

Modal shift analysis for the 2024 ERA Compelling Vision

Final report - May 2024

1. Modal share: Goals and reality

Rail is the most energy efficient mode of transport¹ thanks to its low rolling resistance and its ability to transport a large amount of goods or high number of passengers within a single train.

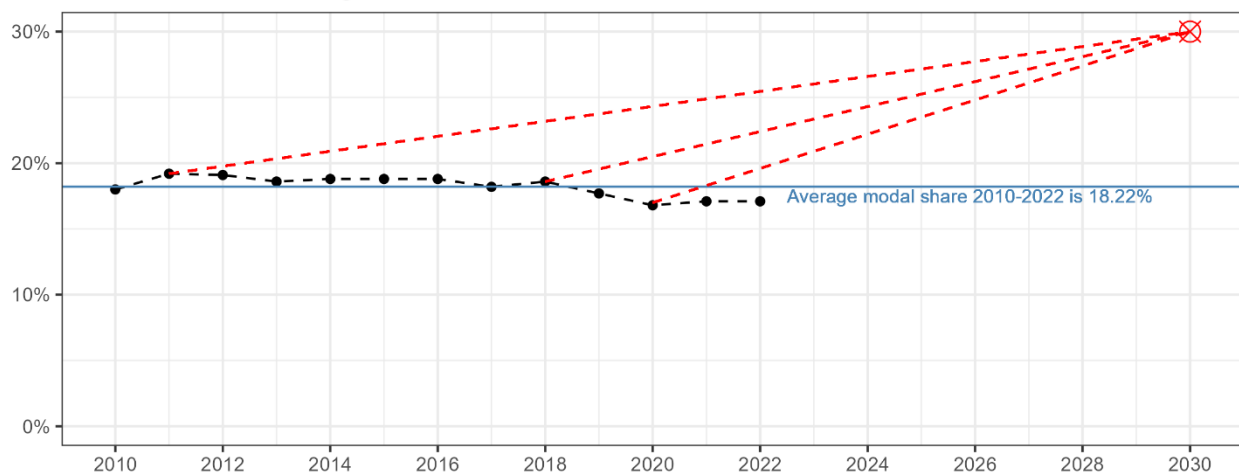
The downside of this efficiency is that trains are restricted to destinations where tracks have been laid out. Capacity can moreover be strongly reduced by other trains sharing the same tracks. Another structural limitation of rail is the relatively high costs of keeping fixed installations and rolling stock operational. Consequently, a high level of utilisation is required to cover these fixed costs.

Beyond the mentioned structural constraints, rail in Europe has been historically weakened by limited harmonisation across borders. This had led to lower quality, connectivity, and reliability of services. Rail has moreover suffered from insufficient investments in many European countries, exacerbating its weaknesses.

Statistics confirm that rail in Europe is in a tough spot. The 30% modal share goal for rail freight that governments and sector organisations have set at multiple moments in time is far from materialising (see Figure 1). It seems that the goal remains the same, even though the time to achieve it is shortening.

Figure 1

Rail's share of total European inland freight transport Far from achieving modal share ambitions



Source: European Union Agency for Railways, Eurostat [tran_hv_frmod]

Similar to the 30% modal share ambition, the European Commission's Smart and Sustainable Transport Strategy goal to double rail freight and triple high-speed rail transport by 2050 versus the 2015 baseline is not on a path to materialise. The modal share ambitions for passenger transport are equally falling behind expectations.

This observation prompts us to investigate the factors contributing to the stagnation of the modal share and to identify potential strategies for achieving modal shift objectives. This paper delves into these points by examining historical rail statistics, relevant literature and case studies.

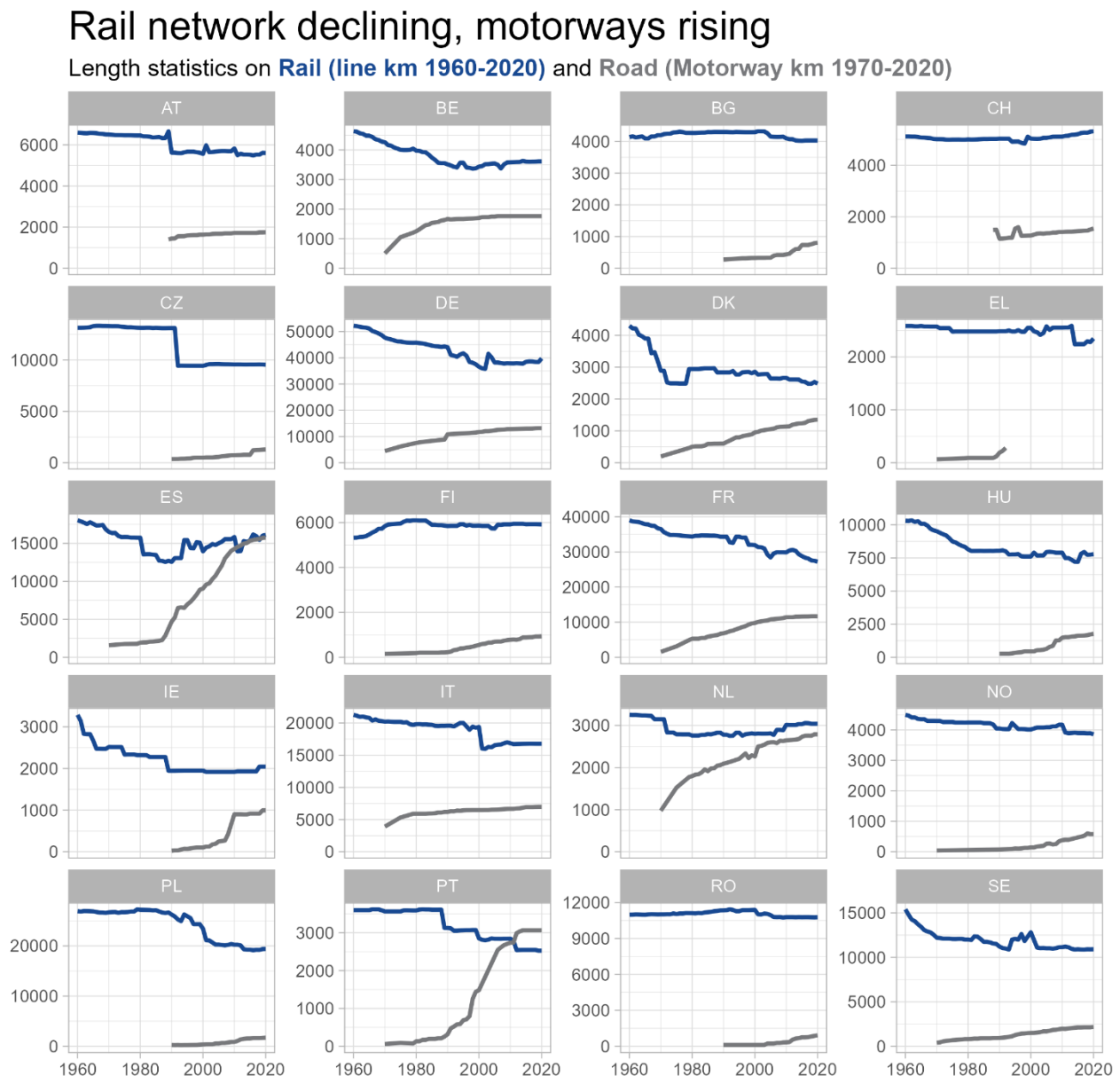
¹ [Energy intensity of passenger transport modes, 2018 – Charts – Data & Statistics - IEA](#)

2. How is rail evolving?

2.1 Network

Rail is in continuous competition with other modes of transport, notably road. An analysis of the performance of rail therefore needs to be bundled with an analysis on road. Prior to looking at actual transport performance it is important to understand how the rail and road networks evolved over time.

Figure 2

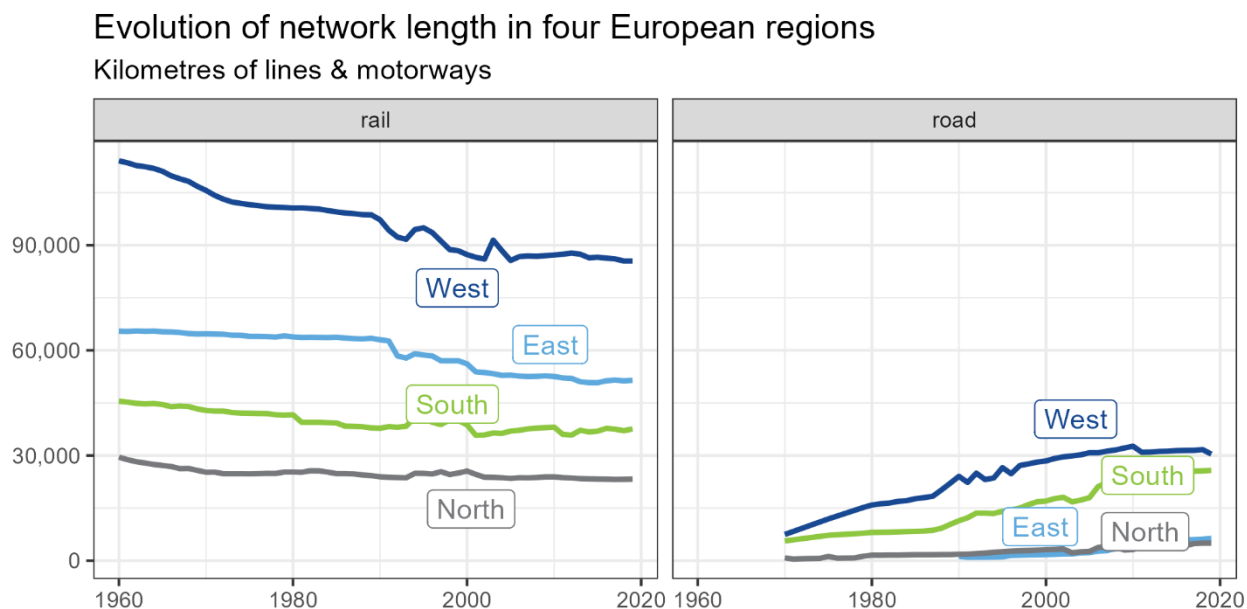


Although Figure 2² shows considerable data gaps on the motorway network, it does provide an indication on the trend. Using the first and last year of the available data per country shows that **about 53 000 km of motorways have been constructed whereas approximately 55 500 km of rail lines have been removed**. These are striking numbers that clarify European investment priorities over the past decades.

² The selection of countries in this and subsequent charts in this report is largely determined by data availability

This trend occurs across all regions, as visualised below in Figure 3. The figure shows that the overall rail network length is larger than that of motorways. That said, the length of the total rail network is considerably smaller than the total road network, considering all roads on top of motorways.

