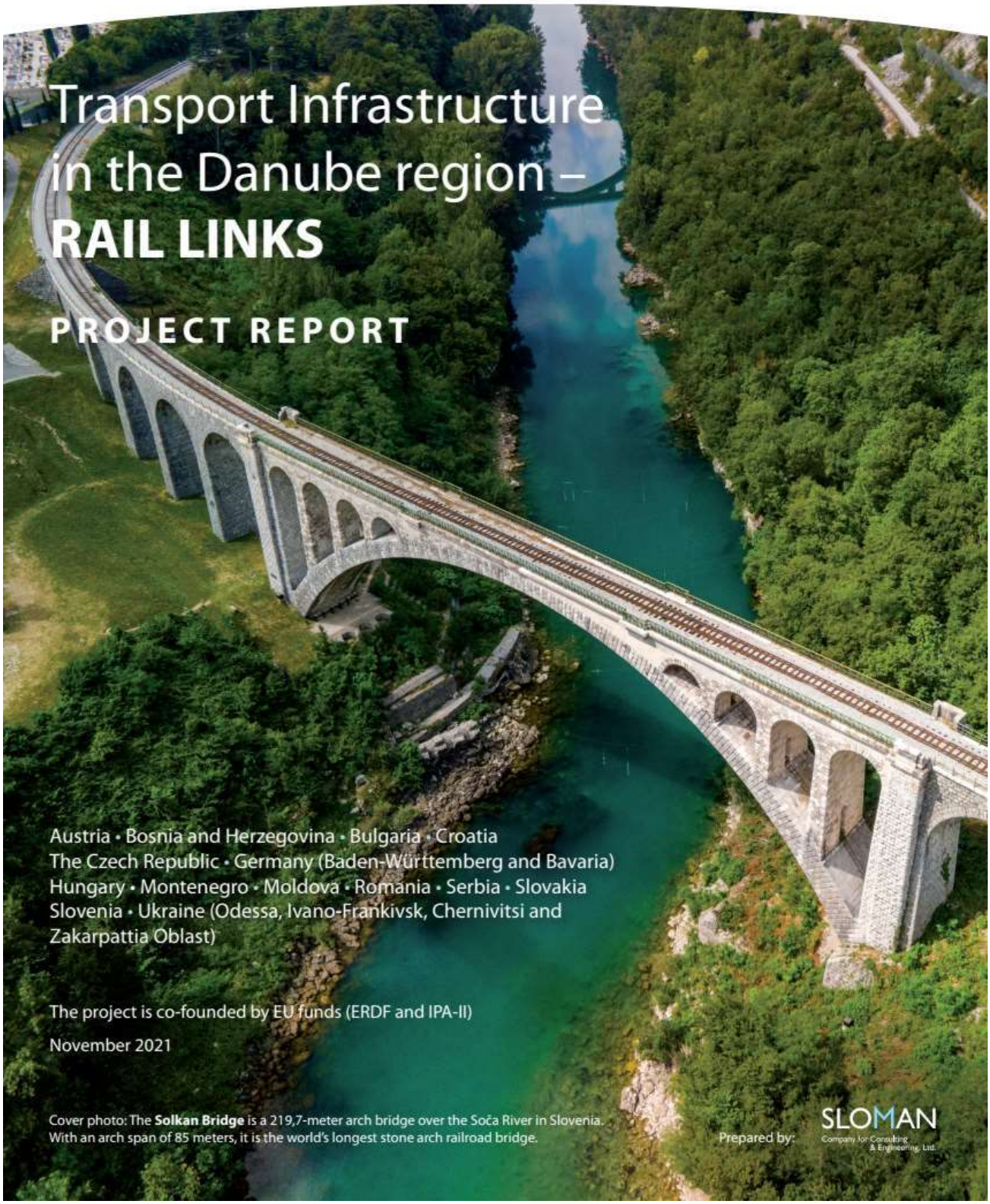
Interreg
Danube Transnational Programme

DANUBE REGION strategy
Mobility | Rail-Road-Air

EUROPEAN UNION



Transport Infrastructure in the Danube region – **RAIL LINKS**

PROJECT REPORT

Austria • Bosnia and Herzegovina • Bulgaria • Croatia
The Czech Republic • Germany (Baden-Württemberg and Bavaria)
Hungary • Montenegro • Moldova • Romania • Serbia • Slovakia
Slovenia • Ukraine (Odessa, Ivano-Frankivsk, Chernivitsi and Zakarpattia Oblast)

The project is co-founded by EU funds (ERDF and IPA-II)

November 2021

Cover photo: The **Solkan Bridge** is a 219,7-meter arch bridge over the Soča River in Slovenia. With an arch span of 85 meters, it is the world's longest stone arch railroad bridge.

Prepared by: SLOMAN Company for Consulting & Engineering, Ltd.

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SLOMAN company activities

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- Preparation of general studies in the field of transport infrastructure.
- Advanced geodetic services in different phases of project implementation.
- Leading of professional associations.
- Preparing of technical and project documentation for roads and traffic infrastructure.
- Implementation of new technologies in building and maintenance of road infrastructure.
- Pavement measurements and measurements of road surroundings.
- Preparing of pavement structure design for roads, airports, ports, parking areas and other.
- Preparing the program of research.
- Organizing the system of quality assurance and quality control and preparation of technical regulations for traffic infrastructure.
- Road management consultancy.
- Organizing of specialized technical events, round tables and conferences.
- International projects and cooperation with related organizations.

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Disclaimer:

The views expressed in this document are those of the consultant and only those members of the EUSDR PA1b Steering Group, who have been actively involved in the preparation of this publication.

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1. RAILWAYS IN THE DANUBE REGION

1.1. Summary

The Danube Region is a functional area defined by its river basin, including basins of its main tributaries: Tisa, Prut, Drava, Sava, Siret and also Dnister/Nistru river, along and across which have been developed all key railway connections.

The area covered by the Danube macro-region stretches on a 1.092.662,32 km2, from the Black Forest (Germany) to the Black Sea (Ukraine-Romania-Bulgaria) and is a home to around 114 million inhabitants in 14 countries: Austria, Bosnia and Herzegovina, Bulgaria, Croatia, the Czech Republic, Germany (Baden-Württemberg and Bavaria), Hungary, Montenegro, Moldova, Romania, Serbia, Slovakia, Slovenia and Ukraine (Odessa - Ivano Frankivska – Chernovitsi – Zakarpatya Oblasts).

From all aspects the Danube Region is very heterogeneous with significant differences in size and growth of the economies, unemployment and welfare, where the less developed countries lag behind the wealthier ones. There are 66.874 km of railway lines in the Danube region. One of the indicators of the development of the railway network is also the length of the network per million inhabitants in each country. This average is 585,71 km per million inhabitants for the region. Individual countries have less than 300 km and some more than 900 km per million inhabitants.

The main missing links are cross-border rail network connections between Germany and Austria and the Czech Republic, cross-border links with Slovenia, Croatia and Hungary. Bottlenecks in Slovakia, Hungary, Romania and Bulgaria—and between Austria and Slovakia also need to be addressed. Numerous missing links remain with most of the multimodal connections between Hungary, Bulgaria and Romania yet to be constructed or substantially upgraded. There are also two missing links located at the alpine crossings in Austria; the Semmering Base Tunnel and the Koralm Railway line. A major bottleneck will be alleviated by the construction of the Brenner Base Rail Tunnel, when it becomes operational in 2026. Western Balkans section of the Danube plays an important part in the function of connecting the region and must therefore attain similar high standards of railway infrastructure.

The development of railway infrastructure is reflected in the differences between Upper Danube, Central Danube and Lower Danube region. Countries of Upper Danube (in particular Germany and Austria) have better developed and maintained rail networks, in comparison to the Central and Lower Danube countries. Most of the Danube macro-region countries are still developing their rail networks.

The Danube region covers a large part of the European Union. Trans-European Railway Network (TEN-T) (core and comprehensive network) and international rail corridors for competitive freight transport pass through this region. Part of the Trans-European Network (TEN-T), are the following Core Network corridors in the Danube region: Baltic-Adriatic Corridor, Mediterranean Corridor, Orient – East/Med Corridor, Rhine-Danube Corridor, Rhine-Alpine Corridor and the Scandinavian-Mediterranean Corridor.

Besides making mobility in the Danube region more sustainable and adapt it to challenges of climate change, another important goal is to increase the safety of traffic and transport. Data on the number of railway accidents in the region were also a part of the study. There have been around 4.000 railway accidents in the Danube region in the last three years (2018, 2019, 2020). Average number of fatalities per million inhabitants in railways accidents in year 2020 is 3,44 fatalities per million inhabitants. Between countries this number differs from 0,99 (Croatia) to 14,60 (Slovakia).

1.2. General data of the Danube macro-region

The railway network of the Danube region covers 66.874 km of main and regional railways, of which 16.907 km are double-track railway lines. 47 % of all railway lines are electrified.

This network is very heterogeneous. On the one hand, we have countries where the railway network is very developed, and on the other hand, there are countries where this network still needs to be developed. Differences also occur in the maintenance of this network.

The heterogeneity of rail networks between the countries of the Danube region is conditioned by significant differences in the size and growth of economies, unemployment and prosperity, where less developed countries lag behind the wealthier ones.

One of the indicators of the development of the railway network is also the length of the network per million inhabitants in each country. This average is 585 km per million inhabitants for the region. Individual countries have less than 300 km, and some more than 900 km per million inhabitants.

The data on the length of railways per km^2 of territory also shows large differences. The average for the region is 0.03 km / km^2. Some countries have less than 0.02 km and some more than 0.08 km / km^2

Both data should not be taken absolutely. In addition to the development of the country, the conditions of transit traffic include the structure of settlement and the configuration of the territory.

There are also big differences in the electrification of the network in each country. There are on average 47 % of electrified lines in the whole region. In some countries this share is less than 40%, and in others more than 60 or 70%.

The required axle load capacity of 22.5 tonnes / axle is not achieved in all sections of TEN-T and freight corridors.

The equipment with GSM-R and ETCS equipment also varies greatly from country to country.

High-speed railways as part of the European high-speed network are being built in only two countries in the Danube region. Germany and Austria.

All this affects the flow of rail transport on international and interstate transport within the region.

Of particular importance are the lines of the railways in the European TEN-T corridors and the Rail Freight corridors. The length of the railway network of the Danube region in the TEN-T corridors is 26.317 km[1].

The main missing links are cross-border rail network connections between Germany and Austria and the Czech Republic, cross-border links with Slovenia, Croatia and Hungary. Bottlenecks in Slovakia, Hungary, Romania and Bulgaria—and between Austria and Slovakia also need to be addressed. Numerous missing links remain with most of the multimodal connections between Hungary, Bulgaria Romania, Moldova and Ukraine yet to be constructed or substantially upgraded. In addition, the Western Balkans section of the Danube region plays also an important part of connecting the region and must therefore attain similar high standards of railway infrastructure. Also, full integration of the Croatian railway infrastructure in to TEN-T railway network is necessary.

[1] Data for Croatia, Bavaria and Slovakia are not taken into account.

There are also two missing links located at the alpine crossings in Austria; the Semmering Base Tunnel and the Koralm Railway line. A major bottleneck will be alleviated by the construction of the Brenner Base Rail Tunnel, when it becomes operational in 2032.[2]

The development of railway infrastructure is reflected in the differences between Upper Danube, Central Danube and Lower Danube region. Based on the "Global Competitiveness Report 2017–2018, Pillar 2: Infrastructure" (World Economic - forum), the quality of railways (2.03) in the Danube countries compared to 101 countries of the world (out of 193) are as follows: Germany is ranked 9, Austria is ranked 13, Slovakia is ranked 25, Czech Republic 26, Ukraine 37, Hungary 44, Bulgaria 58, Slovenia 62, Montenegro 63, Croatia at 70, Moldova at 71, Romania at 73, Serbia at 71. 79, and Bosnia and Herzegovina at 89.

The countries of the Upper Danube (especially Germany and Austria) have a better developed and maintained railway network compared to the countries of the Middle and Lower Danube. Therefore, the development of railway networks is a necessary condition for development for most countries in the region.

The speed of rail transport is affected by both the quality of the infrastructure and the administrative procedures at the borders between individual countries.

There are also great differences between individual countries in the field of protection of the natural and living environment from the effects of railway transport. Nevertheless, in all countries there is a tendency for this area to be regulated by appropriate measures. These measures are being introduced on both infrastructure and rolling stock.

A very specific role for railway connections further development in EUSDR area wiil play the environmental issues in general cintext of Transport problems for Global Climate Change, as well as for European Green Deal embodiment (e.g., accordingly to proclamation of the core EU C omisioner A. Vălean at the day of Green Deal proclamation by the Commission on 11.12.2019 "As part of the EU Green Deal our aim to move a significant part of the inland freight done by vehicles to rail and inland waterways, using multimodal solutions"[3]).

Corner stones for this facet of EUSDR Railways System further development are underbuild by Transport Protocols of Alpine and Carpathian Conventions. But, if Alpine one has been developed and signed in 2007 - before EUSDR beginning - elaboration and approval of the Carpathian Convention Transport Protocol in 2014[4] was realized "symbiotically" with EUSDR establishment.

[2] https://transport.ec.europa.eu/transport-themes/infrastructure-and-investment_en

[3] https://twitter.com/AdinaValean/status/1204788263359328257

[4]http://www.carpathianconvention.org/eventdetailcop/events/cop4-fourth-meeting-of-the-conference-of-the-parties-to-the-carpathian-convention-copy.html

1.3. A brief history[5] of beginnings of railway infrastructure in the Danube region

Europe and the world: The importance of rail transport to the history of Europe cannot be underestimated since the implementation of railway lines throughout Europe brought about huge changes to Europe as a continent and continues to play an important role in Europe to this day.

Railways existed as early as 1550, in Germany. These pathways of wooden rails called “wagonways” were the beginning of modern rail transport, making it easier for horse-drawn wagons or carts to move along dirt roads.

The growth and impact of early railways started in 1767 when the first iron rails were laid at Coalbrookdale (near Birmigham), England. It is believed that the beginning of the railway age started in September 1825 by opening of the Stockton to Darlington line (England). The line comprised 27 miles of track. Early railways were a combination of horse power, fixed steam engines and locomotives. The adaptation of steam engines to railways was slow.

[5] Source: Several Internet sites e.g. https://www.britannica.com/technology/railroad/Railroad-history and http://foundations.uwgb.org/railroads-time-distance/ and https://www.sinfin.net/railways/world/index.html and https://intrans.iastate.edu/news/trains-a-history/ https://en.wikipedia.org/wiki/History_of_rail_transport and https://en.wikipedia.org/wiki/History_of_rail_transport , etc.

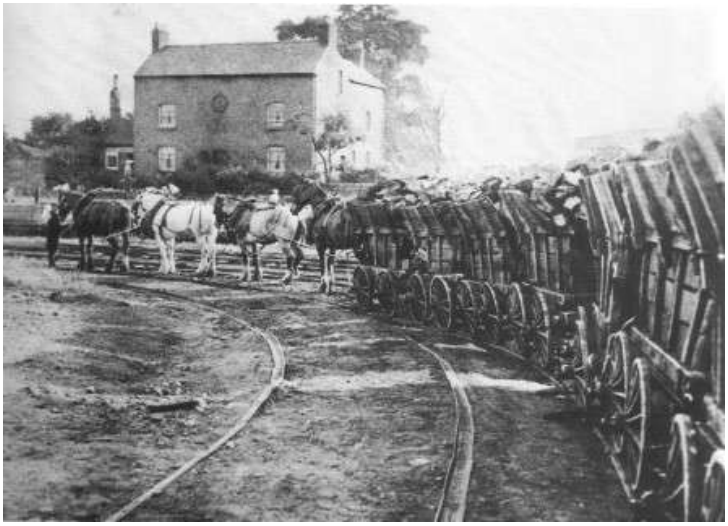

Figure 1: Horses pulling loaded coal waggons The Little Eaton Gangway wagonway (open 1795–1908)
Source: https://www.wikiwand.com/en/Wagonway, obtained 9.11. 2021

The Stockton to Darlington (England) railway line was opened on 27 September 1825. There were thirty-two waggons in the train which, pulled by the Locomotion, travelled at about 10 miles per hour. A man on horseback rode in front of the engine and twenty-four horse drawn waggons followed it. This event marked the beginning of the railway age.
The growing interest in the new railway phenomenon is reflected in rapid construction in all parts of Europe and the world.

The industrial revolution at the beginning of the ninetieth century brought about the first steam-driven railways. Selected key milestones are shown in the table below.

Table 1: Key milestones in railway history

Year	Country	Line
1825	United Kingdom	Stockton — Darlington railway, with the steam locomotive by George Stephenson (41 km)
1829	United States of America	Baltimore — Ohio railroad: Baltimore — Ellicott's Mills (24 km)
1835	Belgium	Brussels — Mechelen/Malines (20 km). The first train on the European continent.
1835	Germany	Bavaria: Nürnberg — Fürth (6 km). The first railway on the Danube macro-region territory.
1837	France	Paris — St. Germain (21 km)
1837	Austria	Kaiser Ferdinands-Nordbahn: Floridsdorf — Deutsch Wagram (13 km).
1838	Russia	St. Petersburg — Zarskoye Zelo (27 km)
1854	Austria	K. u. K. Südbahn: Semmering mountain section (41 km) closing the last gap between Vienna and Trieste
1863	United Kingdom	The first underground railway started working in London. Success of this track gave birth to the modern subways.
1881	Germany	The First public electric tram line opened in Berlin.
1913	Sweden	Diesel powered locomotives started being used in Sweden.

