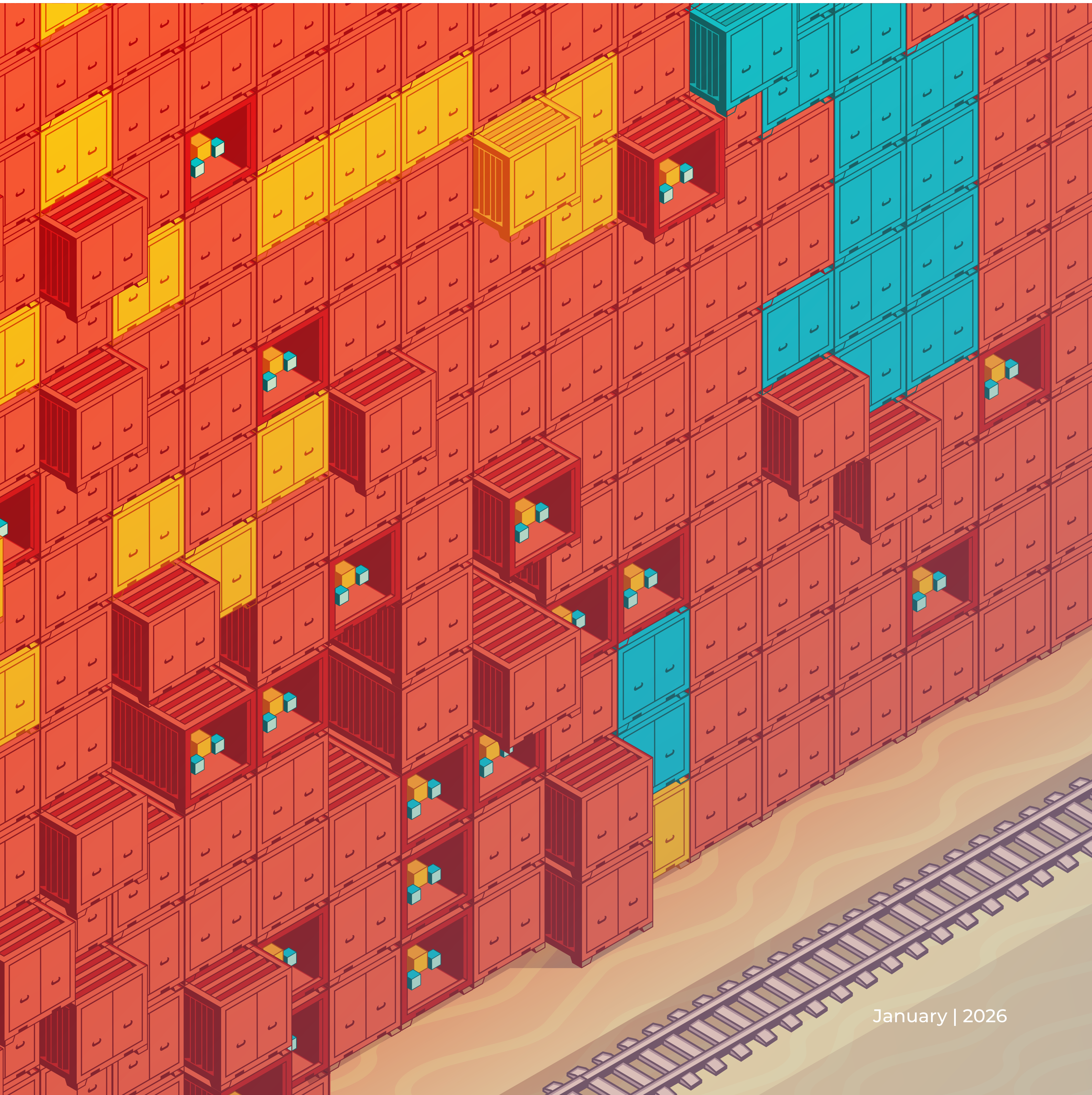
Eurasian Rail Alliance Index

Report

THE EUROPEAN RAIL SECTOR: CURRENT CONDITIONS AND TRENDS ALONG THE CHINA — EUROPE — CHINA ROUTE



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Contents

Summary 2

Introduction 3

Strategic Initiatives of the European Union 4

1. TEN-T Revision 4

2. Import Control System 2 (ICS2): A New Architecture for EU Customs Security 9

3. Infrastructure Charges: Track Access Charges 11

The Current State of European Rail Infrastructure 15

Infrastructure Projects in Europe 20

Prospects for the Development of European Railway Infrastructure 24

SUMMARY

1. The EU completed a major reform of its transport policy by adopting the revised TEN-T Regulation (Regulation EU 2024/1679). This regulation provides the legal basis for the creation of a single, interconnected rail network.

2. The planned European Transport Network comprises three levels: core (2030), extended core (2040), and comprehensive (2050).

3. The regulation introduces mandatory new standards:

   - design speeds of at least 160 km/h for passenger transport and at least 100 km/h for freight transport
   - ensuring the operation of freight trains at least 740 m long
   - increasing axle loads to 22.5 t
   - reducing the average dwell time of freight trains at borders between EU Member States to 25 minutes

4. Mandatory implementation of the European Rail Traffic Management System (ERTMS) is required, with national systems being phased out by 2040.

5. The TEN-T is supported by nine European transport corridors, which carry the main freight and passenger flows.

6. Germany and Poland are key infrastructure hubs on the Eurasian China–Europe–China route. They are located at the intersection of the North Sea–Baltic and Rhine–Danube corridors, and also provide connections to ports on the North Sea and Baltic Sea.

7. Import Control System 2 (ICS2) completely replaces Import Control System 1 (ICS1) and introduces mandatory Entry Summary Declarations (ENS) for all modes of transport, including rail (effective September 1, 2025). For Poland, ICS2 will become mandatory effective June 1, 2026, subject to a deferment request submitted by the country.

8. Track Access Charges (TAC) — a charging system for access to rail infrastructure in the EU based on marginal costs, mark-ups, and other coefficients and surcharges related to capacity constraints and environmental considerations. Direct costs constitute the minimum TAC access package, which has demonstrated a downward trend. Meanwhile, the commercial cost of container shipping increased by an average of 40-50% from 2022 to 2025.

9. Germany, Poland, and Austria form the core of European rail freight logistics in terms of traffic volume and network density. Infrastructure projects aimed at removing bottlenecks and increasing the capacity of key hubs will be implemented in these countries in the coming years. In particular, the modernization of the border terminal in Małaszewicze in Poland, scheduled for completion in June 2026, is aimed at significantly increasing capacity and accelerating the processing of container trains on the China–Europe–China route. The project's implementation will strengthen Central Europe's role as the main entry hub for Eurasian rail flows into the EU.

INTRODUCTION

European railway infrastructure is at a critical juncture in its development. For decades, European railway networks have developed unevenly, shaped by national priorities, budget constraints, and fragmented investment strategies. As a result, despite the high level of development of individual corridors and hubs, a significant portion of the system has accumulated structural bottlenecks and hidden vulnerabilities.

Today, the demands placed on European railways extend far beyond their traditional transport function. The network is expected to deliver greater reliability and capacity in the face of growing cross-border traffic and the increasing dependence of industrial supply chains on predictable logistics.

The current stage of development of the European railway network is characterized by a profound transformation, simultaneously affecting the institutional, infrastructural, and technological foundations of its operation. The adoption of the TEN-T Regulation (Regulation EU 2024/1679) in 2024 marks a turning point in the development of European transport policy. For the first time, not only the network's infrastructure parameters but also operational performance indicators, digital requirements, and a unified technological vector for railway development have been established at the supranational level. The EU railway system is transforming from a model of fragmented national networks into a unified functional space, where a weak link or non-compliance with standards in one section can impact the efficiency of the entire system.

These processes are particularly significant in the context of Eurasian railway routes. This study provides a comprehensive understanding of the current state and development vector of the European railway network and allows for an assessment of how the transformation of EU railway infrastructure impacts the sustainability and efficiency of the China–Europe–China route.

STRATEGIC INITIATIVES OF THE EUROPEAN UNION

1. TEN-T Revision

The Trans European Transport Network (TEN-T) policy is one of the European Commission's key initiatives for creating a seamless, efficient, intermodal transport network across the EU. In 2024, with the adoption of Regulation (EU) 2024/1679, the TEN-T policy was revised (TEN-T Revision) with the aim of strengthening infrastructure quality and increasing connectivity between countries and modes of transport.