Figure 3

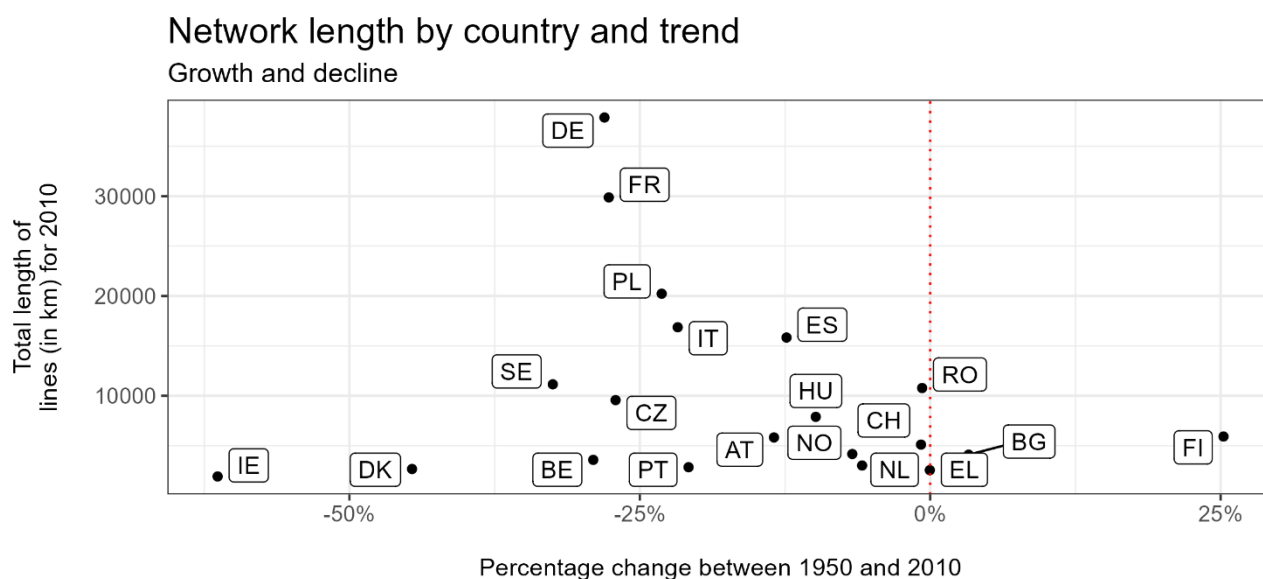


Source: International Historical Statistics (rail) Eurostat (road)

North - DK, FI, NO, SE. East - BG, CZ, HU, PL, RO. South - EL, ES, IT, PT. West - AT, BE, FR, DE, IE, NL, CH

Eurostat provides statistics on state, provincial and communal road. As these statistics suffer from larger data quality issues, no visual trend comparison is provided on this. It is however illustrative that for 15 countries for which complete data existed, in the latest available year, the rail network is thought to be ~200 000 line km, the motorway network ~62 500 km, and other roads ~ 3 000 000 km. This makes that for that sample **the total rail network is about 6.5% the size of the total road network.**

Figure 4



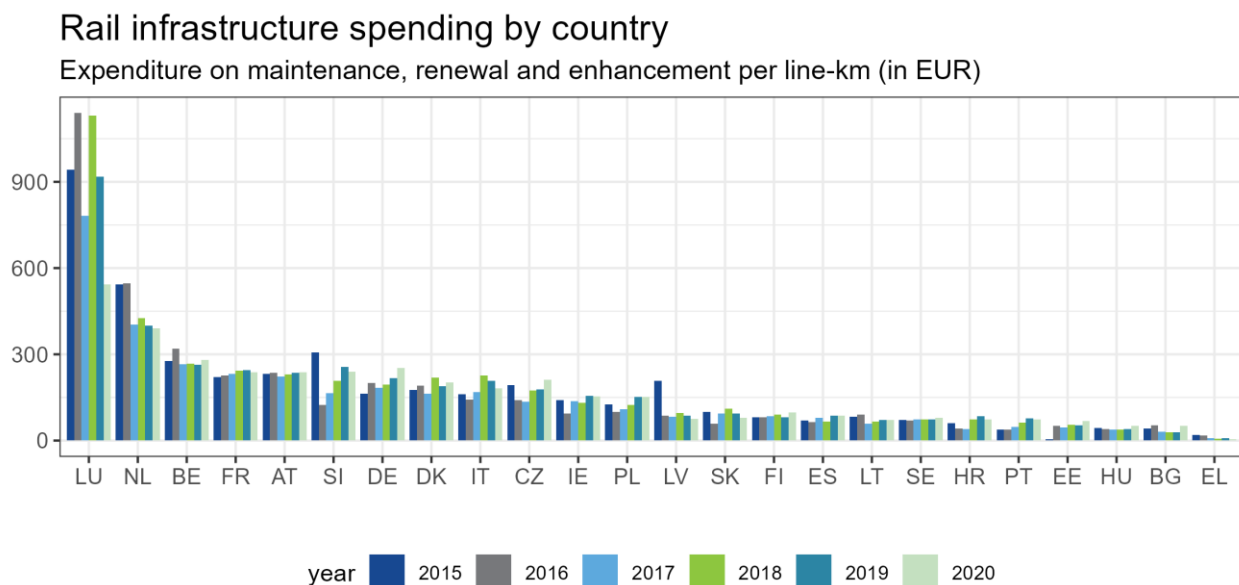
Source: International Historical Statistics

Looking at the evolution of the rail network, the great majority of countries have a railway network which shrunk over the last decades. As shown in Figure 4 it is not untypical for countries to have lost over 25% of all lines since 1950. This finding aligns with other studies that highlight the large loss of connections, particularly when it concerns cross-border sections³.

Besides network length it is important to consider that the quality of the lines varies. The degree of electrification, installed signalling systems, and level of maintenance have a substantial impact on the frequency, reliability and speed of rail services. Also on these dimensions there are large differences between countries⁴.

The level of investment is a key explanatory factor. As can be derived from Figure 5, in 2020 **the top 5 countries invest about seven times more per line kilometre than the bottom 5 countries**. This is in part explained by the relative cost of services and materials, but also by the extent to which a high performing network is prioritised by the Member States. It should be noted that *Figure 5* does not show how underinvestment accumulates over time. In some countries this has led to large compensatory efforts that cause long-term closures with a profound disruptive effect on rail transport.

Figure 5



Source: RMMS 8

Several studies highlight that connectivity issues are even greater at borders. Across Europe a total of 149 cross-border rail connections are no longer operational, 119 of which were identified as promising for reactivation⁵. Yet even if a border crossing is active, operational and technical barriers make that the actual crossing imposes substantial costs on railway undertakings and thus their users⁶. The lack of cross-border connectivity has been a strong impediment to prosperity, preventing growth of 4.5% of regional gross value added or more in some border regions⁷.

Another concern relates to the fragmentation and complexity of the infrastructure in technical terms. Due to historical investment decisions some level of fragmentation is hard to overcome. Still, with four different main track gauges, various platform heights, four key electrification systems, numerous train protection systems, and over 170 distinct non TSI compliant train detection systems, there is a high level of network

³ [analysis of transport infrastructure in europe \(greenpeace.at\)](#), [Cross-border rail transport connections \(europa.eu\)](#)

⁴ [Rail Market Monitoring \(RMMS\) \(europa.eu\)](#)

⁵ [cb_rail_connections_en.pdf \(europa.eu\)](#),

⁶ [Report - Cross-border Rail Transport Potential \(europa.eu\)](#)

⁷ [EPRS STU\(2023\)740233_EN.pdf \(europa.eu\)](#)

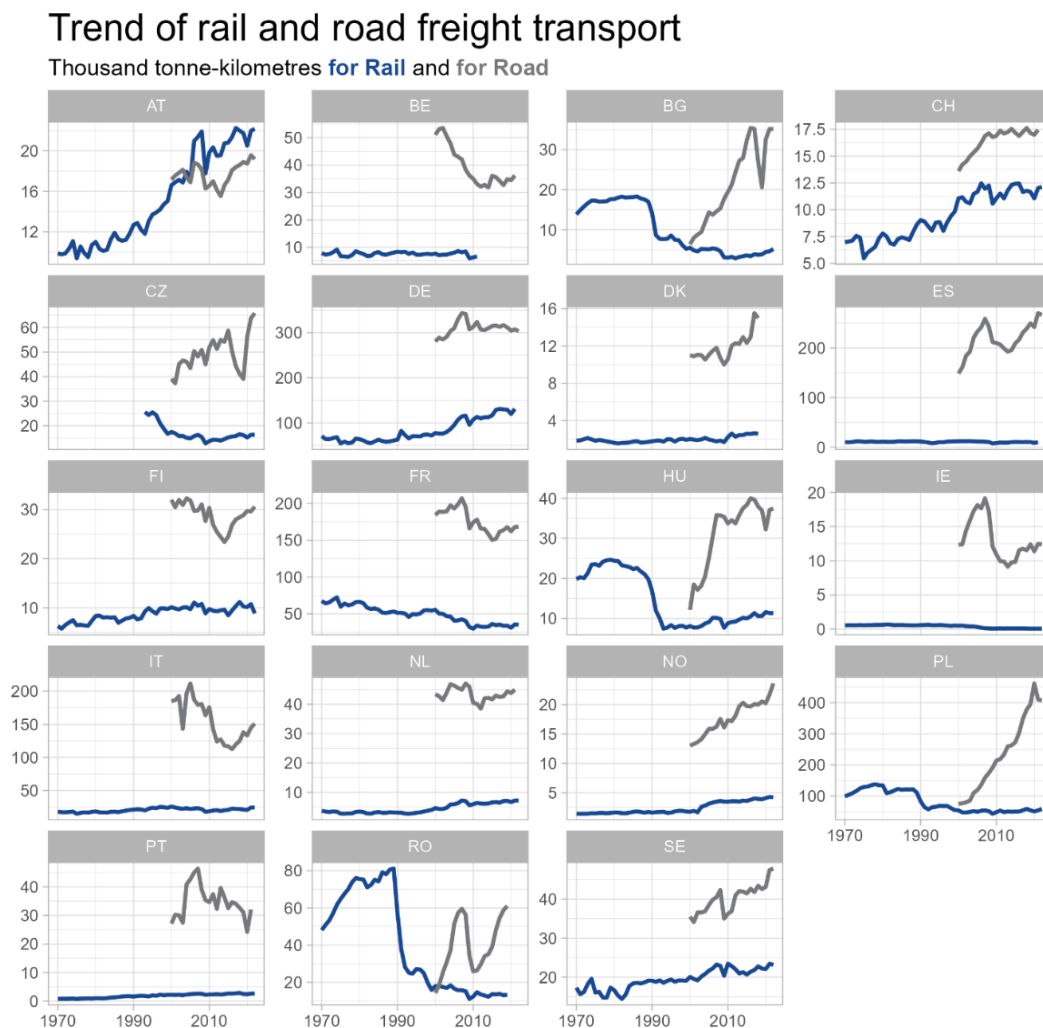
complexity that needs greater harmonisation to reduce purchase and maintenance costs. This is particularly important as it has been reported that in distinct cases rail infrastructure investments and maintenance would cost up to 10 times more than what is the case for road.