1937	Germany	German inventor Hermann Kemper[6] patented train system that used magnetic levitation (maglev).
1964	Japan	The first high-speed rail system began operations in Japan. It is known as the Shinkansen or "bullet train."
1981	France	High speed train: The LGV Sud-Est from Paris to Lyon opened and TGV started passenger service. Speed: 270 km/h, then 300 km/h.
1990	France	French TGV broke the speed record for electric train, with unimaginable speed of 515 km/h.
1991	Germany	The Hanover–Würzburg high-speed railway was the first railway line for InterCityExpress traffic. Speed of trains: 280 km/h.
1995	The EU	The European Commission defined a global strategy for the further development of the European Railway Traffic Management System (ERTMS).
2009	The EU	In July 2009, the first adoption of the European ERTMS Deployment plan marks a new milestone for ERTMS. For the first time, the retroftting of ERTMS on a number of listed lines (the six ERTMS corridors and additional freight lines) becomes mandatory.
2020	China[7]	At the end of 2020, China had 37,900 km of operational HSR (69% of the world's total). This included 13,700 km of railways with a maximum operating speed of 300-350 km/h, and 24,200 km with a maximum operating speed of 200-250 km/h.

The origin and development of railways as well as steam locomotives took place in the first decades of the 19th century in Great Britain, from where it later gradually spread all over the world. The first half and the middle of the 19th century are characterized by the construction of intercity and mining-industrial railways of a narrow-gauge.

Danube macro-region: The development of railways in the Danube region countries was and is closely linked to the transport needs and transport policies of European countries. Side by side with economic needs, the core role for this railways net development've played the Geo-Spatial peculiarities of above mentioned Danube and its tributaries basins space, as well as mountains systems of Alps and, especially, Carpathians. As an example can serve implementation of the initial Alpine experience for the nowadays 8 Carpathian countries around Geographic Centre of the European Continent (7 EUSDR member states + concerned Bulgaria and Republic of Moldova + Poland in EUSBSR).

Most obvious example on these railway conections value gives the shortest Carpathians crossing way, which construction was finalized before I WW. For today It unites western Black Sea area and all 4 Ukrainian regions in EUSDR since Odessa Oblast, as well as neighbor regions along Hungarian, Romanian and Moldavian borders with Ukraine, with the zone of convergence of Hungarian, Slovakian, Ukrainian and also Polish borders near Europan Geographic Centre (where multimodal terminal "West-East Gate" in Hungarian Feneslitke is in final stage, and also border with Slovakia is crossed by railway 1520 mm to Kosice with further continuation to Bratiislava, Vienna)

From the very beginning of EUSDR this idea've find support by formulation of EU Council[8]: "invites the Member States concerned and the Commission to explore the possible interconnections and synergies between the two existing macro-regional strategies, namely the EU Strategies for the Baltic Sea Region and the Danube Region. CALLS ON the European Commission to ensure on this basis the coherent

[6] https://en.wikipedia.org/wiki/Hermann_Kemper
[7] http://en.qstheory.cn/2021-11/15/c_680145.htm
[8]https://www.consilium.europa.eu/uedocs/cms_data/docs/pressdata/EN/genaff/121511.pdf (item18)

development of both macro-regions, including infrastructural connections between them" For today this vision of eastern connections between key European railway corridors[9] became priority Nr. 1 of Three Seas Initiative (3SI)[10] and for common desire of Ukraine and Republic of Moldova to become intergrated into it[11].

And for each EUSDR member country this way had the following spacific features:

1. **AUSTRIA (1832):**

The history of Austrian rail transport starts with the Reisszug, a private, horse-drawn funicular serving Hohensalzburg Fortress (Salzburg). Built at the end of the 15th century (1495) and first documented in 1515, it is the oldest known funicular in the world, and very likely the oldest existing railway line.

The introduction of railway traffic in the Austrian Empire (from 1804 to 1867) dates back to 1810 when a first 22 kilometres long horse-drawn railway line was built at the Eisenerz mine in Styria for the transport of iron ore.
The first public railway in Austria was also the first in continental Europe. This was a 129 km horse drawn line from České Budějovice to Linz, built to the very unusual gauge of 1106mm. It opened in 1832, and was extended 4 years later to Gmunden, nearly doubling its length.

In 1837 the Kaiser Ferdinands-Nordbahn (Emperor Ferdinand Northern Railway) was opened, with a line running from Floridsdorf to Deutsch Wagram – reaching Vienna in 1838.
The first section of a new steam locomotive railway from the Austrian capital Vienna to Kraków in the Kingdom of Galicia and Lodomeria operated by the Emperor Ferdinand Northern Railway company opened in 1837. The line then was the second solely steam-powered railway on the continent, after the inauguration of the Belgian Brussels–Mechelen railway line in 1835.

At the end of World War I (1914-1918) the Austro-Hungarian Empire was broken up, and various lines became parts of the state railways in their constituent countries: Poland, Czechoslovakia, Yugoslavia, Italy and Romania.

2. **BOSNIA AND HERZEGOVINA (1872):**

The first railway line in Bosnia and Herzegovina was opened for traffic on 24th December 1872. It was a standard-gauge track from Banja Luka to Dobrljina (101.6 km), built as a section of the Istanbul main route which was, in accordance with the Turkish plans, supposed to connect Istanbul and Vienna.
Following the Berlin Congress (1878), Austro-Hungarian Empire occupied Bosnia and Herzegovina and immediately began intensive construction of railways. Already in September 1878 construction of narrow-gauge railway track from Bosanski Brod to Sarajevo started.
Also in 1878, a standard (1435mm) gauge line between Banja Luka and Prijedor was constructed by the Ottoman Empire. However, railway development started in earnest in the following year with the opening of the 96 km line from Srpski Brod to Doboj, the first section of a line to Sarajevo. It was built to 760 mm gauge, and as such was the first narrow-gauge line constructed in the Austro-Hungarian Empire. Subsequent construction was mostly to this gauge, the network reaching its peak by the end

[9]http://ecoresource.ddns.net/SiteAssets/SitePages/EUSDR/TENT_and_contrailer_links_bypass_and_across_Carpathians.ppsx
[10] http://ecoresource.ddns.net/SiteAssets/SitePages/EUSDR/3SI=TEN-T+UA.jpg
[11] https://www.president.gov.ua/en/news/spilna-zayava-prezidenta-ukrayini-volodimira-zelenskogo-i-pr-65993

of the First World War. Many of the lines were converted to standard (1435mm) gauge during the reconstruction of the then Yugoslavia following the Second World War, and most of the remaining narrow-gauge lines were closed.
The present-day network has international connections with neighbouring Croatia and Serbia.

3. BULGARIA (1866):

Construction of the first Bulgarian railway, the Ruse – Pliska – Varna started in 1864. The Turkish government had commissioned for it an English company and the Barkley brothers, civil engineers. The 223 km long railway line was opened in 1866.
In 1888, a decade after Bulgarian independence, the recently formed State railway company took over all existing railways and was to exercise control over all new railways in the country into the 21st century.

4. CROATIA (1860):

Croatian Rail network dates back to mid 19th century, when first train lines were built around Zagreb and Northern Croatia in 1857 through 1860.
On the 17th December 1857 began the construction of railway connection between Pragersko (Slovenia) and Nagykanizsa (Hungary), with the continuation for Budapest. The purpose was to connect Budapest through Croatia and Slovenia to the existing Vienna - Trieste railway line. The project was completed in 1960. This was actually the first railway line to pass through Croatian territory, more precisely, its northern region named Medjimurje. The new railway line made connection between following Croatian localities: Kotoriba, Donji Kraljevec and town of Čakovec (Csaktornya). The overall length of the first railway line in Croatia is 42.39 km, with maximal ascent of 3.0 mils, and practically straight direction, enabling ideal exploitation conditions. There were only two greater buildings required on the line: the bridges over the river Drava near Ptuj (Slovenia) and over the river Mura at Croatian-Hungarian border near Kotoriba.
The next significant railway event took place in 1862, with the opening of a line from Zidani Most (Slovenia) to Sisak, via the Croatian capital, Zagreb.

Development of railways in Dalmatia (Southern Croatia) came later than in other places and the first railway (from Split to Siverić) was opened for traffic in 1876. And the next year the branch from Perković to Šibenik followed. There was little traffic for this isolated railway, and in 1888 it was extended to the important centre of Knin.

5. CZECH REPUBLIC (1832):

The history of Czech railways starts in 1832. The first public railway in Czech Republic was also the first in continental Europe. This was a 129 km horse drawn line from České Budějovice in the present-day Czech Republic to Linz, built to the very unusual gauge of 1106mm. It opened in 1832, and was extended 4 years later to Gmunden, nearly doubling its length.

The first steam hauled railway in the country reached Břeclav (Lundenburg) in Moravia from Vienna in 1839, extended to Brno (Brünn) later the same year. The railways continued to develop under the Austrian Empire, constructed mainly to standard (1435 mm) gauge but with a number of narrow-gauge lines in remote areas.

6. GERMANY (1835):

The history of German rail transport starts with wheeled trucks running on wooden or iron rails that were in use in mines in Germany from early days, possibly as long ago as the 16th century. Possibly the

first route recognisable as a railway was the Rauendahler Schiebeweg, opened in 1794 to convey coal from mines near Sundern, south of Bochum, to a wharf on the Ruhr. It was a horse drawn tramroad similar to ones that had already appeared in England and was about 1.6 km long.

The first public railway was the Prinz-Wilhelm-Eisenbahn, a horse drawn tramway opened in 1831 between Hinsbeck, south of Essen, along the Deilthal to Nierenhof, near Velbert, a distance of 7.5km. It had a gauge of 820mm. Initially used for the transport of coal, but by 1833 it also carried passengers. The line was converted to steam operation by 1847 and remains open today as part of the route from Essen to Wuppertal.

Bavaria: The first steam hauled railway in Germany, the Ludwigs-Eisenbahn, opened between Nürnberg and Fürth (Free State of Bavaria) on 7th December, 1835. It was just 6 km long and was constructed to standard (1435mm) gauge, the first locomotive, Der Adler (The Eagle) being built by George & Robert Stephenson in the United Kingdom. The line closed in 1922, having been superseded by a new line further south. Much of the original route is followed by Line 1 of the U-Bahn Nürnberg.

At the period of these early railway lines, Germany was a loose federation of states, each of which pursued their own individual railway policy. This continued even under the days of the German Empire, so development tended to be unevenly spread. However, this did not prevent the eventual construction of an extensive and efficient network by the early decades of the 20th century.

The First World War impoverished the railways; runaway inflation made matters worse. The entire railway system was nationalized, as Deutsche Reichsbahn, in 1924.

Figure 2:Central railway station, Munich
Source:https://www.needpix.com, obtained 9.11. 2021

Partition of Germany in the 1950s lead to the railways being split again. East Germany retained the Reichsbahn name, while the West German railways became Deutsche Bundesbahn. The Bundesbahn also operated the stations in West Berlin and provided the trains from there that ran heavily guarded through East German territory to reach the rest of the Federal Republic.

Baden- Württemberg: Despite the early and systematic state support of railway construction the opening of the first railway in Württemberg. In the other larger states of the German Confederation (Deutscher Bund), such as Bavaria, Saxony, Prussia, Austria, Brunswick, Baden, and Hanover, at least one, and in some cases, several railways had been put into service by that time.

The Zentralbahn (Central line) was the first line to be started which connected Stuttgart via two separate branches with Ludwigsburg and Esslingen. Construction began in 1844, and the first section between Cannstatt und Untertürkheim was opened for service on 22 October 1845, with the entire line completed in 1846. The Nordbahn was completed in 1848, and the Ostbahn and Südbahn were completed in 1850.
The Westbahn was constructed between 1850 and 1853, and subsequently put into service. In 1854, a connection to the Bavarian railway network was achieved in Ulm.

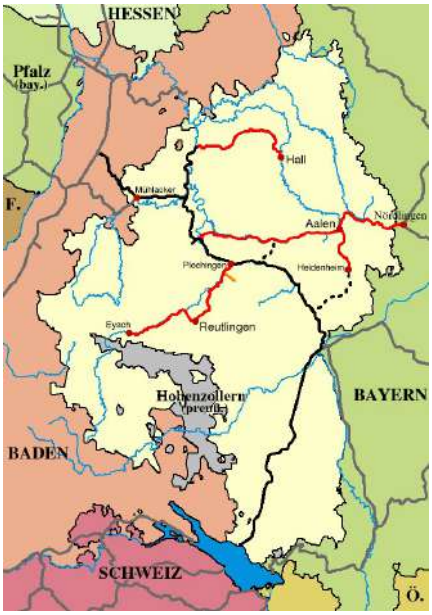

Figure 3: Baden- Württemberg Railway network in 1864
Source: https://en.wikipedia.org/wiki/History_of_railways_in_W%C3%BCrttemberg, obtained: 9.11. 2021

The direct route Bretten–Stuttgart–Ulm developed into the most important railway axis in Württemberg, and it came to be known as the Hauptbahn[12] (Main line).

7. HUNGARY (1846):

The The first railway in Hungary opened in 1846 between Pest and Waitzen (present day Vác), a distance of about 33km. Hungary was at that time part of the Austrian Empire and this was naturally a major influence on railway development, including the choice of standard gauge (1435mm) for main line railway construction.

Besides the main line network, there were many narrow-gauge lines, typically of 760mm gauge and used in conjunction with forestry operations. A number of these have survived as tourist railways.

Budapest is the home of the oldest underground city railway in continental Europe. The first section opened in 1896, pre-dating the Paris Métro by 4 years. It was known as Millenniumi Földalatti Vasút (the Millennium Underground Railway), marking the 1000th anniversary of the traditional date for the founding of Hungary by Árpád, leader of the Magyars. This railway now forms the core of an extensive modern metro system.

[12] Note: Nowadeys this sections are part of The "Magistrale for Europe" initiative, founded in 1990 and committed to the rapid expansion of the Paris-Budapest/Bratislava rail axis (https://magistrale.org/en/).

While the greater part of the Hungarian main line network remained in State control, one remarkable independent railway (GySEV[13]) has survived wars, the breakup of Empire and a period of Soviet domination to become a significant player in today's competitive international freight market.

8. MOLDOVA (1867):

The first railway line in Moldova opened in 1867. It runs from the Ukrainian border to Tiraspol (Pridnestrovie). This line was extended in 1871 to Chişinău. The line was built to Russian standard gauge (then 1524mm). Further development took place at the same gauge, including in 1877 a line as far as Iaşi in Romania, a country whose railway network is for the most part standard (1435mm) gauge.

Following the First World War, Moldova became part of Romania. The railways were converted to standard gauge and several new lines constructed. Then, following the Second World War, Moldova was taken into the Soviet Union and the lines were regauged to 1520mm.

Moldovan Railways was created on the dissolution of the Soviet Union, and owns and operates the network to this day.

9. MONTENEGRO (1901):

In 1901 the Austro-Hungarian government completed a line from Gabela in Herzegovina to Zelenika on the Bay of Kotor. It was constructed to 760 mm gauge, as were most other railways in the region at that time. The Bay of Kotor region, together with the last few kilometres of the railway, was the subject of territorial dispute for much of the first half of the 20th century, but in 1945 it was confirmed as part of the Republic of Montenegro in the then Federation of Yugoslavia. The railway thus became the oldest in Montenegro. It closed in 1969.

The first railway to be built in Montenegro itself opened in 1908 between Bar and Virpazar, a distance of around 20 km, and formed the first section of a line to Beograd in Serbia. It was also built to 760mm gauge. Further lines were built to the same gauge, resulting in a network which served most of the major towns of the sparsely populated country. In the 1960s and 1970s, the major routes were reconstructed to standard gauge and the narrow-gauge lines closed.

A standard gauge line from the capital Podgorica to Hani i Hotit in Albania, linking with the Albanian network, was opened in 1986. The present-day railway network of Montenegro thus has international links with Serbia and (for freight only) with Albania.

10. ROMANIA (1854):

The first railway line in Romania was opened in the Banat area by the Austrian Empire in 1854. The 62.5 km standard (1435mm) gauge line ran between Oraviţa and Baziaş and was built primarily for the transport of coal. Subsequent railway development in the country was primarily standard gauge but there were also a number of narrow-gauge railways, in particular 760 mm gauge railways serving the

[13] The Raaberbahn or GySEV is a Hungarian-Austrian railway company based in Sopron, Hungary. The company is a joint enterprise of the states of Hungary (65.6%), Austria (28.2%) and a holding belonging to ÖBB Austrian Federal Railways (4.9%).

forestry industry. One of these is still active as a forestry railway, and also runs a tourist passenger service; several others continue to operate as tourist railways.

Answering nowadays challenges and common key priorities of EUSDR and 3SI in general context of main European Green Deal requirements to TEN-T and RFC corrindors development, taking also into consireation perspectives of collaboration in the frame of EU Eastern Parnership[14].
The present-day standard gauge network consists of over 10.000 route km. There are trams in various cities and a metro in the capital, Bucureşti.

11. SERBIA[15] (1854):

On the territory of today's Serbia (and Romania), one of the first narrow-gauge railways was built in 1856, Oravica - Jasenovo - Crvena Crkva - Bela Crkva - Vračev Gaj - Sokolovac to Bazijaš (village and monastery on the Danube), during the Austrian Empire. It was originally intended for the transport of coal to the Danube and for the needs of steamers.

Figure 4: Steam hauled passenger train on the narrow-gauge Šargan (Serbia)

The second half of the 19th century is characterized by the construction of international railways of normal gauge, with the aim of connecting distant lands for the transport of goods and passengers.
The primary railway development in Serbia itself commenced in1881, when the construction of the 271 km Beograd – Niš line started (as part of the agreement made upon Berlin congress in 1878 when Serbia gained indepence) and was finished in August 1884. It was constructed to standard (1435mm) gauge. The first train left Belgrade on September 4, 1884 and after fourteen hours of driving arrived in Nis. As early as 1885, the Orient Express train used the new line; the train that would later become one of the most famous trains in the history of world railways. At the same time, from 1881 to 1884, the Budapest-Belgrade railway was built via Subotica and Novi Sad, and from 1885 to 1888 two railway branches were built, the first Niš-Pirot-Sofia and the second Niš-Vranje-Skopje.
Subsequent railway development used a variety of gauges, a complex situation which was only gradually resolved during the reconstruction of the then Yugoslavia following the Second World War.

[14] https://ec.europa.eu/transport/infrastructure/tentec/tentec-portal/site/en/maps.html
[15] Source: Internet e.g. https://www.sinfin.net/railways/world/pmr.html

The program of the modernization of then Yugoslav Railways was adopted in 1964, and it foresaw the mass abolition of narrow and unprofitable lines.