Rail Infrastructure

The European transport system is built as a single, interconnected network. Therefore, the TEN-T Regulation emphasizes that the failure or non-compliance of even a short segment can disrupt the functioning of the entire system, reducing its competitiveness and preventing the benefits of the network as a whole from being realized (Article 20 of the Regulation).

Another key principle of the TEN-T is to ensure accessibility and connectivity across all EU regions, including peripheral, mountainous, island, and sparsely populated areas (Article 21 of the Regulation). This approach creates a truly large-scale regional network, where each section must be integrated into overall transport flows.

The TEN-T Regulation structures the European transport network into three layers: the core network, the extended core network, and the comprehensive network.

The implementation period for the core network initiatives is set to end on 31 December 2030. The core network covers the busiest routes, major rail lines, access roads to sea and dry ports, airports, and terminals.

The period for the extension of the extended core network is set to end on 31 December 2040. It complements and reinforces the core network, including corridors and nodes critical to the capacity and sustainability of the transport system. Both of these components serve as the foundation of the EU's multimodal network. They focus the Union's efforts on projects with the greatest "European added value," including eliminating bottlenecks, developing multimodal logistics hubs, and increasing rail and terminal capacity.

The final stage — the creation of a comprehensive network — is to be completed by 31 December 2050. Upon achieving these goals, infrastructure across the EU should reach uniform standards, ensuring full connectivity across all regions.

As part of the TEN-T review, specific performance indicators have been established for freight trains, aimed at reducing border crossing times and increasing corridor reliability.

One of the key requirements was to reduce the average dwell time for freight trains at internal EU borders to 25 minutes (Article 32 of the Regulation). However, the legislation recognizes realistic exceptions. For example, the 25-minute standard does not apply when changing track gauge (at the Poland-Belarus border), which physically requires re-arranging bogies or reloading containers; as well as for delays caused by third countries through whose territory the train passes.

Furthermore, a target is being introduced for the majority of trains crossing at least one border along the European Transport Corridors to arrive at their destination either on schedule or with a delay of no more than 30 minutes. According to Article 19 of the Regulation, by 2030, at least 75% of freight trains crossing at least one border along the European Transport Corridor must arrive at their destination (or at an external EU border) strictly on schedule or with a delay of no more than 30 minutes. This target only includes delays for which the infrastructure owners of EU Member States are responsible; disruptions occurring in third countries are not included.

Punctuality is an important indicator for rail transport. According to the T&E report, as of December 2024, only 8 out of 25 rail operators (32%) achieved a punctuality rate above 80%, with the punctuality threshold being a delay of no more than 5 minutes behind schedule.

Most of the EU operates on the standard European gauge of 1435 mm, which allows for through train traffic without technical restrictions. However, a number of Member States (for example, Finland and the Baltic states) use the broad gauge of 1520 mm. The TEN-T Regulation explicitly defines such sections as isolated networks—that is, networks or parts thereof that are not connected to the standard-gauge mainline network. European legislation recognizes that such networks, by definition, cannot fully utilize the benefits of the unified EU infrastructure and are therefore exempt from compliance with regulations that are economically unjustified for such a network.

Requirements for transport infrastructure have been introduced and strengthened. In particular, by 2040, all railway lines must support speeds of at least 160 km/h for passenger traffic and 100 km/h for freight traffic (Article 16 of the Regulation). Terminals and transfer points must be capable of handling trains up to 740 meters long (Article 15 of the Regulation). On double-track lines, it must be possible to allocate at least two freight train lines per hour in each direction for trains at least 740 meters long. On single-track lines, the minimum standard is one line every two hours in each direction (Article 19 of the Regulation). Article 20 of the Regulation notes the possibility of developing infrastructure for trains longer than 740 meters (up to 1,500 meters) and with an axle load of up to 25 metric tons, subject to a positive socio-economic analysis.

Significant attention is paid to reducing the negative environmental impact of rail transport, primarily through measures to reduce noise and vibration, including requirements for both rolling stock and infrastructure, including noise barriers. Infrastructure must be prepared for alternative fuels and multimodal hubs (e.g., charging/fueling points for hydrogen and electric vehicles). Particular attention is paid to the multimodality and interconnectivity of individual modes of transport, such as connecting major airports with long-distance rail lines.

Emphasis is also placed on the implementation of innovative technologies. The Regulation explicitly refers to developments within Shift2Rail and Europe's Rail initiatives, including automatic train control and advanced traffic management systems. Mandatory implementation of the European Rail Traffic Management System (ERTMS) is required, with the gradual phase-out of national systems (Article 18 of the Regulation). ERTMS (European Rail Traffic Management System) is a standardized control, signaling, and communication system designed to improve the safety, efficiency, and interoperability of rail transport in Europe. It consists of two main components: the European Train Control System (ETCS), a unifying system for national systems and a set of unified standards developed through international cooperation for railway automation, telemetry, communications, and dispatch control; and the Global System for Mobile Communications — Railways (GSM-R), a radio communication standard for the European Train Control System based on the GSM standard specifically reserved for railways. With ERTMS, trains can seamlessly cross national borders without changing their control system.

The regulation establishes the European Rail Traffic Management System (ERTMS) as a mandatory technological standard to ensure interoperability, safety, and capacity in rail transport. Article 18 establishes a phased and differentiated implementation schedule for ERTMS depending on the network category. EU Member States are required to ensure that the core network's railway infrastructure is equipped with ERTMS by 31 December 2030 at the latest, with the exception of individual railway sidings referred to in Article 14(1)(d), i.e., so-called last-mile connections providing access to terminals, ports, and junctions. For such connections, ERTMS implementation is also required by 2030, but only where the Member State concerned, in coordination with railway infrastructure owners and other stakeholders, deems such equipment necessary. Similar requirements apply to the extended core network, with a deadline of 31 December 2040 at the latest, and to the comprehensive network, with a deadline of 31 December 2050 (Article 18(2) of the Regulation).

Member States shall ensure that Class B[1] systems are decommissioned no later than 31 December 2040 on the core network, 31 December 2045 on the extended core network, and 31 December 2050 on the comprehensive network, provided that an adequate level of safety is ensured. An exception is made for sections in urban hubs where lines are used by suburban passenger traffic and are equipped with dedicated national systems (clause 3 of Article 18 of the Regulation).

Member States shall ensure the implementation of the ERTMS radiocommunication system on the railway infrastructure of the core network, extended core network, and comprehensive network no later than 31 December 2050. However, for new railway lines, such equipment will become mandatory from 31 December 2030, and for projects modernizing existing signaling systems from 31 December 2040 (clause 4 of Article 18 of the Regulation).

At the same time, the Regulation allows for waivers from these obligations by Member States. In justified cases, Member States may request a waiver if the results of a socio-economic analysis show a negative impact from the implementation of the new system, or if there are significant limitations to interoperability.

[1] National Class B systems in Europe are national train control and signaling systems that existed in European countries prior to the implementation of the unified European standard ERTMS and continue to be used alongside it, such as the German PZB and the French KVB. The planned decommissioning is due to the lack of full interoperability between the systems.

