IRG-rail

Independent Regulators' Group - Rail

12th Annual Market Monitoring Report

March 2024

01

Introduction

Participating countries

AT - Austria
BE - Belgium
BG - Bulgaria
HR - Croatia
CZ - Czech Republic
DK - Denmark
EE - Estonia
FI - Finland
FR - France
DE - Germany
EL - Greece
HU - Hungary
IE - Ireland
IT - Italy
XK - Kosovo*
LV - Latvia
LT - Lithuania
LU - Luxembourg
MK - North Macedonia
NL - Netherlands
NO - Norway
PL - Poland
PT - Portugal
RO - Romania
RS - Serbia
SK - Slovakia
SI - Slovenia
ES - Spain
SE - Sweden
CH - Switzerland
UK - United Kingdom

SCOPE

31 countries

5 years of data
2018 - 2022

Main focus this year
Heterogeneity of network usage and potential determinants

CONTENT OF THE REPORT

FOCUS TOPICS IN PREVIOUS REPORTS

2017	2018	2019	2020	2021
Competition for the passenger market	Competition in the railway markets	Impacts of the COVID-19 pandemic in the first half of 2020	Additional analyses of the Impacts of the COVID-19 pandemic in 2020	Impacts of COVID-19 in 2021 and market recovery

*Kosovo (XK): This designation is without prejudice to positions on status and in line with UNSCR 1244 (1999) and the ICJ opinion on the Kosovo declaration of independence.

IRG-Rail – A network of cooperation

The Independent Regulators' Group-Rail (IRG-Rail) was established by 15 European rail regulatory bodies in June 2011. Since foundation, the objective of the group has been to establish a network of cooperation between member organisations in the railway sector. The group has expanded over the years and now includes members from 31 countries.

IRG-Rail members aim to consistently deal with regulatory challenges and rail developments across Europe. IRG-Rail acts as a platform for cooperation, sharing best practice and promoting a consistent application of the European regulatory framework. As put forward in the Group's statutory document[1], 'the overall aim of IRG-Rail is to facilitate the creation of a single, competitive, efficient and sustainable railway market in Europe'.

What we do

Article 56 (paragraph 2) of Directive 2012/34/EU states that regulatory bodies have a formal duty to monitor the situation in the railway market. Market monitoring is therefore an essential task for the national regulatory bodies. It is also a vital instrument for enhancing market transparency, setting direction for the activities of regulatory bodies and encouraging market participants to develop and improve their activities.

General aim of the Market Monitoring Working Group

The IRG-Rail Market Monitoring Working Group was set up as a platform for cooperation and to exchange best practices in terms of data collection and analysis. The group has an agreed set of guidelines[2] for gathering railway data. Based on the results of a yearly collection, an annual Market Monitoring Report is produced by the Working Group.

This is the IRG-Rail's 12th Market Monitoring Report and covers calendar year 2022, unless otherwise stated.

Content of the report

The Market Monitoring Report provides an overview of market developments and the economic conditions in the railway sector with respect to IRG-Rail member countries. The report also compares developments and the competitiveness of the railway market over time.

The report consists of two parts. The Main Report presents results at the overall European level. The Working Document[3] includes country specific data and more detailed observations. In addition, the underlying data is available on the IRG-Rail website[4].

Each Market Monitoring Report focuses on one or several specific subject(s). This year, the report includes an in-depth analysis of the heterogeneity in European rail network usage and its potential determinants. Furthermore, in this Main Report, readers can find new indicators on infrastructure managers (number and expenditures), ECTS-enabled network, electrified train-km and railway undertakings' spendings on energy. More indicators are available in the Working document (high-speed route length, train punctuality, etc.).

Methodology

It is the responsibility of each regulatory body to gather, quality-assure and submit data according to the guidelines agreed by the Working Group. The Working Group has developed a common template in order to ease the effort for the regulatory bodies and to ensure the comparability of the data. Data can originate from market surveys carried out by the regulatory bodies and/or national statistics as well as other trustworthy sources.

31 countries contributed to this 12th Market Monitoring Report. However, most countries were not able to provide data for all measures. In order to ensure reliable and consistent information, this report only presents indicators for which enough data was made available. Consequently, some analyses are performed using data from a subset of participating countries. Therefore, some sections may not cover all 31 countries. In each section of the report however, key figures and analyses presented use a consistent sample of countries[5]. Detailed information and specific data by country are also provided in the Working Document.

[1] https://www.irg-rail.eu/irg/about-irg-rail/general-information/About-the-IRG-Rail.html
[2] The guidelines can be found here.
[3] The Working Document can be found here.
[4] The data can be found here.
[5] The data coverage for each figure is included in the footnotes. All countries are included, unless otherwise specified.

Recent trends in European rail transport (2019-2022)

Passenger services

Passenger train-km	Passenger-km	TAC* from passenger RU	Operator revenues
-2%	-10%	+0.3%	+5%
(31 countries)	(31 countries)	(29 countries)	(25 countries)
(2021-2022 : +4%)	(2021-2022 : +52%)	(2021-2022 : +15%)	(2021-2022 : -1%)

Freight services

Freight train-km	Freight tonne-km	TAC* from freight RU	Operator revenues
+1%	-0.2%	-13%	+11%
(31 countries)	(31 countries)	(30 countries)	(23 countries)
(2021-2022 : +1%)	(2021-2022 : -1%)	(2021-2022 : +36%)	(2021-2022 : +10%)

Note: All comparisons are for 2022 compared with 2019, plus additional information in grey below each indicator which is the comparison between 2022 and 2021. The number of countries included is provided under each metric. *Track Access Charges

OVERVIEW

In 2022, the European railway market continued its recovery from the impacts of the COVID-19 pandemic but not regaining its level observed in 2019. Moreover, high inflation levels were observed in all countries in 2022, which reached 8.5% on average compared to 2021.

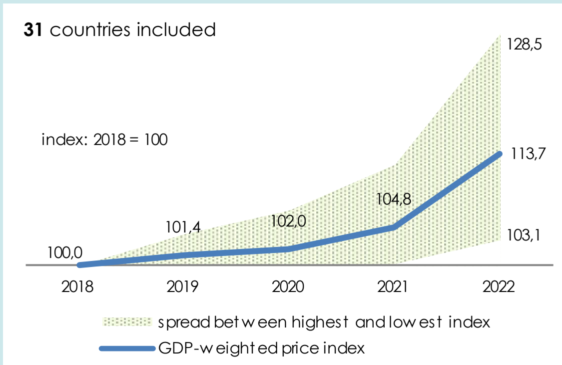
While **passenger traffic on the supply side mostly recovered** (down 2% from 2019 level), **passenger demand** for transport (passenger-km) **remained 10% lower** than in 2019, despite a 52% increase from 2021. This drop of total passenger-km compared with 2019 was driven by the contraction of PSO traffic (-13%) since non-PSO passenger-km only fell by 3%.

Being less affected during the pandemic, **freight train-km and tonne-km in 2022 stayed close to 2019 as well as 2021 levels.**

With high inflation and reduced public subsidies, **track access charges (TAC) from railway undertakings (RU) increased sharply** in 2022 compared to 2021 (+15% for passenger services and +36% for freight services), **well beyond the rise in train-km** (+4% for passenger services and +1% for freight). Compared to 2019, while TAC from passenger RU reached its pre-pandemic level again, TAC from freight RU dropped by 13%, due to retention of some public subsidies initiated during the pandemic for freight TAC.

Infrastructure managers' expenditures per route km increased by 6.3% in 2022 compared to 2021, which could at least partly be explained by high inflation.

Figure 1 – Average price index from 2018 to 2022



In 2022, **RUs' revenues from passenger services exceeded the 2019 level by 5%** but decreased slightly (-1%) compared to 2021. This is because PSO compensations, which represent 42% of total passenger revenues, dropped sharply between 2021 and 2022 (-35%) but remained higher than 2019 level by almost 40%. **For freight services, the increase in RUs' revenues in 2022** compared to previous year is much higher than the growth in traffic but similar to that of price index.

Driven by the escalation of energy costs in Europe due to the Ukraine War, **RUs' spendings in electricity (per kWh) increased by 34% and those in diesel (per litre) rose by 42%.**

02

Characteristics of the railway network

IN 2022

Network length

233,355 km total route length

4.78 km of lines per 100 km² country area

4.35 km of lines per 10,000 inhabitants

Network usage intensity

52 trains per day per route km

81% for passenger services

19% for freight services

56% share of electrified route

3.8% share of high-speed route

The sample used to calculate these figures is specified in the following pages.

European railway network

In 2022, the overall route length for IRG-Rail monitored countries was approximately 233,355 km. The total route length has remained stable over recent years. However, there have been some changes within specific countries (see Working Document for more detail).

Over 50% of the total route length comes from the five countries with the largest networks: Germany, France, Italy, Poland and the UK. Luxembourg has the shortest network of all participating countries (271 km).

Figure 2 – Route length (in km) of participating countries in 2022

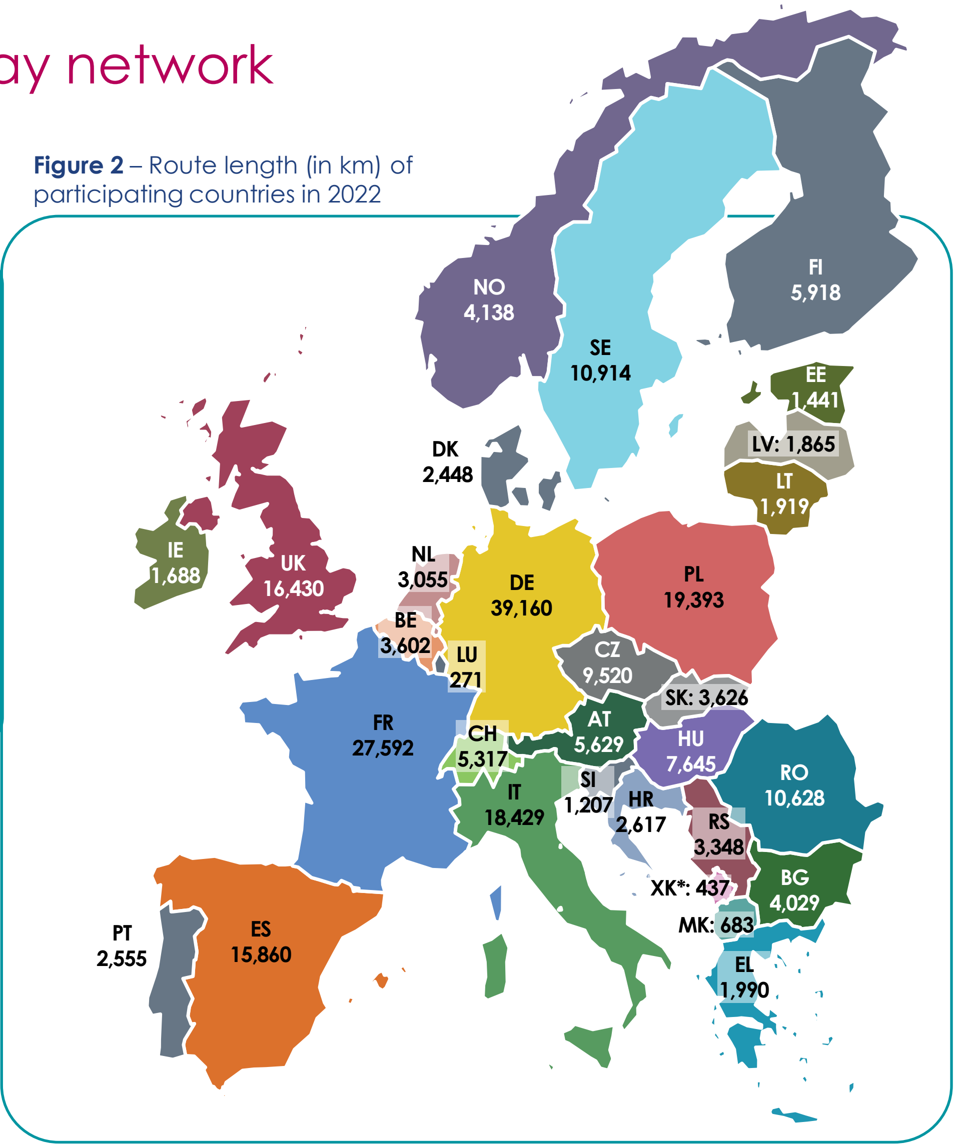
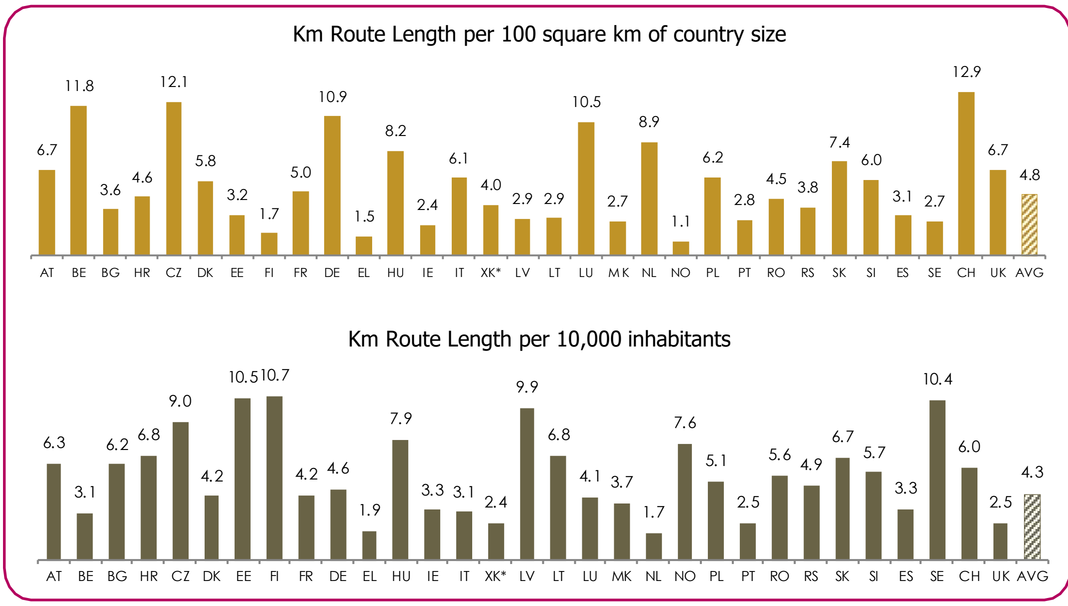


Figure 3 – Network density with respect to country area and population in 2022



Network density is an indicator for the development and coverage of the rail network in each country. The average network density in monitored countries was about the same in 2022 as it was in 2021.