The first electrified railway Belgrade-Šid-state border (Zagreb) was opened to traffic on May 31, 1970.

12. SLOVAKIA (1840):

The first railway in Slovakia opened in 1840 between Bratislava and Trnava, a distance of about 50 km. Trains were originally drawn by horses, locomotive traction followed later.

Figure 5:A freight train of ŽSSK Cargo, hauled by a Siemens Vectron electric locomotive Source: https://railcolornews.com/2019/12/29/sk-exotic-destinations-zssk-cargo-vectrons-in-use-by-other-operators/, obtained: 9.11. 2021

The majority of main line railways in Slovakia were built to standard (1435mm) gauge. There were many narrow-gauge minor railways, especially in the mountainous areas, several of which are still in operation as tourist railways. There is also a Russian gauge (1520mm) line connecting Košice and its nearby steelworks to the Ukrainian border, providing direct access to the railways of the former Soviet Union. A long-term proposal exists to extend this line westwards to a major freight exchange in Wien (Vienna), Austria.

13. SLOVENIA (1846):

An early wagonway with wooden rails using a combination of gravity and manpower to move wagons carrying timber is recorded around 1820 near the town of Idrija.[16] Although earlier wagonways (and indeed railways) are recorded elsewhere in connection with mining coal or ores, the Idrija line may represent the first dedicated forestry railway in the world.

Slovenia received its first railway connection in the 1840s, when the Austrian Empire built a railway connection - Südliche Staatsbahn (Southern Railway) - between its capital, Vienna, and its major commercial port, Trieste.[17] Thus, Maribor was connected by railway to Graz in 1844. The stretch was extended via Pragersko to Celje in 1846.

[16] https://www.geopark-idrija.si/en/cultural-heritage/mining-heritage/
[17] https://en.wikipedia.org/wiki/Slovenian_Railways

The history of the first public railway in Slovenia dates back to 2 June 1846, the opening day of the Graz to Celje section (130 km with standard (1.435 mm) gauge) of the Austrian Southern Railway (Südbahn). The events that day included the inaugural run of the first train to operate in Slovenia. The difficult and dangerous task of extending the line though challenging terrain to Ljubljana was completed by 1849; the line eventually continued to Trieste (1957), now in Italy. The length of the Southern railway is 577,2 km. Most Slovenian railways were built during Austro-Hungarian Empire.
In 1999, a single-track line between Murska Sobota and Hodoš was rebuilt, offering a direct connection with the Hungarian railway system. The line was originally built in 1907 and closed down in 1968 among numerous other lines closed down during the 1960s. In April 2016 the electrification of the Pragersko - Hodoš line was completed.

Figure 6:The first of the new modern Stadler trains was put into service (December 2020) Source: https://uic.org/com/enews/article/slovenia-slovenian-railways-expands-its-passenger-fleet-and-adds-double-decker, obtained: 9.11. 2021.

The present day Slovenian Railways is a modern network with electrified main lines and modern conventional passenger trains on major corridors. Slovenia is also proud of their heritage and operate a museum train on a number of scenic routes.

14. UKRAINE (1861):

The oldest railway in present day Ukraine runs from the Polish border near Przemyśl to Lviv. It opened in 1861, the last section of a line from Kraków to Lemberg (Lviv), when both cities were in Galicia, a province of Austro-Hungarian Empire. Further it was very soon continued in eastern direction (historic "Silk Way") through Brody and Ternopol, as well as in southern-eastern direction to Province of Bukovina and further to Russioan Bessarabia – Odessa and in southern direction through Romania and Bulgaria to Mediterranenan and Middle East space (on historic path "from Varrangians to Greeks"). In parallel there were constructed railway connectios between Lviv and Budapest – Bratislava (*Pressburg*) through Mukachevo – Chop, as well as through Bukovina - Transilvania – Serbia to Adriatic ports. Between I and II World Wars these territories were partitioned between Poland, Czechoslovakia. Hungary and Romania and further – also in the Ukrainian SSR of the former Soviet Union, with becoming the independent Ukraine in 1991.

The original line was built to the standard gauge of 1435mm, as were other lines in the same region, whereas lines in those parts of Ukraine that were formerly part of the Russian Empire were for the most part built to the Russian standard gauge of 1520mm gauge. The principal exception being a few narrow-gauge forestry and industrial lines of 750mm gauge.

After the Second World War, the Soviet administration converted almost all the remaining 1435 mm gauge lines in the Ukraine to 1520 mm. This is therefore the predominant gauge today, although one 1435 mm gauge line connects Kovel & Bryukhovichi (Bruchwiese) to the Polish border and Slovakia & Hungary through Chop – Korolevo – Halmeu to Romania, as well as by the railway 1520 mm to Polish Slawkuw (more then 400 km), to Slovakian Kosice and from Vadul-Siret to Romanian Dornesti.

There are international connections with all neighbouring countries.

Figure 7:Train Chisinau - Odessa (regular service begun on 30.3.2018) Source: https://www.ukrgate.com/eng/?p=21453, obtained: 9.11.2021.

1.4. Overview of the main features of the railway traffic in the Danube macro-region

1.4.1. Data on railway traffic in the Danube region obtained with the questionnaire

As part of the project task, a questionnaire regarding the railway network of an individual country in the Danube region was prepared. In this questionnaire, the responses related to rail transport in each country were received.

The obtained data on the rail traffic characteristics of the countries in the Danube region indicate a very differently developed railway network.

The average number of trains per day (freight and passenger) in the network of each country is the first figure, showing a big difference between countries in the Danube region. To obtain more comparable data, we compared data on the average number of trains on the TEN-T network (core and comprehensive) and the average number of trains per day only on the TEN-T core network (freight and passenger) in the Danube region, which also shows a big difference in the number of trains.

Table 2: Average number of trains per day

	The minimum number (Contributing country)	**The maximum number (Contributing country)**
The average number of trains per day on the entire network (freight and passenger)	22,5 (Moldova)	5808 (Austria)
The average number of freight trains/day on the entire network	24 (Montenegro)	4692 (The Czech Republic)
The average number of trains per day only on TEN-T core network (freight and passenger)	10 (Moldova)	4084 (The Czech Republic)
The average freight number of trains per day only on the TEN-T comprehensive network (freight and passenger)	15 (B&H)	1963 (Austria)

*The data obtained from the countries of the Danube region are summarized. Traffic data for Germany - Bavaria and Germany – Baden-Württemberg, Slovenia and Ukraine were not obtained and are not taken into account.

Table 3: Average number of freight trains

	The minimum number (Contributing country)	The maximum number (Contributing country)
The average number of freight trains/day only on TEN-T core network	83 (B&H)	3479 (The Czech Republic)
The average number of freight trains/day only on the TEN-T comprehensive network	36 (B&H)	1213 (The Czech Republic)
The average number of freight trains/day only on other networks	16 (B&H)	273 (Slovakia)

*The data obtained from the countries of the Danube region are summarized. Traffic data for Germany - Bavaria and Germany – Baden-Württemberg, Slovenia and Ukraine were not obtained and are not taken into account.

Table 4: Maximum length of freight trains

	Minimum length (Contributing country)	Maximum length (Contributing country)
The maximum length of freight train (m) on the TEN-T network	535 m (B&H)	750 (Hungary, Austria, Moldova)

*The data obtained from the countries of the Danube region are summarized. Data for Germany - Bavaria and Germany – Baden Wuerttemberg, Slovenia and Ukraine were not obtained and are not taken into account.

1.4.2. Eurostat rail traffic data

For the EU Member States, we obtained data on the annual number of rail transport of passengers, the modal split of Inland freight transport and the percentage of modal split for freight transport.

Inland transport Modal Split in EU28, for the year 2017 data show that 16.5% of all land freight across the European Union is transported by rail.

Table 5: Rail transport statistic[18], Eurostat

Country	The annual number of Rail transport of passengers (2019)	Modal split: Inland freight transport [billion tkm] (2017)	Inland transport modal split of rail freight transport (2019) [%][19]	Changes of modal split data (2019) compared to 2010 data [%][20]
Austria	12.761	22,3	30,8	-2,2

[18] https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=tran_hv_frmod&
[19] Eurostat - Data Explorer (europa.eu)
[20] Eurostat - Data Explorer (europa.eu)

Bosnia and Hercegovina	N/A	N/A	N/A	N/A
Bulgaria	1.520	3,9	21,1	4,1
Croatia	724	2,6	22,8	0
The Czech Republic	10.856	15,8	26,2	-3,9
Germany[21]	100.252	112,2	18,7	0
Hungary	7.710 (2014)	13,4	26,3	-0,8
Moldova	N/A	N/A	N/A	N/A
Montenegro	N/A	N/A	N/A	N/A
Romania	N/A	13,8	26,8	2,4
Serbia	N/A	N/A	N/A	N/A
Slovakia	3957	8,5	31,0	-7,5
Slovenia	572	5,1	35,5	3,7
Ukraine[22]	N/A	N/A	N/A	N/A

*N/A - Data is not available.

1.5. TEN-T Corridors and Rail Freight Corridors (RFCs)

The Danube region covers a large part of the European Union. International rail corridors for competitive freight transport and Trans-European Railway Network (TEN-T) (core and comprehensive network) pass through this region. Among the main objectives of the European Union Strategy for Danube Region in the field of rail mobility are:

- supporting efficient freight railway services,

- improving travel times for competitive passenger railway connections between major cities and

- supporting fully functional multi-modal TEN-T Core Network Corridors in the Danube Region by 2030.

The Trans-European Transport Networks (TEN-T)[23] are a planned set of road, rail, air and water transport networks in the European Union. The TEN-T networks are part of a wider system of Trans-European Networks (TENs), including a telecommunications network (eTEN) and a proposed energy network (TEN-E or Ten-Energy). The European Commission adopted the first action plans on trans-European networks in 1990.[1]

Following the entry into force of the Maastricht treaty in 1993, the TEN-T became one of the key instruments for cohesion and growth within the European Union. Based on these competences, the Essen European Council in 1994 endorsed the so-called "Essen List" including the 14 projects that were supposed to contribute most to European integration. This list of priority projects was later included in the Community Guidelines for the development of the Trans-European Transport Network (TEN-T) that was adopted by the European Parliament and Council in 1996. The first financial regulation for the TEN-T was adopted in 1995.[24]

Almost at the same time, due to the start of the preparation for a larger EU, a set of corridors linking the TEN-T with the neighbouring countries was created. These corridors, called 10 pan-European

[21] Germany: No separate data available for Baden-Wuerttemberg and the Free State of Bavaria.
[22] Ukraine: No separate data for regions that are part of the Danube macro-region.
[23] https://en.wikipedia.org/wiki/Trans-European_Transport_Networks
[24] http://www.green-ten-t.eu/history/

Corridors (I – X) were adopted in the second and third pan-European conference of ministers in Crete (1993) and Helsinki (1997). Projects in candidate and potential candidate countries are supported with EU funds from PHARE and IPA programs.

The first important revision of the TEN-T was made with Decision no.884/2004[25], since the list of projects was extended to a total of 30 projects called "priority projects".

The new legal basis for the development of the trans-European transport network (TEN-T) which has been adopted in December 2013 marks the beginning of a new era in Europe's transport infrastructure policy. TEN-T Core Network Corridors are the backbone of the new EU transport policy.

Compared to the past approach, the main innovation of the new TEN-T policy lies in the definition of an integrated, multimodal core network which shall be developed until 2030 by the Member States and relevant stakeholders. This core network links major nodes (urban nodes, ports, airports and other transport terminals) through key rail, road, inland waterway, maritime and air transport connections.

The core network shall be completed, i.e. a full network shall be in function, missing links between the Member States will be completed and bottlenecks that hamper free flows of transport, thereby causing high cost to the economy will be removed.

Core network corridors play a key role in the coordinated implementation of the new TEN-T policy. The corridors are based on three pillars:

- enhancing cross-border connections and removing bottlenecks;
- integrating different transport modes (multi-modality);
- promoting technical interoperability.

The Connecting Europe Facility (CEF)[26] for Transport is the funding instrument to realize European transport infrastructure policy. It aims at supporting investments in building new transport infrastructure in Europe or rehabilitating and upgrading the existing one.
TEN-T policy objectives foresee:

- completion by 2030 of the Core Network, structured around nine multimodal Core Network Corridors[27],
- completion by 2050 of the Comprehensive Network to facilitate accessibility to all European regions.

The Regulation (EU) 2021/1153 establishing the Connecting Europe Facility (CEF) for the period 2021-2027 was adopted[28]. The Regulation lays down the objectives of the CEF, its budget for the 2021-2027 period, the forms of Union funding and the rules for providing such funding. It also repeals Regulation (EU) 1316/2013 and Regulation (EU)283/2014. The new rules apply retroactively as of 1 January 2021.

CEF 2021-2027 is aimed at supporting investment in key projects in the areas of transport, digital and energy infrastructure with an overall budget of €33.71 billion. The total budget for CEF Transport is €25.81 billion for the period 2021-2027, including €11.29 billion for cohesion countries.

In the transport sector, the programme will promote interconnected and multimodal networks in order to develop and modernise rail, road, inland waterway and maritime infrastructure, as well as

[25]https://publications.europa.eu/en/publication-detail/-/publication/cfd1dc3e-27de-4c58-b64d-5e20e87492d5/language-en
[26] https://ec.europa.eu/inea/en/connecting-europe-facility
[27] Note: revision of TEN-T is foreseen in 2023
[28] https://cinea.ec.europa.eu/news/connecting-europe-facility-2021-2027-adopted-2021-07-20_en

ensuring safe and secure mobility. Priority will be given to further development of the trans-European transport networks (TEN-T), focusing on missing links and cross-border projects with an EU added value. €1.56 billion of the transport budget will finance major rail projects between cohesion countries and €1.69 billion will be devoted to ensuring that when infrastructure is adapted to improve military mobility within the EU, it is dual-use compatible, meeting both civilian and military needs. CEF Transport also supports innovation in the transport system to improve the use of infrastructure, reduce the environmental impact of transport, enhance energy efficiency and increase safety.

These projects are technically and financially managed by the European Climate, Infrastructure and Environment Executive Agency (CINEA)[29], which is the successor organisation of the Innovation and Networks Executive Agency (INEA), which in return is the successor of the Trans-European Transport Network Executive Agency (TEN-T EA) created by the European Commission in 2006.
CINEA has been officially established on 15 February 2021 and it has started its activities on 1 April 2021 in order to implement parts of certain EU programmes. CINEA plays a key role in supporting the EU Green Deal through the efficient and effective implementation of its delegated programmes.

Programmes managed by CINEA of the most importance for mobility and transport projects are:

- Connecting Europe Facility (CEF): The CEF is a key EU instrument to promote growth, jobs and competitiveness through targeted infrastructure investment at European level. It is divided into 3 sectors (Transport, Energy and Digital), only 2 of which are competence of CINEA: CEF Transport and CEF Energy.
- Horizon Europe[30]: Horizon Europe is the largest transnational programme ever supporting research and innovation and will be implemented by the EU. The new EU research and innovation programme will have a budget of around €95.5 billion for 2021-2027 (current prices). This includes €5.4 billion (current prices) from NextGenerationEU to boost our recovery and make the EU more resilient for the future, as well as an additional reinforcement of €4.5 billion (current prices). CINEA will manage the Horizon Europe work programmes of cluster 5, which includes climate, energy and transport areas.

CINEA also manage the following programs:

- Innovation Fund,
- LIFE programme,
- EU Renewable Energy Financing Mechanism,
- Just Transition Mechanism,
- European Maritime, Fisheries and Aquaculture Fund.

CINEA's main objective is to increase the efficiency of the technical and financial management of the programs it manages.

1.5.1. Trans-European Transport Network (TEN-T) in the Danube region

The Trans-European Transport Network (TEN-T)[31] policy addresses the implementation and development of a Europe-wide network of railway lines, roads, inland waterways, maritime shipping routes, ports, airports and railroad terminals. The ultimate objective is to close gaps, remove bottlenecks and technical barriers, as well as to strengthen social, economic and territorial cohesion in

[29] https://cinea.ec.europa.eu/index_en
[30] https://cinea.ec.europa.eu/horizon-europe/transport-research-horizon-europe_en
[31] https://transport.ec.europa.eu/transport-themes/infrastructure-and-investment_en

the EU. The current TEN-T policy is based on Regulation (EU) No 1315/2013, which is currently being revised.

Besides the construction of new physical infrastructure, the TEN-T policy supports the application of innovation, new technologies and digital solutions to all modes of transport. The objective is improved use of infrastructure, the reduced environmental impact of transport, enhanced energy efficiency and increased safety.

TEN-T comprises two networks 'layers':

- The **Core Network** includes the most important connections, linking the most important nodes, and is to be completed by 2030.

- The **Comprehensive Network** covers all European regions and is to be completed by 2050.

Indicative extension to these networks to non-EU countries are defined in Annexes to Regulation (EU) No 1315/2013).

The backbone of the Core Network is represented by nine Core Network Corridors, which were identified to streamline and facilitate the coordinated development of the Core Network. One of the horizontal priorities is the European Rail Traffic Management System (ERTMS).

Figure 8: TEN-T Core Network Corridors in Danube region

Part of the Trans-European Network (TEN-T), are the following Core Network corridors in the Danube region.

- The Baltic-Adriatic Corridor[32]

The Baltic-Adriatic Corridor is one of the most important trans-European-road and railway axes in Central Europe. It runs from the Baltic seaports of Gdansk, Gdynia, Szczecin and Świnoujście in the north, to the Adriatic ports of Koper, Trieste, Venice and Ravenna in the south, taking in the industrial regions of Central and Southern Poland, before straddling the Czech, Slovakian and Austrian/Slovenian boarders on its way south to Italy and Slovenia. The corridor features key railway projects including the Semmering Base Tunnel and Koralm Railway Line in Austria, as well as important cross-border connections between the six corridor countries.

In the Danube region this corridor crosses **Czech, Slovakia, Austria, Slovenia**.