Table 1.
COMPARISON OF TEN-T NETWORK LEVELS

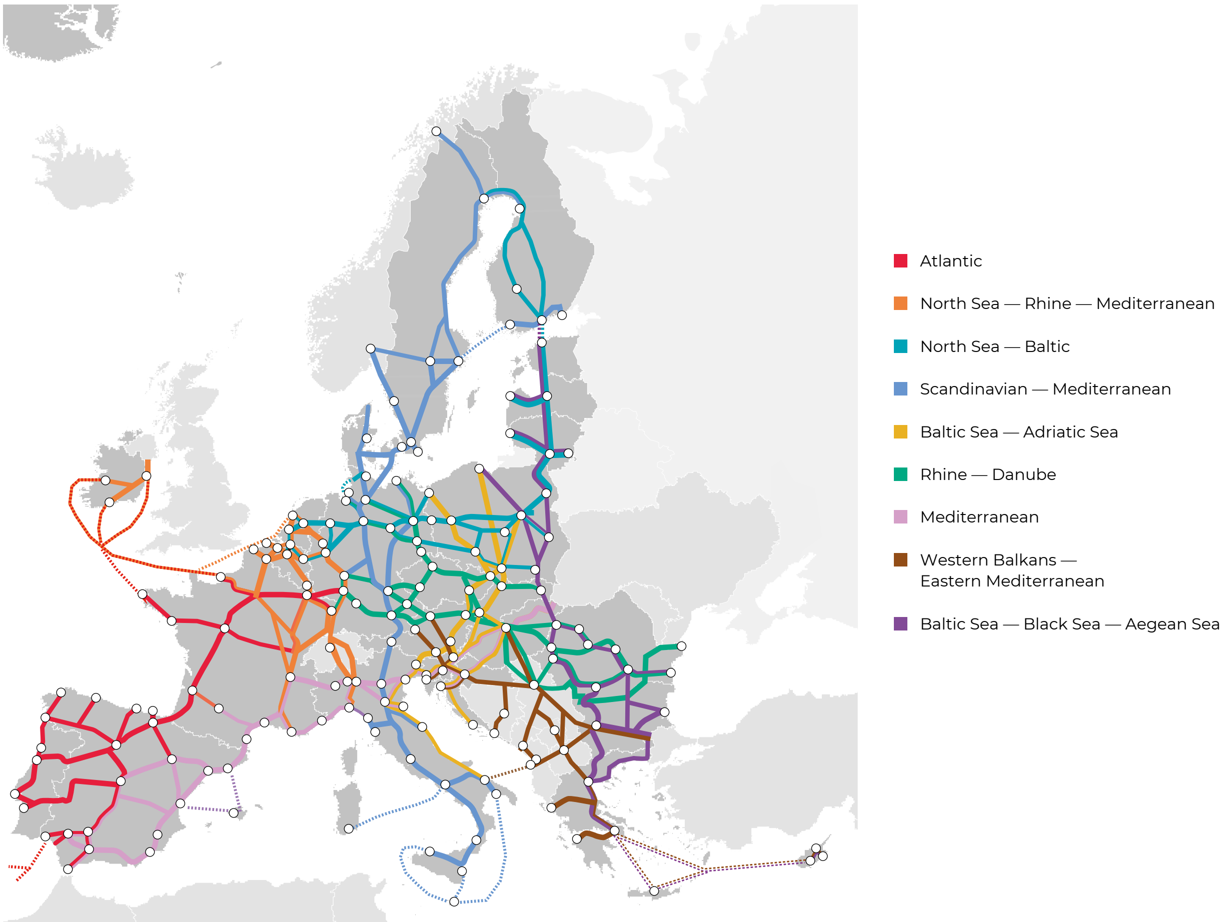
	Core network	Extended core network	Comprehensive network
Description	Major transcontinental corridors and key hubs (sea/land ports, terminals)	Extended core network providing connections to neighboring regions	Covers all remaining network elements: regional routes, auxiliary hubs
Target implementation date	By 31 December 2030	By 31 December 2040	By 31 December 2050
Electrification	Complete for the entire network by 2030	Complete for the entire network by 2040, for new lines by 2030	Complete for all lines and necessary routes by 2050
Axle load	≥ 22.5 t	≥ 22.5 t	≥ 22.5 t (on certain lines)
Freight train length	≥ 740 m	≥ 740 m	≥ 740 m (on priority lines)
Speed (freight trains)	≥ 100 km/h	≥ 100 km/h on ≥75% of sections between nodes	Not installed
Speed (passenger trains)	≥ 160 km/h	≥ 160 km/h on ≥75% of sections between nodes	Not installed
Applicability of requirements	Complete, excluding isolated networks	Complete, excluding isolated networks	Partially, with certain conditions
Possibility of exemptions	Possible, but subject to strict control	Possible, with enhanced EU assessment	Wide, for geographic and other reasons

Source: compiled by the authors

TEN-T Corridors

The coherence of the European transport network is achieved through the TEN-T corridors — key routes through which transport flows (rail, road, inland waterways, and maritime routes) pass. The official website of the European Commission states that the network comprises nine European transport corridors.

TEN-T CORRIDOR MAP



Source: European Commission

The corridors create an infrastructure «highway» across the EU for international rail transport, including the China-Europe route. The countries participating in the China-Europe route — namely, Poland, Germany, Hungary, and Serbia — are located along several key corridors, such as the North Sea — Baltic Corridor and the Rhine — Danube Corridor, where the main terminals for container transit from China (Malaszewicze, Hamburg, and Duisburg) are concentrated. The modernization of these corridors directly impacts the efficiency of the route.

Hungary and Serbia, located on the TEN-T Western Balkans–Eastern Mediterranean southeastern corridor, are seen as key links for diversifying the China-Europe-China route. The Budapest-Belgrade line is being designated a strategic hub, enabling the creation of an alternative overland route to Europe through the Balkans, bypassing the more northern crossing through Poland.

In the Netherlands, the TEN-T Revision is stimulating the development of multimodal terminals in ports. For example, construction has begun on a new freight railway station, Maasvlakte Zuid, in the Port of Rotterdam. The first phase of the project envisions the construction of six tracks, each designed for 740-meter-long trains, and their connection to the existing rail network by mid-2027.

The development of such facilities is primarily aimed at reducing congestion at port terminals and accelerating the movement of containers deeper into Europe. Given periodic surges in imports from Asia, this allows seaports to improve operational stability and reduce the time containers spend at terminals.

Environmental Agenda

Particular attention is paid to reducing the environmental impact of transport. According to paragraph 2 of the Regulation, transport accounts for approximately 25% of all greenhouse gas emissions in the EU, and their volume has continued to grow in recent years. The European Green Deal sets a target of reducing emissions from transport by 90% by 2050. To achieve this, the target is to increase the share of rail freight by 50% by 2030 and double that by 2050 (paragraph 3 of the Regulation).

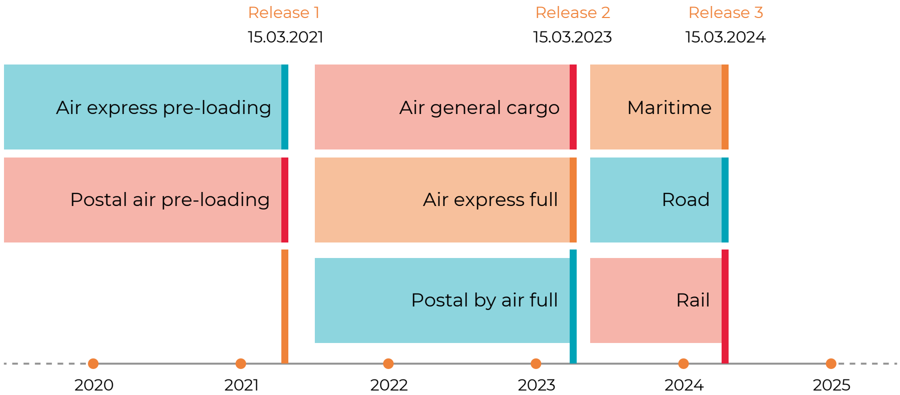
One of the key elements is CountEmissionsEU, on which the EU Council and the European Parliament reached a preliminary agreement in November 2025. The Regulation introduces a unified methodology for calculating greenhouse gas emissions in the transport sector, based on the international standard ISO 14083:2023 and the “well-to-wheel” principle. Emissions calculation remains voluntary, but if a company decides to conduct calculations, for example for reporting, contractual obligations, or marketing purposes, the uniform methodology becomes mandatory. Transport operations will be expressed as CO_2 emissions per metric ton — kilometer for freight transport and as CO_2 emissions per passenger — kilometer for passenger transport.

Particular attention is paid to data quality. Priority is given to the use of primary data obtained directly from vehicles and control systems. This regulation incentivizes companies that measure emissions directly, creating technological demand for sensors, telematics, and digital monitoring platforms. Furthermore, all data collected under other European environmental schemes can be reused. A free emissions calculation tool is provided for small and medium-sized businesses, ensuring the accessibility of environmental reporting regardless of company size. In the long term, the EU plans to expand the methodology to cover the entire life cycle of vehicles, including production, maintenance, and disposal. This will fundamentally change the regulatory environment and allow for the inclusion of indirect emissions, which are currently often omitted from reporting.

2. Import Control System 2 (ICS2): A New Architecture for EU Customs Security

Since 2024, the European Union has been steadily implementing the second generation of its Import Control System — Import Control System 2 (ICS2), a major reform in the digital management of external supplies. The main goal of ICS2 is to strengthen customs and logistics security through the advance exchange of data on goods crossing the EU’s external borders when traveling into Union.