Relative to country size, Switzerland reported the highest network density (12.9 route-km per 100 km^2), followed by Czech Republic (12.1) and Belgium (11.8). Each of these countries have rail networks with a high level of coverage across the countries' land area. Norway has the lowest network density relative to country size of all participating countries (1.1).

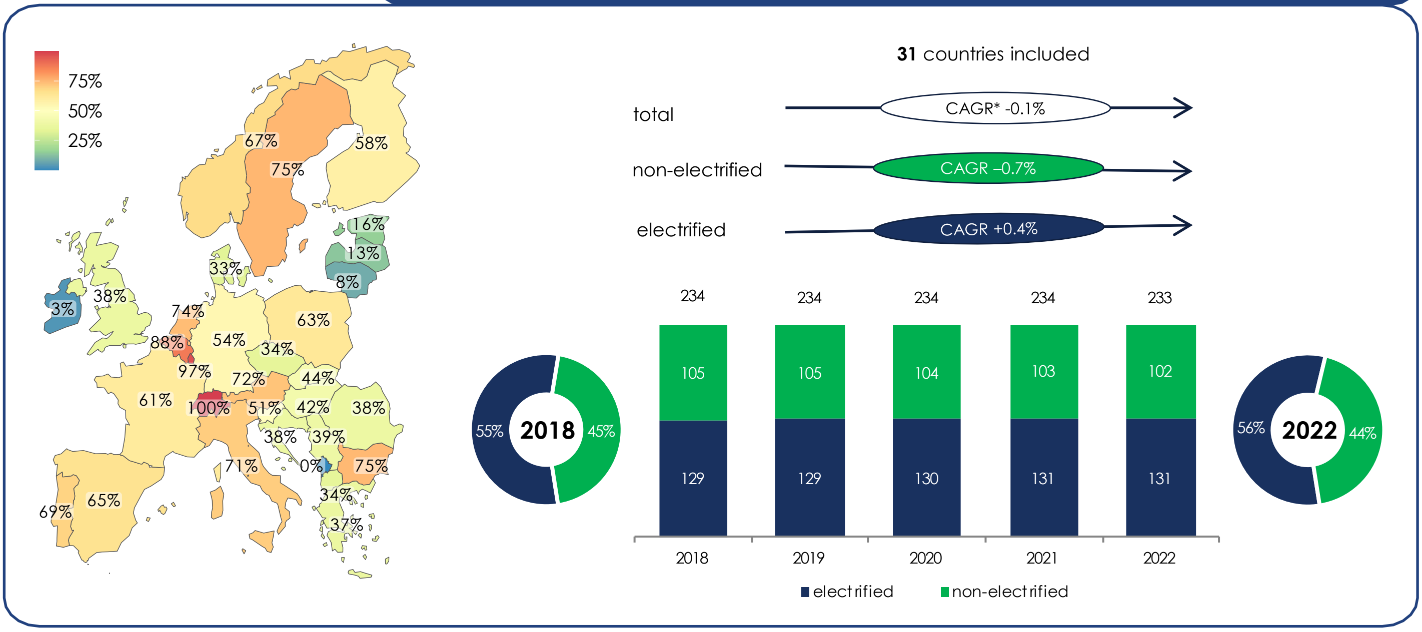
Network density can also be presented in terms of route length per 10,000 inhabitants. This indicator remained largely stable between 2021 and 2022. Latvia's density decreased from 12km of route per 10,000 inhabitants in 2021 to 10km in 2022. Estonia, Finland and Sweden have the densest networks in terms of route length per capita, with more than 10 km of route per 10,000 inhabitants. Finland reported the highest figure with 10.7 km of route per 10,000 inhabitants. Countries with a higher network density relative to population size typically show a lower density in terms of country size. This is usually indicative of a relatively low population density or the fact that there are large areas of the country which are not served by the rail network.

Electrification of the railway network

Figure 4 – Total route length (thousands km) and electrified share of participating countries from 2018 to 2022[6] (right) and electrified share per country in 2022 (left)

Of the 31 countries that reported data, 56% of the total route length was electrified in 2022. This corresponds to an extension of 2,000 electrified route km and an increase of 1 percentage point of electrified route share from 2018.

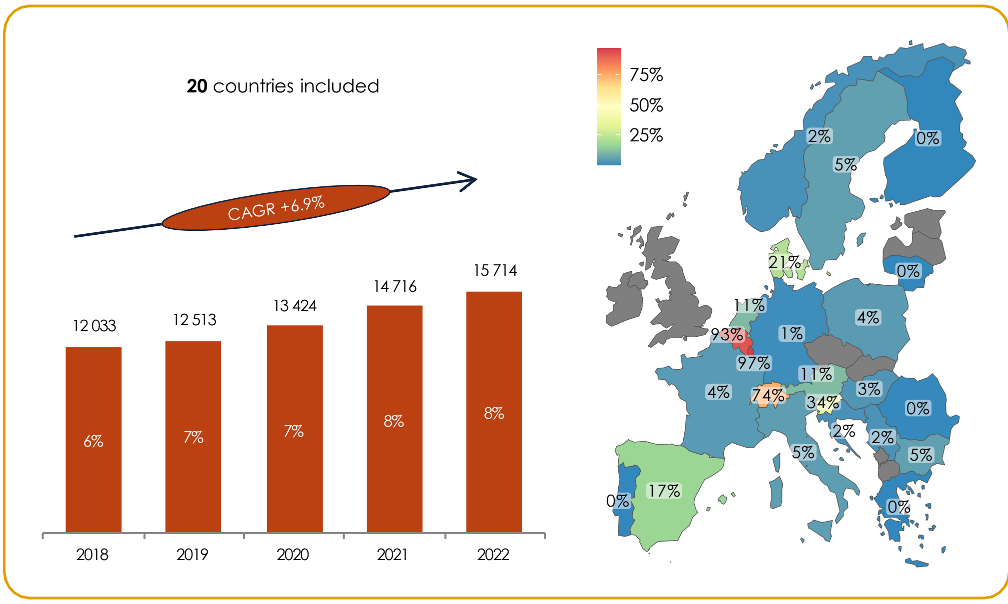
The level of electrification of the railway network varies significantly across Europe, ranging from 0% (Kosovo) to 100% (Switzerland). Among the monitored countries, eight have a share of electrified network higher than 70% and six have a share of electrified network below 33.3%.



CAGR: compound annual growth rate

Interoperability of the railway network

Figure 5 – Total ETCS/ERTMS-enabled route length (km) and share in total routes (%) from 2018 to 2022[7] (left) and share of ETCS/ERTMS-enabled routes per country in 2022 (right)



In 2022, 20 IRG-Rail countries reported ETCS-enabled routes. The total route equipped with this system is over 15,700 km long. Since 2018, the ERTMS/ETCS-enabled route length has increased rapidly, by +7% on average per year, but represented only 8% of the total route length.

Luxembourg has the highest share of ERTMS/ETCS-enabled route length in 2022 (97%), followed by Belgium (93%) and Switzerland (74%). On the contrary, 15 countries have a share of ERTMS/ETCS-enabled route equal to or lower than 5%.

[6] In this graph and the following, CAGR stands for the compound annual growth rate.
[7] 20 countries are included in this figure (Czech Rep., Denmark, Estonia, Ireland, Kosovo, Latvia, Lithuania, the Netherlands, North Macedonia, Slovakia and the UK are missing).

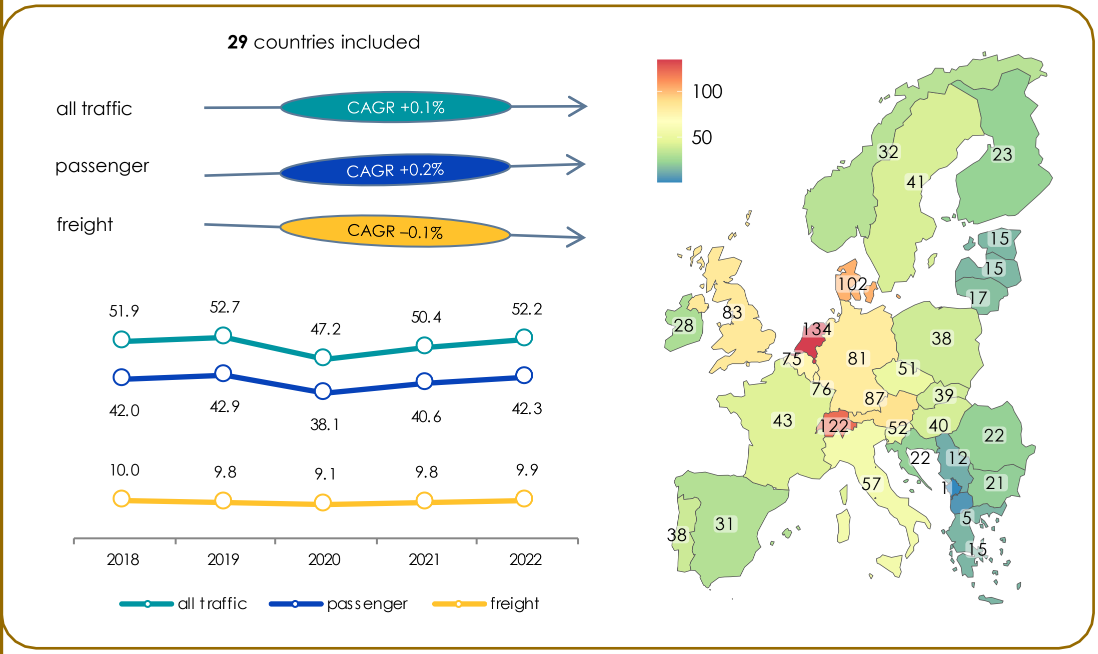
Network usage

More analyses on network usage in the focus chapter (Chapter 7)

The rail network was predominantly used for passenger services in almost all monitored countries, with Slovenia the only network that is used more intensively by freight services. For passenger services, the average usage has returned to 2019 levels, at 42 train-km per route-km per day in 2022, up from 41 train-km per route km per day in 2021. In almost all countries, the network usage intensity for passenger services increased or remained the same compared to 2021. The network usage intensity for these services was highest in the Netherlands, followed by Switzerland, Denmark, and the UK.

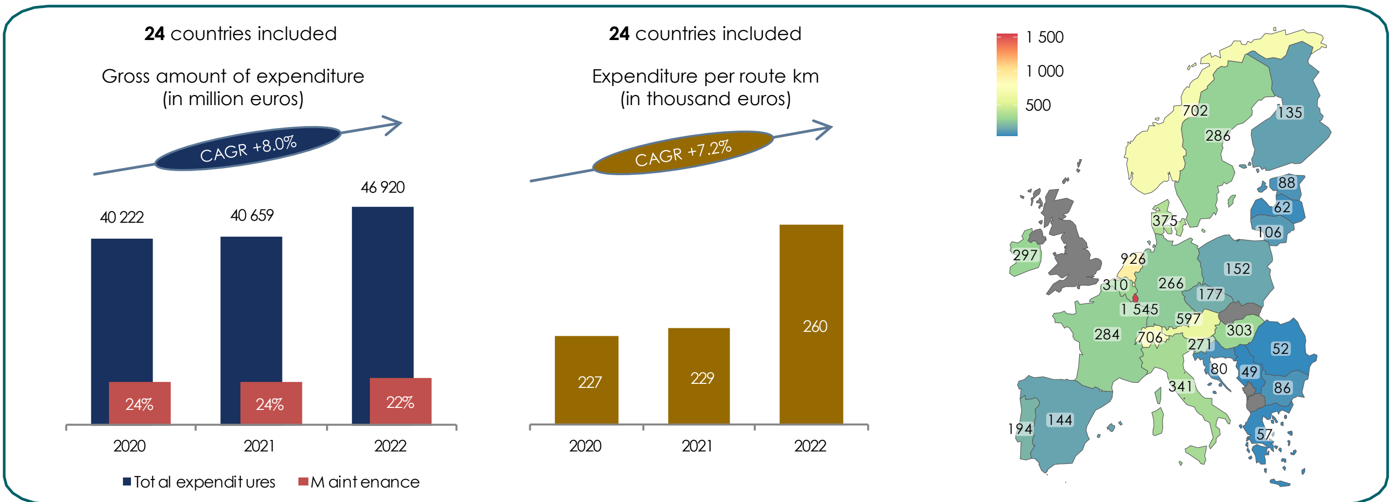
For freight services, which were less affected by the COVID-19 pandemic, the average of between 9 and 10 train-km per route km per day has remained constant from 2019 to 2022. The network usage intensity for freight services was the highest in Slovenia, Austria, and Germany.

Figure 6 – Overall network usage intensity (train-km per route km per day) of participating countries from 2018 to 2022[8] (left) and its 2022 level per country (right)



Infrastructure managers' expenditure on the network

Figure 7 – Infrastructure managers' expenditure on the network, share of maintenance in total amount (left), expenditure per route km (center) from 2020 to 2022[9] and expenditure per route km per country in 2022 (right)



In 2022, infrastructure managers' expenditure on the network reached almost €47 billion according to data from 24 countries, of which 22% was dedicated to maintenance works. Expenditures have increased steadily since 2020 and notably since 2021 (+15% year-on-year). This rise seems to be driven, at least partially, by high inflation in Europe in 2022.

On average, expenditure per route km reached €260 thousand in 2022, with substantial variation across countries. The highest level, by far, was reported in Luxembourg (over €1.5 million per route km) while the unit amount was lower than €100 thousand per route km in seven countries. Many factors contribute to these disparities: actual conditions of the network, historic works realized, composition of infrastructures, usage intensity, etc. (see the Working document for more explanation).

[8] 29 countries are included in this figure (Ireland and Serbia are missing).
[9] 24 countries are included in this figure (Kosovo, Latvia, the Netherlands, North Macedonia, Serbia, Slovakia and the UK are missing).

Additional indicators included in the Working Document:
- High-speed route length

03

Track access charges (TAC) for the minimum access package

IN 2022

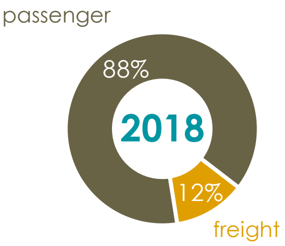
€18.8 bn
TAC from RU

€4.01
avg TAC from RU per train-km

91%
share of TAC from passenger services

The sample used to calculate these figures is specified in the following pages.