The Baltic-Adriatic Corridor still faces important bottlenecks on railway cross border sections, in terms of their compliance with the TEN-T requirements. There are border sections that need to be upgraded between: CZ-AT, AT-SK, AT-SI and SI-IT.

- The Mediterranean Corridor [33]

The Mediterranean Corridor is the main east-west axis in the TEN-T Network south of the Alps. It runs between the south-western Mediterranean region of Spain and the Ukrainian border with Hungary, following the coastlines of Spain and France and crossing the Alps towards the east through Italy, Slovenia and Croatia and continuing through Hungary up to its eastern border with Ukraine. The corridor primarily consists of road and rail, aside from the Po River, several canals in Northern Italy and the Rhone River from Lyon to Marseille. The corridor is approximately 3000 km long; it will provide a multimodal link for the ports of the Western Mediterranean with the centre of the EU. It will also create an east-west link through the southern part of the EU, contribute to a modal shift from road to rail in sensitive areas such as the Pyrenees and the Alps, and connect some of the major urban areas of the EU with high-speed trains.

In the Danube region this corridor crosses **Slovenia, Croatia, Hungary, Ukraine**.

The main bottlenecks in the Danube region on railways on the Mediterranean corridor are the border links with Slovenia, Croatia and Hungary.

- The Orient – East Med Corridor[34]

The Orient/East-Med Corridor connects large parts of Central Europe with ports of the North, Baltic, Black and Mediterranean Seas. It focuses upon fostering the development of these ports as major multimodal logistics platforms and providing economic centres in central Europe with modernized, multimodal connections to Motorways of the Sea. The corridor incorporates the Elbe River as a key inland waterway and will improve multimodal connections between Northern Germany, Czech Republic; the Pannonian region and Southeastern Europe. The corridor will also provide an improved link to Cyprus.

[32] https://transport.ec.europa.eu/transport-themes/infrastructure-and-investment/trans-european-transport-network-ten-t/baltic-adriatic-corridor_en

[33] https://transport.ec.europa.eu/transport-themes/infrastructure-and-investment/trans-european-transport-network-ten-t/mediterranean-corridor_en

[34] https://transport.ec.europa.eu/transport-themes/infrastructure-and-investment/trans-european-transport-network-ten-t/orient-east-med-corridor_en

In the Danube region this corridor crosses **Czech Republic, Slovakia, Austria, Hungary, Romania, Bulgaria.**

The bottlenecks are numerous missing links remain with most of the multimodal connections between Hungary, Bulgaria, Romania and Greece yet to be constructed or substantially upgraded. Cross-border traffic management systems on rail are still to be implemented on many sections.

- The Rhine-Danube Corridor[35]

The Rhine-Danube Corridor provides the main east-west link across Continental Europe. Tracing its route along the Danube River, it connects Strasbourg and Southern Germany with the Central European cities of Vienna, Bratislava and Budapest, before passing through the Romanian capital Bucharest to culminate at the Black Sea port of Constanta. A second branch of the corridor tracks a path from Frankfurt to the Slovakian/Ukrainian border, linking Munich, Prague, Žilina and Košice.

In the Danube region this corridor crosses **Germany, Austria, Czech Republic, Slovakia, Austria, Hungary, Romania, Bulgaria, Ukraine, Croatia, Bosnia and Herzegovina and Serbia.**

The main missing links are cross-border rail network connections between Germany and its neighbours, France, Austria and the Czech Republic. Bottlenecks in Slovakia, Hungary, Romania and Bulgaria—and between Austria and Slovakia also need to be addressed. In addition, the Western Balkans section of the Danube plays an important part in the functioning of this corridor and must therefore attain similar high standards.

- The Rhine-Alpine Corridor[36]

The Rhine-Alpine Corridor constitutes one of the busiest freight routes in Europe. It connects key North Sea ports of Belgium and the Netherlands with the Mediterranean port of Genoa. The regions it encompasses count among the most densely populated and economically strong in Europe. Altogether, more than 70 million people live, work and consume in the catchment area of the Rhine-Alpine Corridor, which is also home to a number of leading manufacturing and trading companies, production plants and distribution centres. The corridor runs through the so-called “Blue banana”, which includes major EU economic centres such as Brussels and Antwerp in Belgium, the Randstad region in the Netherlands, the German Rhine-Ruhr and Rhine-Neckar regions, the Basel and Zürich regions in Switzerland and the Milano and Genoa regions in Northern Italy. This multimodal corridor incorporates the Rhine River as the key inland waterway in Europe, as well as important tunnelling projects in Switzerland, including the world’s longest and deepest rail tunnel, the Gotthard Base tunnel.

In the Danube region this corridor crosses Federal state of **Baden-Württemberg in Germany.**

The Rhine-Alpine is a mature corridor and as such, does not have major missing links. Rather, the main challenges for the corridor constitute bottlenecks emanating from increased traffic flows. The main bottlenecks exist in Germany and Italy where capacity upgrades are required.

- The Scandinavian-Mediterranean Corridor [37]

[35] https://transport.ec.europa.eu/transport-themes/infrastructure-and-investment/trans-european-transport-network-ten-t/rhine-danube-corridor_en

[36] https://transport.ec.europa.eu/transport-themes/infrastructure-and-investment/trans-european-transport-network-ten-t/rhine-alpine_en

[37] https://transport.ec.europa.eu/transport-themes/infrastructure-and-investment/trans-european-transport-network-ten-t/scandinavian_en

The Scan–Med Corridor is the longest of the nine TEN-T Core Network Corridors, it develops its network from the Seine to the Danube. The Scandinavian-Mediterranean Corridor represents a crucial north-south axis for the European economy. The corridor stretches from Finland and Sweden in the North, to the island of Malta in the South, taking in Denmark, Northern, Central and Southern Germany, the industrial heartlands of Northern Italy and the southern Italian ports. The most significant projects on the corridor are the Fehmarnbelt Fixed Link and Brenner Base tunnel, including their access routes.

In the Danube region this corridor crosses **Austria** and Federal State of **Bavaria in Germany.**

The cross-border alpine connection between Munich and Verona represents a major bottleneck on the corridor and will be alleviated by the construction of the Brenner Base Rail Tunnel, when it becomes operational in 2032. The removal of this bottleneck is crucial for the realisation of the entire corridor, linking Northern and Southern Europe. Together with the Gotthard-Monte Ceneri axis in Switzerland and the Lyon-Turin rail connection, the Brenner corridor will bind together a complex network of high-capacity rail links.

1.5.2. Rail Freight corridors of the Danube region

International rail freight corridors for competitive freight transport run through Danube region following EU Regulation 913/2010 on European rail freight corridors (RFC),[38] with the aim to enhance the competitiveness of the rail freight transport to improve the market share of rail over road.

- RFC 5[39] - Baltic – Adriatic Corridor

Baltic – Adriatic RFC includes 4.820 km of railway lines that connect two seas. At the north of Europe Baltic Sea and the Adriatic Sea at the south of Europe. Baltic Adriatic RFC runs through six states of Europe, namely Poland, **Czech Republic, Slovakia, Austria, Slovenia** and Italy.

The route of the corridor: Swinoujscie / Gdynia – Katowice – Ostrava / Žilina – Bratislava / Vienna / Klagenfurt – Udine – Venice / Trieste / Bologna / Ravenna and Graz – Maribor – Ljubljana – Koper / Trieste.

- RFC 6[40] – Mediterranean Corridor

Mediterranean RFC includes railway lines that connect Mediterranean countries from West to South of Europe, it crosses 6 Countries of the European Union: Spain, France, Italy, **Slovenia, Croatia** and **Hungary**.

The route of the corridor: Almeria - Valencia / Algeciras / Madrid - Zaragoza / Barcelona - Marseille - Lyon - Turin - Milan - Verona - Padua / Venice - Trieste / Koper - Ljubljana - Budapest and Ljubljana / Rijeka - Zagreb - Budapest - Zahony (Hungarian-Ukrainian border).

[38] Smernice za železniške strukturne in funkcionalne podsisteme, Program omrežja 2022, Slovenske železnice
[39] https://www.rfc5.eu/
[40] https://www.railfreightcorridor6.eu/RFC6/web.nsf/OnePager/index.html

- Orient / East- Med[41] Corridor (former RFC 7)

Rail Freight Corridor Orient / East-Med (RFC OEM, formerly also RFC 7) is a virtual transport corridor, which has been established to facilitate international rail freight. Infrastructure managers and authorities from eight Central- and Southeast-European countries have teamed up to create better technical and business conditions for using their rail networks. The users - railway undertakings - can thereby make better offers for shippers, and the rail sector increases its attractiveness.

RFC OEM is linking Southeastern Europe with the Northern Sea ports in Germany via Central Europe. It is running through eight EU Member States: **Austria, Bulgaria, the Czech Republic, Germany**, Greece, **Hungary, Romania** and **Slovakia**.

The nodes which are connected by its network are Bremerhaven / Wilhelmshaven / Rostock / Hamburg – Prague – Wien / Bratislava – Budapest – București– Constanța /Vidin – Sofia – Burgas / Svilengrad (Bulgarian-Turkish border) / Promachonas – Thessaloniki – Athína – Patras.

- RFC 9 – Czech-Slovak / Rhine – Danube[42]

Rhine – Danube RFC includes 6.800 km of railway lines. It provides the main East–West link across Continental Europe. It crosses seven countries: **Austria, Czech Republic**, France, **Germany, Hungary**, **Romania, Slovakia**.

- RFC 10[43] - Alps - Western Balkans

Alpine - Western Balkans RFC includes 2.114 km principal lines and 31 km connecteding lines. It crosses five countries: **Austria**, **Slovenia**, **Croatia**, **Serbia** and **Bulgaria** and is the key rail axis in the Western Balkans region, both in terms of passengers and freight.

The corridor route connects: Svilengrad in Bulgaria (on the border with Turkey) over Sofia – Belgrade – Zagreb to Zidani Most in Slovenia, where the route divides into two lines. One line is trough Maribor – Graz to Wells and the other trough Ljubljana – Villach to Salzburg.

- RFC 11[44] - Amber Corridor

Eponym of Amber RFC is the legendary Amber Road, an important ancient trade route, the alignment of which the corridor broadly follows. It crosses Poland, **Hungary, Slovakia** and **Slovenia**.

The route of the corridor: Koper – Ljubljana – Zalaszentiván – Sopron/Csorna – / (Hungarian-Serbian border) – Kelebia – Budapest - / - Komárom – Leopoldov / Rajka – Bratislava – Žilina – Katowice / Kraków – Warszawa / Łuków – Terespol – (Polish-Belarusian border).

1.6. Organizations, bodies and initiatives in the field of railways and rail transport.

Existing organizations and initiatives to promote cooperation among countries for railway transport at an international level:

[41] https://www.rfc7.eu/
[42] https://rfc-rhine-danube.eu/
[43] https://www.rfc-awb.eu/
[44] https://rfc-amber.eu/

- International Union for Railways (UIC). UIC was established in Paris in 1922 with the main purpose to harmonize and improve conditions for railway construction and operations. At the moment UIC has 82 active members from railways of Europe, Asia, the Middle East and Africa.

- International Rail Transport Committee (CIT). The main objective of the CIT is to promote the interoperability of international railway transport by promoting the harmonization of legal frameworks and supporting uniform implementation of laws governing railway transport.

- ILCAD initiative (International Level Crossing Awareness Day).

Existing organizations, agencies, programs and initiatives to promote cooperation among countries for railway transport on European level:

- European Union Agency for Railways (ERA). The main objective of this organization is to make the railway system work better for society, contributing to the effective functioning of a Single European Railway Area without frontiers. Its main tasks are to promote a harmonized approach to railway safety. Devise the technical and legal framework to enable the removal of technical barriers, and act as the system authority for ERTMS and telematics applications. Improve accessibility and use of railway system information Act as the European Authority under the 4th Railway Package issuing vehicle (type) authorizations and single safety certificates, while improving the competitive position of the railway sector.

- Connecting Europe Facility (CEF). This program operates within an executive agency (CINEA). It is a key EU funding instrument to promote growth, jobs and competitiveness through targeted infrastructure investment at the European level. CEF investments fill the missing links in Europe's energy, transport and digital backbone.

- Interreg programme[45]: **The Danube Transnational Programe** (DTP). A financing instrument of the European Territorial Cooperation (ETC), better known as Interreg. ETC is one of the goals of the European Union cohesion policy and provides a framework for the implementation of joint actions and policy exchanges between national, regional and local actors from the different Member States.

- **The European Union Strategy for the Danube Region** (EUSDR). It intends to develop coordinated policies and actions in the area of the river basin, reinforcing the commitments of Europe 2020 strategy towards smart, sustainable and inclusive growth based on four pillars and twelve priority areas. These shall tackle key issues like mobility, energy, biodiversity, socio-economic development or safety.

- CER (The voice of European railways)[46]

- EIM[47] (European Rail Infrastructure Managers)

[45] http://www.interreg-danube.eu/about-dtp/
[46] https://www.cer.be/
[47] https://eimrail.org/

1.7. Harmonization of passenger train timetables and an integrated public passenger transport system

An integrated transport alliance offers the passenger, under the application of a uniform tariff system, the benefit of a joint ticket at a discounted rate covering all involved scheduled transport operators (rail, public and private bus operators, and municipal transport companies).[48]

This system is introduced only in few Danube countries - Austria, Croatia, Czech Republic, Germany and also in Hungary and Slovenia.

Some countries are involved in an international project that promotes international connectivity and improvement of public transport in the region, CONNECT2CE.

Slovenia and Italy are participating in a pilot project for the development of an integrated ticket on the Ljubljana-Trieste route, which will connect train and bus passenger transport. Similar cooperation has been established with the Croatian Railways.

1.8. A display of basic data on railways in the Danube region presented in charts

Charts on the brochure contain data about:

- Kilometres of railways per million inhabitants
- Kilometres of railways per km^2 of the land area
- Share of electrified lines
- Percentage of TEN-T network in a country
- Average number of trains/day (freight and passenger) - entire network (2020)
- Traffic safety – number of fatalities per million inhabitants in railways accidents in year 2020
- Gross investment spending in railways infrastructure in Mio EUR/year 2020 per Mio inhabitants
- Maintenance expenditures in railways infrastructure in EUR/year 2020 per km of road network (length of all roads)

Charts in the brochure shows a quick overview of the few important parameters that are important at describing a road network. On the charts, one can compare different parameters between counties.

[48] https://www.bmk.gv.at/en/topics/mobility/transportation/publicpassenger.html