The performance of the network is also limited by the capacity allocation process. Path allocation has historically been organised nationally, with countries assigning priorities based on different principles. Moreover, the standard path request and allocation process takes over 1 year, which is incompatible with the more flexible approach that is needed for rail freight⁸. A large number of cancelled and unused paths are the unfortunate outcome of this. A recent proposal by the European Commission and subsequent proposal by the European Parliament⁹ aim to tackle these key issues.

2.2 Freight transport

Like the rail network length, rail freight transport volumes have substantially declined in many countries as shown in Figure 6. The historical data on road transport is admittedly patchy. The figure nevertheless highlights that road transport volumes are considerably higher than those for rail transport in practically each country. The relative growth of road freight has been higher, too.

Figure 6



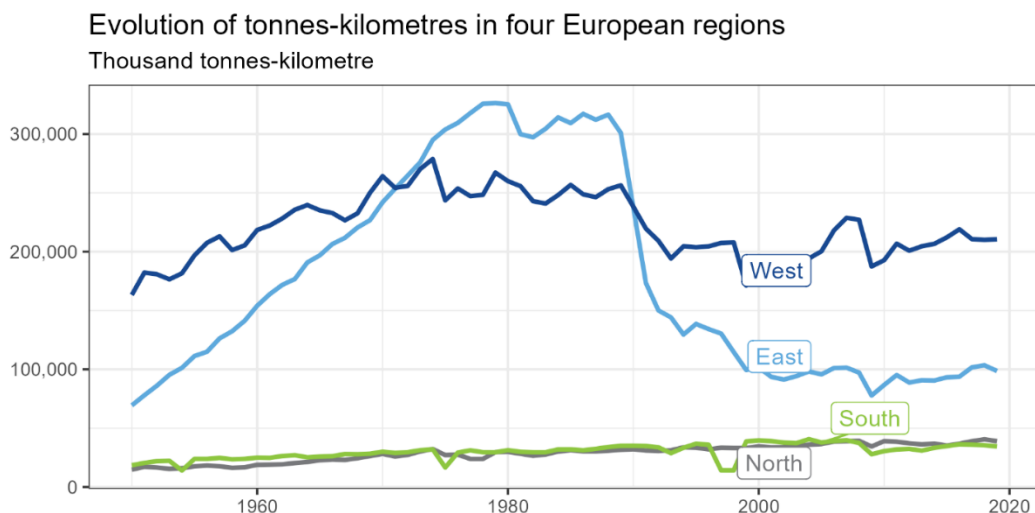
Source: European Union Agency for Railways, OECD

⁸ [1 EN impact assessment part1 v5.docx \(europa.eu\)](#)

⁹ [Report on the proposal for a regulation on the use of railways infrastructure capacity \(europa.eu\)](#)

Figure 7 clarifies that the biggest drop in rail volumes occurred in Eastern Europe. In the North, South and West of Europe rail freight volumes have been mostly flatlining or seeing minor growth. The numbers are more nuanced depending on the type of goods that are transported. The transport of heavy bulk and general cargo has generally been on the decline progressively because of the energy transition and closure of European mines. Rail has nevertheless been successful in adapting to the continuing containerisation of goods. The stabilisation of the sector is largely driven by the fact that intermodal transport operations have grown substantially, whereas block and single wagon load transport have flatlined or decreased substantially.

Figure 7

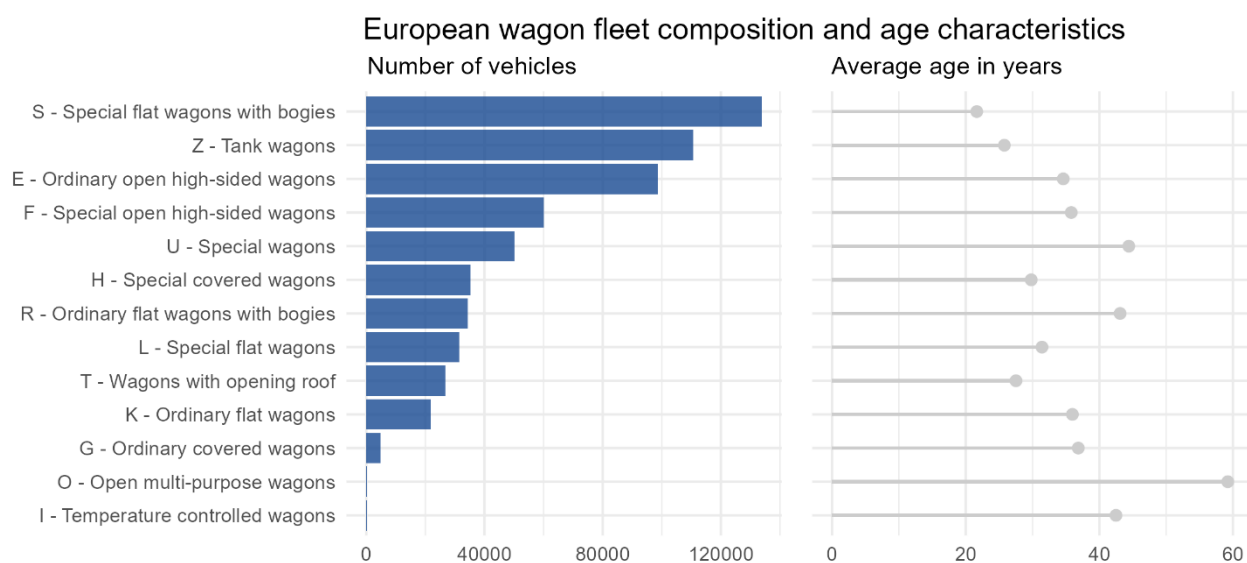


Source: International Historical Statistics, Eurostat

North - DK, FI, NO, SE. East - BG, CZ, HU, PL, RO. South - EL, IT, PT, ES. West - AT, BE, FR, DE, IE, NL, CH, UK

Rail freight is facilitated by about **643 000 wagons that are registered as being operational in European vehicles registers**. There are large differences in age and transport performance of the different types of wagons as shown in Figure 8.

Figure 8

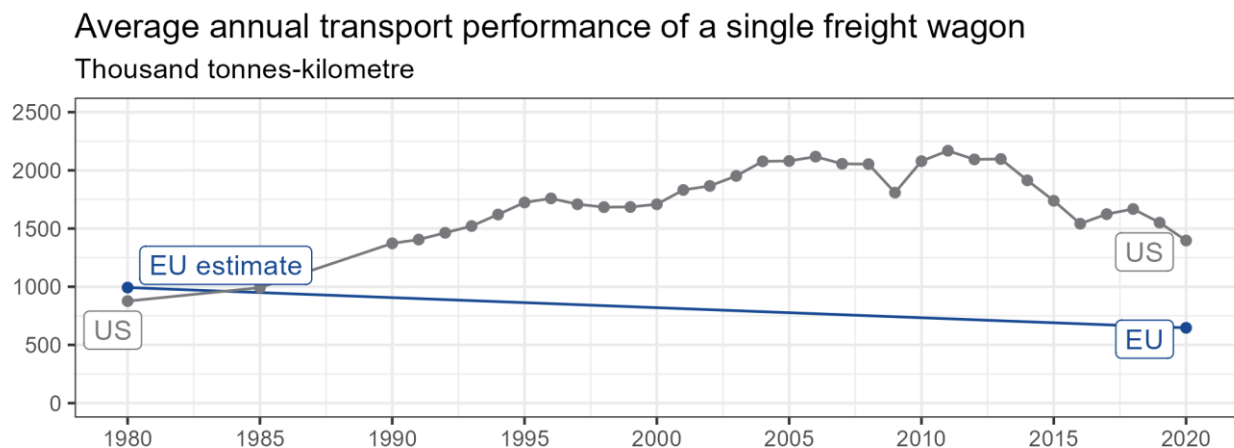


Source: EVR, European Union Agency for Railways

For instance, flat wagons are generally younger and intensively used for intermodal transport, whereas a large part of high-sided wagons were constructed in the 1980s for coal and other bulk transport with a large part of them standing idle.

The extent to which wagons are used efficiently is a recurrent topic and there is a general belief that transport performance can be improved. Comparing the performance of rail freight versus other regions is hampered by lacking historical European fleet statistics. Yet assuming that the number of wagons in Europe was similar in 1980 as it is today, implies that the performance per wagon has dropped (see Figure 9). Comparatively, in the US the efficiency of wagons has increased drastically since 1980. In recent years, **a wagon in the US would have 2 to 3 times the transport performance (in tkm) of a European wagon**. Some efficiency gains are achieved through operational concepts that are hardly attainable at scale in Europe, such as double-stack rail transport. The figure does nevertheless point to a large potential for improved European rail freight performance.

Figure 9



Source: Eurostat, EVR, AAR, Bureau of Transportation Statistics

A final point to add is the cost position of rail versus road freight. The energy crisis has caused a steeper increase in electricity prices compared to diesel prices. This has undermined the cost proposition of rail freight. In addition, the 2004 enlargement of the European Union had a major impact on the offering of road freight transport services by new EU members. The ensuing competition, particularly in terms of labour costs, made road freight comparatively cheaper even for longer distances. Rail freight, being more strongly regulated in terms of skills and language requirements, does not compete on salary costs. Hence, **the flatlining of rail freight's modal share can be partially explained by the deteriorating cost position versus road freight**.

There is a key role for legislators to reflect on how the cost position of rail versus road freight can be structurally improved. This is a multifaceted topic that covers legislation that is rail or road specific (e.g. rail capacity allocation legislation for rail or the regulation on driving time and rest periods for road), or multimodal (e.g. Weights and Dimensions Directive or the Combined Transport Directive). On top of that there are other non-EU legislative developments (e.g. as the Luxembourg Protocol¹⁰) that have an impact on the cost competitiveness of rail freight. An integrated review of this framework is therefore valuable to reflect on the cost position of rail freight.