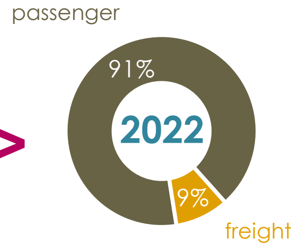
Evolution of TAC[10]



€18.6 billion

In 2022, the total amount of track access charges (TAC) paid by railway undertakings to infrastructure managers was €18.8 billion, implying a strong increase of 17% from €16.1 billion in 2021. With this growth, the pre-pandemic level of 2019 of €19.0 billion is almost reached again.

Total TAC, which include TAC from RU plus public funding[11], increased by 9% from €20.7 billion in 2021 to €22.5 billion in 2022. However, the TAC paid by public subsidies in 2022 went down by 18% to €3.8 billion, from €4.6 billion in 2021. Many compensation measures introduced during the pandemic ended or had their fundings diminished in 2022, which explains the reduction in TAC from public subsidies.



€18.8 billion

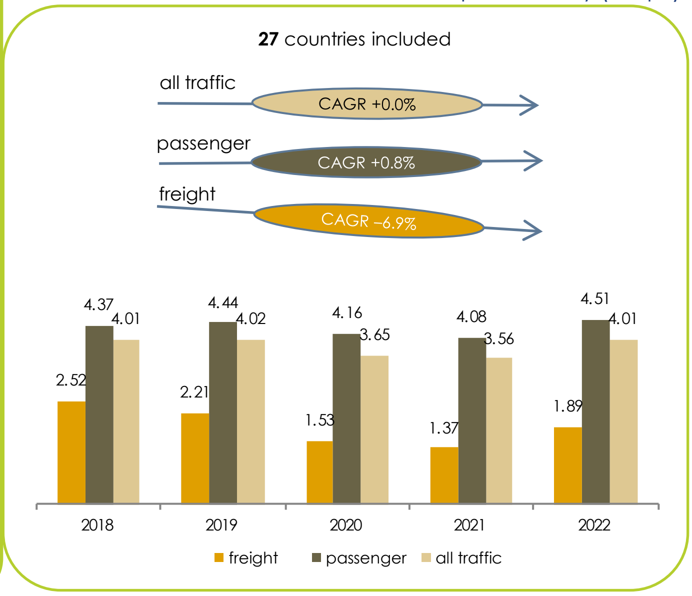
TAC from railway undertakings per train-km

Over 90% of all European track access charges (TAC) are paid by passenger services. While the average TAC per passenger train-km was €4.51 in 2022, this indicator varies substantially among European countries. In eight countries, the charge was lower than €1, while it was higher than €5 in another five countries, even exceeding €10 in France. On average, non-PSO TAC were almost twice as high as PSO TAC.

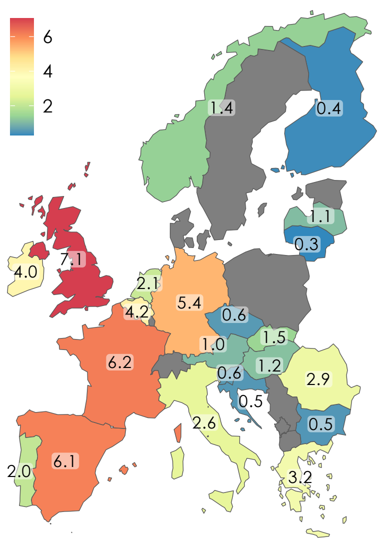
After a substantial decline of TAC from RUs during the pandemic, TAC for both passenger and freight started to rise again in 2022. While passenger TAC exceeded its 2019 level (+2%), freight TAC remained 14% below. On the one hand, the year-over-year increase is the result of a falling share of publicly subsidized TAC in several countries. Most financial relief measures, which had been introduced during the pandemic, were reduced or suspended in 2022. The share of subsidized TAC was 15% for passenger train charges and 30% for freight train charges. On the other hand, high inflation might have contributed to the surge in TAC in 2022.

With average TAC paid by RU for passenger services growing faster than that for freight services, the gap between passenger and freight TAC became wider in 2022 compared to pre-pandemic years.

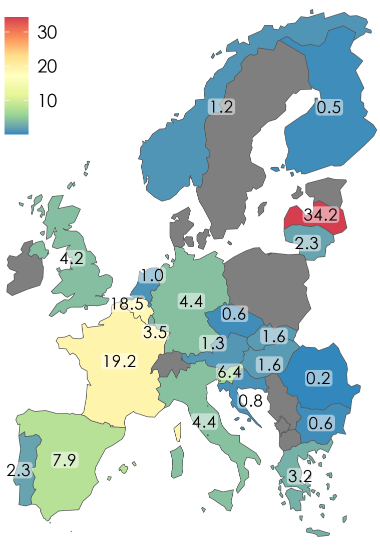
Figure 8 – Track access charges paid by railway undertakings[12] (in Euro per train-km) for the Minimum Access Package[13] from 2018 to 2022 (chart) and 2022 level per country (maps)



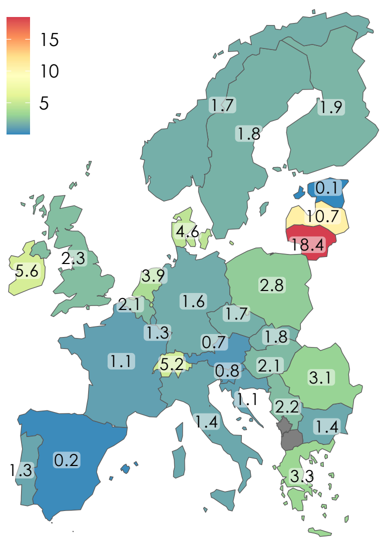
PSO



Non-PSO



Freight



[10] 27 countries are included in this paragraph and its associated figures (Ireland, Kosovo, North Macedonia and Switzerland are missing).
[11] Total TAC is a proxy of the sum of TAC from railway undertakings and TAC from public subsidies. Please note that the data of TAC from public subsidies might not be exhaustive since the scope of public funding for TAC varies substantially across countries so that several RB could not specify the exact amount.
[12] 27 countries are included in this figure (Ireland, Kosovo, North Macedonia and Switzerland are missing).
[13] Directive 2012/34/EU of the European Parliament and of the Council.

04

Market players and European rail traffic

IN 2022

4.31 bn
total train-km

Between
1 and **342**
railway undertakings
in each country

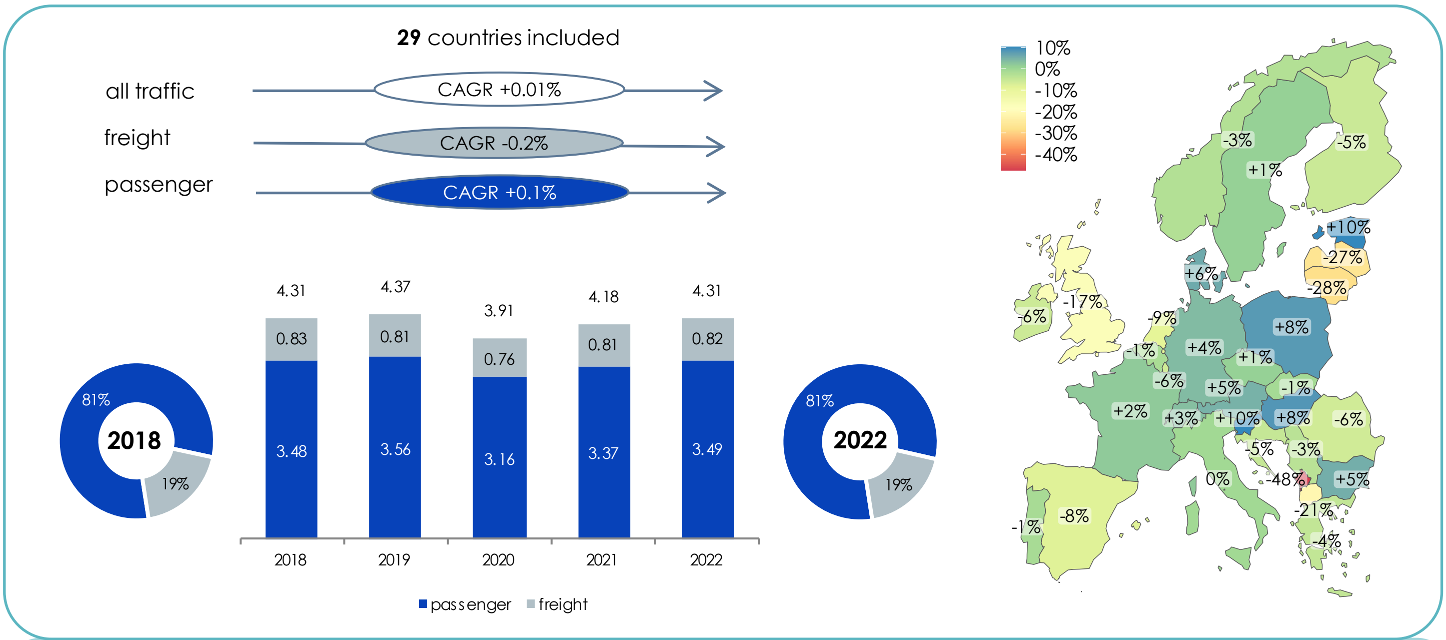
2018 > **+0.01%** **total train-km** > 2022
(compound annual growth rate)

Passenger services:
81% of total train-km

The sample used to calculate these figures is specified in the following pages.

Total rail traffic

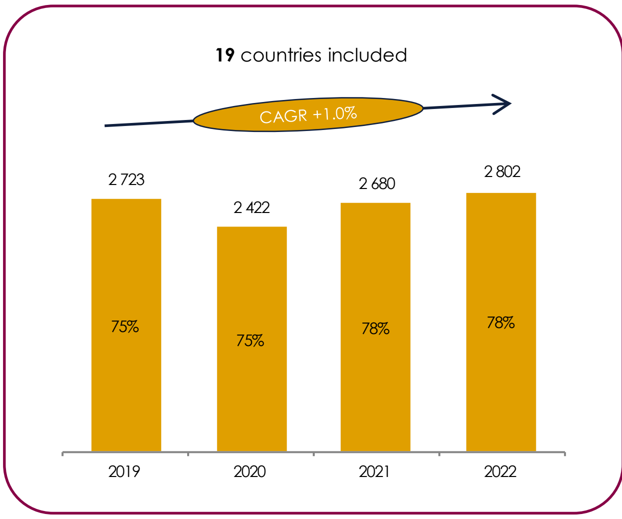
Figure 9 – Rail traffic in billion train-km from 2018 to 2022[14] (left) and 2022/2019 change (right)



In 2022, a total of 4.31 billion train-km was reported by member countries. This was an increase of 3% on the 4.18 billion train-km reported in 2021, which almost brought rail traffic to its pre-pandemic level (-1%). Traffic recovery varies substantially between countries. While for example Slovenia, Estonia (+10% each) or Hungary and Poland (+8% each) reported notable increases in 2022 traffic relative to 2019, Kosovo (-48%), Lithuania (-28%) and Latvia (-27%) still indicated significantly less traffic than before the pandemic. Rail traffic in Baltic states was sharply affected by the interruption of freight services to/from Russia amid the Ukraine War. While the strong recovery of passenger services in Estonia helped the total traffic exceed its 2019 level, passenger services recovered moderately in Latvia (+5%) and even went down in Lithuania (-6%), resulting in large drops in train-km in both countries in 2022 compared to 2019. Passenger traffic still accounted for 81% of total traffic in 2022, while freight traffic represented just 19%, proportions that remained unchanged over the last five years.

Electrified traffic

Figure 10 – Electrified train-km (in million) and share in total rail traffic (%) from 2019 to 2022[15]



In IRG-Rail countries, more than three quarters of rail traffic is electrified. In 2022, electrified train-km totalled 2.8 billion, slightly higher than pre-pandemic level (+3%). This results in an increase in the share of electrified train-km of 3 percentage points.

While some countries show shares of electrified train-km close to 100% (Sweden 99%, Belgium and Bulgaria both 94%), Baltic countries observe high proportions (more than 60%) of all provided train-km resulting from diesel locomotives.

Apart from a few exceptions, the majority of electrified train-km are run in the passenger segment (81% on average). Interestingly, the share of electrified train-km is higher in the freight sector (80%) than in the passenger sector (78%). This is a surprising finding since most of the non-electrified sections are served by passenger services more frequently than by freight services.

[14] 29 countries are included in this figure (Ireland and Switzerland are missing).

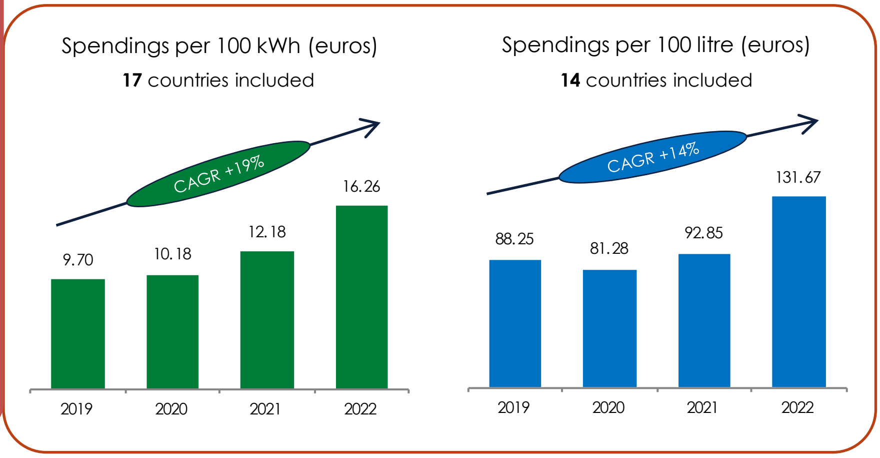
[15] 19 countries are included in this figure (Austria, Czech Rep., Denmark, Ireland, Kosovo, Luxembourg, Netherlands, North Macedonia, Norway, Slovenia, Slovakia and Switzerland are missing).

Railway undertakings’ spendings on energy

Railway undertakings’ spendings on energy have significantly increased since 2019. This is true for both spendings on traction current and diesel, which recorded an average annual growth rate of 19% and 14% respectively. The upswing was particularly strong from 2021 to 2022, +34% for electricity and +42% for diesel spendings. High inflation and the Ukraine War were the major causes of this surge in energy prices.

Spendings on traction current more than tripled in 2022 compared to 2019 in Hungary and Lithuania and doubled in Portugal. The latter also reported the highest increase in spendings per diesel litre (+166%) during the same period.