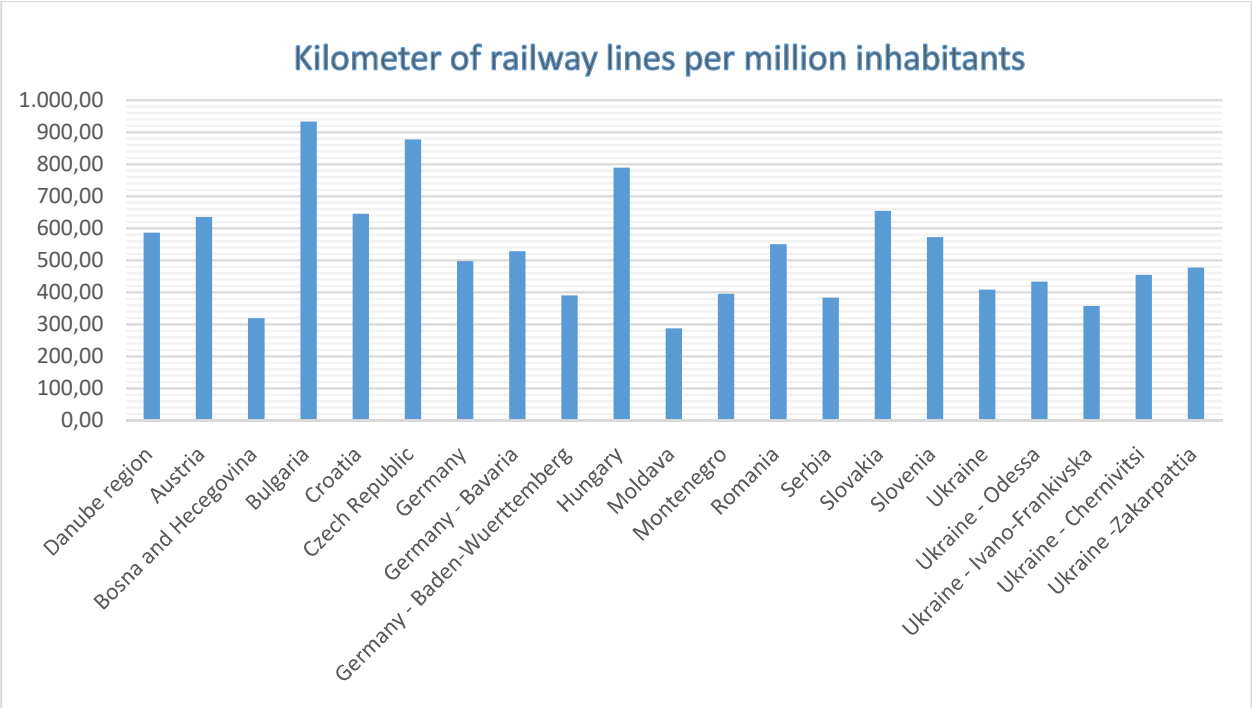

Figure 9: Kilometers of railway lines per million inhabitants

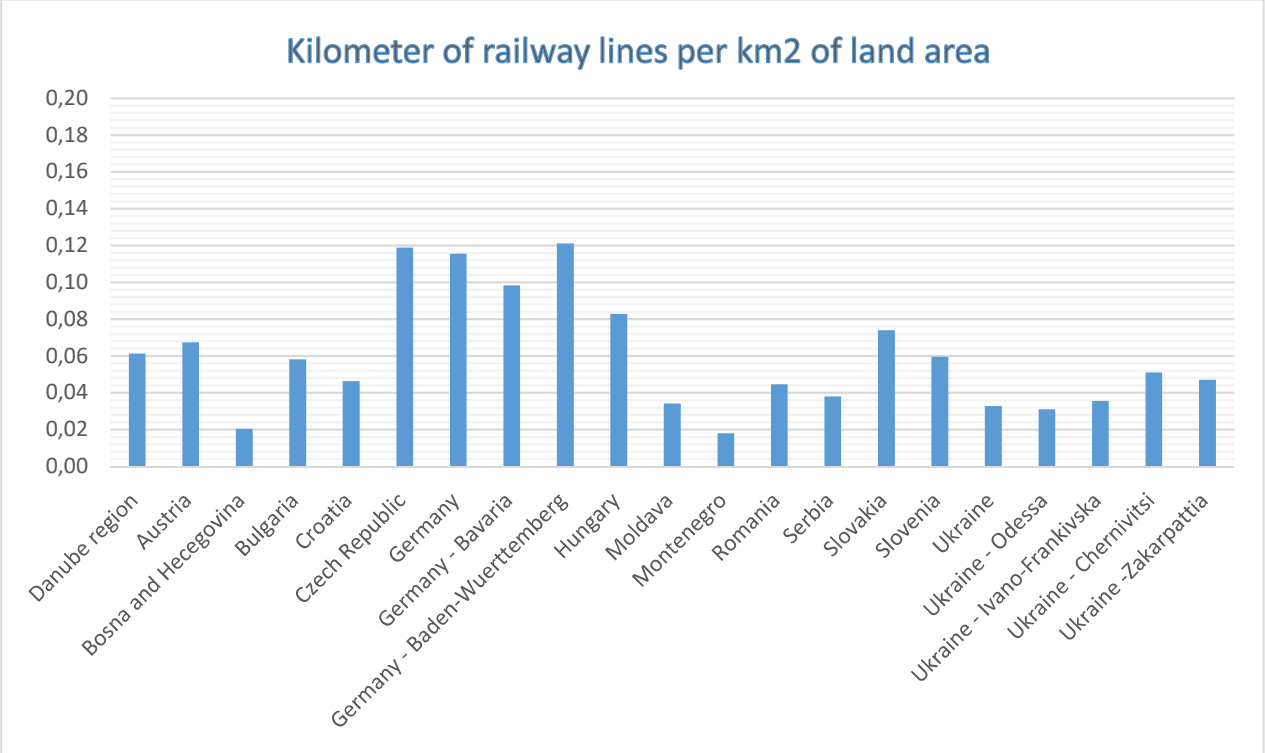

Figure 10:Kilometers of railway lines per km2 of land area

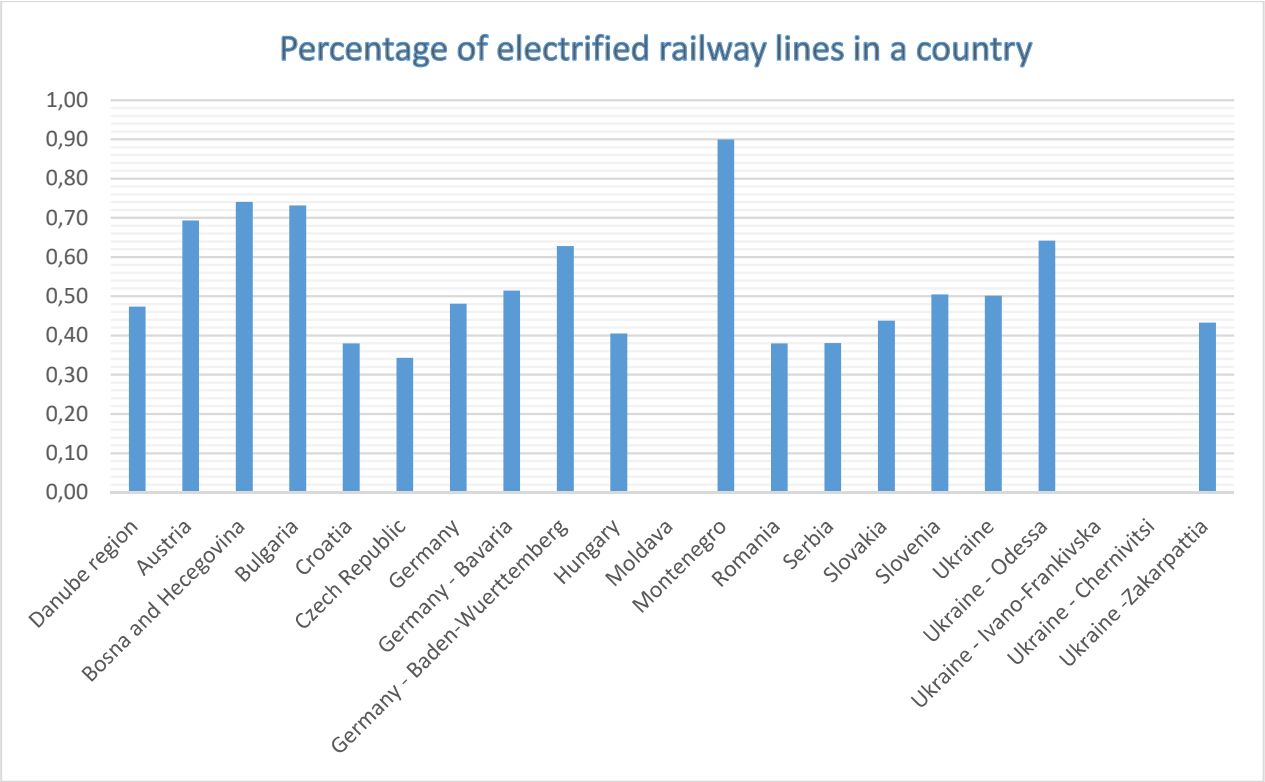

Figure 11: Percentage of electrified railway lines in a country

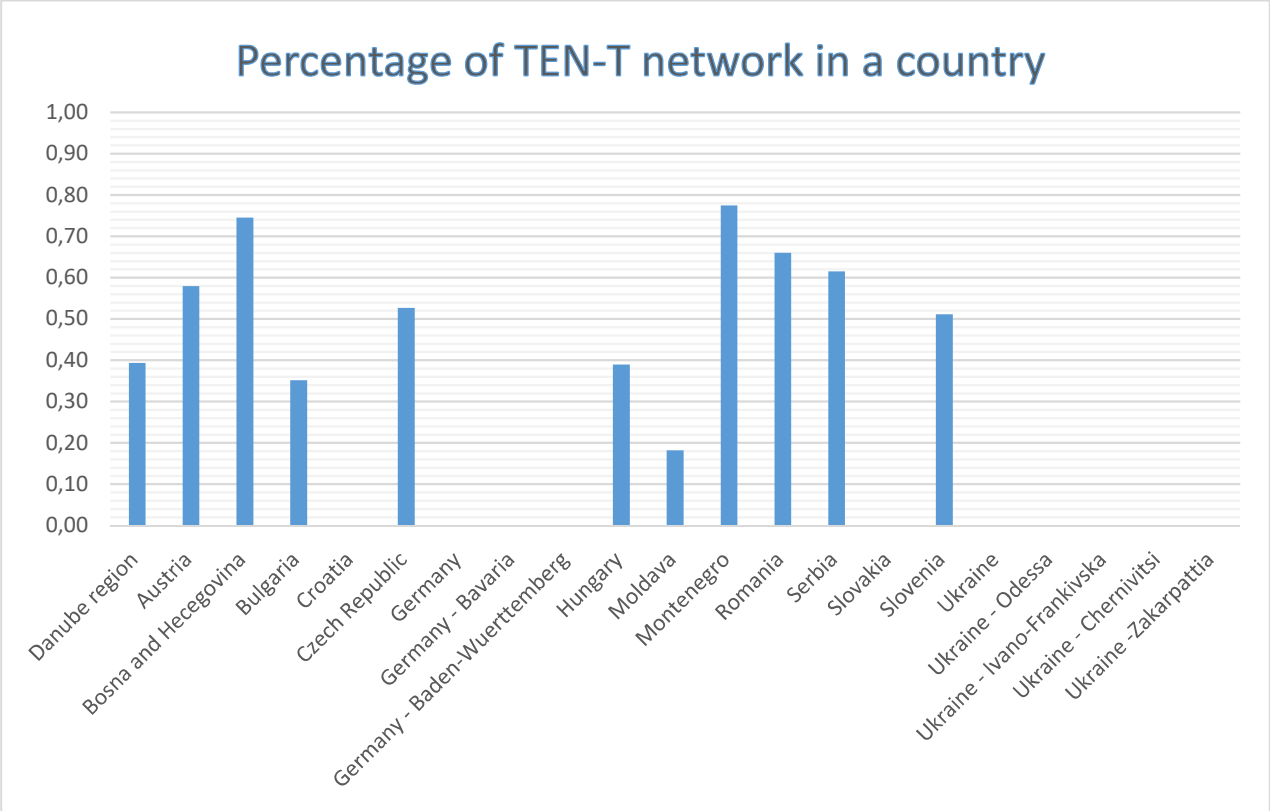

Figure 12:Percentage of TEN-T (core and comprehensive) railway lines in a country

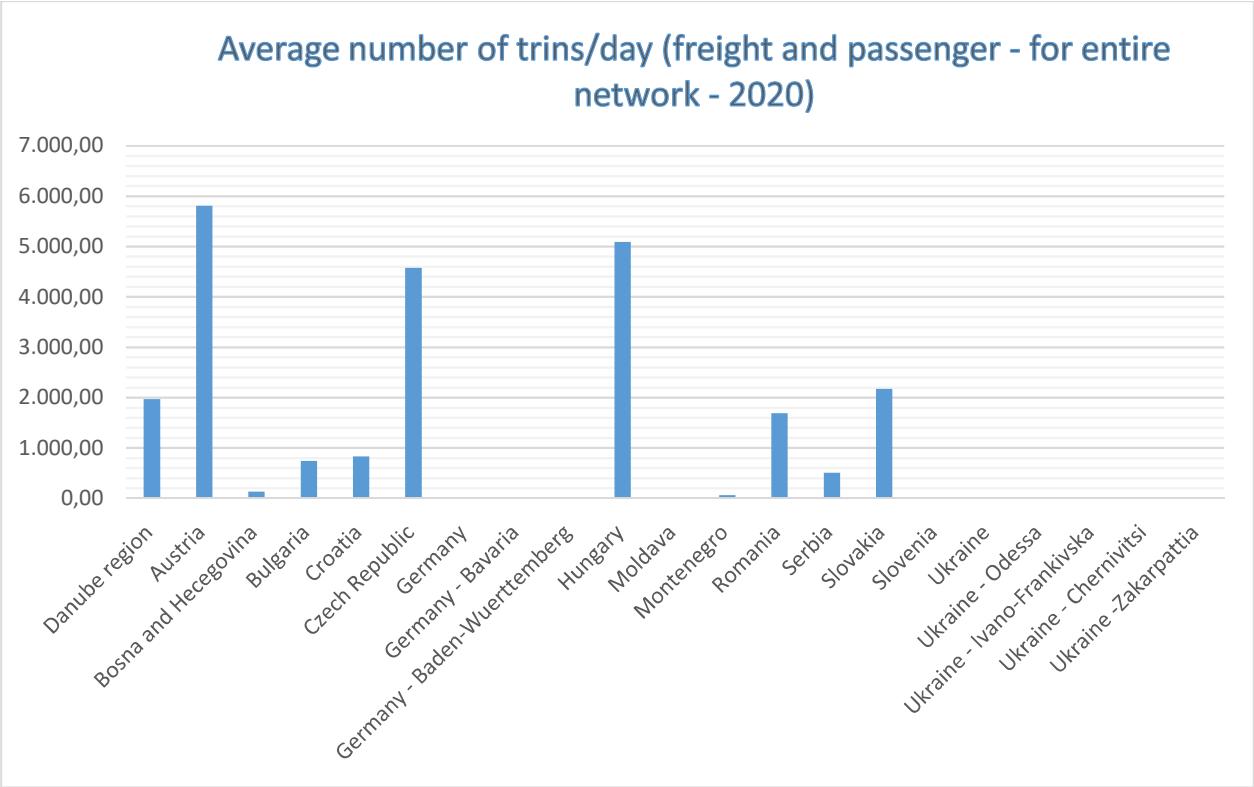

Figure 13:Average number of trains/day (freight and passenger - for entire network - 2020)

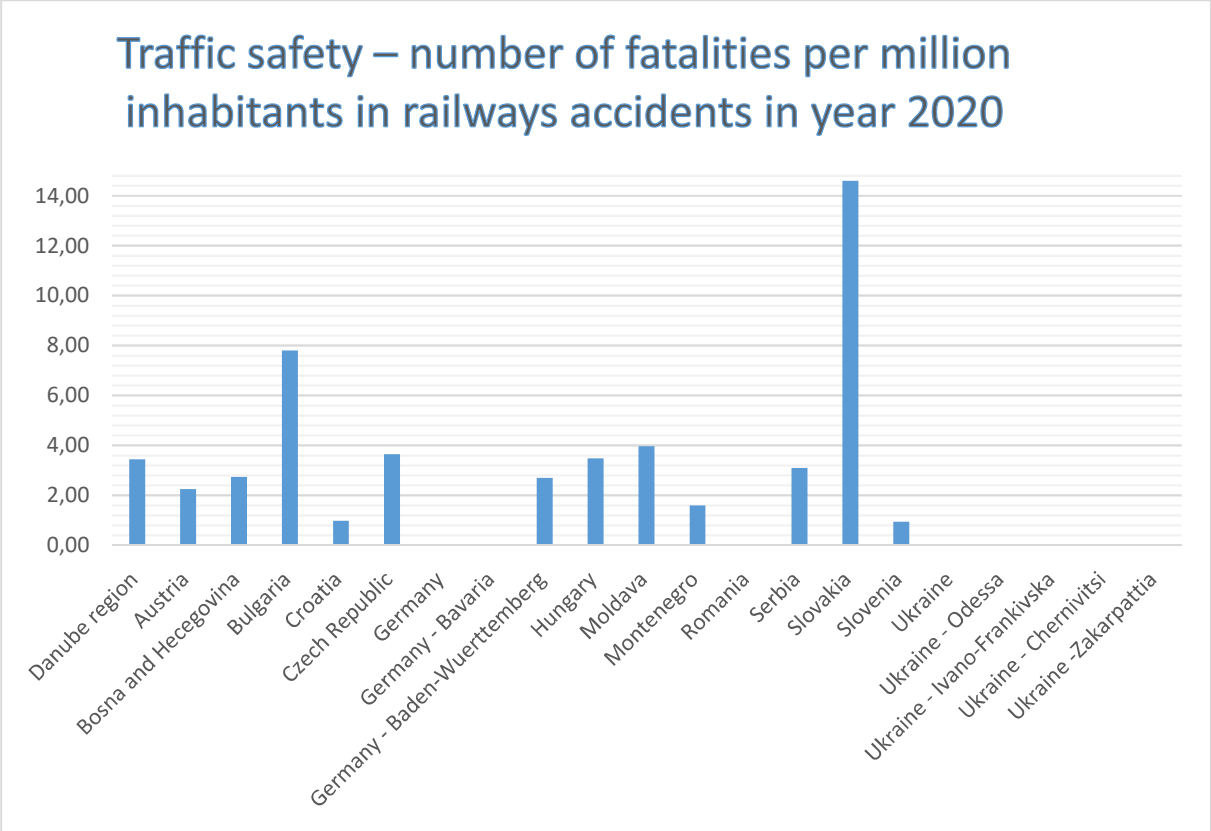

Figure 14:Traffic safety – number of fatalities per million inhabitants in railways accidents in year 2020

2. REGION DESCRIPTIONS IN THE DANUBE REGION

2.1. AUSTRIA

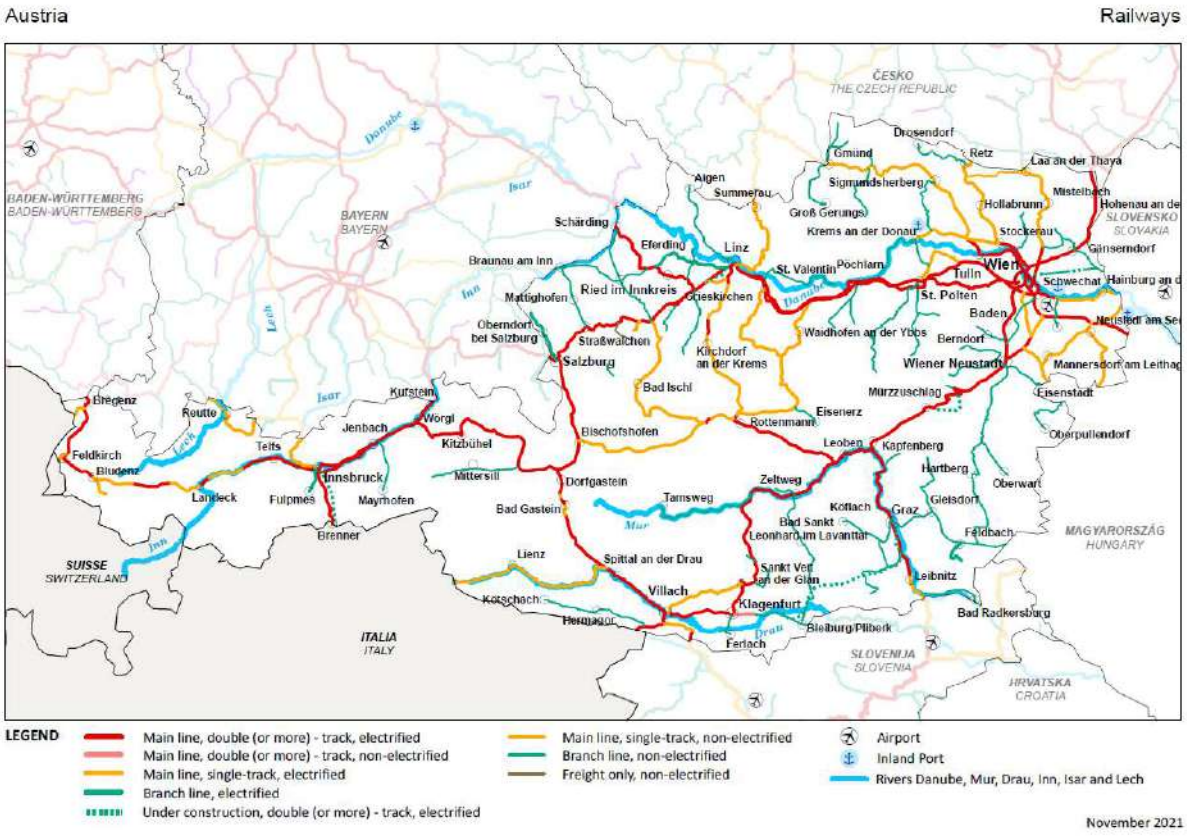

Figure 15:Railways map of Austria

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Austria is a country situated in Central Europe. Most of its territory lies on the right side of the Danube River. Austria borders Slovenia and Italy in the south, Hungary in the southeast, Slovakia in the east, the Czech Republic and Germany in the north, Switzerland and Liechtenstein in the west. The landscape is mostly Alpine, only 32 % of the country is below 500 m above sea level[49]. Austria has 83.879 km^2 of land area and 8.690.076 inhabitants with 40.200 EUR per capita GDP.

