extra-EU flights not covered

At 1.14 €-ct/kWh, rail operators in Germany pay one of the highest electricity tax rates in Europe, with only Austria charging higher rates. The German NGO Allianz pro Schiene estimates that rail operators pay € 141 million in fuel taxes, and € 176 million in renewables surcharge every year.[74]



Source: Allianz pro Schiene (2019)[75]

Value added tax

The final price a transport user pays is also influenced by the value-added tax (VAT). Domestic flights pay the full rate of 19%, but no such tax is levied on tickets for international flights in Germany. This gives aviation a clear advantage. The VAT rate for regional trains is 7%, for long-distance train tickets the rate was reduced from 19% to 7% in late 2019. For bus and coach tickets, Germany is one of the few EU countries to charge the full 19% tax rate. As car users do not need to buy a ticket, the comparison is not straightforward - they pay 19% VAT on the fuel they buy, the vehicle itself, spare parts etc.

	Road	Rail	Aviation
VAT on tickets	Full rate of 19% on coach/bus tickets, and on fuel for cars/ HGVs	Reduced rate of 7%	Full rate of 19% on domestic flights; No VAT on cross-boundary flights

Aviation tax

The aviation tax is charged on aeroplane tickets and was introduced in 2011 to counterbalance the kerosene tax exemption. The tax rate is dependent on the distance travelled, and as of 1 April 2020 was increased to € 13.03 (short haul), € 33.01 (mid haul), and € 59 (long haul). If the revenues gathered through this tax and the auctioning of EU ETS allowances together exceed € 1.75 billion (before April 2020: € 1 billion), the government can cap the tax. The government has already made use of this exemption in 2012, 2017, 2018, 2019 and 2020. This cap nullifies the impact of the EU ETS on airlines.

The aviation tax is still a long way off from creating fair conditions of competition: if the same tax rate was charged on kerosene as on petrol, revenues of around € 8.1 billion could be collected in the aviation sector, and charging the full VAT rate on international flights would amount to € 4.2 billion.[76] This means that the aviation tax would need to be 7 times higher than the current € 1.75 billion maximum to make up for the tax exemptions.

Company car taxation

Companies can deduce the purchase and use of company cars from taxes – around 65% of newly registered cars are company cars. They thus have a significant impact on average fleet emissions.

If employees use company cars for private purposes, they only have to declare 1% of the car's listing value as a non-cash benefit, and often companies even pay for the fuel. Studies have found that this incentivises employees to make more use of cars, and increases overall transport demand.[77] Several studies have found that employees tend to travel less by train, bicycle etc. because car use becomes the standard, and almost 'free' transport mode.[78] There are estimates that the very low tax rate represents a subsidy of € 3.3 to 5.5 billion annually.[79] Companies also tend to buy cars with higher engine power and higher CO_2 emissions than private buyers do.[80] Still, in contrast to many EU member states, the German company car taxation scheme is not even based on CO_2 emission intensity.

If the company provides the equivalent to a 'free to use' company car, an annual rail subscription (Bahncard 100), the cost of the Bahncard 100 is counted as taxable pay (if the value of actual business trips is less than the costs of the Bahncard, the difference counts as taxable pay).

SOLUTIONS:

- Introduce kerosene tax and full VAT for airlines, and working towards full auctioning of ETS allowances. As a first step, abolish € 1.75 billion cap on air ticket tax revenues
- Reduce track access charges for trains to the level of marginal costs
- Gradually introduce a comprehensive toll for the use of highways, starting before 2025
- Increase (direct or indirect) CO_2 price to a level that has a real steering effect, while using the revenues for decreasing social and rural-urban fairness gaps
- Relate company car tax benefit to CO_2 emissions, and limit deductibility [81]

Support for airport operation costs

Most airports, especially small regional airports used by low-cost airlines, are loss-making and would go bankrupt without public subsidies.

The federal government supports small regional airports with around € 20 million per year. With this subsidy, airport operators can recover parts of the costs of the air traffic control.[82] Much more significant, however, are subsidies provided by the state and city governments. These data are not always openly available but some examples have been made public: the Dortmund airport, for example, has received € 400 million over the last 20 years from the city of Dortmund.[83] Nuremberg airport received € 8.7 million in two years.[84]

Most airports are partially or completely publicly-owned undertakings. This means that the construction of airports is often paid by the state. The new Berlin airport (37% Berlin, 37% Brandenburg, 26% Federal government) has cost € 7 billion so far, of which the Berlin, Brandenburg and the Federal government provided € 2.9 billion in equity capital and in loans, which might not be paid back – earlier loans have already been converted to equity capital.[85] As shareholders, the state or city also has to carry part of the operational losses. Kassel airport made losses of € 6 million in 2017, which was largely covered by the State of Hesse with its 68% shares.[86] In March 2020, the Berlin airports Tegel and Schönefeld received € 300 million in equity capital from its shareholders (Berlin, Brandenburg, Federal government) for cushioning the effects of Covid-19.[87]