IMPORT CONTROL SYSTEM IMPLEMENTATION STAGES



Source: IT Subway Map

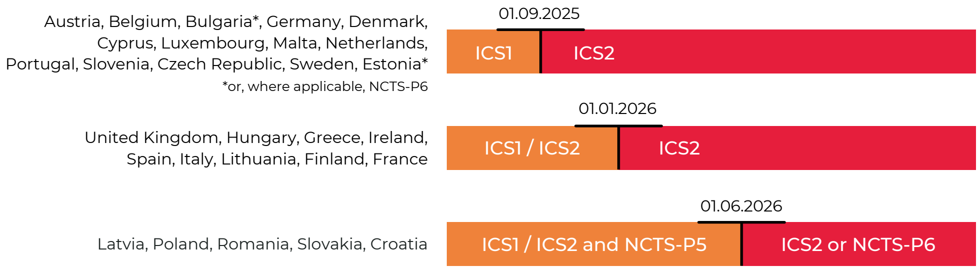
The system is based on the pre-filing of an Entry Summary Declaration (ENS), which includes information on the sender, recipient, route, description of the goods, and mode of transport. This information is entered into a centralized database, where automated risk analysis is performed at the level of the European Commission and national customs services.

ICS2 completely replaces the Import Control System (ICS1), which has been in effect since 2011, and significantly expands the scope of operator responsibilities. The obligation to submit ENS now falls not only on carriers but also on freight forwarders, shippers, and those actually organizing the transport.

Furthermore, ICS2 harmonizes security rules across the Union: all customs authorities use a single risk assessment algorithm, eliminating inconsistencies between countries and minimizing the possibility of regulations being circumvented through less-controlled borders.

According to the official announcement of the European Commission, ICS2 requirements were extended to rail and road transport as of 1 April 2025. A transitional period (deployment window) lasted until 1 September 2025, during which operators were required to integrate their IT systems and test ENS submission. After 1 September 2025, ICS2 is considered fully mandatory for all modes of transport (including rail) in all Member States, except in cases where individual countries have applied for deferrals. Specifically, Poland will fully transition to ICS2 on June 1, 2026. New message formats (v3) are used for ENS declarations, and older versions (v2) will be phased out on February 3, 2026.

ICS2 ADOPTION BY EUROPEAN STATES



Source: European Commission

ICS2 implementation is of strategic importance for the China-Europe-China route. All rail carriers entering the EU through border crossings in Poland, Germany, Hungary and other countries will be required to transmit ENS data in advance. While this enhances transparency and reduces the risk of smuggling or prohibited shipments, it also increases the administrative burden on participants and increases the likelihood of delays due to incomplete or erroneous declarations. For cargo owners and route operators, this means that ICS2 compliance will be a competitive advantage.

3. Infrastructure Charges: Track Access Charges

In Europe, the management of rail infrastructure and transportation is divided between infrastructure managers (IMs) and railway undertakings (RUs). The former are organizations (e.g., DB InfraGO in Germany, SBB Infrastructure in Switzerland, ÖBB-Infrastruktur AG in Austria) that own, manage, and maintain railway infrastructure to ensure access for various carriers, promoting competition and the development of a single European market. The latter are companies or organizations engaged in the rail transport of freight and/or passengers. Railway undertakings (RU) may also own all or part of the infrastructure (IM), but the most common form is the holding model, in which the owner and carriers are legally separate but part of a single corporate group (e.g., Deutsche Bahn in Germany, SNCF in France, ÖBB in Austria). Track Access Charges (TAC), in turn, are fees paid by railway undertakings (RU) to infrastructure managers (IM) for using the infrastructure.

The legal basis for TAC is laid out in Directive 2012/34/EU and Commission Regulation 2015/909, which define the principles for setting the fees. Article 31 of the Directive requires that the base rate for the minimum access package (MAP) correspond to the direct costs incurred by the movement of a specific train. This refers to the so-called marginal cost: track wear and tear, operating costs, and other expenses incurred specifically because the train used the infrastructure. This rate is not permitted to include capital expenditures, administrative costs, or other costs that exist regardless of whether the train is in operation.

However, the Directive allows for the modification of this base rate. First, the infrastructure owner can adjust the rate based on environmental factors, including incentives for using less harmful technologies or penalties for negative impacts — environmental coefficients. Second, a component reflecting capacity shortages — the so-called scarcity or congestion charge — is permitted. This element is applied during periods or in areas where infrastructure demand exceeds capacity, and its purpose is to rationalize the use of scarce resources.

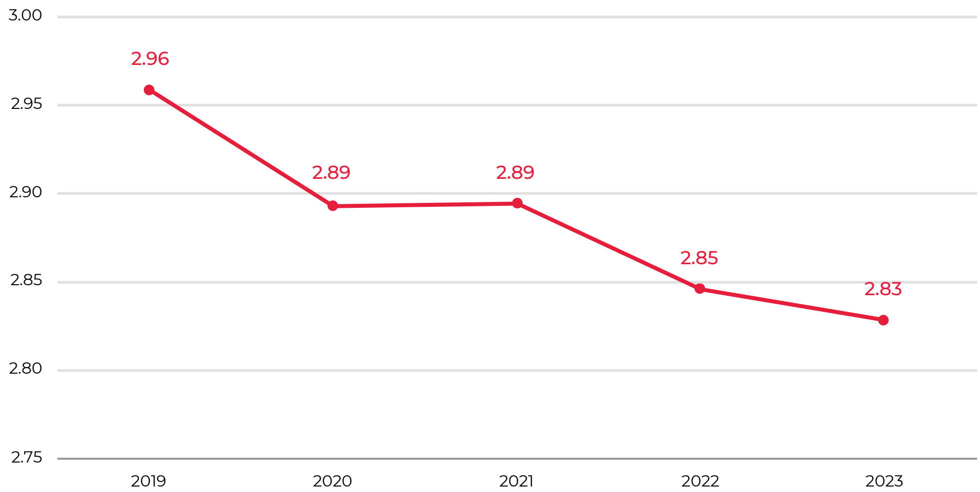
The most important additional element is mark-ups. Article 32 of the Directive permits their use in exceptional cases to allow the infrastructure owner to compensate for costs not covered by the base rate. This is a key tool that allows different national systems to balance the financial needs of infrastructure. However, the introduction of mark-ups is limited by a number of conditions. Mark-ups must not hinder the use of infrastructure by efficient market participants, cannot be discriminatory, and must be set taking into account the ability of the relevant market segment to withstand the additional financial burden. Countries independently define segments, with some dividing the market into freight and passenger transport, while others distinguish segments based on the type of cargo transported: bulk, industrial, hazardous goods, and container transport.

In other words, the admissibility of a mark-up is assessed not for individual railway companies, but at the level of the market segment as a whole and is verified using the criterion of a cost-effective operator. An "efficient operator" is defined as a carrier that operates rationally and without excessive costs, using technologies and organizational solutions typical for a given segment. This approach is used to assess whether the market as a whole can withstand the established mark-ups. If the mark-up level makes infrastructure use economically unviable for an efficient operator in a given segment, the mark-up is considered a violation of the Directive's principles.

Therefore, the TAC structure can include three components: mandatory payments covering direct costs (the minimum access package), additional mark-ups, and optional coefficients and charges related to environmental issues or capacity constraints.

According to the IRG-rail report, the TAC rate for the minimum access package, which carriers paid to infrastructure owners from 2019 to 2023, has been declining.

AVERAGE TAC RATE FOR THE MINIMUM ACCESS PACKAGE IN 29 IRG MEMBER STATES (EXCLUDING KOSOVO AND SERBIA), EUR PER TRAIN-KM



Source: IRG-rail report

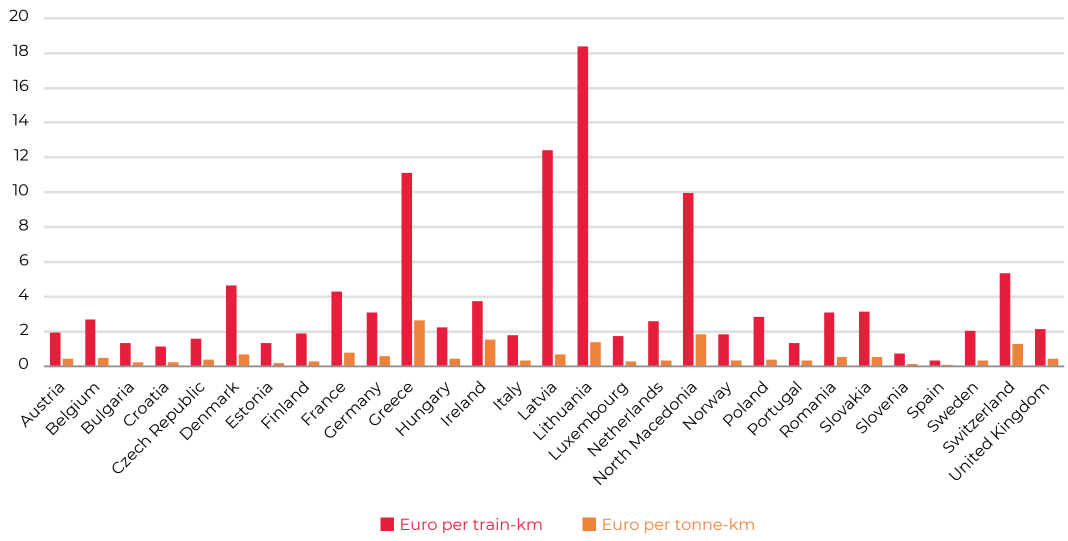
In practice, the TAC system has proven significantly more varied and complex. Infrastructure owners in different EU countries have developed their own approaches to using surcharges, and the key factor in their choices has been the degree of public funding for infrastructure. The level of actual infrastructure support varies greatly across countries: in some countries, the state reimburses a significant portion of network maintenance costs, while in others, owners are forced to rely on mark-ups to cover funding shortfalls.