The length of all Austrian railways is 89,000 km. 69% of the railway network is electrified. Austria has good railway connections with most neighbouring countries. The railway coverage of the country (km per km2 of land) is above the regional average. It also has more than the regional average length (km) of railways per million inhabitants. The country also has high-speed rail lines.

[49] https://en.wikipedia.org/wiki/Austria

2.2. BOSNIA AND HERCEGOVINA

Figure 16:Railways map of Bosnia and Hercegovina.

Bosnia and Herzegovina is situated in the Balkan peninsula in South-Eastern Europe. It has borders with Croatia in the north, west and southwest, Serbia and Montenegro in the east. It is located on the right side of the middle part of the Danube River. Its terrain is mostly mountainous in the east and centre of the country, the northwest is mostly hilly and flatlands can be found mainly in the northeast.

The length of all Bosnian-Herzegovinian railways is 1,048 km. 74% of the railway network is electrified. Bosnia and Herzegovina does not have good railway connections with any of the neighbouring countries. The railway coverage of the country (km per km2 of land) is below the regional average. It also has below the regional average length (km) of railways per million inhabitants.

2.3. BULGARIA

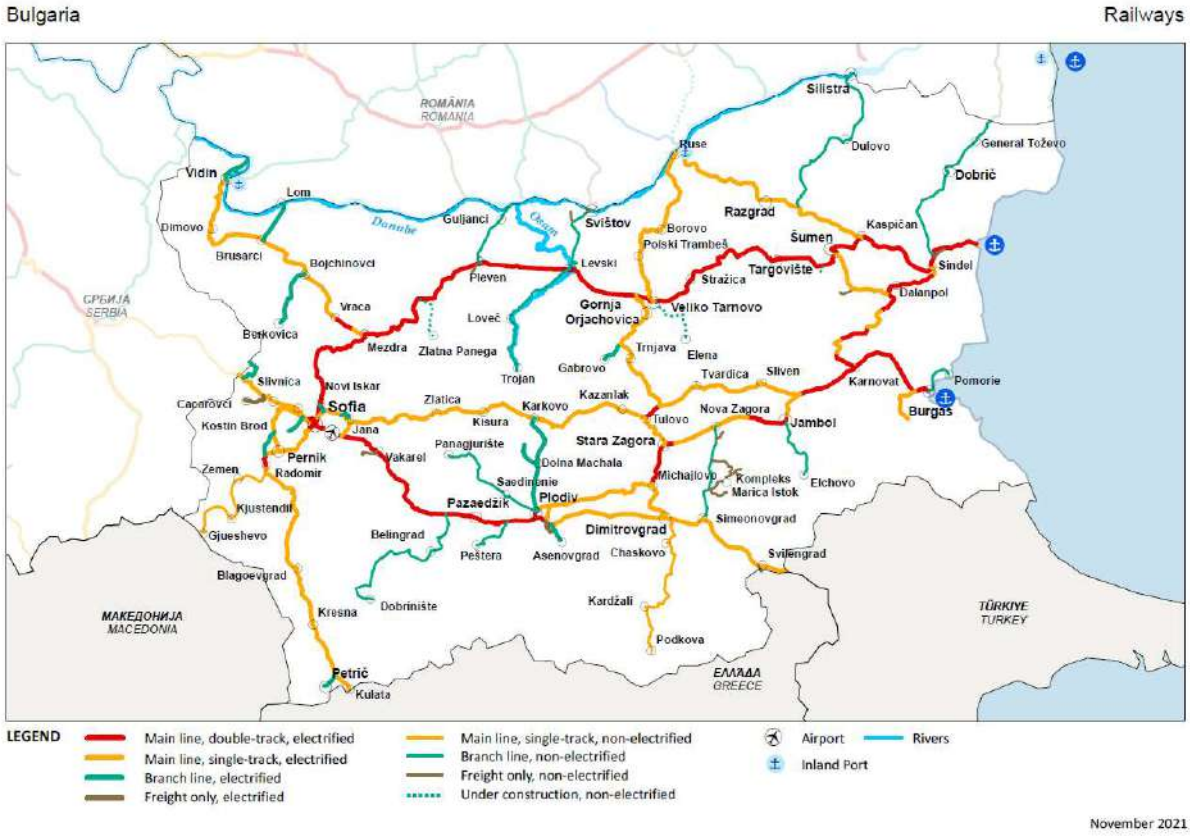

Figure 17:Railways map of Bulgaria.

Bulgaria is situated in South-Eastern Europe. It has borders with Romania on the north, Serbia on the northwest, FYR Macedonia on the west, Greece on the southwest and south, Turkey on the southeast and the Black Sea on the east. It is located in the right side of the lower part of the Danube River. Its terrain is diverse. On the west is a part of the Balkan Mountains in the middle Thracian plain and on the North-Northeast Danubian plains.

The length of all Bulgarian railways is 6,454.00 km. 73% of the railway network is electrified. Bulgaria also does not have good railway connections with any of the neighbouring countries. The railway coverage of the country (km per km2 of land) is above the regional average. It also has more than the regional average length (km) of railways per million inhabitants.

2.4. CROATIA

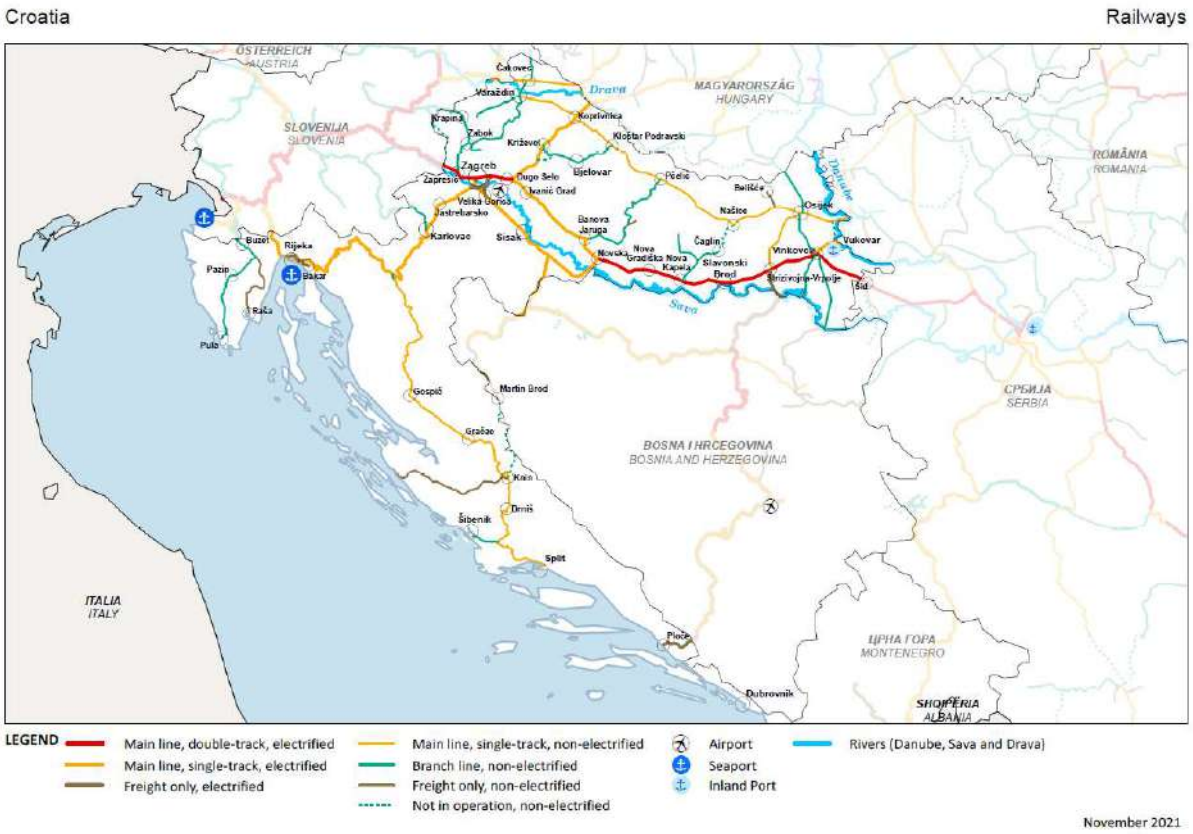

Figure 18:Railways map of Croatia.

Croatia is country situated in the north of the Balkan region – Southeast Europe, on the right side of the Danube River basin. Its borders are Slovenia on the north, on the west Adriatic Sea and the sea border with Italy, on the south Bosnia and Hercegovina and Montenegro, on the east Serbia and on the northeast Hungary. Croatia consists of the Dinaric Alps on the west, hilly northern parts of Hrvatsko Zagorje and a part of the Pannonian basin in the east. Croatia has over 5.800 km of shore line on the Adriatic Sea.

The length of all Croatian railways is 2.617 km. 38% of the railway network is electrified. Croatia do not have good railway connections with the neighbouring countries. The country's railway coverage (km per km^2 land area) is below the regional average. Length (km) of railways per million inhabitants is also below the regional average.

2.5. CZECH REPUBLIC

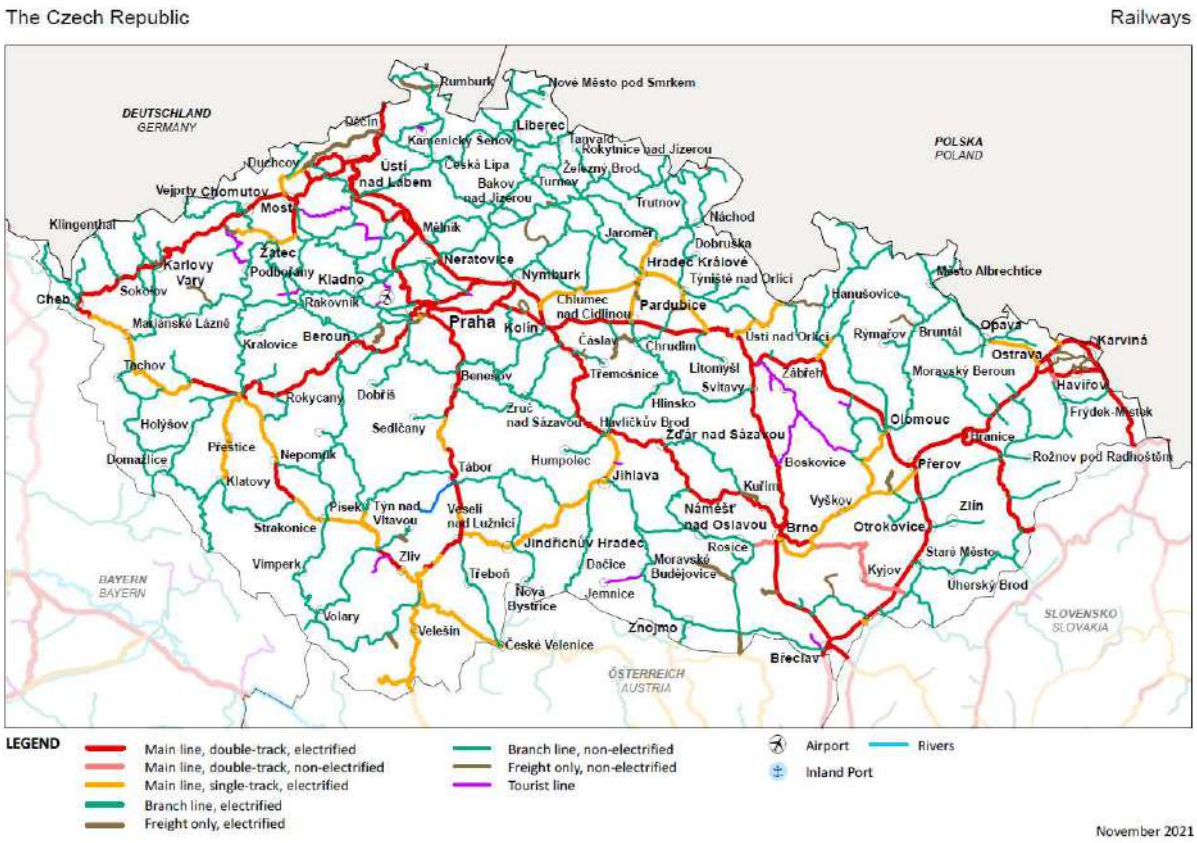

Figure 19: Railways map of the Czech Republic.

Czech Republic is a country situated in Central Europe in the left side of the Danube River. In the northwest and west, it shares a border with Germany. In the south it has a border with Austria, at the southeast, it borders Slovakia and, in the northeast, it borders Poland. Its geography is mainly hilly, with its highest point Sněžka 1.603 m.

The length of all Czech railways is 9.377,00 km. 34 % of the railway network is electrified. Czech Republic has good railway connections with most of the neighbouring countries. The railway coverage of the country (km per km2 of land) is the same as the regional average. More than the regional average is the length (km) of railways per million inhabitants.

2.6. GERMANY - BADEN WÜRTTEMBERG

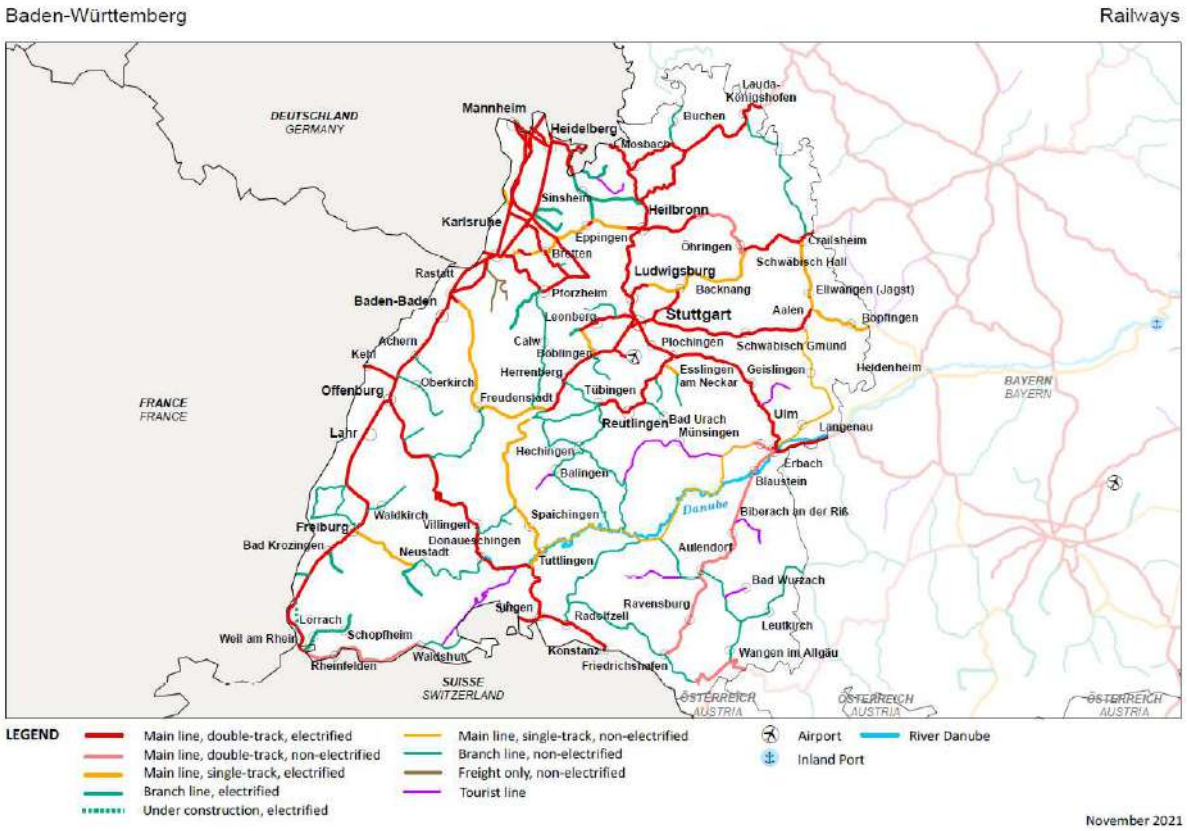

Figure 20: Railways map of Baden Wuertemberg.

Baden Wuerttemberg is a federal state in Germany, with 10.879.618 inhabitants. It is situated in the upper Danube region southwest of Germany at the border of France and Switzerland. In the southwest lies the Black Forest (Schwarzwald) and in the south, there are the foothills of the Alps[50]. The Danube River originates at Donaubach spring (Donaueschingen) in the Black Forest[51].

The length of all Baden Wuerttemberg railways is 4,326.00 km. 63% of the railway network is electrified. Baden Wuerttemberg has good railway connections with neighbouring countries and federal states. The railway coverage of the country (km per km2 of land) is above the regional average. The length (km) of railways per million inhabitants is below the regional average. The country also has high-speed railways.