To conclude, there are several reasons why rail freight has so far not been able to realise the modal shift ambitions. For one, rail freight historically favoured bulk goods. The deindustrialisation and energy transition towards sustainable energy reduces the bulk transport of coals and other heavy goods. At the same time the

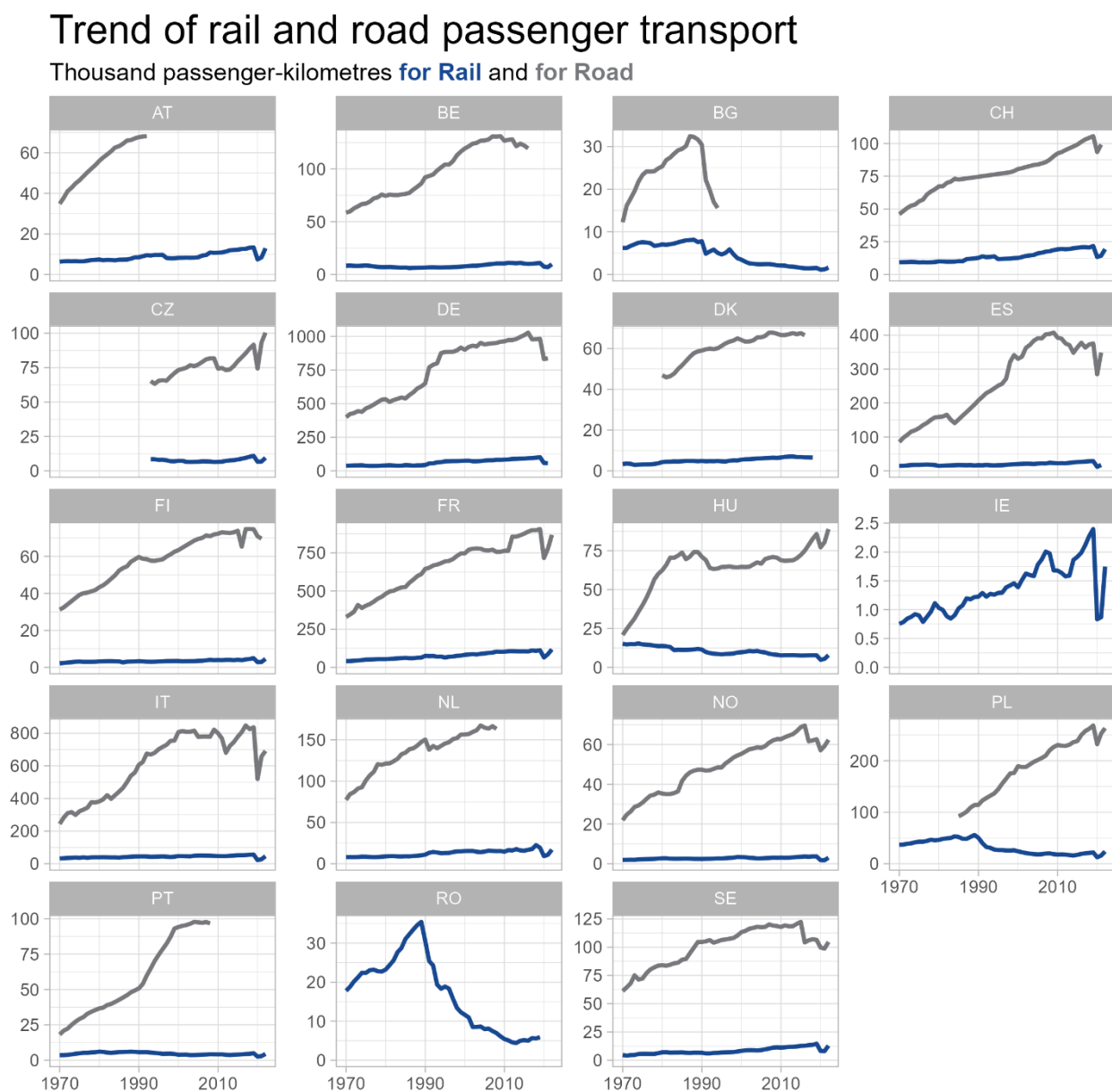
¹⁰ [Rail Protocol – Rail Working Group](#)

liberalisation of the European road freight market led to greater competition and more companies operating across the continent, driving down costs. Rail freight however continues to experience barriers when crossing borders, leading to comparatively higher costs on shorter distances. Moreover, supply chain management strategies such as just-in-time delivery, entailing smaller inventories and thus a need for reliable logistics, often favour road because of its greater flexibility and reliability.

2.3 Passenger transport

For rail passenger transport a similar bleak picture can be drawn. Despite some data gaps and concerns about data quality, Figure 10 depicts that the number of road passenger kilometres (covering motorcycles, cars and busses) is uniformly higher than for rail transport regardless of the moment in time. Importantly, the growth of road passenger kilometres has been substantial, whereas that of rail has been meagre at best, and declining in most cases.

Figure 10



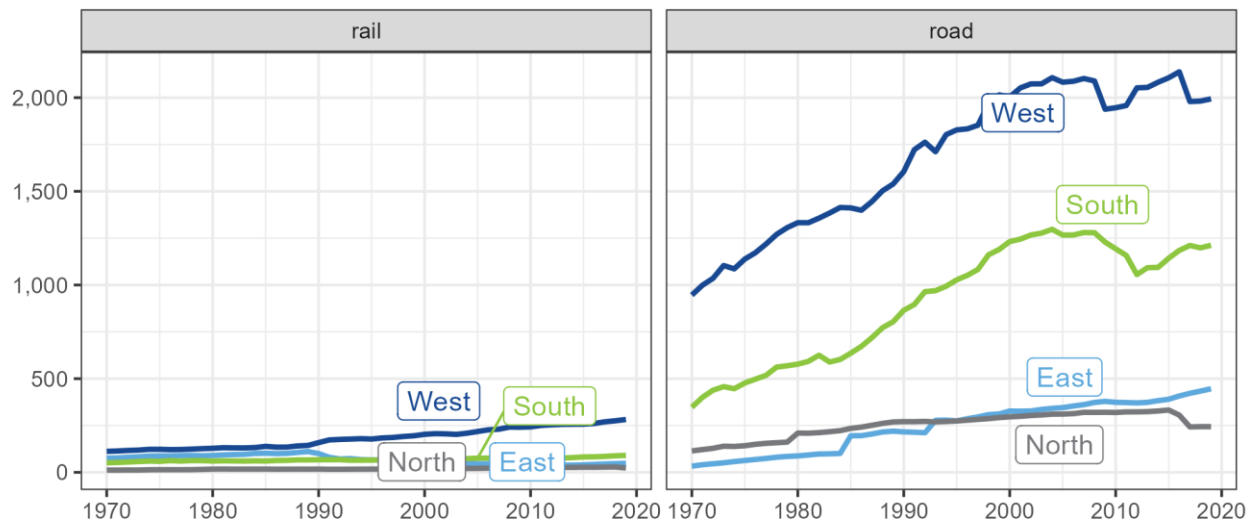
Source: European Union Agency for Railways, OECD

Grouping the results of the above figure by region provides us with the figure below. Some caution needs to be taken while interpreting the data due to several data quality issues, but the story appears the same for all regions. Growth of passenger rail has been sluggish whereas road transport has grown substantially.

Figure 11

Evolution of passenger-kilometres in four European regions

Thousand passenger-kilometres



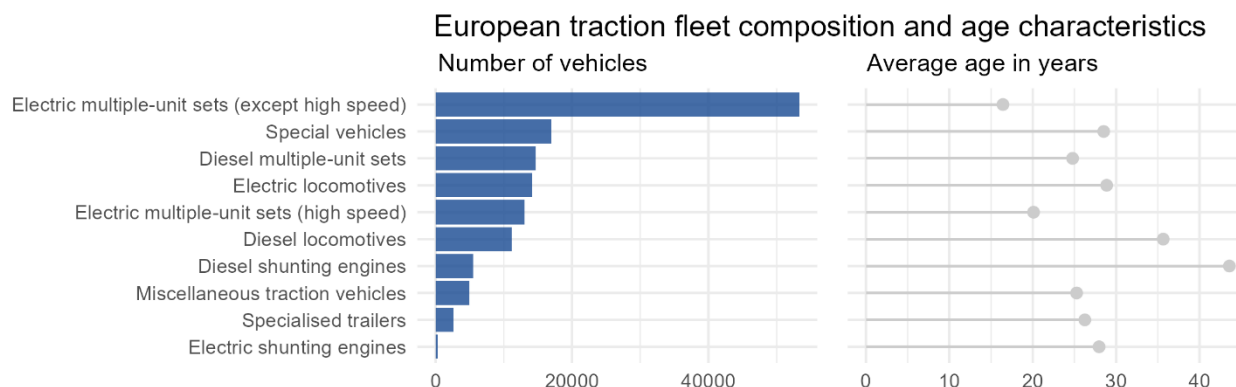
Source: OECD

North - DK, FI, NO, SE. East - BG, CZ, HU, PL, RO. South - IT, PT, ES. West - AT, BE, FR, DE, IE, NL, CH

It is important to emphasize that, similar to rail freight, the drop in passenger kilometres in several eastern European countries has been profound since the 1990's and has not recovered since. This is linked to the closure of numerous lines that connected mid-sized urban centres, as well as the reduced frequency and reliability of rail services. At the same time, substantial investments have been made in the road network and car ownership has been encouraged.

The attractiveness of passenger rail is further impacted by the quality of rolling stock. The 2023 European rail fleet consisted of approximately 137 000 traction vehicles (Note that each car within a multiple-unit set is counted as a distinct vehicle). The exact number of multiple-unit sets cannot be easily determined using the European Vehicle Register because the number of cars varies from 2 to 10 and over. Considering this, it is estimated that there are around 45 000 unique traction vehicles. A share of these, particularly locomotives and shunting engines, are dedicated to rail freight operations. Also note that a large number of vehicles, while registered, are not actively used for passenger operations. The numbers below thus provide an indication on the upper bound.

Figure 12



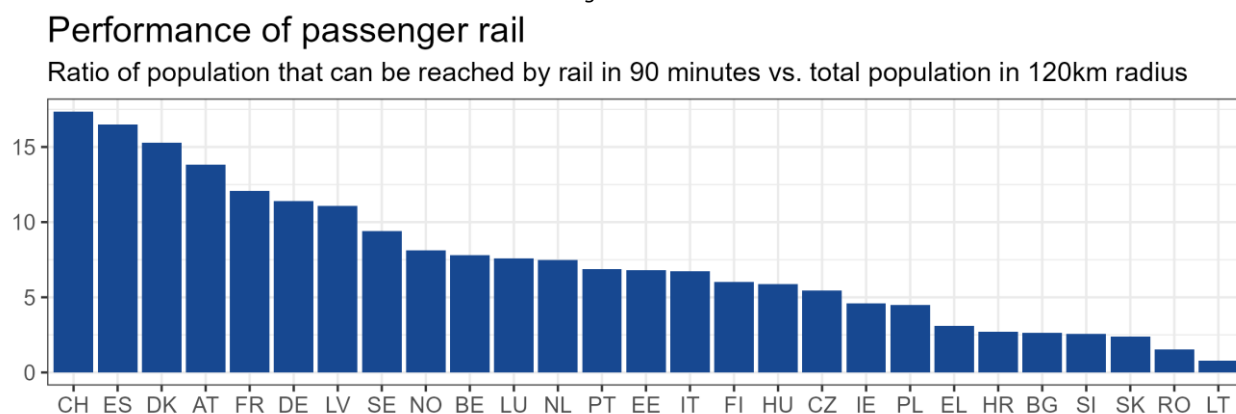
Source: EVR, European Union Agency for Railways

On top of passenger traction vehicles there are about 37 000 passenger coaches registered, with an average age of ~27 years. These figures highlight that the passenger rolling stock fleet is on average relatively old, albeit strong differences exist between countries.