Governments can also channel additional subsidies through these airports, e.g. for operational costs. The Munich airport GmbH, for instance, belongs 51% to the State of Bavaria, 26% to the Federal Republic of Germany and 23% to the City of Munich. Munich airport has supported airlines with € 295 million between 2005 and 2018, and € 25 million in 2019, for the operation of specific connections.[88]

SOLUTIONS:

- Phase-out direct subsidies for airport operation

Support for R&D, education and training favours road

Research plays a key role in promoting different transport modes. In 2018, the German government provided around € 71 million for R&D for road transport, but only € 9 million for rail transport - that is almost a factor of eight.

However, the funds available for aviation are actually much higher. In 2018, the government provided € 156 million for aviation research (Luftfahrtforschungsprogramm LuFo); Federal and state governments jointly funded the German Aerospace Center (DLR) with € 206 million dedicated to aviation research; the Ministry for Transport offers € 0.7 million annually for aviation R&D; and the Ministry for Economy offers grants for R&D related to aviation equipment.[89]

The government also supports vocational education and training for road freight transport (€ 125 million in 2019), but not for equivalent training for the rail sector, although shortage of skilled workers is one of the main reasons for cancellation of rail services.[90]

Finally, the government also supports the automotive industry indirectly with scrappage premiums for old cars, premiums on the purchase of electric vehicles, or simply by purchasing or leasing cars for the public sector. A parliamentary enquiry by the Left party in 2017 revealed that government support for the automotive industry totalled € 13 billion over the span of ten years.[91]

SOLUTIONS:

- Support education and training in the rail sector to help overcome shortage of skilled workers and
- Support R&D in the rail sector to improve rail performance

	Road	Rail	Air
Number of projects started in 2018	191	44	19
Outflow of resources in 2018	€ 70.8 million	€ 8.7 million	€ 2.4 million
Outflow of resources 2009-2018	€ 363.9 million	€ 42.3 million	€ 60.8 million

Source: Kleine Anfrage Drucksache 19/14693

Safety costs of road transport are externalised

Trains are one of the safest means of transport. The risk of an accident is 113 times higher on the road than on a train.[92] Safety regulations for cars do not reflect the actual safety risks. These risks are thus not reflected in the costs of driving a car. The costs of accidents are externalised and paid by society, e.g. via the health system. In contrast, train operators need to adhere to high safety standards. Just to give a few examples:

- automatic stopping of the train if it passes a red signal
- train drivers require a special training for each train type, and for each route
- fire protection regulation is much stricter on trains than on buses[93]

For cross-boundary trains, operators often need to fulfil various different safety schemes, increasing costs significantly. The German government is additionally planning to charge train and network operators fees for 'government services', e.g. for calling the police, or for controlling safety regulations.[94] Strict regulations have also been adopted for airlines and airports, but the government partially steps in for these costs (see above).

SOLUTIONS:

- Provide financial support to rail operators to cover safety costs, so as to create a level playing field across transport modes

Recommendations

	Solution
STRATEGY	❱ Adopt a comprehensive long-term low-carbon mobility strategy, encompassing all transport modes and their synergies
INFRA-STRUCTURE FINANCE	❱ Short term: Stop public investment on new federal highways, additional highway lanes, highway-like roads and bypasses ❱ Prioritise railway infrastructure, both regional and long-distance, especially projects that are key for implementing the nationwide integrated regular interval timetable ('Deutschland-Takt') and cross-boundary connections ❱ Revise Federal Transport Infrastructure Plan, and undertake a 1.5°C check. Include reduction of road passenger and freight transport as a strategic target in of the Plan ❱ Plan infrastructure based on coordinated timetable intervals ('fahrplanorientierte Infrastrukturplanung')
TAXATION	❱ Introduce kerosene tax and full VAT for airlines, and work towards full auctioning of ETS allowances. As a first step, abolish € 1.75 billion cap on air ticket tax revenues ❱ Reduce track access charges for trains to the level of marginal costs ❱ Gradually introduce a comprehensive toll for the use of highways, starting before 2025 ❱ Increase (direct or indirect) CO_2 price to a level that has a real steering effect, while using the revenues for decreasing social and rural-urban fairness gaps ❱ Relate company car tax benefit to CO_2 emissions and limit deductibility
AIRPORT OPERATION	❱ Phase-out direct subsidies for airport operation
R&D, TRAINING	❱ Support education and training in the rail sector to help overcome shortage of skilled workers and ❱ Support R&D in the rail sector to improve rail performance
SAFETY COSTS	❱ Provide financial support to rail operators to cover safety costs, so as to create a level playing field across transport modes

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Germanwatch

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April 2020

GERMANWATCH