[50] https://www.google.si/maps/@48.6582234,7.8826842,8z?hl=sl
[51] https://en.wikipedia.org/wiki/Danube

2.7. GERMANY – BAVARIA

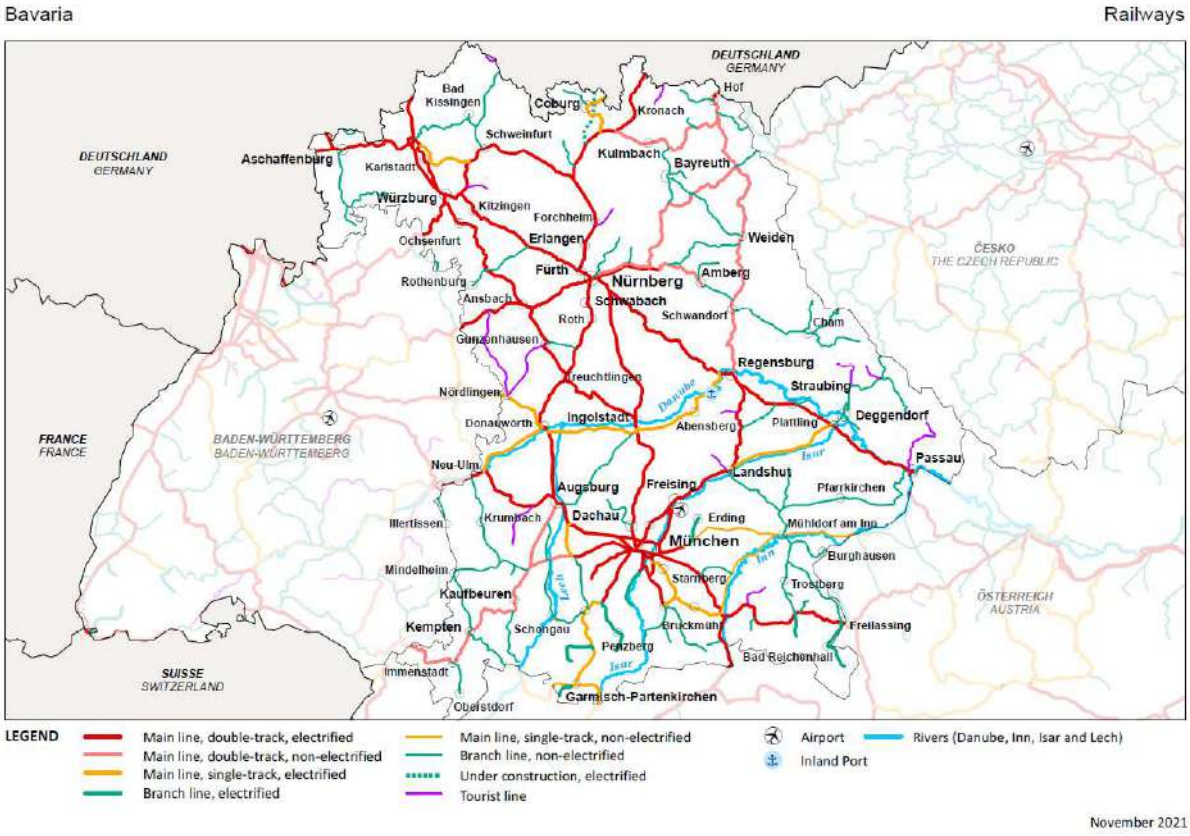

Figure 21: Railways map of Bavaria.

The Free State of Bavaria is a German federal state located in the southeast of Germany. It borders Baden Wuerttemberg on the west, Switzerland on the southwest, the Czech Republic on the east and Austria on the south. Bavaria is the largest German state according to land area and the second-largest according to population[52]. The Danube River flows directly through the centre of the state. The southern part of Bavaria lies in the foothills of the Alps, the rest of Bavaria is hilly and flat.

The length of all Bavarian railways is 6.932 km. 51% of the railway network is electrified. Bavaria has good railway connections with neighbouring countries and states, except the Czech Republic. The railway coverage of the country (km per km2 of land) is almost at the regional average. The length (km) of railways per million inhabitants is also higher than the regional average. The country also has high-speed railways.

[52] https://en.wikipedia.org/wiki/Bavaria

2.8. HUNGARY

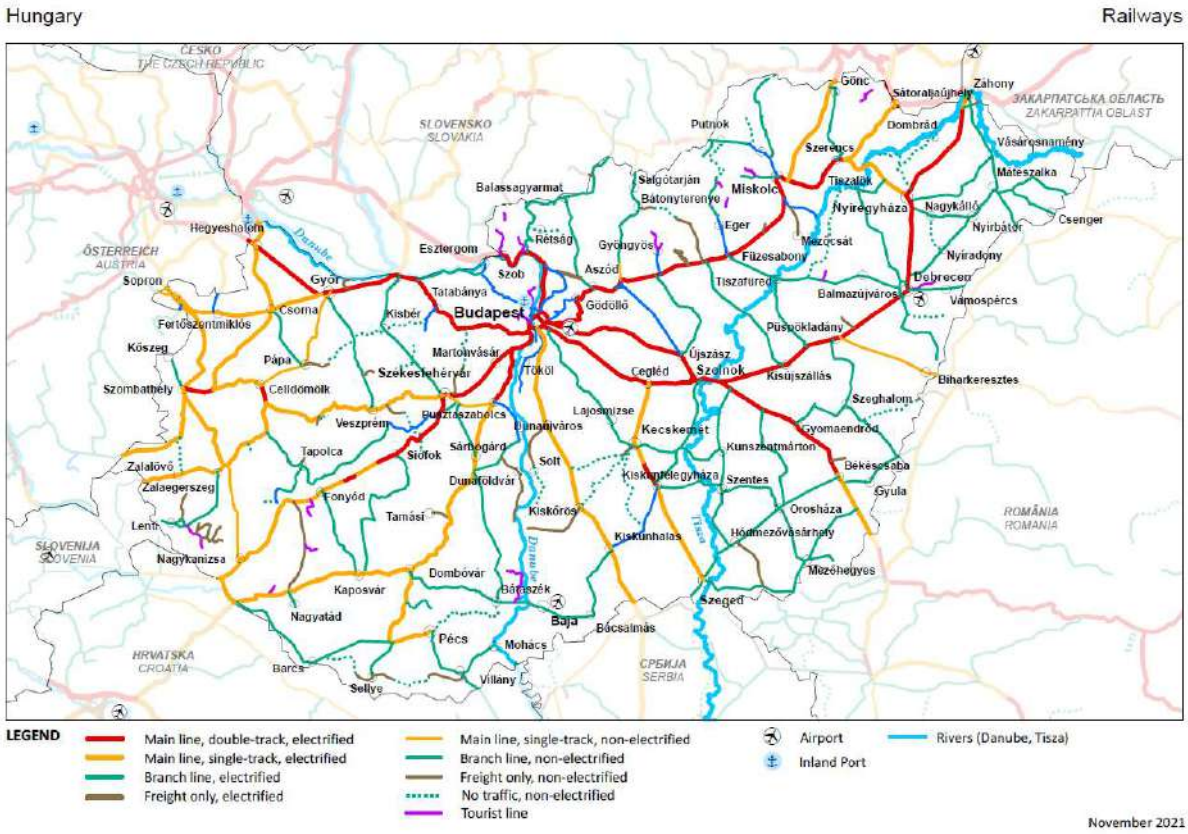

Figure 22:Railways map of Hungary.

Hungary is situated in central Europe. The Danube River crosses Hungary through its capital Budapest. Hungary borders Slovakia on the north, Austria on the northeast, Slovenia on the west, Croatia on the southwest, Serbia to the south, Romania to the east and Ukraine on the northeast. Hungary is mostly a flat country. The terrain ranges from flat to rolling plains.

The length of all Hungary railways is 7.712,00 km. 41 % of the railway network is electrified. Hungary has good railway connections with most of the neighbouring countries. The railway coverage of the country (km per km2 of land) is the same as the regional average. The length (km) of railways per million inhabitants is above the regional average.

2.9. MOLDOVA

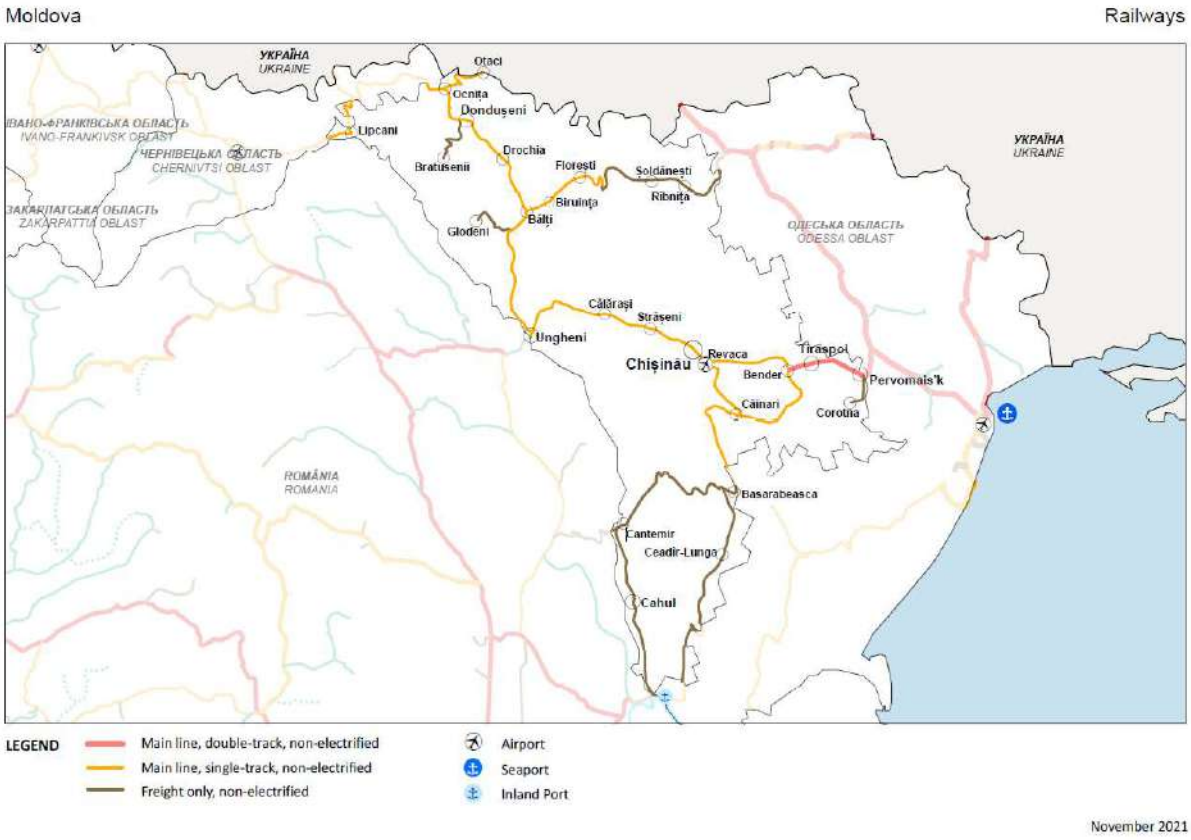

Figure 23: Railways map of Moldova.

Moldova is a country with 33.846 km^2 of land, situated in Eastern Europe and a GDP of 1.723 EUR per capita. It has borders with Romania in the west and Ukraine in the east. It is located on the left side of the lower part of the Danube River. Its terrain is mostly hilly.

The length of all Moldovan railways is 1.157 km. The state has no electrified lines. Moldova does not have good railway connections with neighbouring countries. The country's railway coverage (km per km^2 land area) is below the regional average. Length (km) of railways per million inhabitants is also below the regional average.

2.10. MONTENEGRO

Figure 24: Railways map of Montenegro.

Montenegro is situated in the Balkan peninsula in south-eastern Europe. It has borders with Croatia on the west, Serbia on the east, Bosnia and Hercegovina on the north and Albania on the south. It is located on the right side of the middle part of the Danube River. Its terrain is mostly mountainous and only in the coastal area, a small part of flatland can be found.

The length of all Montenegro railways is 248 km. 90 % of the railway network is electrified. Montenegro does not have good railway connections with neighbouring countries. The country's railway coverage (km per km^2 land area) is below the regional average. Length (km) of railways per million inhabitants is also below the regional average.

2.11. ROMANIA

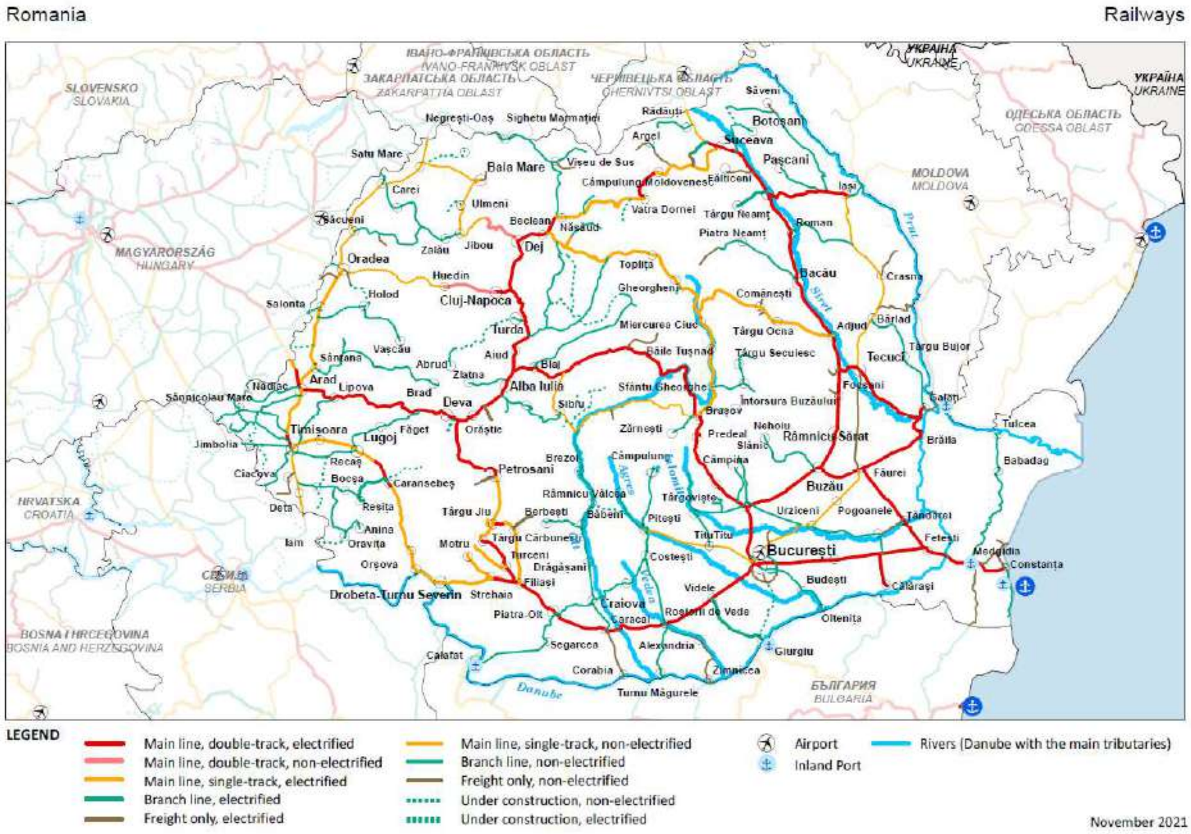

Figure 25: Railways map of Romania.

Romania is situated in south-eastern Europe. It has borders with Hungary on the northwest, Serbia in the west, Bulgaria in the south, Moldova in the east and Ukraine in the southeast and north. It is located on the left side of the lower part of the Danube River. Its terrain is mostly mountainous in the centre and flat in the south and southeast, where the Danube delta is situated. Romania has a long coast along the Black Sea.

The length of all Romanian railways is 10.630 km. 38 % of the railway network is electrified. Romania does not have good railway connections with neighbouring countries. The country's railway coverage (km per km^2 land area) is below the regional average. Length (km) of railways per million inhabitants is also below the regional average.

2.12. SERBIA

Figure 26: Railways map of Serbia.

Serbia is located in the central part of the Balkans in southeast Europe. Its borders are with Hungary to the north, Romania to the east, Bulgaria to the southeast, FYR Macedonia, Albania to the south and Montenegro, Bosnia and Herzegovina and Croatia to the southwest. The Danube River flows through the north of the country through the city of Novi Sad. North of Serbia's land is a part of the Pannonian Plain. The centre of Serbia is mostly hilly traversed by rivers. The south of the country is dominated by Dinaric Alps.

The length of all Serbian railways is 3.348 km. 38 % of the railway network is electrified. Serbia is well connected to practically all neighbouring countries, but connections are in poor condition. Priority projects are focused on all connections towards neighbouring states. The country's railway coverage (km per km^2 land area) is below the regional average. Length (km) of railways per million inhabitants is also below the regional average.