Figure 11 – Railway undertakings’ spendings (in euros) per 100 kWh and per 100 litre of diesel from 2019 to 2022[16]



Railway undertakings

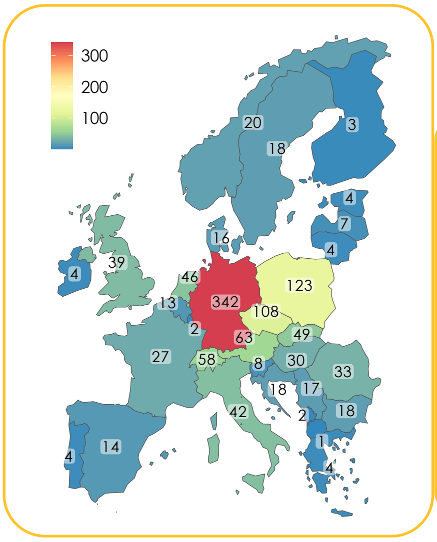


Figure 12 – Number of railway undertakings by country in 2022

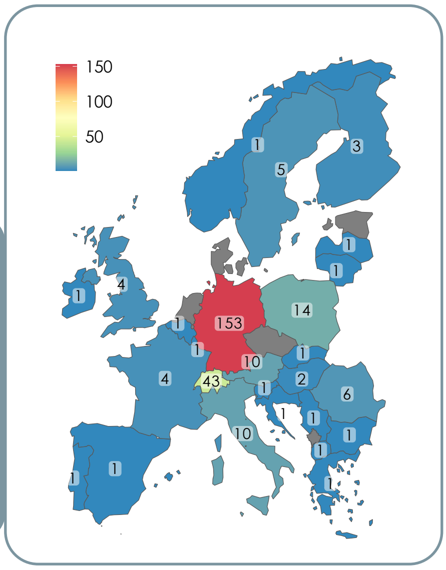
The number of active railway undertakings (RU) varies substantially across members, from one RU in North Macedonia to 342 in Germany.

For most members (22), the number of active RU operating freight services exceeded the number operating passenger services, thanks to the earlier opening of the freight market. Freight services were offered by 74% of all railway undertakings, while passenger services were only offered by a third of operators.

Railway undertakings in the passenger sector can be categorised as operating PSO and non-PSO services. All countries reported at least one active railway undertaking operating under a public service contract (PSO), with some members reporting that all passenger traffic was operated by PSO operators. Nevertheless, 17 countries feature more than one operator in the non-PSO segment.

Infrastructure managers

Figure 13 – Number of infrastructure managers by country in 2022



A total number of 269 infrastructure managers was reported by participating countries for 2022. Similar to the number of active railway undertakings, the number of IMs varies across countries. Germany again shows the highest number (153) followed by Switzerland (43) and Poland (14). However, a majority of countries (15) reported only one infrastructure manager operating the whole network.

The number of infrastructure managers seems to be a result of historical developments, demographical circumstances and geographical features of a country. In some countries, due to profitability reasons, some individual regional networks which used to be managed by the main infrastructure manager are now run by local governments.

[16] 17 countries are included in the figure of spendings per kWh (Austria, Czech Rep., Denmark, Finland, Kosovo, Latvia, Luxembourg, North Macedonia, Netherlands, Norway, Serbia, Sweden and Switzerland are missing). 14 countries are included in the figure of spendings per litre (all countries above plus Croatia, Greece, Slovakia and UK). Italy is missing in the first figure but included in the second one.

05

The rail freight market

IN 2022

819 m
freight train-km

463 bn
freight net tonne-km

Freight load factor:
550 net tonne-km per freight train-km

52%
total market share of competitors* in the freight market
(net tonne-km)

€22.96
RU's revenue per freight train-km

€cent 4.17
RU's revenue per net tonne-km

The sample used to calculate these figures is specified in the following pages.
* Competitors in each country refer to all railway undertakings other than the domestic incumbent.

The rail freight market size

For reference, the modal split of rail freight transport in the EU countries was 17.0% of total inland freight tonne-km in 2021, down 0.7 percentage point from 2019 (source: Eurostat).[17]

Moderately affected by the pandemic, freight traffic had already come back to its 2019 level in 2021. In 2022, while freight train-km grew slightly over year, so exceeding the pre-pandemic level (+1%), tonne-km fell down by 1% compared with 2021 to the same level as in 2019. Severely affected by the interruption of freight services to/from Russia due to the Ukraine War, freight traffic in Baltic states remained 50% below its 2019 level.

Figure 14 – Total freight traffic from 2018 to 2022[18] (left) and 2022/2019 change in tonne-km (right)

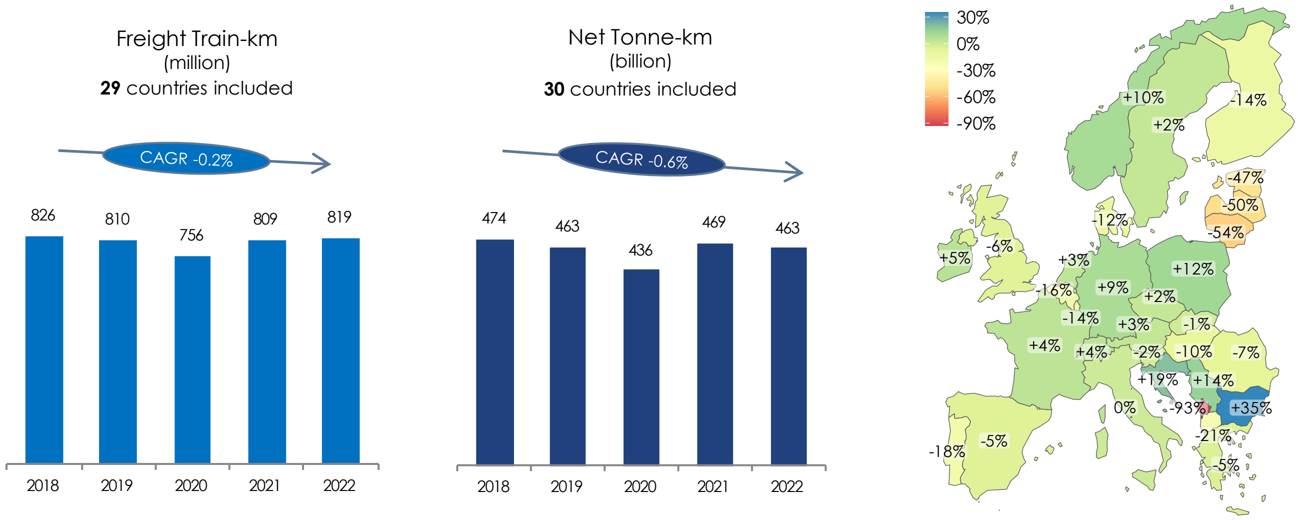
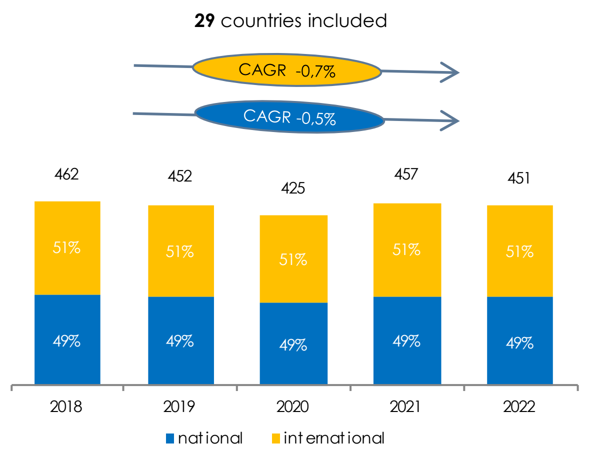


Figure 15 - National and international freight traffic (in billion net tonne-km) from 2018 to 2022[19]

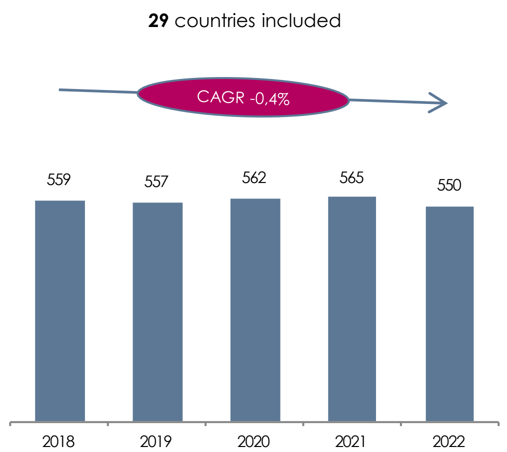


In 2022, international transport accounted for 51% of total freight traffic (in tonne-km) and domestic transport the remaining 49%. This ratio has remained remarkably stable over the past five years, resulting from mostly stable international and national traffic.

*The difference with the total volume reported in Figure 14 is notably explained by the absence of decomposition of national and international traffic for Switzerland, accounting for a total of 12 billion net tonne-km.

Compared to 2021, there was a marked reduction of 3% in the freight load factor in 2022, measured as net tonne-km per freight train-km. In fact, a third of countries reported an over-5% decrease in this indicator, reversing the annual growth trend of 0.8% observed between 2017 and 2021.

Figure 16 – Freight load factor (net tonne-km per freight train-km)[20]



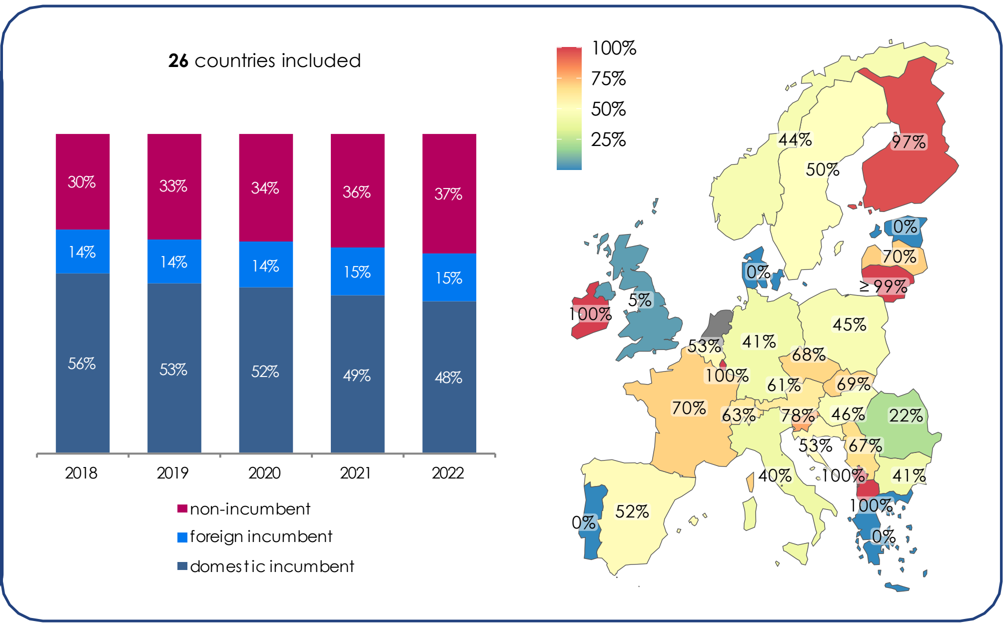
[17] Data on the modal split of freight transport in the European Union can be found on Eurostat website.
[18] 29 countries are included in the figure for freight train-km (Ireland and Switzerland are missing), 30 countries are included in the figure for net tonne-km (Ireland is missing).
[19] 29 countries are included in this figure (Ireland and Switzerland are missing).
[20] 29 countries are included in this figure (Ireland and Switzerland are missing).

Market shares of freight railway undertakings

Consistent with the trend over recent years, the market share of domestic incumbents continued to decline in 2022 to 48%. This is a drop of 8 percentage points since 2018. In contrast, the market share of non-incumbents has been on an upward trajectory since 2017, now reaching 37%. The portion of the market held by foreign incumbents has remained stable at approximately 15%.

Overall, the composition of the freight market seems to have been largely unaffected by the pandemic.

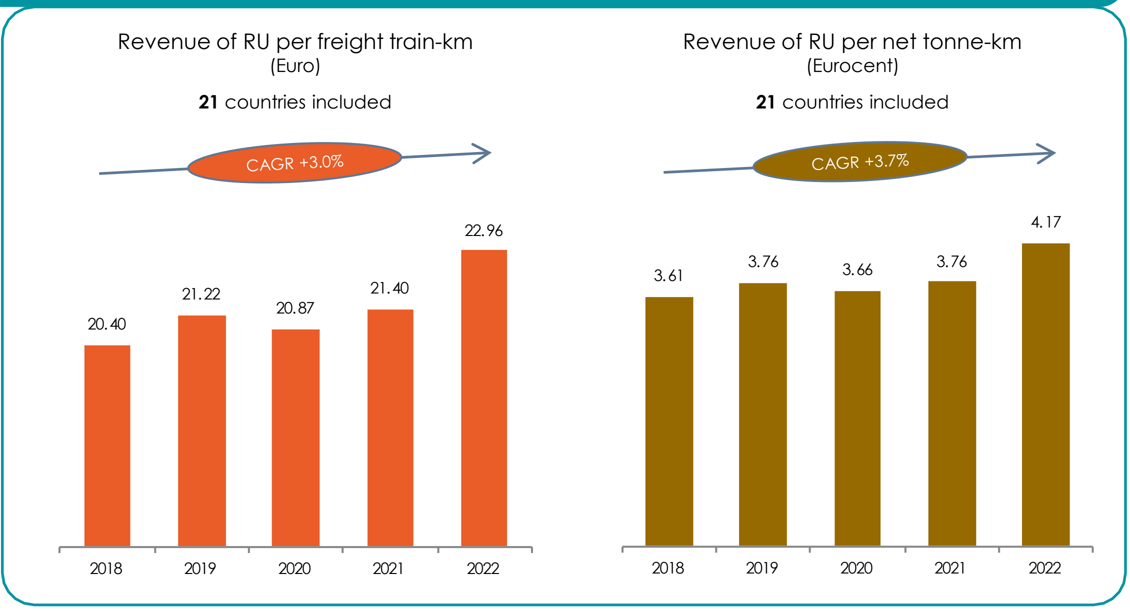
Figure 17 – Market shares (based on net tonne-km) of freight railway undertakings (left)[21] and share of the domestic incumbent by country in 2022 (right)



Economic performance of freight railway undertakings

Railway undertakings' revenue from freight services had remained on a moderate upward trend until 2021 before surging by 7% and 11% in 2022 for revenues per freight train-km and per net tonne-km respectively. Operators' gross freight revenue, on its own, rose by 9.3% from 2021 to 2022, which is higher than the average inflation rate in IRG-Rail countries (8.5%). For revenue per tonne-km, the increase was further amplified by a decrease in total tonne-km (the denominator).