Like for the rail network, historically there has been a lack of harmonisation for the rolling stock put on the market. The lack of standardisation increases the complexity and cost of a vehicle during its entire life cycle. The further harmonisation of passenger rolling stock throughout Europe could therefore lead to cost savings and increased industrial output.

It should be noted that the differences in the number and quality of rolling stock, as well as service characteristics, translate into varying levels of passenger rail performance. A comprehensive study by DG REGIO¹¹ defined passenger rail performance as a ratio of the population that can be reached within 90 minutes to the population within a radius of 120 km. The outcomes of that study, as shown in Figure 13, suggest that the service performance is an important explanatory factor behind the different levels of passenger rail success in the various countries.

Figure 13



Source: DG REGIO

It should also be mentioned that in large countries in which urban centres are separated by great distances, high speed rail is increasingly leveraged to provide passenger services. Yet high-speed networks are often constrained by national boundaries, greatly limiting its potential to create performant cross-border links¹².

¹¹ [Inforegio - Passenger rail performance in Europe: Regional and territorial accessibility indicators for passenger rail \(europa.eu\)](https://ec.europa.eu/info/policies/infrastructure/passenger-rail-performance-in-europe_en)

¹² [Long-distance cross-border passenger rail services - Publications Office of the EU \(europa.eu\)](https://ec.europa.eu/info/policies/infrastructure/long-distance-cross-border-passenger-rail-services_en)

In practice, this makes that growth segments remain underdeveloped and existing services lose market share to road and air transport.

A final point is that the attractiveness of passenger rail transport is considerably impacted by high costs for energy and track access charges. While there are differences between countries, the relative costs that are imposed on passenger rail versus other modes of transport (notably bus transport and aviation) are found to put rail at a competitive disadvantage.

Like for rail freight, substantial changes would need to occur to the passenger transport market to turn this trend around.

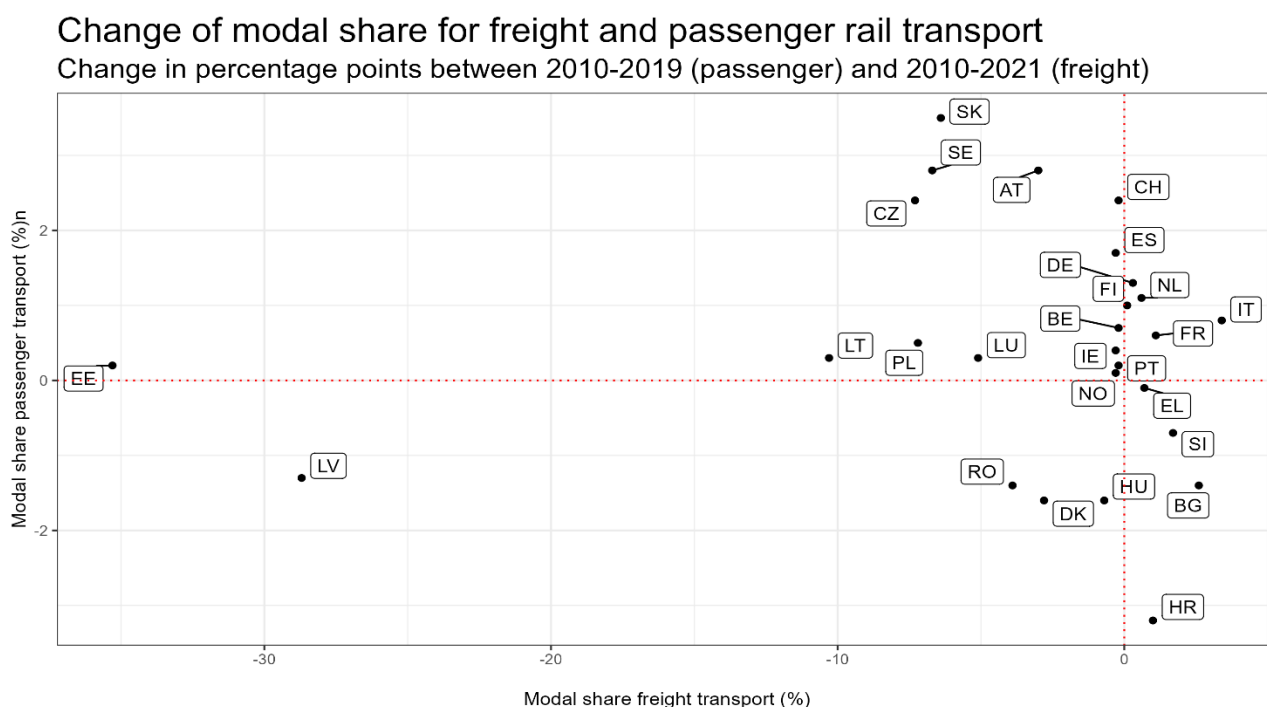
3. Modal shift analysis

3.1 Case studies

The presented statistics paint a negative image of the overall performance of rail. The network length has declined, freight volumes decreased, and passenger numbers dropped. Still, there are some positive evolutions identified in some countries.

Figure 14 shows the change in percentage points between 2010 and 2019 for passenger rail and between 2010 and 2021 for freight rail modal shares. The different periods were selected because the COVID pandemic had a disproportionate impact on passenger rail. The figure shows that after decades of declining modal shares several countries experience a small rebound.

Figure 14



Admittedly, the changes are small and insufficient to reach European modal shift targets. Understanding the drivers of change can however provide additional ideas on how modal shift ambitions can be realised.

One country was selected from each quadrant as a case to better understand the context and actions that drove the changes. The selected countries are Austria, Bulgaria, Denmark and Italy, each representing a different European region as well. Key numbers by country are summarised in Table 1.

Table 1

Country	Rail passenger modal share 2019	Passenger change 2010 - 2019	Rail freight modal share 2021	Freight change 2010 - 2021
Austria	13.9%	+2.8%	30.0%	-3.0%
Bulgaria	2.2%	-1.4%	19.6%	+2.6%
Denmark	8.2%	-1.6%	8.7%	-2.8%
Italy	6.3%	+0.8%	12.6%	+3.4%

The case study analyses are focused on four major aspects:

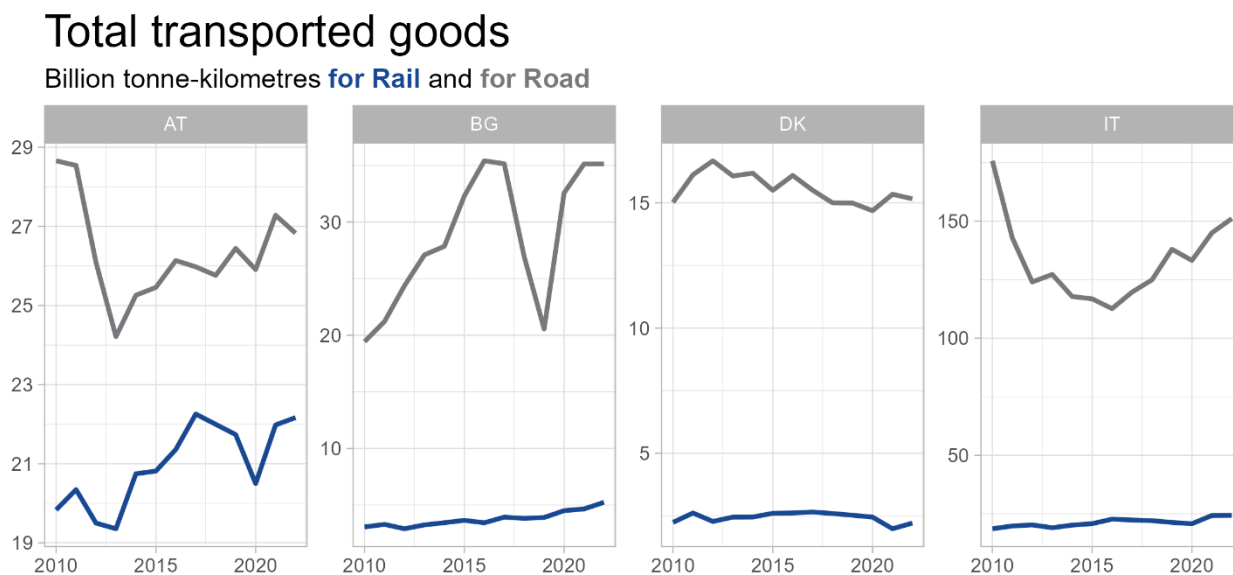
1. *Market demand: Passenger and freight transport demand*
2. *Infrastructure: Information on changes to the national rail network*
3. *Rolling stock: Information on the registered fleet and its interoperability*
4. *Policy: Information on the existence of policies that favour rail and/or road transport*

The goal of this section is to concisely provide insights into the drivers for change.

3.1.1 Market demand

A first step is to understand how the demand for transport changed within the case countries. Figure 15 shows that in Austria, Bulgaria and Italy road and rail freight both increased during several years. In Denmark road and rail freight volumes appear to have stagnated.