As noted in the Interpretative Guidelines for Setting Rail Infrastructure Charges, the condition of the infrastructure also varies. Where the network is modernized and equipped with advanced traffic management systems, including ERTMS, operating costs may be lower and traffic density higher. This allows fixed costs to be distributed among a larger number of users and reduces pressure on fares. In countries where infrastructure is aging, has low capacity, or requires significant investment in upgrades, infrastructure owners are forced to resort more frequently to mark-ups to meet their financial obligations to the state and ensure network reliability.

Current practice also reveals significant differences in how owners define market segments for the application of mark-ups. Some countries fine-tune the market into numerous categories: segments can vary by cargo type, speed parameters, and the availability of night trains. Others opt for minimal fragmentation, retaining only basic groups such as passenger and freight transportation.

The methodology for calculating the mark-ups themselves also varies. Some countries use complex econometric models that estimate long-term costs and distributes them proportionally to network usage; others employ a simpler approach based on historical costs and fixed coefficients. As a result, a significant fragmentation of TAC systems is observed at the EU level.

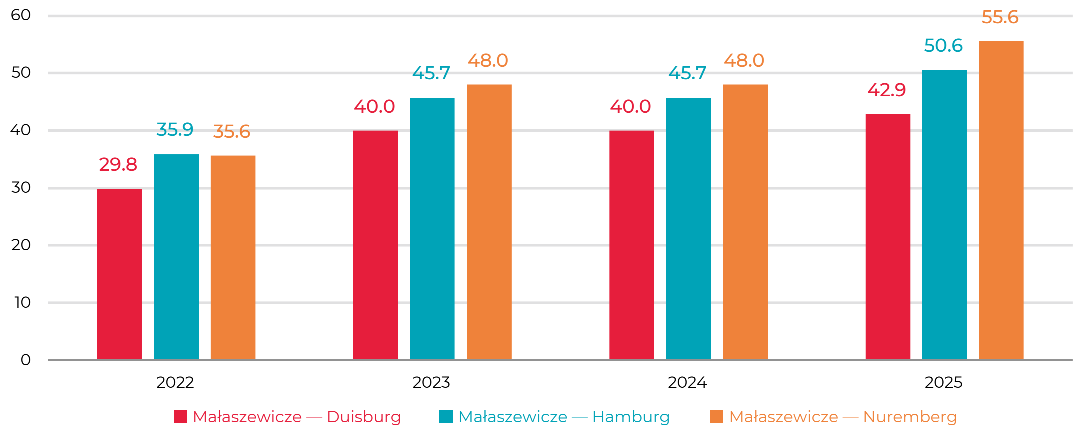
RAIL INFRASTRUCTURE ACCESS CHARGES PAID PER TRAIN-KILOMETER AND TON-KILOMETER FOR FREIGHT TRANSPORT IN 2023



Source: IRG-rail report

The average TAC in Europe in 2023 was approximately €2.83 per train-km. However, this figure should not be directly compared with the market price of rail container train transport, which, according to European operators, ranges from €40–55 per train-km.

CONTAINER TRAIN COST IN THE EU, € PER TRAIN-KM



Source: compiled by the authors

While the average Track Access Charges (TAC) in Europe trended downward from 2019 to 2023, the actual commercial cost of rail container transport, on the contrary, increased annually. It is worth noting that the comparison period for the data is different, but the figures for 2022–2023 are similar. The aforementioned trend is confirmed by the fact that during this period, the TAC decreased from 2.85 to 2.83, while the average cost of transporting a container train increased by 30%.

Thus, cheaper access to infrastructure did not lead to a proportional decrease in market rates for freight transportation. This indicates that the dynamics of the final cost of services are determined by more than infrastructure payments. The TAC reflects only the minimum fee for access to infrastructure, while the commercial rate is formed by a combination of services provided by rail carriers, forwarders, and terminal operators.

An additional factor that may explain the higher final cost of transporting container trains is the use of mark-ups. Mark-ups can be differentiated by segment, provided that the relevant segment can withstand such a load without losing access to infrastructure. In this logic, container shipping is generally considered a separate commercial segment for which higher surcharges are permitted compared to other types of rail freight.

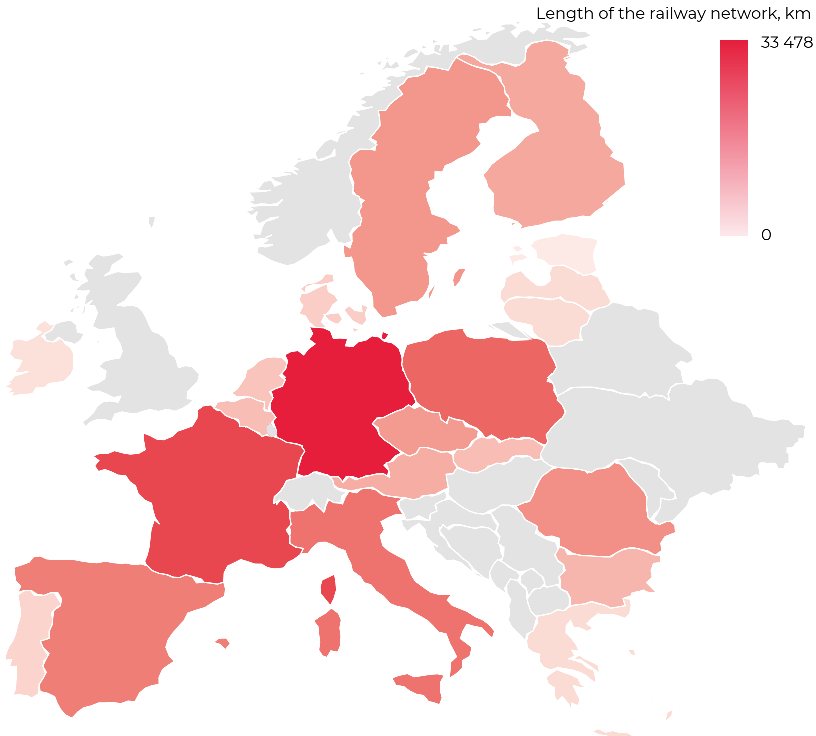
THE CURRENT STATE OF EUROPEAN RAIL INFRASTRUCTURE

Despite the stated strategic objectives, the current state of the European rail system shows that significant work remains if one hopes to achieve the stated goals. Current rail infrastructure development indicators demonstrate the need for further efforts to reduce emissions through network electrification, increased speeds, and the full-scale implementation of digital traffic management systems.

The largest networks are concentrated in countries with a developed industrial base and a high volume of domestic and international traffic. Germany leads the way with a network of 33,500 km, followed by France (27,700 km) and Poland (18,800 km). These countries form the key backbone of the European rail space, accounting for a significant share of freight and passenger traffic within the EU.

Other countries with large and well-developed networks include Italy (17,400 km) and Spain (16,000 km). Romania (10,600 km), the Czech Republic (9,400 km), Hungary (6,900 km), and Austria (5,100 km) remain important regional hubs in Central and Eastern Europe.