Figure 18 – Freight railway undertakings' revenue per train-km and per net tonne-km from 2018 to 2022[22]



[21] 26 countries are included in this figure (Denmark, Estonia, Ireland, Serbia and Switzerland are missing). Incumbents include their subsidiaries, if any.

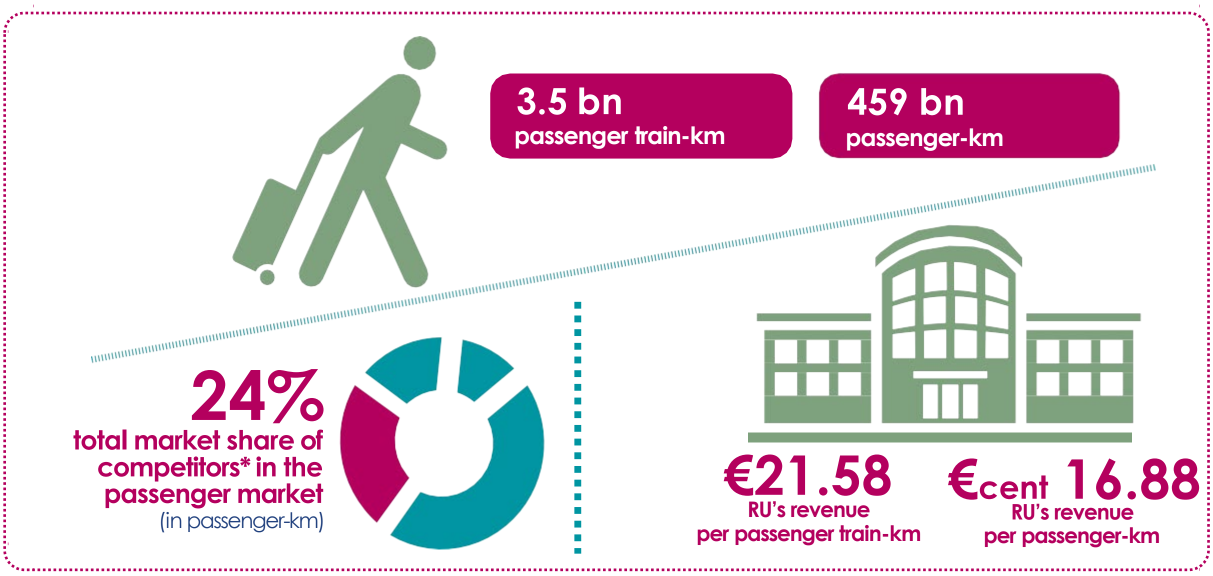
[22] 21 countries are included in this figure (Czech Republic, Denmark, France, Ireland, North Macedonia, the Netherlands, Serbia, Slovakia, Switzerland and the United Kingdom are missing).

Additional indicators included in the Working Document:
- Freight train punctuality

06

The rail passenger market

IN 2022



The sample used to calculate these figures is specified in the following pages.

* Competitors in each country refer to all railway undertakings other than the domestic incumbent.

The rail passenger market size

In 2021, the modal share of rail passenger services in the European Union represented 6.0% of the total inland transport by passenger-km, meaning a decrease of 2 percentage points compared with the pre-COVID year of 2019.[23]

Despite recent increases in traffic, the rail passenger market has not yet recovered to its pre-pandemic level. In 2022, there were 3.5 billion passenger train-km, which is a rise of 4% on 2021 but a drop of 2% compared to 2019. On the demand side, passenger-km increased sharply (+52%) compared with 2021 but remained 10% below the 2019 level.

Compared with 2019, the market remains below 2019 levels with 16 countries reporting lower passenger train-km and 24 countries reporting lower passenger-km. This explains the bigger gap of traffic on the demand side from 2019 to 2022.

Figure 19 – Total passenger traffic from 2018 to 2022[24] (right) and 2022/2019 change in passenger-km (left)

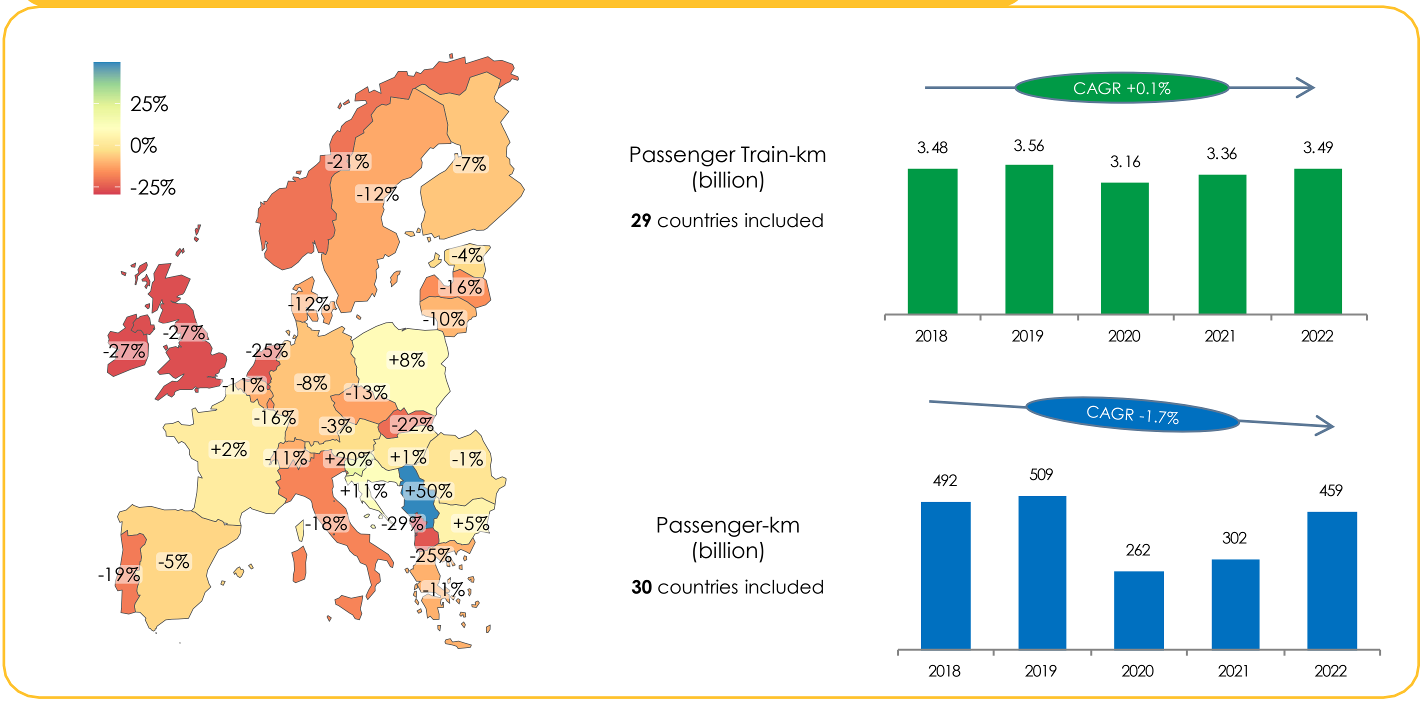
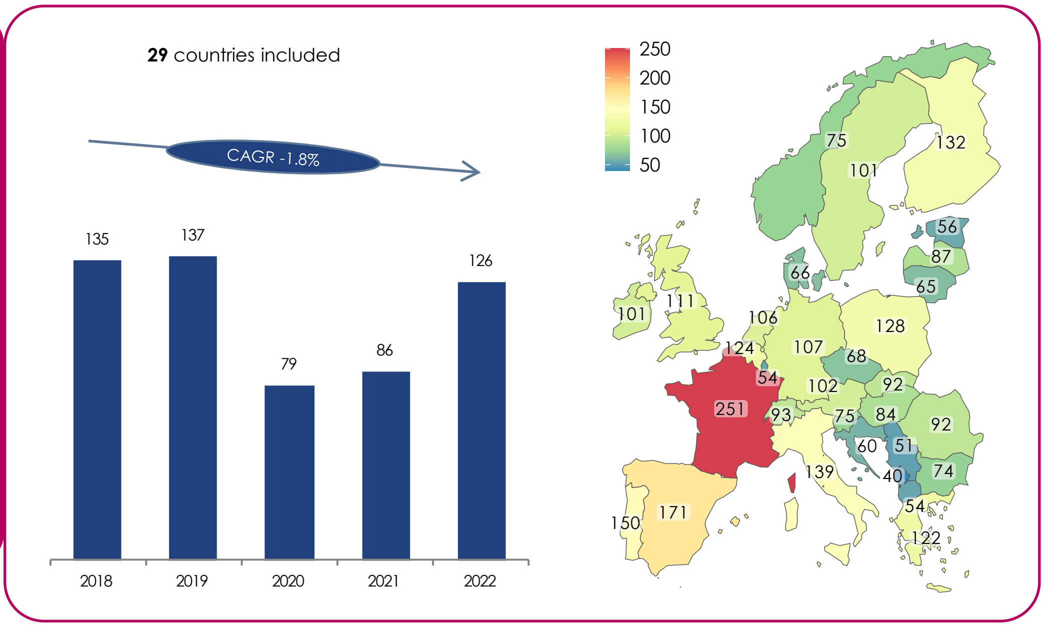


Figure 20 – Passenger load factor (passenger-km per passenger train-km) from 2018 to 2022 (left)[25] and 2022 level by country (right)

Since passenger train-km was only moderately affected by the pandemic, large falls in passenger-km resulted in the same trend for passenger train load, which is the ratio of passenger-km to passenger train-km.

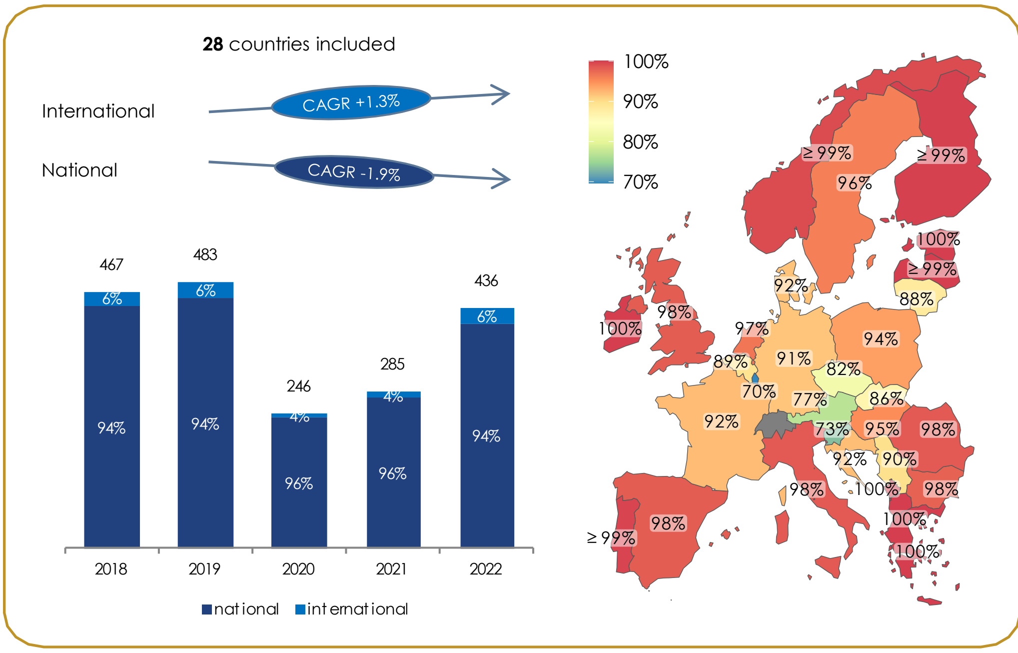
In 2022, there were an average of 126 passengers per train. This is up by 48% compared with 2021. Passenger load factor remained similar in 2018/19, before a significant fall in 2020 (-42%). This has resulted in a moderate decrease over the past five years (-2%).



23 Data on the modal split of passenger transport in the European Union can be found on Eurostat website.
24 29 countries are included in the figure for passenger train-km (Ireland and Switzerland are missing). 30 countries are included in the figure for passenger-km (Ireland is missing).
25 29 countries are included in this figure (Ireland and Switzerland are missing).

The rail passenger market components

Figure 21 – National and international passenger traffic (in billion passenger-km) from 2018 to 2022 (left)[26] and share of national traffic per country in 2022 (right)



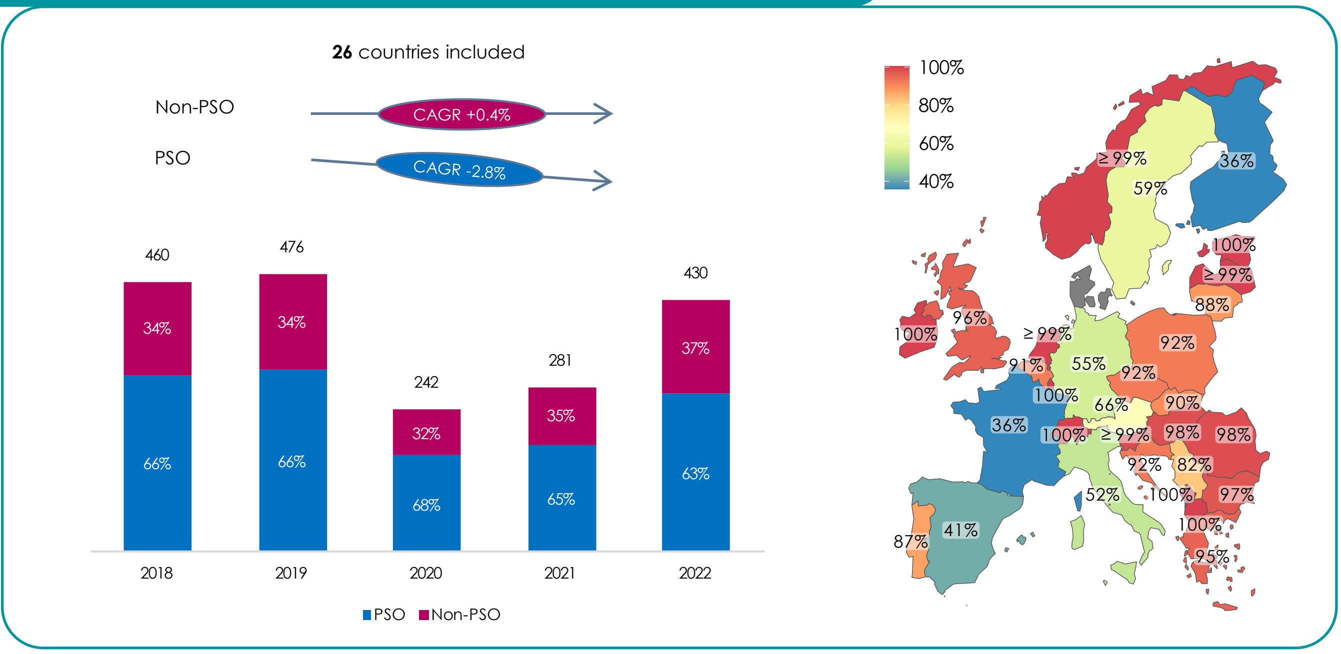
In 2022, there were increases in both national and international passenger traffic (in passenger-km) compared to 2021. The increase in international traffic (+135%), was proportionately more than the increase in national traffic (+49%). This can be explained by the removal of restrictions on international cross-border movement, which were imposed by many countries throughout 2020 and 2021. This development has brought the distribution between national and international traffic back to what was observed prior to the pandemic, with 94% of traffic taking place domestically and 6% in international services.