Figure 15



Source: Eurostat [rail_go_total][road_go_ta_tot]

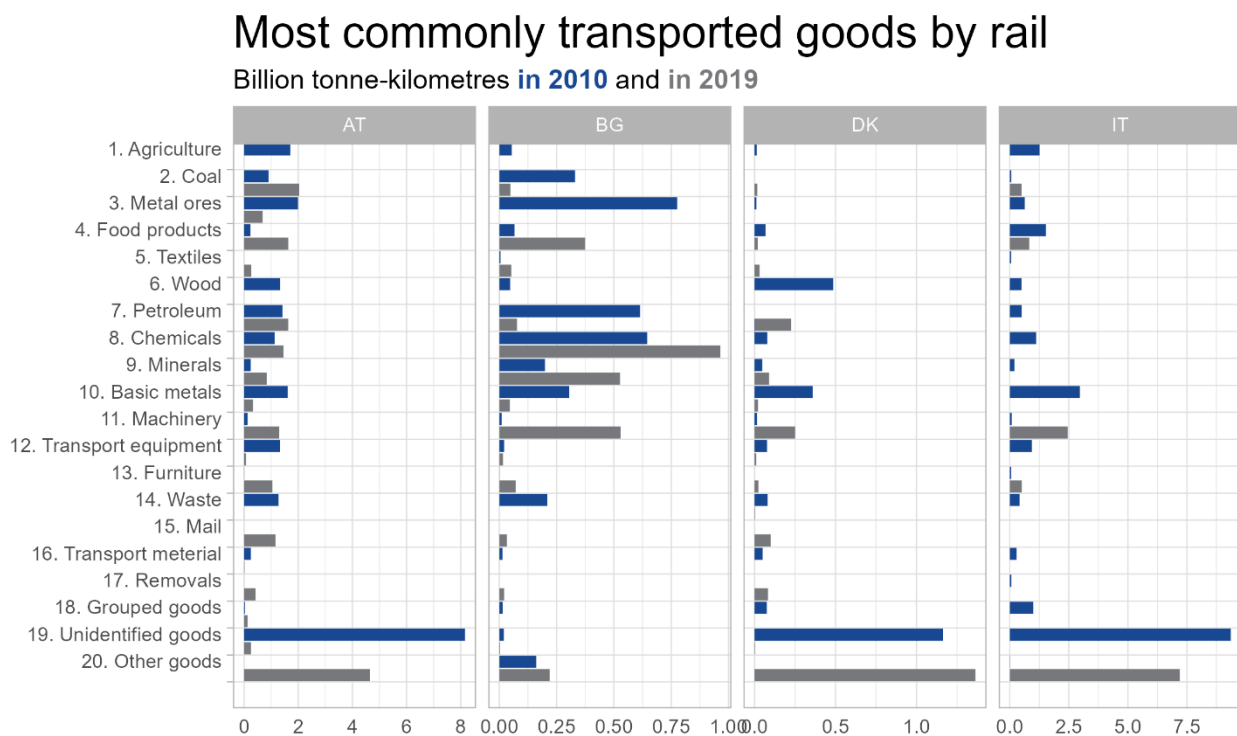
More insights into the drivers of change can be derived by looking at the type of goods that are transported.

Figure 16 tells this story by showing the change for rail freight between 2010 and 2019 as expressed by NST07 good category.

Admittedly, the statistics are patchy and need careful interpretation. Having said that, the figures suggest that rail freight operators in Austria have been successful in attracting more food products and minerals. Surprisingly, there is also a large uptick in coal transport. A large loss is noted in the transport of basic metals. In Bulgaria coal and petroleum transports decreased, whereas chemicals and machinery found their way to rail. Unfortunately, too many gaps appear for Denmark and Italy to make meaningful comparisons.

Figure 16 suggests that the rail sector adapted quite strongly to different market demands. This has had its repercussions regarding the wagon fleet usage and itineraries. The degree of competition and the competitive advantages of each operator are likely explanatory factors behind the different growth rates.

Figure 16



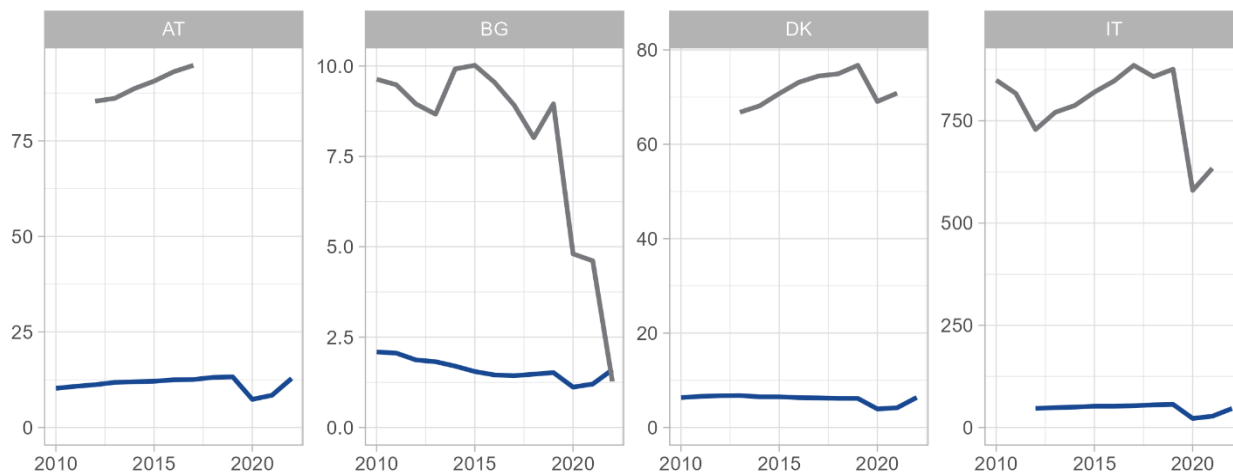
Source: Eurostat [rail_go_grpgood]

For passenger transport the picture resembles that of good transport, meaning that no big changes occurred besides the known drop in passenger-kilometres during the COVID pandemic. Unfortunately, the road statistics suffer from large data quality issues which complicates clear comparisons.

Figure 17

Total passenger transport

Billion passenger-kilometres **for Rail** and **for Road**



Source: Eurostat [rail_pa_total][road_pa_mov]. Scale for BG years 2010-2012 adjusted

In summary, in all countries the demand for freight transport stayed equal or grew in the reference period. However, operators in some countries appear to have been more successful in adjusting to changing market demands than others. This points to the importance of the flexibility of the fleet and the capability of market players to reach new markets.

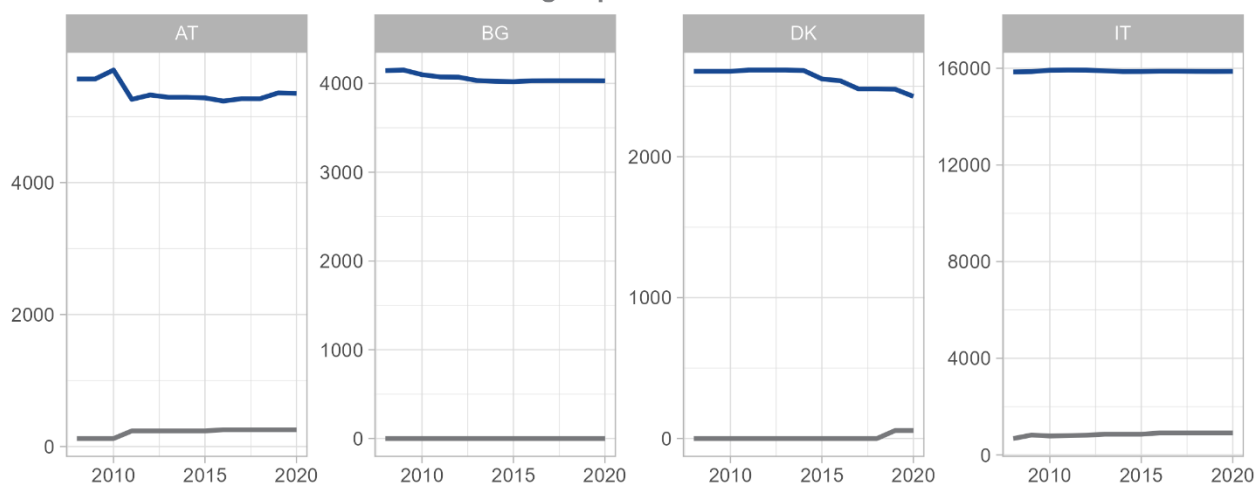
3.1.2 Infrastructure

Figure 18 suggests that the length of the railway network has been a rather uneventful topic. But there have been some noteworthy changes that explain changes in volumes today.

Figure 18

Length of railway network

Line kilometres for **conventional** and **high-speed**

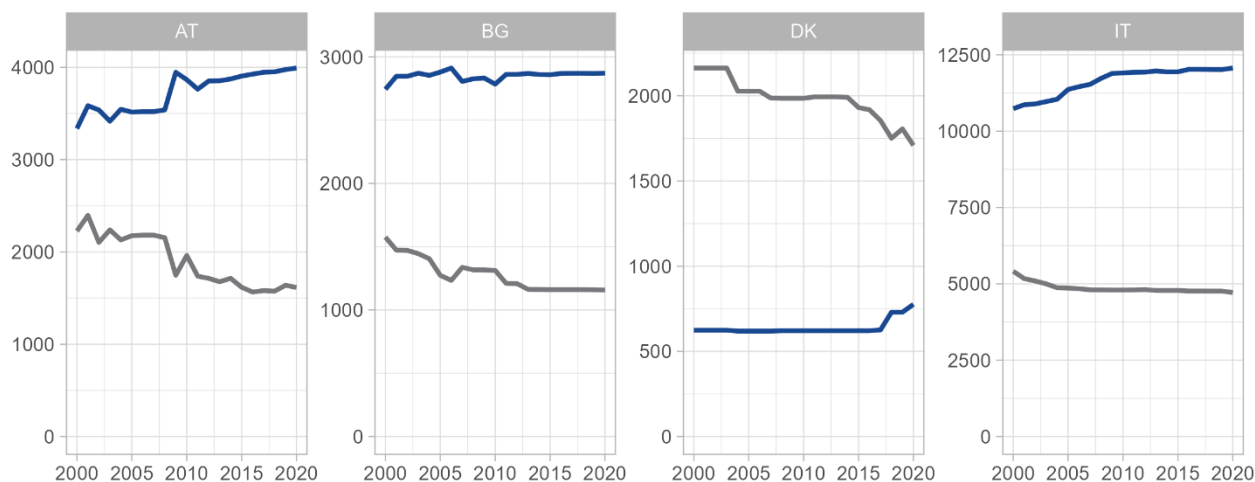


Source: Eurostat [rail_if_line_sp]. No data available pre-2008. High speed includes RL_DHSPD & RL_UHSPD

Figure 19

Length of electrified railway network

Line kilometres for **electrified** and **non-electrified**



Source: Eurostat [rail_if_line_tr]

In Austria large investments were made in network electrification. The infrastructure on the main Vienna-Salzburg line was upgraded to provide higher-speed operations, too. At the same time there are also investments in terminal infrastructure. For instance, the state has supported large investments in intermodal freight terminals (e.g, Vienna, Wels, Wolfurt, Linz¹³ and Graz¹⁴). Through these investments the capacity and facilities of terminals improved substantially. Other investments in the Austrian high-speed network are ongoing, notably the Semmering Base Tunnel, Koralm railway and Brenner Base Tunnel. Beyond increased speed these investments will reduce the overall travel distance, effectively making rail a more attractive alternative. The magnitude of the impacts of these investments is however still to be seen.