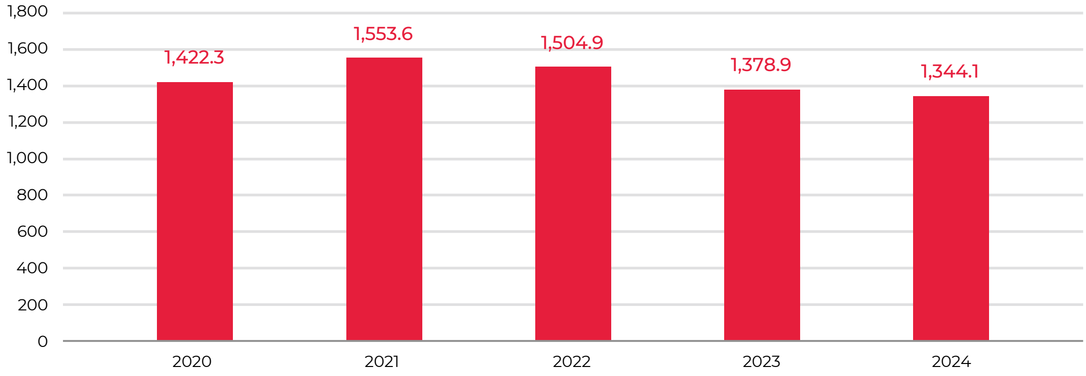
LENGTH OF THE EUROPEAN RAILWAY NETWORK, KM



Source: compiled by the authors

According to Eurostat, rail freight volumes in Europe have been declining by 4.7% annually from 2021 to 2024.

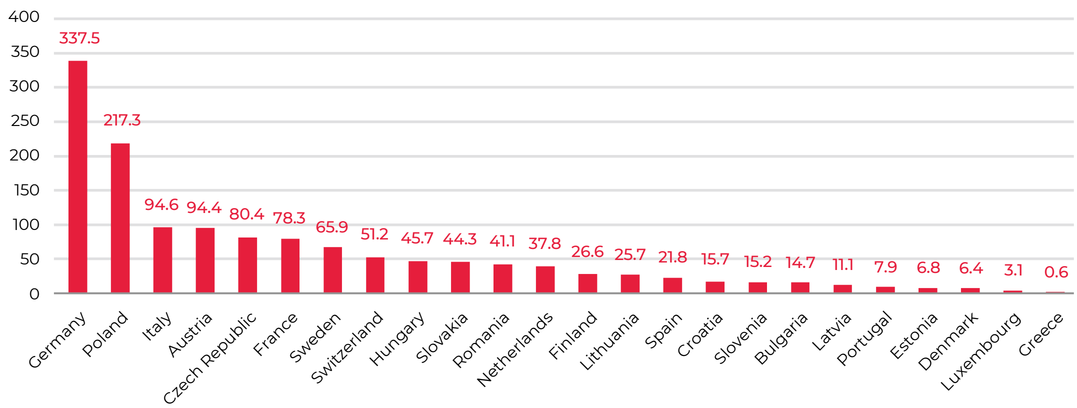
RAIL FREIGHT IN EUROPE FROM 2020 TO 2024, MILLION METRIC TONS



Source: compiled by the authors based on Eurostat data

Rail freight volumes vary significantly between EU countries, creating a distinct hierarchy of transport hubs. The leaders in freight volumes are Germany (337.5 million metric tons) and Poland (217.3 million tons). These two countries play a key role in Eurasian transportation infrastructure and serve as key links on the China-Europe-China route. Their extensive terminal networks, high levels of intermodality, and modernized infrastructure enabled them to handle significant cargo volumes and secure a stable position in transit flows. According to the IRG-rail report, Germany has a record number of freight terminals—1,058—followed by Poland with 676.

FREIGHT TRAFFIC VOLUME ON THE EUROPEAN RAIL NETWORK AT THE END OF 2024, MILLION TONS

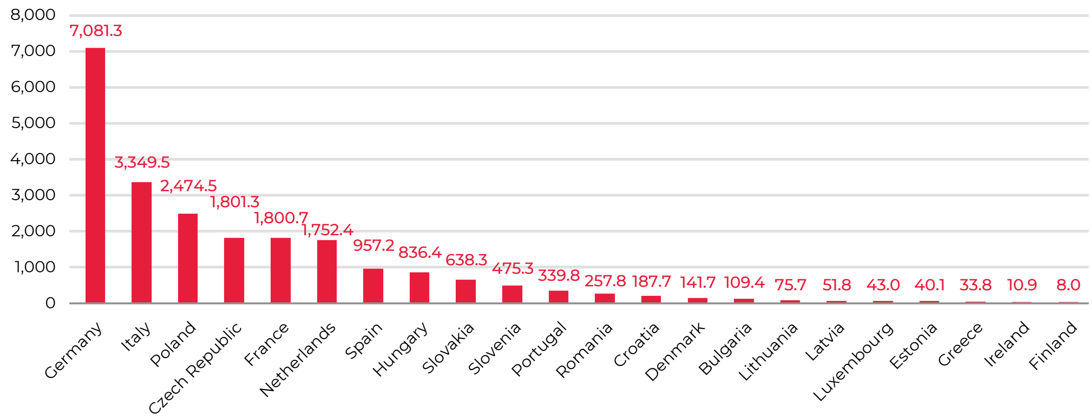


Source: compiled by the authors based on Eurostat data

In 2024, container rail traffic volumes in Europe were heavily concentrated in a small number of countries. Germany remained the clear leader, with traffic volumes reaching 7.08 million TEU. This is more than twice the volume of its closest rival, Italy (3.35 million TEU), and reflects Germany's role as the continent's central logistics hub and the main distribution hub for container flows. The group of countries with high volumes also includes Poland (2.47 million TEU), the Czech Republic (1.80 million TEU), France (1.80 million TEU), and the Netherlands

(1.75 million TEU). Poland and the Czech Republic play a key role on land routes between Eastern and Western Europe, including routes linked to China-Europe-China connections. Countries in the Balkan region demonstrate significantly lower traffic volumes. Thus, in Romania, container rail traffic amounted to 258,000 TEUs, in Croatia — 188,000 TEUs, and in Bulgaria — 109,000 TEUs. A similar situation is typical for the Baltic and Northern European countries, where volumes do not exceed 100,000 TEUs per year.

CONTAINER TRAFFIC VOLUME ON THE RAIL NETWORK OF EUROPEAN COUNTRIES AT THE END OF 2024, IN THOUSANDS OF TEUS



Source: compiled by the authors based on Eurostat data

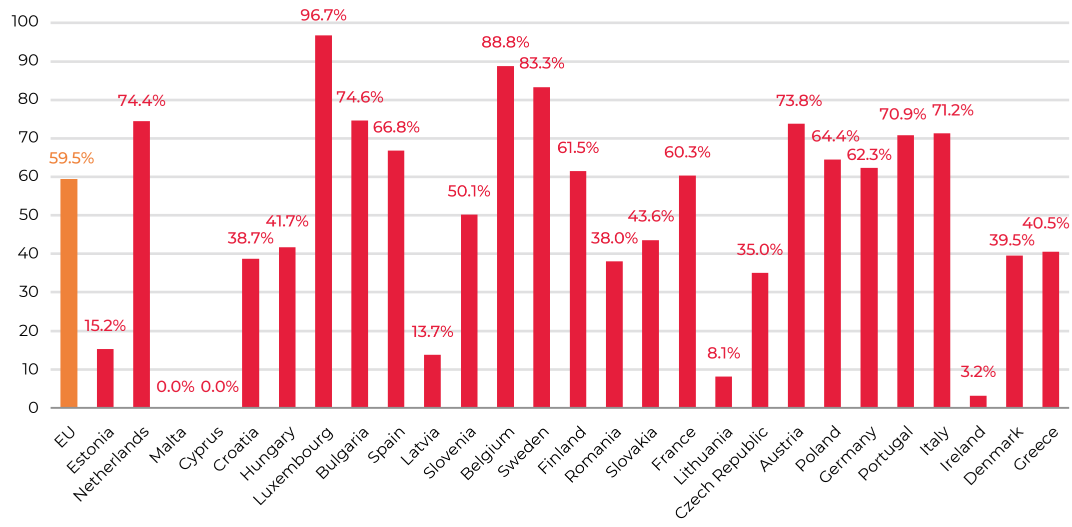
According to UIC data, just over half of the European rail network (59.4%) is electrified, and the variation between countries reveals significant structural differences.

Countries with developed and compact transport systems have some of the highest levels of electrification: Luxembourg (96.7%), Belgium (88.8%), Sweden (83.3%), the Netherlands (74.4%), and Austria (73.8%). On the other hand, there are countries in Europe with a significantly lower share of electrified lines. For example, Ireland, where only 53 km (3.2%) of its 1,650 km network are electrified, also has low rates: The Baltic countries have low electrification rates: Estonia (15.2%), Latvia (13.7%), and Lithuania (8.1%). The contrast is also striking in Southern Europe: Greece is only 40.5% electrified, worse than Croatia 38.7%, and Romania 38.0%.