Figure 21 presents the share of national traffic across monitored countries. The map shows that, for many countries, national services represent more than 90% of the total passenger market, with the likes of Estonia, Greece, Ireland, Kosovo* and North Macedonia reporting national traffic of 100%. The highest share of international traffic was reported in Luxembourg (30%).

Severely affected during the pandemic, non-PSO traffic has recovered more strongly than PSO traffic. Non-PSO traffic increased by 63% compared to 2021, reducing the gap from 2019 levels to only 2%. Meanwhile, PSO traffic rose by 48% compared with 2021, remaining 13% below its pre-pandemic level.

Figure 22 shows the share of PSO traffic across monitored countries. There is substantial variation across countries, ranging from 36% in Finland and France to 100% in countries such as Ireland and North Macedonia.

Figure 22 – PSO and non-PSO traffic (in billion passenger-km) from 2018 to 2022 (left)[27] and share of PSO traffic per country in 2022 (right)



[26] 28 countries are included in this figure (Ireland, Slovakia and Switzerland are missing).
[27] 26 countries are included in this figure (Denmark, Ireland, Luxembourg, Slovakia and Switzerland are missing).

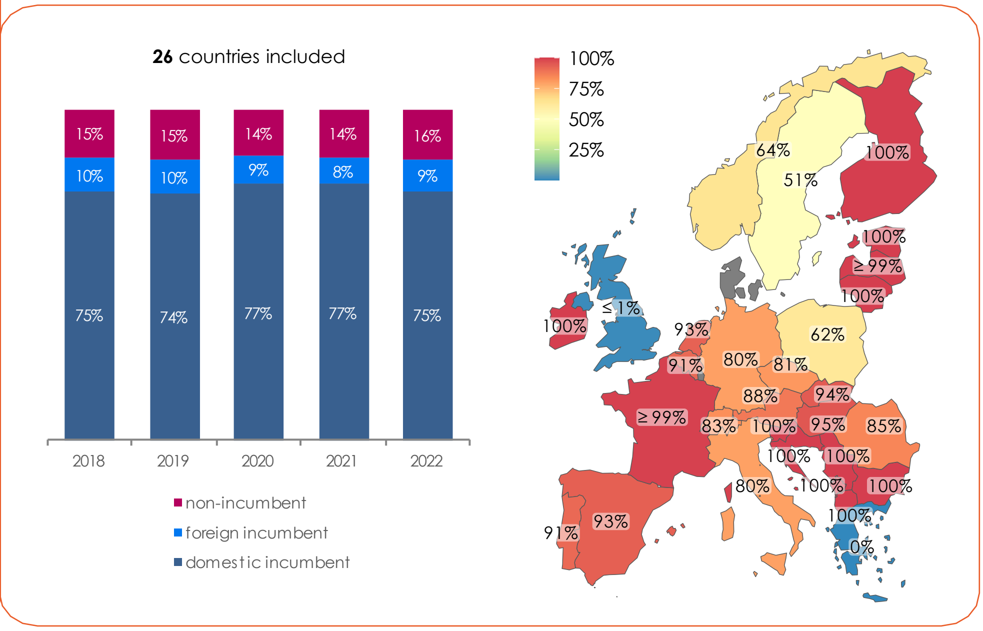
Market shares of passenger railway undertakings

In 2022, domestic incumbents' share in the passenger market returned to its pre-pandemic level of around 75%. The pandemic appeared to affect domestic incumbents less severely than their competitors, but this effect was temporary. Non-incumbents' share reached 16% for the first time, by gaining 1 percentage point compared to 2019, at the expense of foreign incumbents.

13 countries reported having a *de facto* monopoly, with (almost) all passenger traffic being operated by domestic incumbents and their subsidiaries.

2022 is marked by the effective entrance of the first competitors into French[29] and Spanish markets, which are among the biggest passenger markets in Europe. For a longer discussion, see the Working Document.

Figure 23 – Market shares (based on passenger-km) of passenger railway undertakings (left)[28] and share of domestic incumbent per country in 2022 (right)

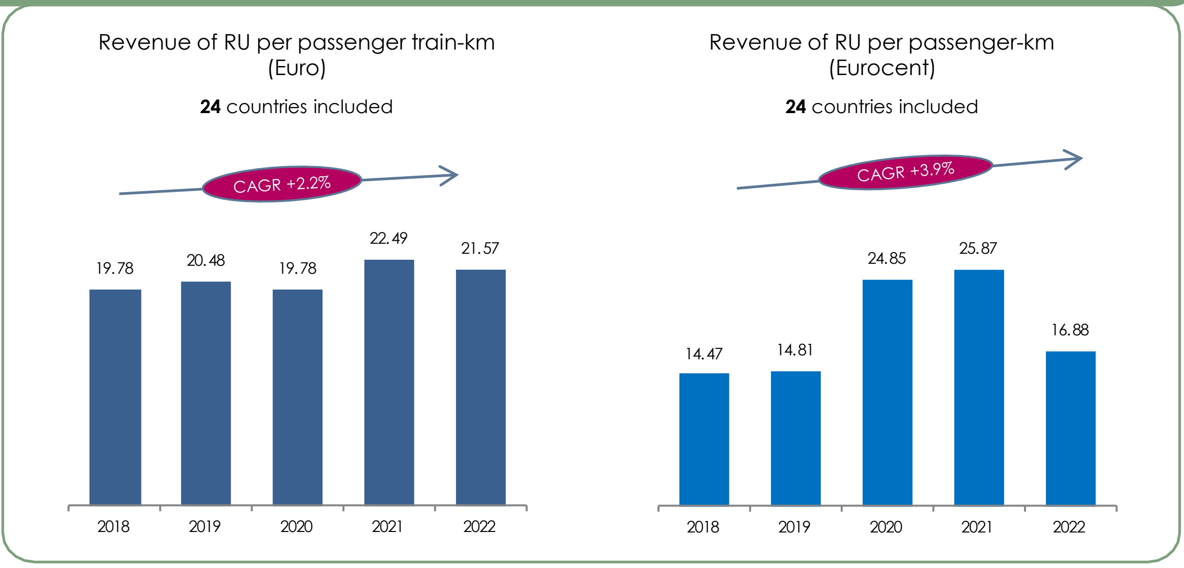


Economic performance of passenger railway undertakings

In 2022, railway undertakings' revenue from passenger services per passenger train-km and per passenger-km both declined compared to 2021 but increased from 2019 levels. However, these global developments hide various individual development of revenue components (see also the Working Document). Behind the 5% drop of revenue per train-km from 2021 to 2022, PSO revenue declined by 13%, driven by a large drop in PSO compensations (-36%). Compensations fell from €44.8bn in 2021 to €27.8bn in 2022 (not adjusted for inflation). Meanwhile, non-PSO revenue surged by 35% (exceeding IRG-Rail average inflation rate of 8.5%).

Compared to 2019, the rise in revenue per train-km (+6%) resulted from a 7% increase in PSO revenue (boosted by high compensations, +34%) and a small increase (+1%) of non-PSO component. Regarding revenue per passenger-km, its peaks and troughs over the last three years are due mostly to the disconnect between total revenue (the numerator), which had been kept high thanks to large amounts of PSO compensations, and passenger-km (the denominator), which fell drastically in 2020-2021 and is now close to its pre-pandemic level.

Figure 24 – Passenger railway undertakings' revenue (from fares and compensations) per train-km and per passenger-km from 2018 to 2022[30]



[28] 26 countries are included in this figure (Denmark, Hungary, Ireland, Luxembourg, and Serbia are missing). Incumbents include their subsidiaries, if any.
[29] Trenitalia's entrance in France was on 18 December 2021.
[30] 24 countries are included in this figure (Denmark, Ireland, North Macedonia, Portugal, Serbia, Slovakia and Switzerland are missing).

Additional indicators included in the Working Document:
- Passenger train punctuality

07

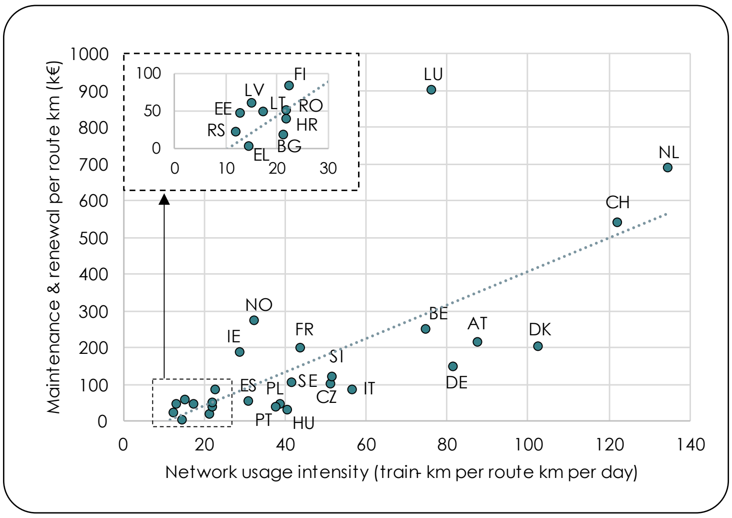
Heterogeneity in European network usage and potential determinants

INTRODUCTION

Network usage intensity is a widely used indicator when analysing railway markets. By reporting the level of traffic relative to network size, it quantifies rail network usage and provides a benchmark across countries. This knowledge is crucial to understand the efficiency of rail transport and justify financial support to rail infrastructure (Figure 25).

On average, network usage intensity is over 52 train-km per route km per day in Europe in 2022, as shown in Figure 6 in Chapter 2. However, it varies a lot across countries, ranging from 1 train-km per route km per day in Kosovo to 134 in the Netherlands. It is yet to be fully understood what lie(s) behind this difference and which factor(s) could explain it. Another question is whether the usual construct of network usage intensity itself allows an efficient comparison between countries. For instance, how best could we account for disparities between areas of each country and how to consider the composition of the network and traffic on different types of rail (electrified, high-speed, etc.).

Figure 25 – Network usage intensity and expenditures on maintenance and renewal per country in 2022

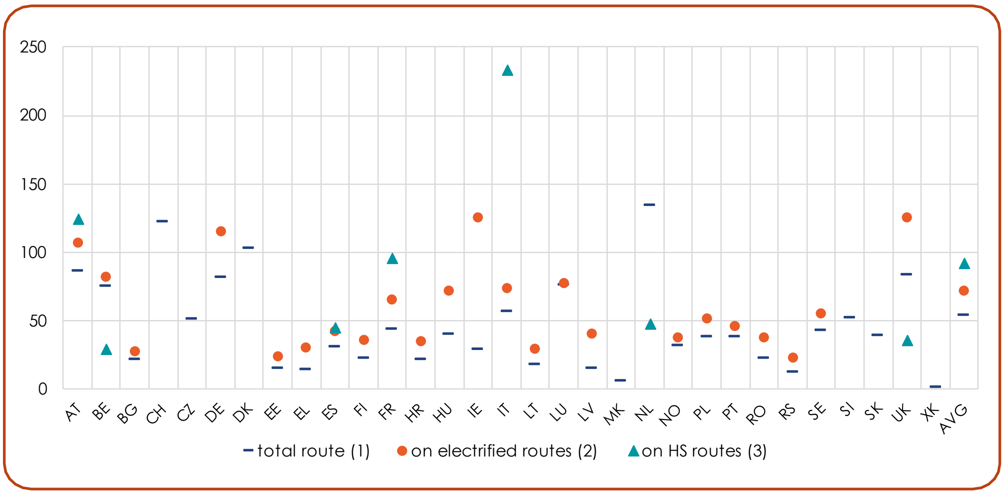


In this chapter, we firstly study the heterogeneity of network usage in Europe by analysing the network usage intensity on different types of rail and by sub-national geographic breakdown. This is followed by an analysis of the potential determinants of this disparity, such as population density, carriage capacity and effective load of trains, track access charges, etc.

Network usage intensity in Europe

Network usage intensity is usually presented as the number of train-km per route km per day. Figure 6 in Chapter 2 and Figure 26 show the **average level per country** in 2022. The highest network usage intensity is recorded in the Netherlands (134 train-km per route km per day), followed by Switzerland (122) and Denmark (102), while the IRG-Rail average level is 54 and seven countries have less than 20 train-km per route km per day.

Figure 26 – Network usage intensity (train-km per route km per day)[31] per country in 2022



It is interesting to look at alternative constructions of network usage intensity to better understand the occupancy of the railway network. For all countries reporting traffic on **electrified routes**, network usage intensity on these routes is higher than the overall indicator, by 9% in Belgium to more than three times in Ireland (Figure 26). The gap should be much bigger when comparing traffic on electrified routes with that on non-electrified routes (see the Working Document of the present report). Usage intensity on electrified routes exceeds 100 train-km per route km per day in four countries in 2022 and 70 train-km per route km per day on average among reporting countries.

In some countries, traffic is considerably more crowded on **high-speed (HS) routes** than on classic routes, resulting in network usage intensity on HS routes much higher than the overall indicator (Figure 26). For instance, Italy records more than 230 train-km per route km per day on its HS routes in 2022 (three times higher than the usual indicator on overall network) due to intense competition on these routes. The values for France are 95 HS train-km per HS route km per day and a surplus of 120% compared to the reference level. Among reporting countries, the average level is 91 HS train-km per HS route km per day.