For Bulgaria the picture looks mixed. More than 70% of the Bulgarian network is electrified however key cross-border connections to Bucharest over the Danube bridge and to Thessaloniki are not electrified thus affecting interoperability. The deployment of ERTMS is almost inexistant. Overall, the Bulgarian network suffers from a low level of public investment, the third lowest in the EU in terms of expenditure per capita as per RMMS 2023. This partially explains why rail is generally not an attractive alternative to road passenger transport and the modal share for rail passenger transport is low. However, the EU is providing substantial funding to upgrade key lines and corridors and in recent years important modernisation projects have been tendered. Bulgaria also invests in the upgrade of the connection with Turkey with the goal to increase cross-border traffic.

Denmark is distinct from the other cases as the non-electrified network is longer than the electrified one. Important investments were made over two decades ago, such as the Great Belt Fixed link in 1997, and the Øresund Bridge, which had a positive impact on rail traffic. The ongoing investments in the Fehmarn Belt link is similarly expected to have a positive impact on rail. Additional rail infrastructure projects are underway on both sides of the link to enable higher speeds on the different sections. In particular, the Copenhagen-Ringsted link opened in 2019 that can permit speeds of up to 250 km/h. Moreover, ERTMS deployment on the entire national Danish railway network is being taken forward with expected completion by 2030.

In the case of Italy it is important to mention that there were substantial investments in high-speed rail infrastructure. Most of the Rome–Naples line opened in December 2005, the Turin–Milan line partially opened in February 2006 and the Milan–Bologna line opened in December 2008. The remaining sections of

¹³ [Austria to boost railway investment \(railwaypro.com\)](https://www.railwaypro.com/austria-to-boost-railway-investment)

¹⁴ [EUR 40 mio for freight terminal and logistic centre in Austria \(eib.org\)](https://eib.org/eur-40-mio-for-freight-terminal-and-logistic-centre-in-austria)

the Rome–Naples and the Turin–Milan lines and the Bologna–Florence line were completed in December 2009. All these lines are designed for speeds up to 300 km/h. These line openings are an important factor to explain increasing passenger counts. It should also be noted that there are currently several key rail infrastructure construction projects ongoing, notably the Brenner Base tunnel and the Turin-Lyon tunnel. In absolute kilometres it will make a relatively small difference to the respective rail networks. The time gains and increased connectivity will however be substantial. A recent analysis by Greenpeace¹⁵ shows that in Italy over the period 1995-2018 the cumulative investments for the road network were 1.28 times higher than the investment for rail. Yet this tendency seems to be reverted in recent years (2018-2021), as also observed by ITF¹⁶ (i.e. only six countries have shifted more than half of their infrastructure spending towards rail in the last years). There also appear to be greater investments in rail terminals¹⁷. The shift in investment priorities are likely to be drivers behind the greater modal share for both passenger and freight transport by rail.

In conclusion, the numbers and context suggest that investments in the network by Italy and Austria increased their ability to provide a more attractive passenger offering in the last decade, supporting the modal shift.

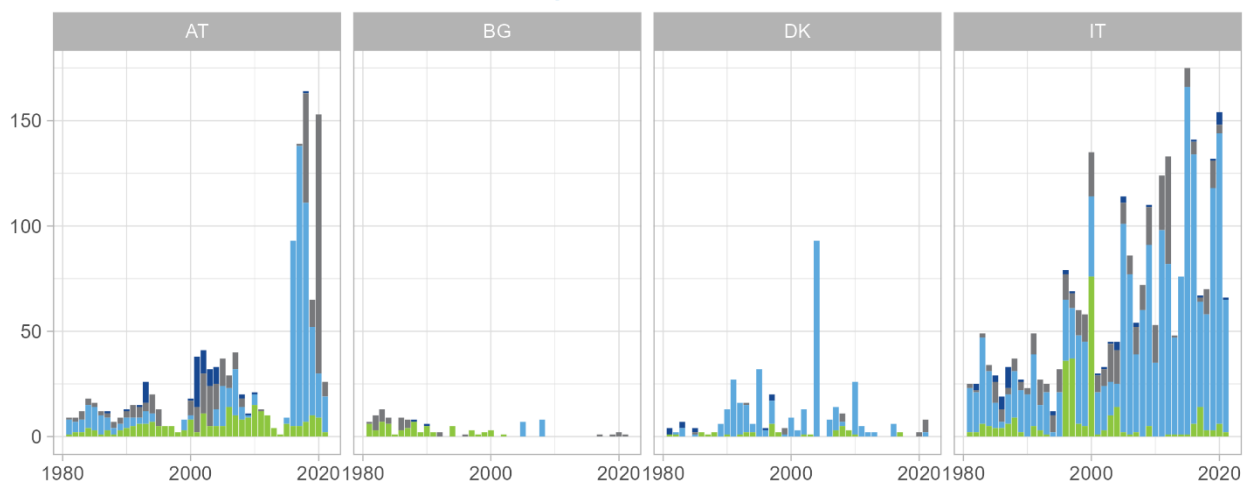
3.1.3 Rolling stock

Besides infrastructure it is critical to understand the availability of rolling stock to determine the supply side of rail transport. Figure 20 and Figure 21 below show the number of vehicles registered in the case study countries. This does not imply that only these vehicles perform transport operations, as vehicles registered in other countries could perform operations, too. This particularly holds true for wagons, which are more inclined to perform cross-border operations and typically have a greater area of use than coaches and traction vehicles.

Figure 20

Trend in number of vehicles registered by country

Trend for **diesel locs**, **electric locs**, **multiple-unit sets** and **others**



Source: European Union Agency for Railways - ECVVR

¹⁵ https://greenpeace.at/uploads/2023/09/analysis_development-of-transport-infrastructure-in-europe_2023.pdf

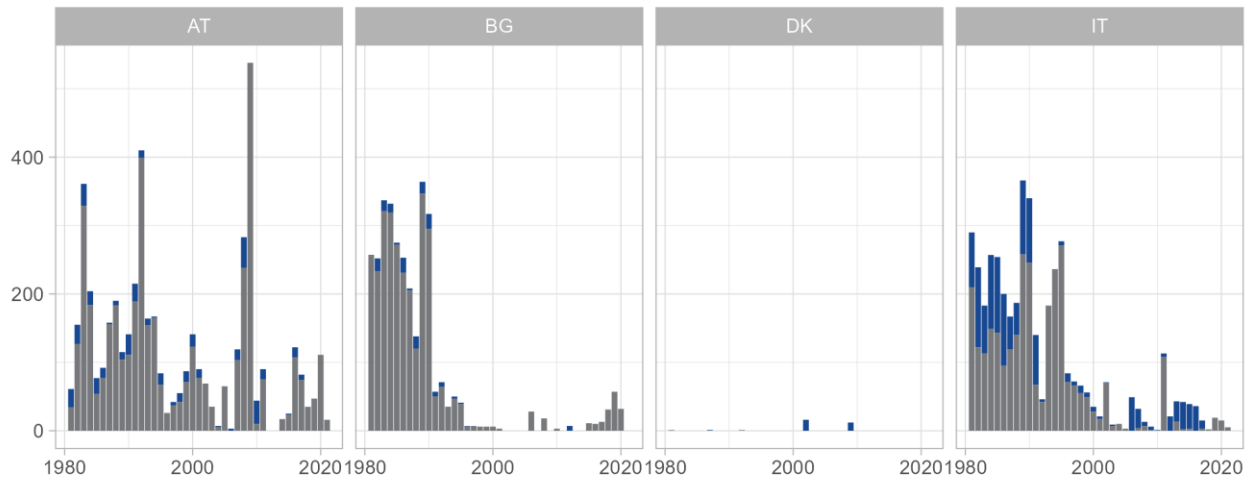
¹⁶ <https://www.itf-oecd.org/modal-shift-cleaner-transport-fails-materialise>

¹⁷ E.g. <https://www.railfreight.com/railfreight/2022/12/12/hupac-and-fs-partner-up-for-three-terminals-in-italy/>

Figure 21

Trend in number of vehicles registered by country

Trend for **coaches** and **wagons**



Source: European Union Agency for Railways - ECVVR

That said, the presented figures showcase the magnitude of investments in modern rolling stock for each of the countries. In Austria and Italy, large investments have been made in multiple-unit sets, possibly explaining their success in attracting greater passenger numbers. Bulgaria and Denmark on the other hand operate a relatively dated fleet.

In Austria a substantial amount of resources has been spent on modernising the passenger fleet. ÖBB invested in ~250 CityJet Desiro EMUs for regional lines.¹⁸ A framework contract for 540 Mireo EMUs with delivery starting in 2028 is also concluded, again bolstering the passenger fleet¹⁹. Finally, a large contract has been signed to procure up to 700 passenger coaches for night train operations²⁰. It shows that recent and planned purchases in Austria bolster the position of rail.

In Bulgaria, between 2020 and 2023 BDZ procured new passenger trainsets, locomotives and coaches to rejuvenate its fleet. For the time being a relatively old fleet is a major issue for the quality and reliability of passenger transport. While the Bulgarian registered wagon fleet is also outdated, it is noteworthy that this did not prevent Bulgaria to increase the amount of goods transported by rail. This could also point to a greater increase of wagons not registered in Bulgaria being used in Bulgaria, for instance for transit traffic, foreign operators or through leasing companies.

For Denmark it is noted that there was a problematic acquisition of new DMUs (IC4) trainsets in the beginning of the 00s. These should have formed the core of the rolling stock for the long-distance passenger services between Copenhagen and Funen / Jutland but were facing significant delays in delivery. The first train sets should have been in operation over the period 2003-06, but in fact the first set were only introduced during 2007, while the entire IC4 series was taken out from November 2011 to 2012. In 2022 DSB and the European Investment Bank (EIB) completed a 25-year lending agreement worth EUR 500 million for the acquisition of new electric trainsets to replace its ageing diesel-powered trains – the IC3 and IC4 models. DSB is expecting to acquire 150 EMUs in the next four decades. It is also noticeable that there are very few freight wagons registered in Denmark. For this it is important to emphasize that since 2001 DB Cargo acquired the Danish

¹⁸ https://de.wikipedia.org/wiki/%C3%96BB_4744/4746/4748

¹⁹ https://de.wikipedia.org/wiki/Siemens_Mireo

²⁰ [Siemens Mobility to deliver 20 more night trains to ÖBB \(railway-technology.com\)](https://www.railway-technology.com/news/siemens-mobility-to-deliver-20-more-night-trains-to-obb/)

incumbent rail freight operator. A foreign registered fleet is therefore performing the bulk of the freight operations in Denmark.