Even among the largest rail systems, there is significant variation. Germany has achieved 62.3% electrification of its extensive network, while France has 60.3%. Italy and Spain demonstrate higher rates (71.2% and 66.8%, respectively).

In Central and Eastern Europe, development rates are closer to the European average, but also with greater internal variability. The railway infrastructure of Poland is 64.4% electrified, Slovakia — 43.6%, Hungary — 41.7%, and the Czech Republic — 35.0%.

EUROPEAN RAIL NETWORK ELECTRIFICATION LEVELS BY THE END OF 2023 (%)



Source: Railisa UIC Statistics

According to the T&E report, average permitted speeds on rail lines vary across European countries: 3% of TEN-T corridor lines allow trains to travel faster than 150 km/h, while 30% operate at speeds slower than 60 km/h. Eight Member States have achieved a maximum speed of 80 km/h on most of their lines, below the TEN-T target of 160 km/h.

SPEED LIMITATIONS IN THE EUROPEAN RAIL NETWORK (KM/H)

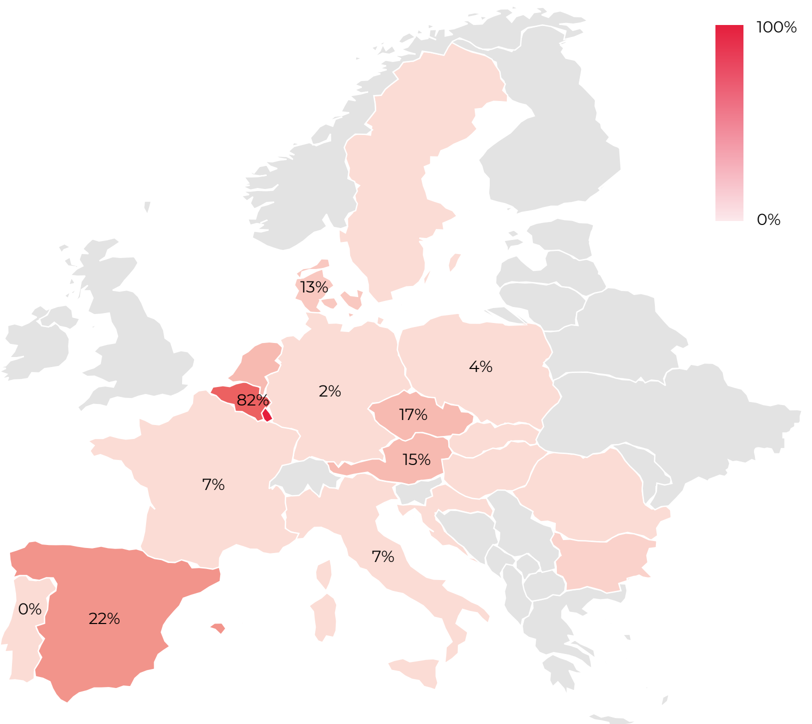
Source: T&E report

Speed differences between countries are often explained by technical and geographical limitations. Spain and France stand out, boasting two of the five largest high-speed rail networks in the world. More than 20% of the Spanish network allows travel at speeds above 240 km/h, the result of a long-standing high-speed development strategy. At the same time, most of the Croatian network is limited to speeds below 80 km/h. Austria, despite its high-quality standards, also has a significant proportion of low-speed lines due to its mountainous terrain. Germany and Italy, for example, have a relatively low share of dedicated high-speed lines, but provide a large absolute number of high-speed services through hybrid operation of mixed lines. The main factor in the persistent gap remains financial constraints, including chronic underinvestment in modernization in several Eastern European countries. High-speed lines are virtually nonexistent here, despite the high demand for them.

Less than 20% of TEN-T corridors are equipped with the European Train Control System (ETCS) — a key element of ERTMS, which is necessary for the safe movement of trains across borders and for increasing the capacity, speed, and reliability of rail transport.

According to TEN-T requirements, the system must be deployed across the entire core network infrastructure by 2030, with national systems to be completely decommissioned by 2040. As of 2023, GSM-R covers 61% of the core network, while ETCS is used on only 15%. According to OpenRailwayMap, Germany uses the national PZB (Punktförmige Zugbeeinflussung) system on most of its rail infrastructure, with LZB (Linienzugbeeinflussung) and ETCS on some sections. As of the end of 2024, ETCS had been implemented on only 1.6% of the German rail network. France primarily uses the national KVB (Kontrôle de Vitesse par Balises) system and only uses ETCS on some sections.

SHARE OF THE RAIL NETWORK EQUIPPED WITH THE EU'S ETCS TRAIN CONTROL SYSTEM



Source: T&E report

According to the data provided, only Belgium and Luxembourg are close to completing the implementation of ETCS across their entire networks. Many other countries remain at less than 10% coverage, which is particularly critical for France, Germany, and Poland—countries that play a central role in the European transport system. These gaps limit the ability of railways to provide faster and more reliable service.

INFRASTRUCTURE PROJECTS IN EUROPE

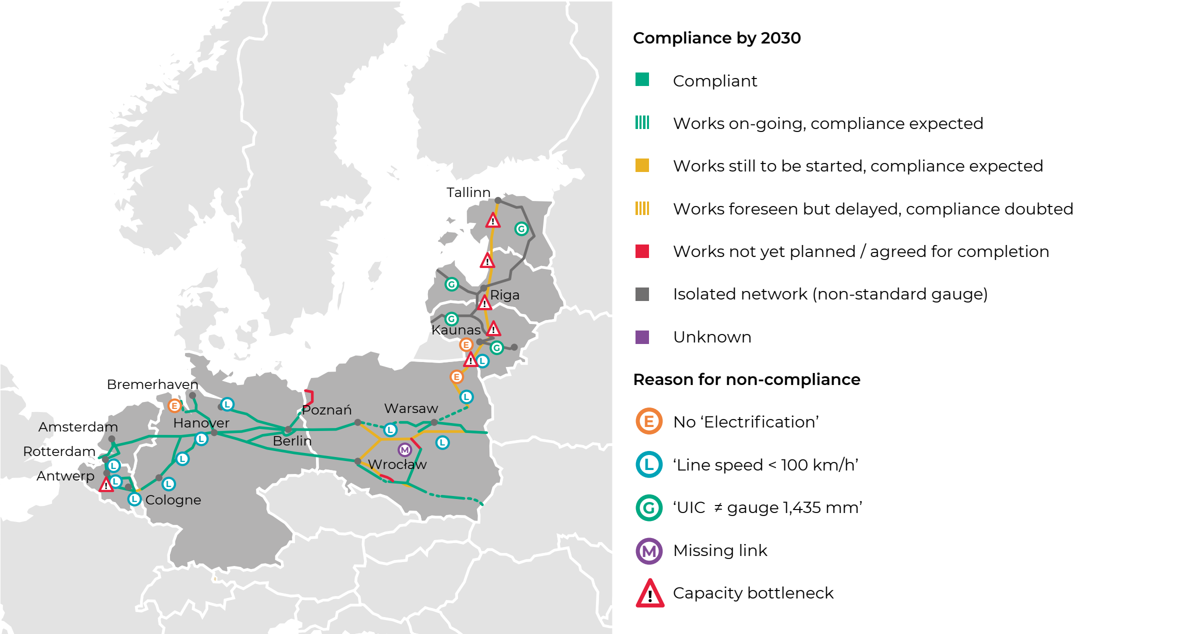
According to the European Commission, completing the core TEN-T network by 2030 will cost approximately €515 billion. By 2040, this figure will rise to €850 billion. The development of the North Sea — Baltic corridor is of particular importance for our study. This 9,030-kilometer corridor spans the Baltic states, Sweden, Finland, Poland, Germany, the Netherlands, and Belgium. The Poland — Germany section is key to the Eurasian railway route connecting China with Europe. Consequently, development of the corridor is a priority for route participants.

Strategic Development of the North Sea — Baltic Corridor

According to the Implementation Plan 2025 for the Rail Freight Corridor North Sea–Baltic, the corridor is defined as the main axis for multimodal and rail freight and passenger flows, with the strategic goal of improving service quality, stability, and interoperability, as well as increasing the share of rail in freight transport, while implementing EU environmental policies. Regarding technical requirements, the document requires that the lines comply with TEN-T standards: electrification, the 1435 mm standard European gauge where possible, train lengths up to 740 meters, compliance with gauges and loads, and a gradual transition to the ERTMS train management system.