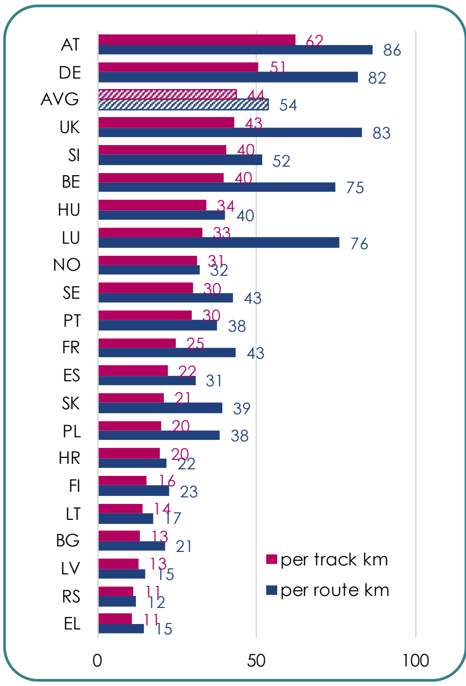


Figure 27 – Network usage intensity in train-km per route km per day and train-km per track km per day[32] per country in 2022

For the same level of traffic, usage intensity should be different on a network that is majorly composed of multiple-track lines than a network that has large share of single-track lines. To account for this difference in network composition across countries, **measuring network usage by using track km** as denominator should be more correct than using route km. The pink bars in Figure 27 represent this variation of network usage intensity. The total track length in 21 countries submitting this indicator is 287,900 km, in comparison with 179,700 route km, which indicates a ratio of 1.6 track km per route km. Luxembourg has the highest number of track km per route km which is 2.3 on average, resulting in a daily network usage intensity of 33 train km per track km (versus 76 train km per route km). Meanwhile, Norway has single-track routes over most of its network (1.03 track km per route km), thus a network usage intensity of 31 train km per track km (versus 32 train km per route km).

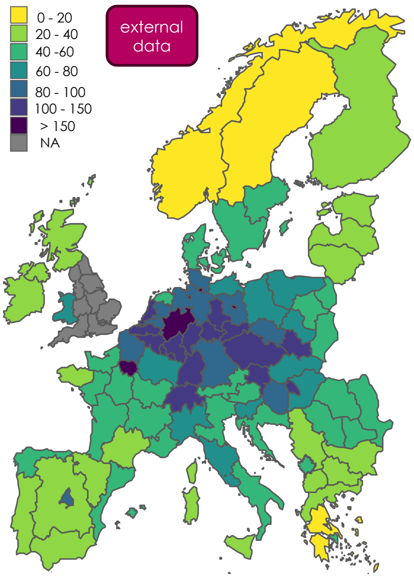
[31] Average level for each indicator is calculated by taking countries that report relevant data into account. Hence, the sample is not the same from one indicator to another:
(1) total routes: 31 countries
(2) electrified routes: 24 countries (Czech Rep., Denmark, Netherlands, North Macedonia, Slovakia, Slovenia and Switzerland are missing)
(3) high-speed routes: 8 countries (Germany is missing, the other countries do not report or have dedicated high-speed lines)
[32] 21 countries are included (Czech Rep., Denmark, Estonia, Ireland, Italy, Kosovo, the Netherlands, North Macedonia, Romania and Switzerland are missing)

Network usage intensity in Europe – sub-national breakdown

There are disparities in network development between areas of each country. Figure 28 shows the distribution of rail network per NUTS 1 region in 2021. For some countries such as France, Spain, Sweden, railways are highly concentrated in a few regions.

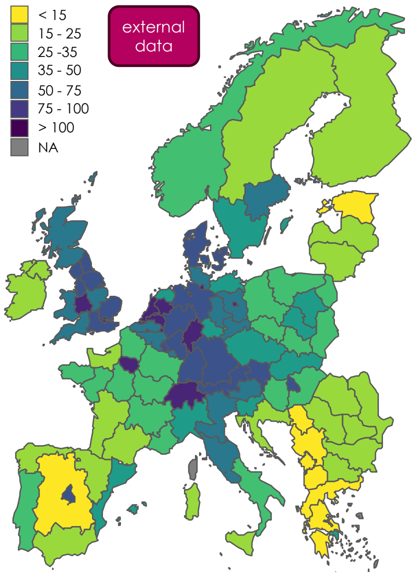
As a result, the usual network usage indicator, calculated as an average per country, cannot account for these regional disparities. Network usage intensity per region is depicted in Figure 29. Similar patterns to Figure 28 can be shown where intensive usage levels are found in regions with a dense network. In France for instance, network usage intensity is particularly high in Paris region (above 150 train-km per route km per day) but below 35 in all other regions, resulting in a national average level of only 42 in 2021. Likewise, Madrid region (Spain), West Midlands and London (UK) or Hessen (Germany) record much higher network usage than other regions of their respective countries.

Figure 28 – Rail density by NUTS 1 region (route km per 1000 km²) in 2021[33]



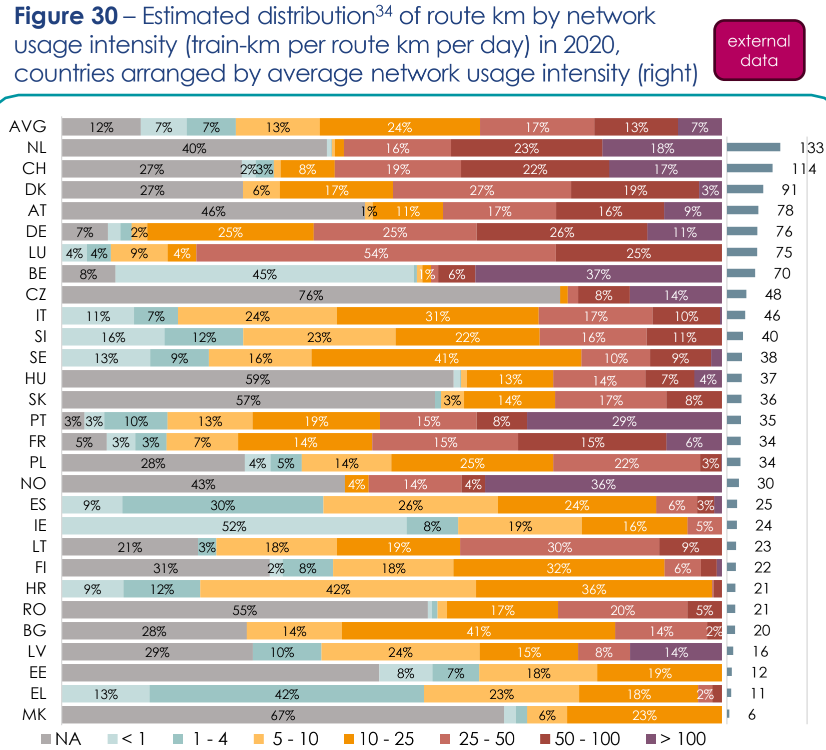
Source: Eurostat

Figure 29 – Train-km per route-km per day by NUTS 1 region in 2020



Source: IRG-rail, Eurostat, UNECE E-Rail Census

Figure 30 – Estimated distribution[34] of route km by network usage intensity (train-km per route km per day) in 2020, countries arranged by average network usage intensity (right)



Source: IRG-rail, Eurostat, UNECE E-Rail Census

Using the detailed decomposition of the network, one can study the network usage per section and the distribution of the network based on usage intensity. Although available data do not allow a complete picture of the distribution of the network for all countries (see Figure 30), they contain some interesting information about the heterogeneity of network usage across Europe.

As depicted in Figure 30, the European rail network shows significant disparities in usage intensity. While 20% of total route km sees more than 50 trains per day, 14% of the network has fewer than 5 trains per day.

In eight countries, sections having over 100 train-km per route km per day account for more than 10% of the network. They are mainly countries of small size, except for Germany. The latter also stands out for having very few lines with less than 10 trains per day.

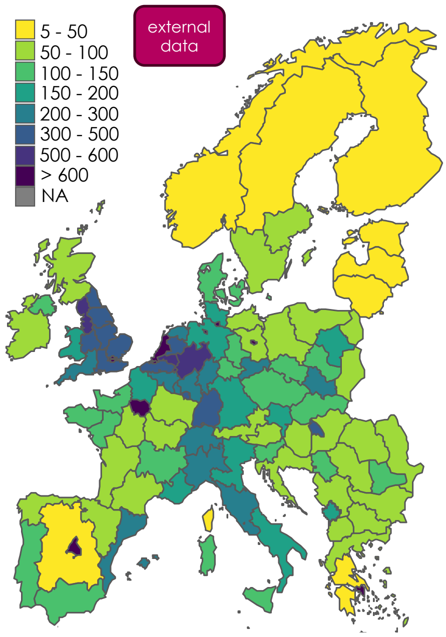
On the contrary, nine countries have a significant part of their network (i.e. at least 15 % of route km) with a maximum of 4 departures per day only.

[33] Different periods and data source apply: Austria (1997), Belgium (2008), Germany (2019), Spain (2020), Northern Ireland (2018), Scotland and Wales (2013), IRG-rail data for Serbia and Kosovo (2021)

[34] The intra-country distribution of network usage intensity uses data by origin-destination. This data is not produced by IRG-Rail members and should be interpreted with caution. Indeed, the scope may differ from one country to another, with some countries declaring only part of their most used network (e.g. TEN-T core). In addition, the distribution is based on distances as the crow flies rather than rail distances. For some countries with a low granularity (i.e long origin-destination) there is a greater difference between the estimated distance and the true rail distance. The length of the network for which the information is unavailable (NA on the figure) depends on these two factors (granularity and perimeter).

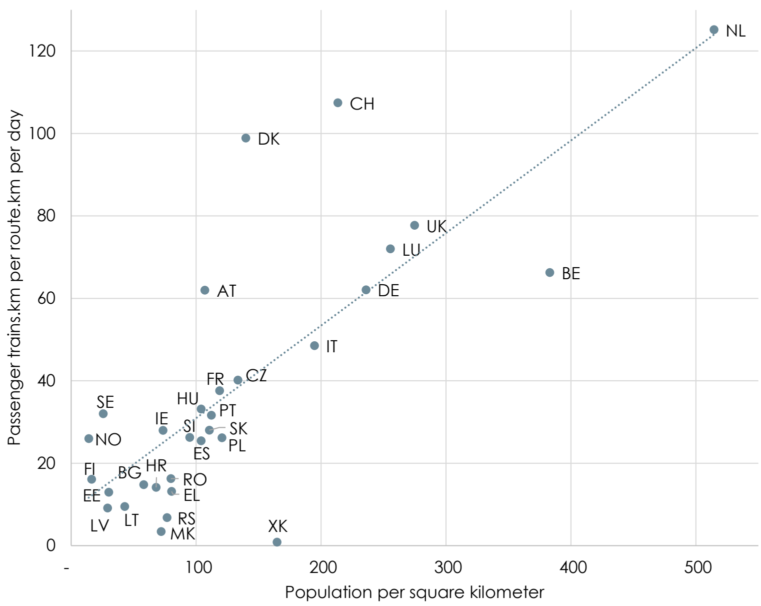
Underlying factors for rail transport demand

Figure 31 – Population density by NUTS 1 region in 2019[35]



Source: Eurostat

Figure 32 – Relationship between network usage intensity of passenger trains and population density in 2022



Source: IRG-Rail

Rail is a mode of transport that is particularly suitable for connecting densely populated areas thanks to its ability to handle mass flows. Figure 32 shows a logical correlation between **population density** and the use of the rail network by **passenger trains**.

Some countries, such as Switzerland, Denmark and Austria, have a relatively high level of network usage intensity compared to other countries with equivalent levels of population density. This points out that other factors like load factor (see next page) may explain network usage intensity.

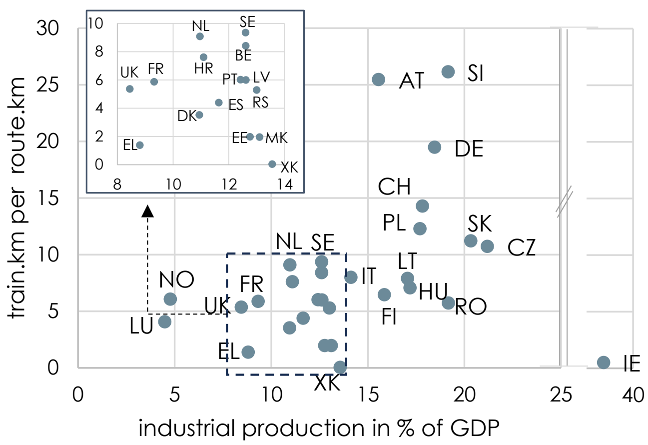
Demand for **freight transport** is driven by economic activity and more particularly by industrial sectors in which rail has comparative advantages.

Indeed, all countries that have a network usage intensity by freight trains above 10 train-km per route-km per day also have an **industrial production** that accounts for more than 15% of their GDP (see Figure 33). This is particularly true for Slovenia, Austria, Germany and Switzerland.

However, high industrial production does not always imply a high use of the network by freight trains, especially when road has a larger modal share. The modal share of rail also depends on the type of industrial production as rail has a significant comparative advantage for heavy goods. Geographical factors may also explain the low use of the network by rail freight, as it is the case for Ireland given its insularity.

Thus, a high value of industrial production seems to be a necessary condition for the railway network to be used substantially by freight trains.