In Italy large number of EMUs were purchased. The high-speed market entrant NTV, operating under the Italo brand, purchased 26 7-car and 25 11-car EMUs, which were delivered between 2010 and 2021²¹. The Italian State Railways operate a range of high-speed EMUs with the most recent being the 8-car ETR-1000 Frecciarossa, of which ~43 are in operation. The recent investments in high-speed rolling stock are strong growth drivers for rail passenger transport.

In summary, the findings imply that the success of passenger traffic is dependent on modern material, whereas for freight transport the age of the domestically registered locomotives and wagons is no strong explanatory factor.

3.1.3 Policies

Evaluating the policies that drive modal shares in the different countries is an arduous task. There are plentiful policies with intricate and possibly opposite effects. This sections therefore should be understood as an overview of selected country initiatives, which are thought to have positively or negatively impacted rail.

Austria:

- *The Austrian state has supported investments in rail infrastructure and rolling stock. Ridership has been further promoted by tickets at a beneficial rate. In 2021 the KlimaTicket has been rolled out at an annual price of EUR 1 095, offering unlimited nationwide travel for practically all public transport with one single ticket. It goes beyond the well-known 'Deutschlandticket' in that long distance connections are included by default. About one year after its introduction more than 200 000 KlimaTickets were sold, showing a considerable interest in the product. The introduction has been coinciding with the COVID pandemic and the influence on ridership is under evaluation. The investment is however indicative of strong political support to improve the modal share of rail.*
- *Infrastructure development is informed by long term development and strategy plans developed by the ministry for transport, SCHIG (national railway expertise centre) and the infrastructure manager. Growth ambitions are translated in timetabling implications, based on which infrastructure investments are determined, prioritised, and budgeted. The plans till 2025 were published in 2010, and the plans till 2040 are to be published in 2024, thereby providing a long-term certainty on rail investments and ensuring that demand and supply match as closely as possible. The long-term strategy and financing commitments are a good practice that is not consistently applied elsewhere in Europe.*

Bulgaria:

- *The incumbent BDZ is in financial difficulties since several years. BDZ operates in a monopoly nearly all its services under a directly awarded Public Service Obligation contract. The level of government subsidisation covers more than 70% of the costs as the level of ticket prices is kept extremely low with also large discounts for certain categories of passengers. BDZ operates local/regional services, long distance services and night trains. That said, the Bulgarian government is opening the passenger market for other players and plans to invest in new rolling stock that it will lease to entrants²².*
- *It should also be emphasized that the demographic situation is challenging, considering a high degree of elderly and strong emigration. This adversely impacts rail, which is more dependent on economies of scale compared to road transport.*
- *Since accession in the EU in 2007, the construction of highways has been a key priority for Bulgaria. The highway network length increased almost threefold in the last two decades. The car ownership*

²¹ [AGV \(train\) - Wikipedia](#), [Elettrotreno NTV ETR.675 - Wikipedia](#)

²² <https://www.mediapool.bg/badeshtivat-subsidiran-zhp-prevozvach-shte-se-izbere-s-targ-news353143.html>

rate almost doubled during the same period and international road freight transport increased by more than 300%.

Denmark:

- *DSB was before 1995 a vertically integrated multimodal transport company responsible for infrastructure, planning and operation covering rail (passenger and freight), ferries and (long distance) buses). The company was organised as a State Directorate-General under the Ministry of Transport and had as such limited managerial independence. A series of reforms have taken place in Denmark over the last decades starting with organisational changes of DSB including separation of infrastructure and operations (in 1997) along with other unbundling and a more independent status for DSB now being an independent public corporation and not a state directorate. In addition, gradual market opening in the passenger market and full market opening, through access rights, for rail freight. Increased investment in public transport and rail infrastructure addressing earlier decades of low level of investment (incl. maintenance), e.g. as demonstrated in the recent Greenpeace study. In particular, a political agreement in 2013 called Togfonden provides further impetus towards infrastructure investment in railways. However, also road infrastructure schemes have been taken forward in recent years.*
- *Another recent step covered the introduction of an integrated ticketing system, Rejsekort, valid across Denmark. In particular, Rejsekort unites the different transport operators, travel zones, ticketing systems, and discount schemes into a common system, which makes it easier for passengers to use public transport services in Denmark. Moreover, an online journey planner (Rejseplanen) facilitates door to door passenger travel across Denmark by bus, rail and other public transport modes.*
- *For the taxation of cars, notably registration charges, these were reduced in 2015 but according to a political agreement in 2020 further changes are being introduced in order to encourage the introduction of low emission / zero emission vehicles.*

Italy:

- *The Ferrobonus is a recent measure to incentivise rail transport. The Ferrobonus, which is aimed at freight forwarders and logistics operators, was established to support the shifting of freight transport from road to rail, with an annual allocation of EUR 20 million during 2016-2018. Article 1, co. 111, of Law 160/2019 extended the contribution to the years 2020 and 2021, allocating 14 million and 25 million euro, respectively. Finally, Art. 1, para. 673 of Law 178/2020 provided for the refinancing of the contribution for an additional EUR 25 million for 2021, EUR 19 million for 2022 and EUR 22 million/year from 2023 to 2026. In addition, the co. 671 of Law 178/2020 provides for EUR 5 mln per year from 2021 to 2034 to companies holding and hiring freight wagons rail freight wagons as well as freight forwarders and multimodal transport operators as support for the economic effects attributable to Covid-19.*
- *In addition, the Regions of Liguria, Piedmont, and Lombardy have decided to adopt respective regional incentive measures regional incentives based on the Ferrobonus scheme. With their own resources they provide annual subsidies for those trains departing and/or arriving in their respective regional territories (excluding mere transit trips), paying the subsidy exclusively on the regional portion of the link. The Operational Understandings (Intese Operative) signed with the Regions of Liguria, Lombardy and Piedmont pursuant to Article 3, co. 4 of the Decree of the Ministry of Transport of 14 July 2017 No. 125 represent the management coordination of the regional measures additional to the national measure. The aforementioned regions were joined by the Region of Tuscany in 2020 with which Ministry of Transport signed the Operational Agreement on 26 May 2020 and finally the Region of Calabria, starting in 2022 (here for further and more updated details).*

3.2 A look into the future

Looking into the future the demand for transport will likely increase substantially. Several transport forecast models exist, each with its strengths and limitations. These models almost unanimously forecast that rail grows faster than road transport. To give a notion of what the future may bring, some observations can be shared from the International Transport Forum's (ITF) Transport Outlook²³ and a study on traffic and modal shift optimisation by FERRMED²⁴.

The studies note that investments and policy initiatives are and should be put in place to facilitate the more than doubling of rail freight by 2050 versus the baseline. Considering the further containerisation of goods and the generally more efficient operations associated with combined transport, this segment is believed to grow fastest. This would require investments in traction vehicles that are reliable and able to operate in a greater number of countries. Equally, the wagon fleet needs to transform to cope with a higher transport demand for semi-trailers, containers and other intermodal loading units. At the same time, investments in freight terminals are direly needed as current capacity is insufficient to cope with the expected volumes. The block train segment, currently mainly for coal and other bulk transports, is expected to grow but at a substantially lower rate due to the energy transition.

The relative growth rates imply that the nature of rail transport will change drastically. From a predominantly bulk oriented sector it will increasingly serve as an integral part of intermodal, containerised transport with more time sensitive goods. As such, a greater emphasize needs to be put on the reliability and predictability of rail freight.

The ITF Transport outlook equally forecasts a strong growth of passenger rail, grounded in the notion that policies shall be set up to support this modal shift. This is notably the case for high-speed rail services. Overall then, the modal share challenge therefore is not for rail to capture market share in a stagnant or declining market, but to grow at a faster rate than road transport does. It is within this context that recommendations to increase rail's modal share should be embedded.

²³ <https://www.oecd.org/regional/itf-transport-outlook-25202367.htm>

²⁴ <https://ferrmed.com/study-of-traffic-and-modal-shift-optimisation/>

4 Proposals for action to realise the modal shift

This report provided an overview of historical statistics, research findings and four case studies to better understand the dynamics behind static modal shares. This approach, admittedly, only provides a partial perspective on what can drive modal shares up as many topics and measures fell out of scope of this report.

Still the report clearly identifies that drastic steps need to be taken if modal shift ambitions are to be achieved. Moreover, it provided several lessons that warrant further consideration. Based on the above, several proposals for action to push the modal shift forward are provided in Table 2.

Table 2

Topic	Proposal	Primary actors
Network		
Capacity	Revise the railway infrastructure capacity allocation framework to ensure more flexible path allocation and increase overall (cross-border) paths	EC Member States
Planning	Align infrastructure investments with forecasted capacity needs. Ensure that the necessary public financing is ensured through long-term commitments	Member States IMs
Connectivity	Reactivate closed (cross-border) lines with high potential. The reactivation of selected lines would be a precondition to reach a higher modal share	Member States IMs
Quality	Invest in the quality of lines (maintenance, upgrade) to improve service speed and reliability	Member States IMs
High-speed as per TEN-T	Invest in high-speed rail lines as per TEN-T as a growth driver for passenger transport	EC & MS IMs
Costs	Drive simplification and cost effectiveness of the network through the harmonisation of technical requirements	EC Member States
Freight transport		
Intermodal	Invest in intermodal wagons and terminals to cope with the expected growth of combined transport.	RUs Private investors
Market access	Promote market access for operators and lessors that can leverage new transport opportunities in changing markets.	EC Member States RUs
Utilisation	Invest in process optimisation, operational models, and technologies that drive down idle time and improve the utilisation of freight rolling stock	EC & MS Manufacturers RUs Private investors
Costs	Inquire how a structural cost reduction for rail freight operations could be achieved through the optimisation of the legal framework	EC Member States
Passenger transport		
Regional traffic	Invest in modern multiple-unit sets and coaches to boost passenger traffic.	Member States RUs Private investors
High-speed	Invest in modern high-speed multiple-unit sets and coaches to boost passenger traffic on upcoming new (cross-border) high speed sections.	Member States RUs Private investors
Utilisation	Offer nation-wide, cross-network integrated tickets to attract greater numbers of passengers.	Member States RUs
Costs	Drive a further standardisation of rolling stock through the harmonisation of technical requirements and the reduction of market adaptations in order to lower costs and increase industry output	EC Member States RUs

While these proposals for action are believed to have EU-wide relevance, the degree to which they apply can differ between countries and interaction effects between investments should be duly considered.

The proposals require substantial investments in the railway system. Considering that the budget for such investments competes with other policy priorities, further work is warranted to assess the magnitude of the investments and determine in greater depth the impacts of each of the proposals on modal shift across Europe.

Disclaimer

The report is a support study by the European Union Agency for Railways (ERA) as input for ERA's 2024 Compelling Vision. It is a non-legally binding document of an analytical and explorative nature. It does not necessarily represent the view of other EU institutions and bodies. The report was drafted end 2023 and early 2024.