As early as 2026, the corridor is scheduled to enter the accelerated phase of ERTMS implementation and modernization of sections critical to ensuring uniform European standards. Although ETCS will only cover a small portion of the route by 2025, the European Commission requires corridor member countries to complete equipping all sections of the core network by 2030. Work will be particularly significant on sections in Germany and Poland, where the introduction of ERTMS will offset high network congestion and allow for shorter intervals, increasing the capacity of existing lines without the need to build new tracks.

COMPLIANCE OF THE NORTH SEA — BALTIC CORRIDOR RAILWAY NETWORK WITH TARGETS BY 2030



Source: 5th North Sea-Baltic TEN-T Corridor work plan

Poland is becoming the core of the development of the eastern segment of the TEN-T. By 2030, electrification work is planned on its territory, strengthening the track's load-bearing capacity, increasing the maximum train length to 740–750 meters (currently, some sections in Poland can only handle trains that are 620–695 meters long), and increasing speeds on those sections that are slated to become part of the high-speed service as part of the updated TEN-T network.

Development of the Polish terminal in Małaszewicze, a key link in the corridor, is also planned. The Małaszewicze terminal expansion project is conceived as a major multimodal hub. Key projects include new access roads, cranes, cargo handling areas, longer platforms, and new warehouse capacity. This will enable the handling of long container trains and ensure faster and more efficient gauge changes (from 1520 mm to the standard 1435 mm), as well as reduce downtime and waiting times. The Polish government has guaranteed PLN 3.2 billion (EUR 744 million) in funding for the project. Its ultimate goal is to double the capacity of the transshipment hub on the Polish-Belarusian border. The reconstruction is scheduled for completion in June 2026, and the capacity of the border hub is expected to more than double — from 16 to 35 pairs of trains. The maximum train length will be increased from 750 to 1,000 meters.

Poland's port infrastructure is also developing. In November 2025, PKP Polskie Linie Kolejowe (PKP PLK), a Polish railway infrastructure manager, and the Port of Gdansk Authority signed a cooperation agreement to begin work on expanding rail and road access to the deep-water terminals located on the port island in the North Port of Gdansk. The planned investments include the construction or modernization of the port's rail infrastructure and hinterland. The projects will increase the capacity of the Gdansk-Port Północny station.

In northwestern Europe, significant work will continue in Germany, the Netherlands, and Belgium. In Germany, the expansion and modernization of the Rhine-Ruhr and Rhine-Main sections, which provide access to the ports of Rotterdam and Antwerp, is planned for 2030.

The central project is the development of the Rhine-Alpine Corridor — one of the busiest and most strategically important routes in the EU. This route connects Northern European ports (Belgium, the Netherlands) and the Rhine-Ruhr industrial region with Italy and southern European countries. The project modernizes critical junctions: lines between Mannheim, Koblenz, Frankfurt, and the Rhine-Ruhr region are being expanded, the ETCS/ERTMS system is being implemented, and capacity for freight and passenger trains is being increased.

Also noteworthy is the project for a new combined transport terminal in Dortmund (Dortmund Logistics Park). This terminal is intended to become an important multimodal hub on the northwestern approach to the Rhine-Alpine Corridor. It will ensure the efficient handling of container cargo, serve as a transshipment point for shipments to and from Northern European ports, and increase the flexibility of logistics chains.

Developing Connectivity with Balkan Countries

Since the beginning of 2023, the European Commission has officially signed agreements with several Balkan countries to adapt and expand the TEN-T network in the Western Balkans. This means that the region is becoming a priority area for investment, modernization, and connection to the European transport system. Through this initiative, the network of railways, ports, roads, and river routes in the Balkans is intended to become part of a unified multimodal system.

According to the Five-Year Rolling Work Plan for the Development of Indicative TEN-T Extension of the Comprehensive and Core Network in Western Balkans, work to bring the network up to TEN-T standards is planned to begin in 2025–2026, including electrification, track modernization, signaling upgrades, and junction reconstruction.

China is also an active player in the Balkan region. China has financed the Belgrade-Budapest railway modernization project. The modernization of the Belgrade-Budapest railway line aims to bring the outdated infrastructure up to modern standards. The project envisions the construction of a high-speed, double-track, electrified line 350 kilometers long (184 kilometers in Serbia and 166 kilometers in Hungary), designed to carry both passengers and freight. The main goal of the modernization is to reduce travel time between Belgrade and Budapest from eight hours to two hours and forty minutes for passenger travel, as well as to facilitate the accelerated transportation of Chinese goods through Mediterranean ports to Western European countries and establish Hungary as a regional logistics hub. The line's design speed is 200 km/h, with an operational speed of 160 km/h. Track construction on the Serbian side began in 2018 and is already complete, while work on the Hungarian side has been ongoing since October 2021. The railway line is expected to begin operating on February 20, 2026.

Kazakhstan is also joining the region. At the end of 2024, the heads of state of Kazakhstan and Hungary agreed to establish a joint intermodal freight terminal in Budapest. The terminal, with a capacity of 230,000 TEUs per year, will increase the number of container trains on the China-Europe-China route, including transit along the Trans-Caucasian International Transport Route.

The Port of Piraeus in Greece remains a key element of the China-Europe-China connection, having developed over the past decade into one of the largest container ports in the Mediterranean. In October 2009, Greece leased half of the port to China Ocean Shipping (Group) Company (COSCO) for 35 years. Since COSCO assumed management, container throughput at the port has grown from 1.5 million TEUs to 5 million TEUs per year. Its role in the TEN-T system is strengthened by integration with rail corridors leading through North Macedonia, Serbia, and Hungary to Austria, Germany, and the Benelux countries. For the EU, the development of Piraeus and its rail links means diversification of entry points for cargo from Asia and reduced dependence on Northern European ports and the Kazakhstan-Russia-Belarus land route. For countries in the Balkan region, this represents an opportunity to become part of high-value-added China-Europe transport and logistics chains.

PROSPECTS FOR THE DEVELOPMENT OF EUROPEAN RAILWAY INFRASTRUCTURE

In the coming years, the development of the European railway industry will be determined by a transition from the already completed strategic planning phase to the full-scale practical implementation of planned reforms and infrastructure projects. The adopted TEN-T Regulation and the accompanying corridor work plans set a strict timetable: Member States must ensure the functionality of the core network by 2030, and complete the extended core and comprehensive network by 2040–2050. This means that the period 2026–2030 will be crucial for focusing investment and eliminating bottlenecks.

The most significant changes are expected at cross-border sections and corridors with a high share of freight traffic. This is where the EU is focusing funding and regulatory pressure, as addressing infrastructure gaps is essential to achieving transport sustainability targets and increasing the competitiveness of rail compared to road and aviation.

Technically, the implementation of ERTMS/ETCS remains a key focus. Despite the low level of network infrastructure, the coming years will see an accelerated transition from national signaling systems to a European standard, particularly on the core network. In the medium term, ERTMS will increase capacity without the need for the large-scale construction of new lines, reduce border delays, and create conditions for more sustainable international transport.

At the same time, the unification of infrastructure parameters will continue. The basic requirements of the TEN-T include electrification throughout the network, increasing the permissible train length to 740 meters or more, increasing axle loads, and adapting gauges to accommodate standard semi-trailers. This is particularly important for Central and Eastern Europe, where there has historically been a gap in infrastructure development compared to Western Europe.

A separate factor in the coming years will be digitalization and stricter service quality requirements. For the first time, the TEN-T Regulation sets operational metrics for freight transport, including acceptable border dwell times and the proportion of trains arriving without significant delays. Infrastructure projects will increasingly be assessed not only based on actual construction, but also on their real impact on the reliability and predictability of transportation.

Overall, the outlook for European rail infrastructure in the coming years can be characterized as a phase of intensive transition toward a single transport space with common standards, digital management, and a significant role for railways in freight and passenger transport. The elimination of infrastructure bottlenecks, increasing train length to 740 meters, and the implementation of modern train management systems (ERTMS) directly reduce the risk of delays and improve the stability of transit flows, which is important for maintaining competitive transit times on the China–Europe–China route.

The comprehensive development of infrastructure and digital management systems lays the foundation for adapting the transport system to long-term challenges—growing trade volumes, changing supply chains, and increased demands for reliable and environmentally friendly transportation.