Figure 33 – Relationship between network usage intensity of freight trains and industrial production in 2022



Source: IRG-Rail and World Bank

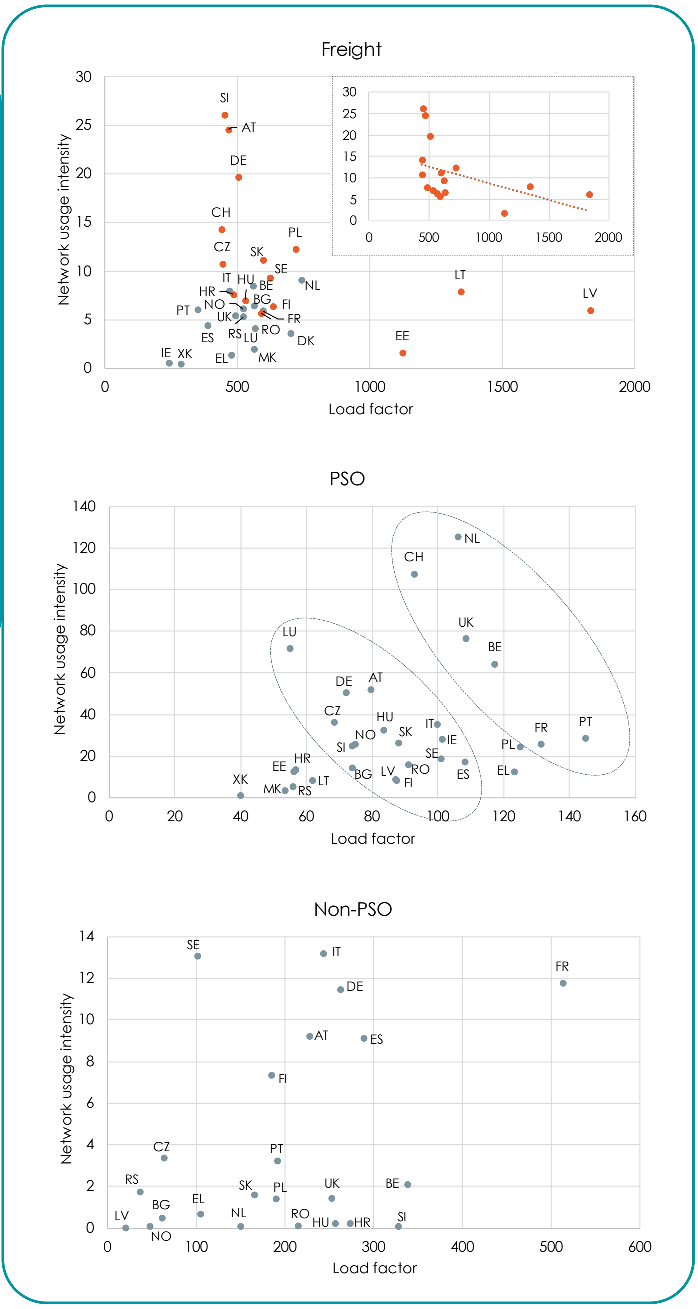
35 UK data as of 2018

Network usage intensity and train load

One potential determinant of the heterogeneity of network usage intensity across countries can be the **train load**. Larger capacity trains can transport a greater number of passengers and/or goods so that fewer trains are necessary to carry the same load compared to low-capacity trains. Figure 34 relates, for each type of train, the network usage intensity to the train load which is the number of passenger-km per passenger train-km for passenger trains and the number of tonne-km per freight train-km for freight trains.

While no clear overall correlation between these two variables can be shown for any type of train presented in the graph, there is some correlation for a selected group of countries. For instance, by comparing the freight figures in countries where the railway share in freight transport is higher than the European average (points in orange on the graph), it can be shown that a higher network usage is associated with a lower load factor. For passenger trains, both PSO and non-PSO, the potential correlation between network usage and train load is much less evident.

Figure 34 – Relationship between network usage intensity (train-km per route km per day) and train load factor (passenger-km or tonne-km per train-km) per country in 2022 [36]



It is also of interest to examine the **train carrying capacity** which is the theoretical load, unlike the real load factor presented above. Measured in number of seat-km per train-km, the carrying capacity should reflect the vision of the operators when building their transport plan. Only 12 countries submitted this indicator for the study, of which France has the largest average train capacity (555 seat-km per passenger train-km), followed by Portugal (517) and Italy (435). For a group of countries such as Belgium, Germany, Italy and France, we can observe the combination of a higher network usage intensity and a lower train carrying capacity for passenger trains (see Figure 35). Similar observations can be made for PSO and non-PSO trains. However, there is no evidence of an overall (negative) correlation between network usage and train capacity.

Figure 35 – Relationship between network usage intensity (train-km per route km per day) and carrying capacity (seat-km per train-km) of passenger trains per country in 2022 [37]

[36] 31 countries are included in this figure; except for PSO and non-PSO trains: 30 countries (Denmark is missing), for high-speed trains: 8 countries (Germany is missing).
[37] 12 countries are included in this figure (Belgium, Croatia, France, Germany, Greece, Italy, Latvia, Norway, Portugal, Serbia, Spain, Sweden).

Network usage intensity and track access charges

Network usage intensity may differ between countries due to the **level of track access charges** (TAC). As higher TAC (per train-km) make train operation more expensive, railway undertakings tend to run less trains and/or trains with larger capacity, resulting in lower network usage measured by the number of trains. Hence, a negative relationship between network usage and TAC level is expected.

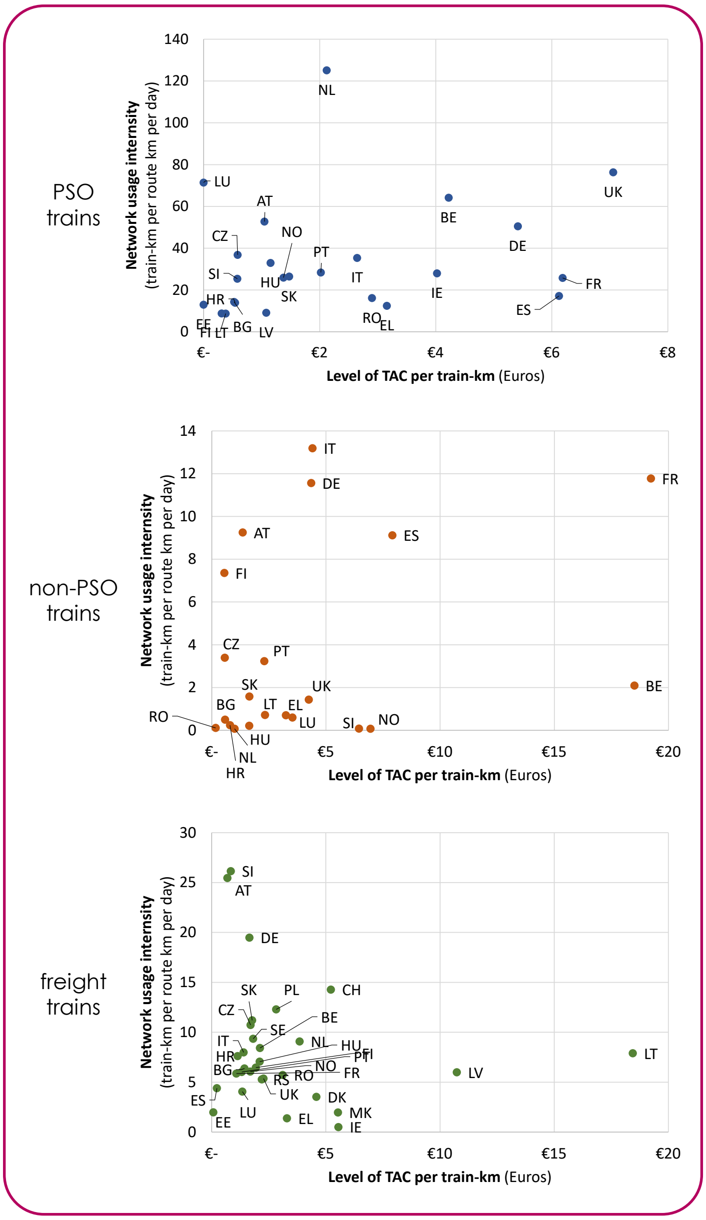
Figure 36, which relates these two variables for IRG-Rail countries, shows no evident overall correlation between them. However, some observations can be made:

For PSO services, TAC appear much higher than the average for six countries. Nonetheless, the network usage intensity does not seem (solely) affected by the level of TAC. The UK and the Netherlands, for instance, record higher usage intensity for PSO services in comparison with countries with comparable levels of TAC.

For non-PSO services, higher levels of network usage intensity does not seem correlated with the level of TAC. Nonetheless, the relative level of TAC may have an impact on the financial equilibrium of railway undertakings operating non-PSO services in these countries, leading to possible adjustment of train offering. For example in France, larger capacity trains (see the previous page) appear to be preferred rolling stock in order to lower TAC per seat-km since TAC per train-km are much higher than in all other countries. In Belgium, non-PSO services are operated only for international services.

For freight services, the majority of countries have quite low and similar levels of TAC per train-km, apart from Latvia and Lithuania. This does not seem to have a major impact on the network usage intensity of freight services.

Figure 36 – Relationship between network usage intensity (train-km per route km per day) and track access charges per train-km paid by railway undertakings per country in 2022 [38]



IRG-Rail countries show very different **structure of TAC** as well. While it is not possible to quantify this feature, a closer look at it may give some insights about how network usage is affected.

Most countries introduced train-km as the main unit for both passenger and freight TAC. An exception goes for Lithuania, which uses gross tonne-km as the main unit and where a relatively high level of TAC seems not to affect network usage intensity in terms of train-km.

Ten countries also levy a mark-up for passenger services, among which five countries report the highest average levels of TAC (France, Spain, Belgium, Germany and Latvia). However, no clear evidence of impacts of mark-ups on network usage is found since mark-ups are usually applied on specific market segments only, or because other charging units than train-km are used (seat-km in Spain, tonne-km in ten countries for instance).

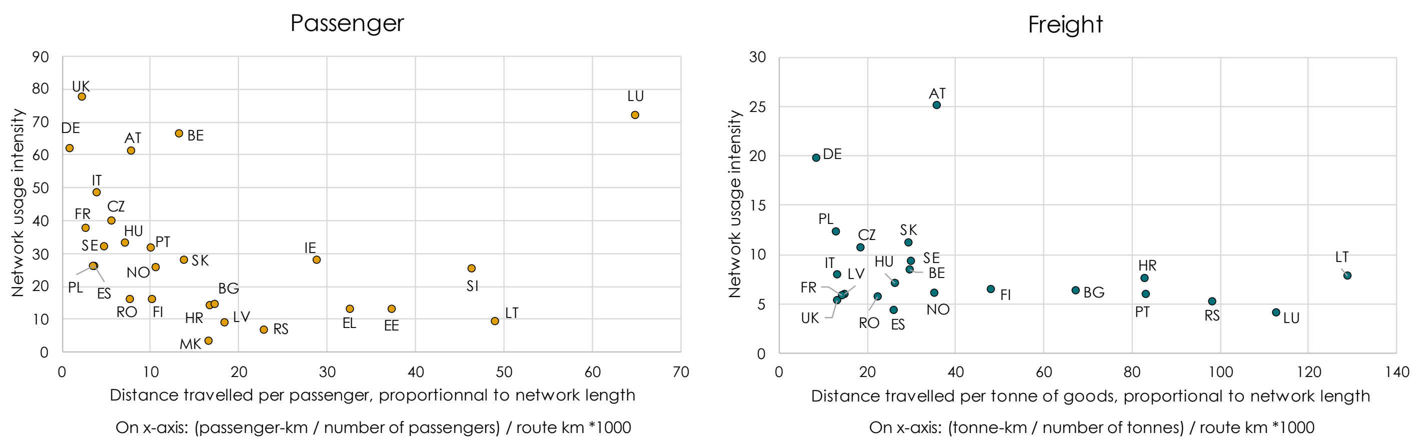
Twelve countries report **public subsidies** for passenger TAC, and ten for freight TAC. The objective of such subsidies is to lower the charges paid by railway undertakings, thus boosting the attractiveness of rail transport and network usage intensity. For example, high network usage and modal share of rail freight services in Austria and Germany may result from substantial public subsidies, which account for a significant share of total TAC.

The majority of answering countries also apply other **specific charges or compensation schemes** in compliance with Articles 31 to 35 of Directive 2012/34/UE. While no direct correlation can be seen (at the global scale and for a specific year) between the application of such charges and network usage, in five countries where discounts are applied for the development of rail services (Spain, Germany, Italy, Latvia and Sweden), network usage levels of non-PSO services are the highest. This may indicate a positive incentive of this measure.

[38] 24 countries are included in the figure for PSO services (Denmark, Kosovo, Macedonia, Poland, Serbia, Sweden and Switzerland are missing), 22 are included for non-PSO services (Kosovo, Poland, Serbia and Sweden are missing, and other countries that do not report non-PSO services), 30 countries are included in the figure for PSO services (Kosovo is missing).

Network usage intensity and distance travelled

Figure 37 – Relationship between network usage intensity (train-km per route km per day) and average distance travelled per passenger (passenger-km per passenger) or distance travelled per tonne of goods (tonne-km per tonne) per country in 2022 [39]



Network usage intensity may also be explained by the trip patterns of passengers and/or of goods, such as the average travelled distance. For passengers, it is the ratio of passenger-km over number of passengers; for goods, it is the ratio of tonne-km over number of tonnes. For countries where rail traffic is composed mostly of commuter traffic, distance travelled per passenger should be smaller while network usage should be larger than that in countries with most traffic being (occasional) long journeys. Therefore, a negative correlation between network usage and travelled distance is expected.

The distance travelled per passenger in 27 countries reporting data varies from 11 km in Macedonia to 94 km in Lithuania in 2022. In 12 countries, the length of a typical trip realised by rail passengers is equal to or less than 50 km. Since average travelled distance may be constrained by the network size, Figure 37 plots the network usage intensity against the distance travelled per passenger, relative to the route length. Apart from Luxembourg, the comparison between other countries seems to show a negative correlation between the network usage and distance travelled per passenger.

In almost all (22) reporting countries, except Latvia, goods travel on much longer distances than do passengers. The average distance of transported goods ranges from 28 km in Latvia to 413 km in Spain. No evidence of a correlation between network usage of freight trains and transporting distance of goods can be shown from Figure 37. In parallel, no theoretical background of such a correlation exists for freight.

Conclusion

It is demonstrated that network usage intensity is quite heterogeneous across IRG-Rail countries, across different areas within a country and across different types of infrastructure (electrification, high-speed network, number of tracks) as well. Investigating the determinants of network usage intensity seems not an easy task as no correlation analysis between network usage and any single factor shows satisfying results.

While specific usages of rail transport (e.g. commuter short-distance traffic) may be correlated with high frequency of trains and may explain the higher network usage in dense metropolitan regions, the heterogeneity of network usage at national level is only partially related to the demand for rail transport (which can be measured by population density and industrial production). Disparities between countries are not fully explained by differences in train load, either. Furthermore, railway undertakings may apply complementary adjustment to their rail transport supply in terms of train capacity and frequency in response to the level and structure of track access charges. This could explain why no strict correlation between TAC and network usage is found, even though a high level of TAC, especially when using 'train-km' as the main unit, may prevent railway undertakings from increasing traffic and consequently network usage.

This results would suggest that other approaches can be more appropriate to study the determinants of rail network usage. One can think of the multivariate analysis or clustering analysis as alternatives.

[39] Sample for this figure:
- Passenger: 27 countries are included (Denmark, Kosovo, Netherlands and Switzerland are missing).
- Freight: 22 countries are included (Denmark, Estonia, Greece, Ireland, Kosovo, Netherlands, North Macedonia, Slovenia and Switzerland are missing).