2.13. SLOVAKIA

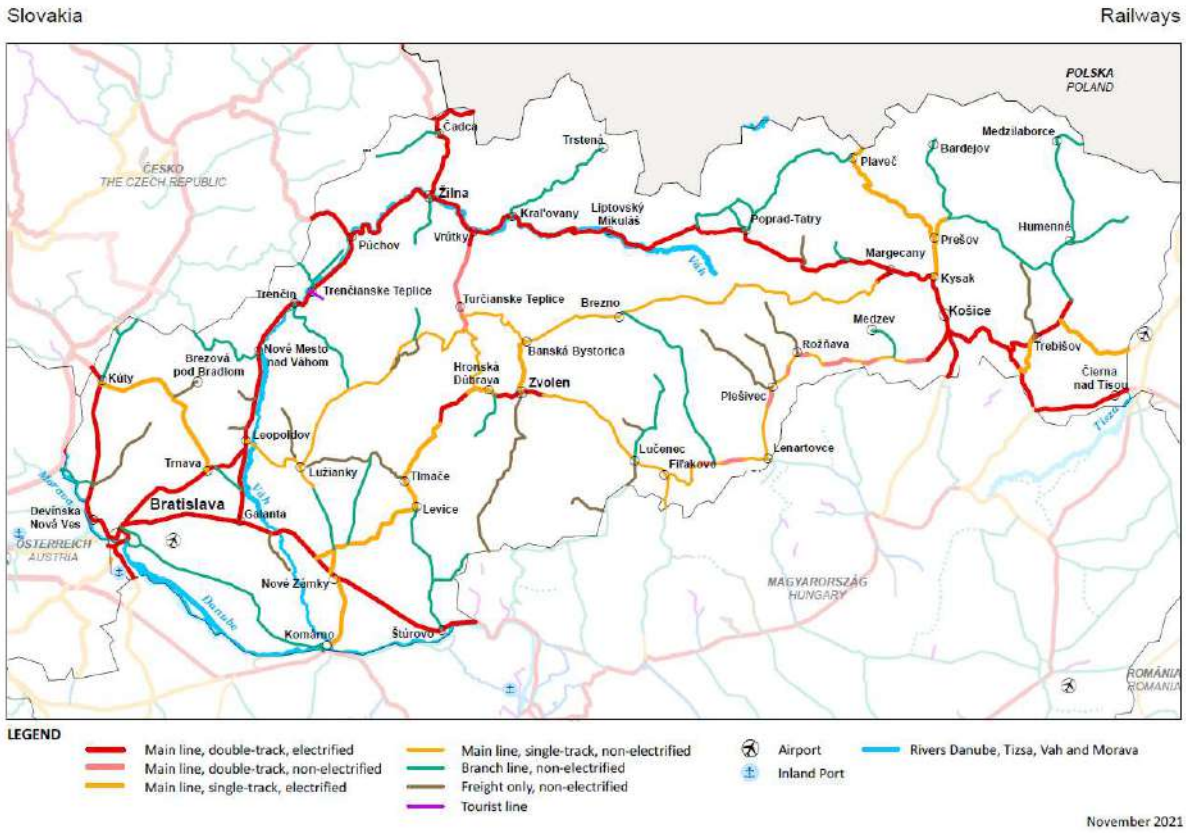

Figure 27:Railways map of Slovakia.

Slovakia is a country situated on the upper left side of the Danube region in central Europe and has been the EU member county since 1st May 2004. Most of the country in the north is dominated by the Carpathian Mountains, while in the southwest, the biggest Slovakian lowland – Danubian Lowland can be found.

The length of all Slovakian railways is 3.627,00 km. 44 % of the railway network is electrified. Slovakia has pretty good railway connections with all neighbouring countries. The country's railway coverage (km per km^2 land area) is below the regional average. Length (km) of railways per million inhabitants is also below the regional average.

2.14. SLOVENIA

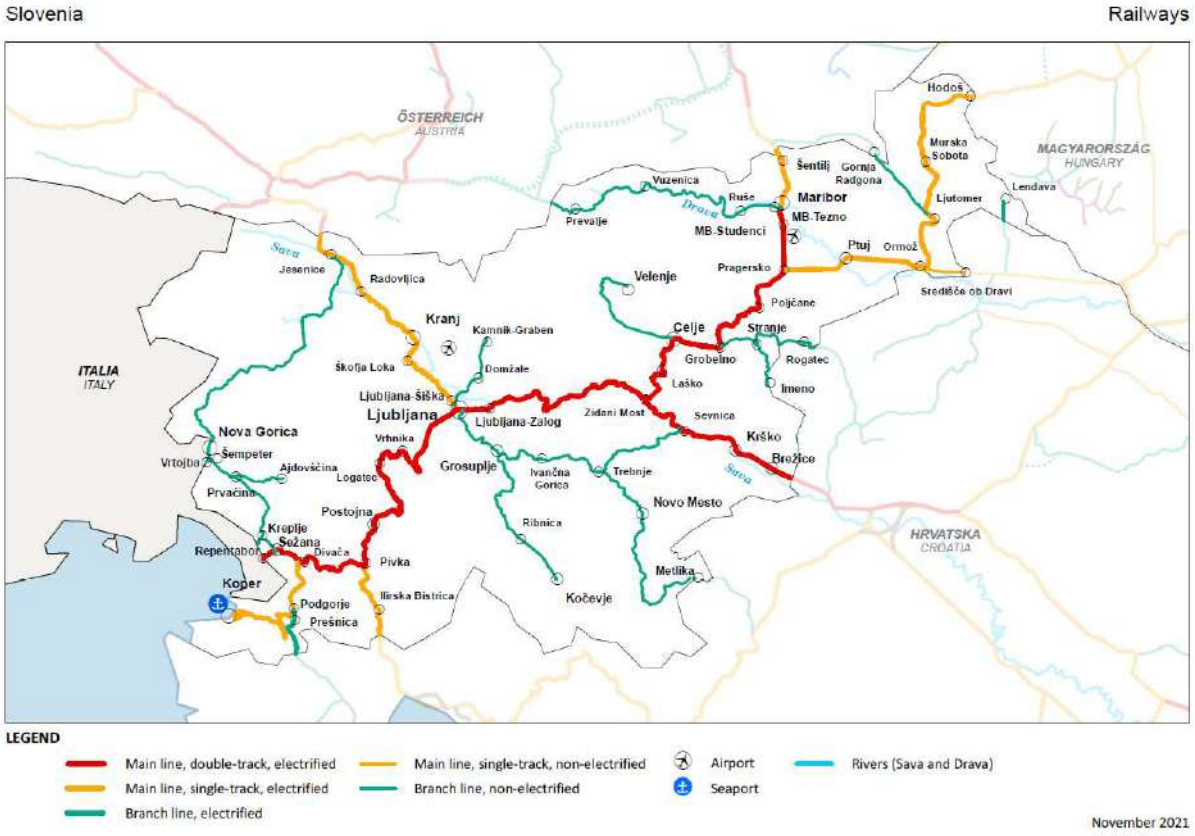

Figure 28: Railways map of Slovenia.

Slovenia is located in Central Europe and borders Austria in the north, Italy in the west, Croatia in the east and Hungary in the north-eastern side. Its topography is mainly Alpine in the north-northwest and hilly in the south. On the east there is lowland – Pannonian Plain through which the rivers Drava and Mura, tributaries of the Danube River, flow.

The length of all Slovenian railways is 1.207,70 km. 50 % of the railway network is electrified. Slovenia has good railway connections with its neighbouring countries. The railway coverage of the country (km per km^2 of land) is below the regional average. The length (km) of railways per million inhabitants is also below the regional average.

2.15. UKRAINE

In 4 Ukrainian regions, which are involved into EUSDR (together with neighbour Ukrainian Lviv, Ternopol, Khmelnitskiy and Vinnytsa Oblasts on the left bank of Dnister/Nistry river)) is concentrated the densest railways net in the country. Historically its development has been close binded with railways in CEE countries.

Therefore National Strategies of Transport Systems development (e.g. “Drive Ukraine 2030”), as well as Association agreement with EU and its Member States foresees more deep integration of historically connected Ukrainian Railways with EU TEN-T and RFC networking, answering EU Council Conclusions on EUSDR establishment of 13.04.2011.

2.15.1. UKRAINE - CHERNIVITSI OBLAST

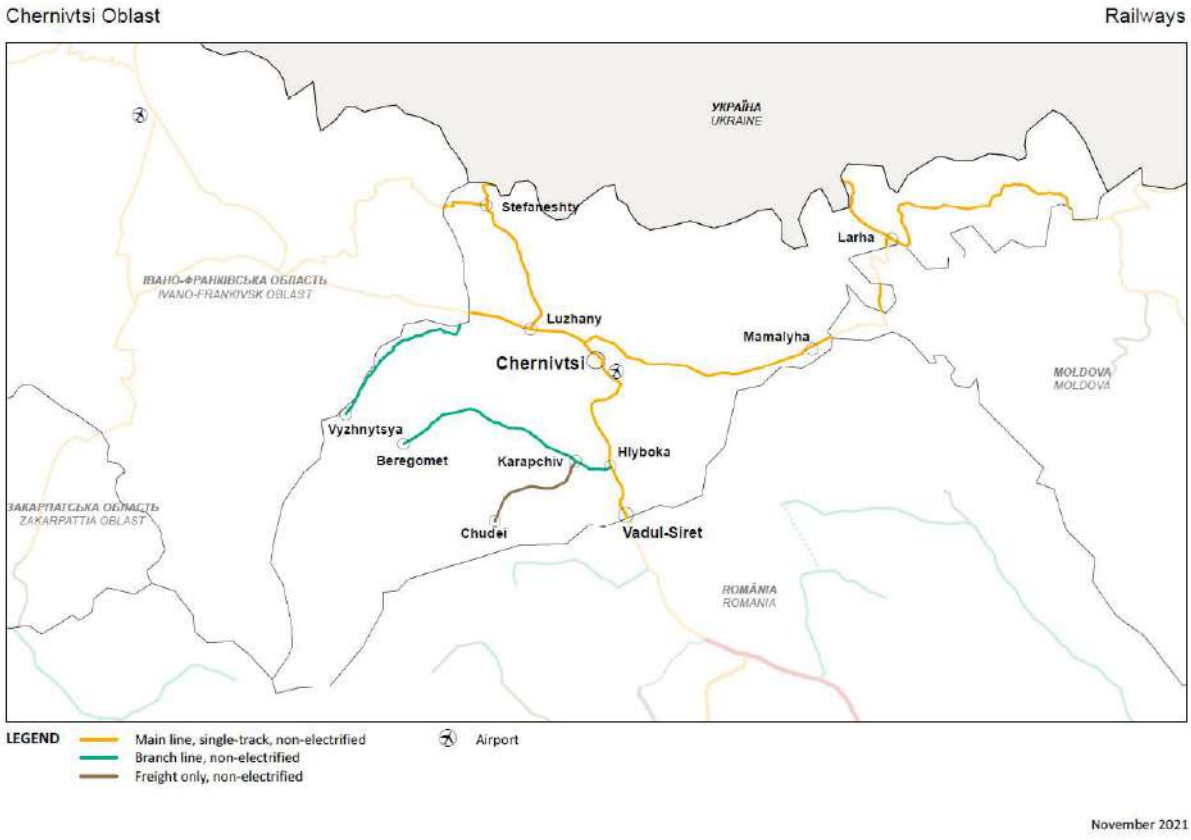

Figure 29: Railways map of Chernivitsi (Ukraine).

Chernivitsi region is situated in Eastern Europe and is a part of western Ukraine. It has more than 400 km of international borders with Romania on the south and with Republic of Moldova in the southeast and the administrative border with Ivano-Frankivsk and 3 other oblasts of Ukraine. It totally located in the upper parts of the main left tributaries of Danube. Its terrain is mountainous at the foothills of Carpathian on the west and flat in the east.

Chernivtsi Oblast is the third in Ukraine on its density railway net. The future plan for railway net in this region is to improve connection with Kyjv and between boundary regions in EUSDR area by construction of approx. 68 km direct railway connection Chernivtsi – Khotin – Kamenets-Podilskiy.[53]

2.15.2 UKRAINE - IVANO FRANKIVSKA

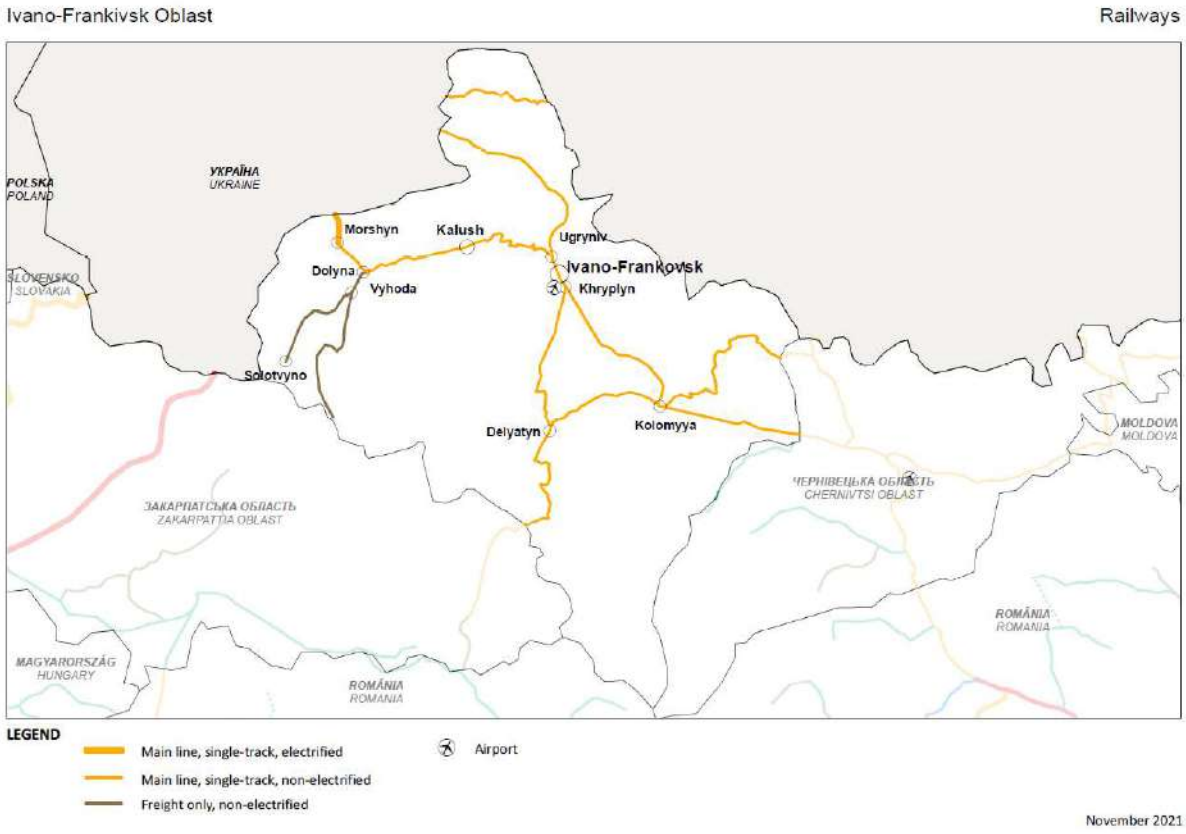

Figure 30:Railways map of Ivano Frankivska (Ukraine).

Ivano Frankivska region is situated in Eastern Europe and is a part of western Ukraine. It has borders with Romania on the south and the rest is the border with Ukraine. It is located on in the upper part the left side of the lower part of the Danube River. Its terrain is mountainous at the foothills of Carpathian on the west and flat in the east.

[53] http://ecoresource.ddns.net/SiteAssets/SitePages/EUSDR/RO_UA_HU_SL_CBC_trains.ppsx

2.15.3. UKRAINE – ODESSA

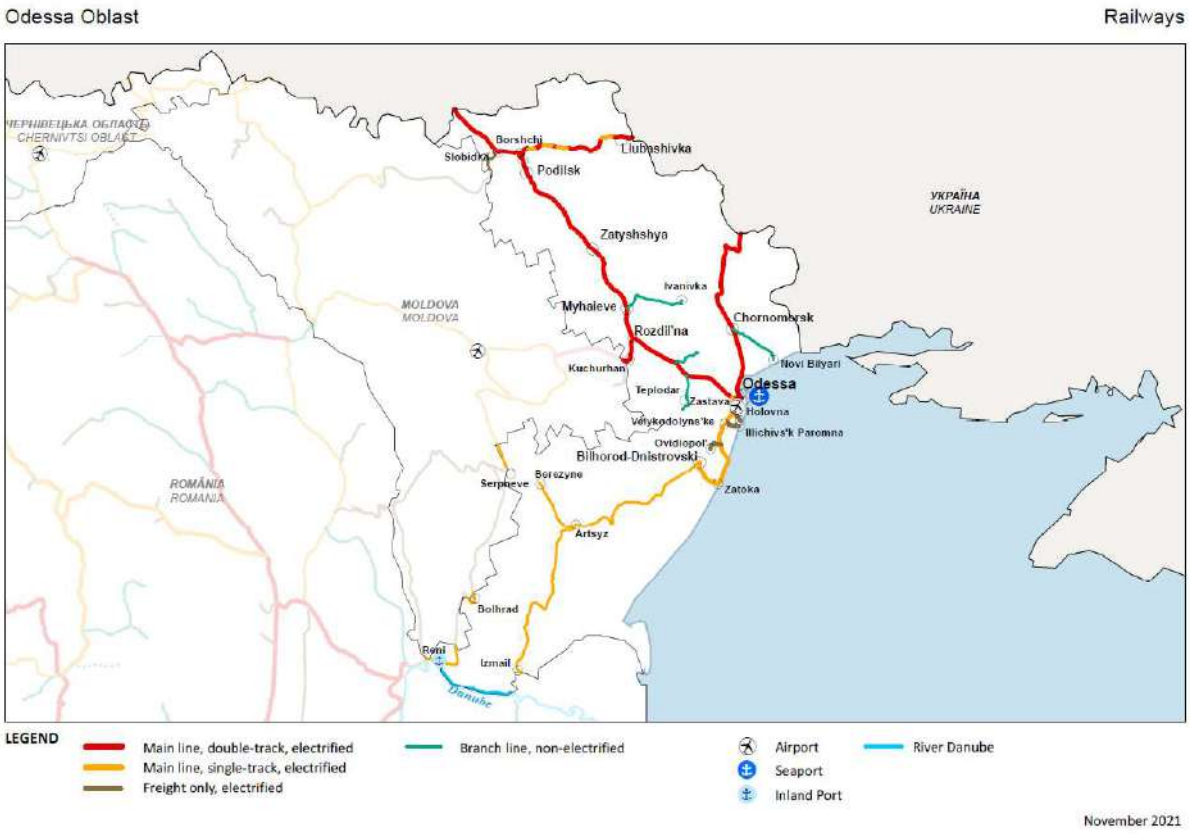

Figure 31:Railways map of Odessa (Ukraine).

Odessa region is situated in Eastern Europe and is a part of southwestern Ukraine. It has borders with Romania in the south, Moldova in the west and Ukraine in the east. It is located in the left side of the lower part of the Danube River. Its terrain is mostly hilly. In Odessa region is the biggest Ukraine sea port – Port of Odessa.

2.18. UKRAINE – ZAKARPATYA

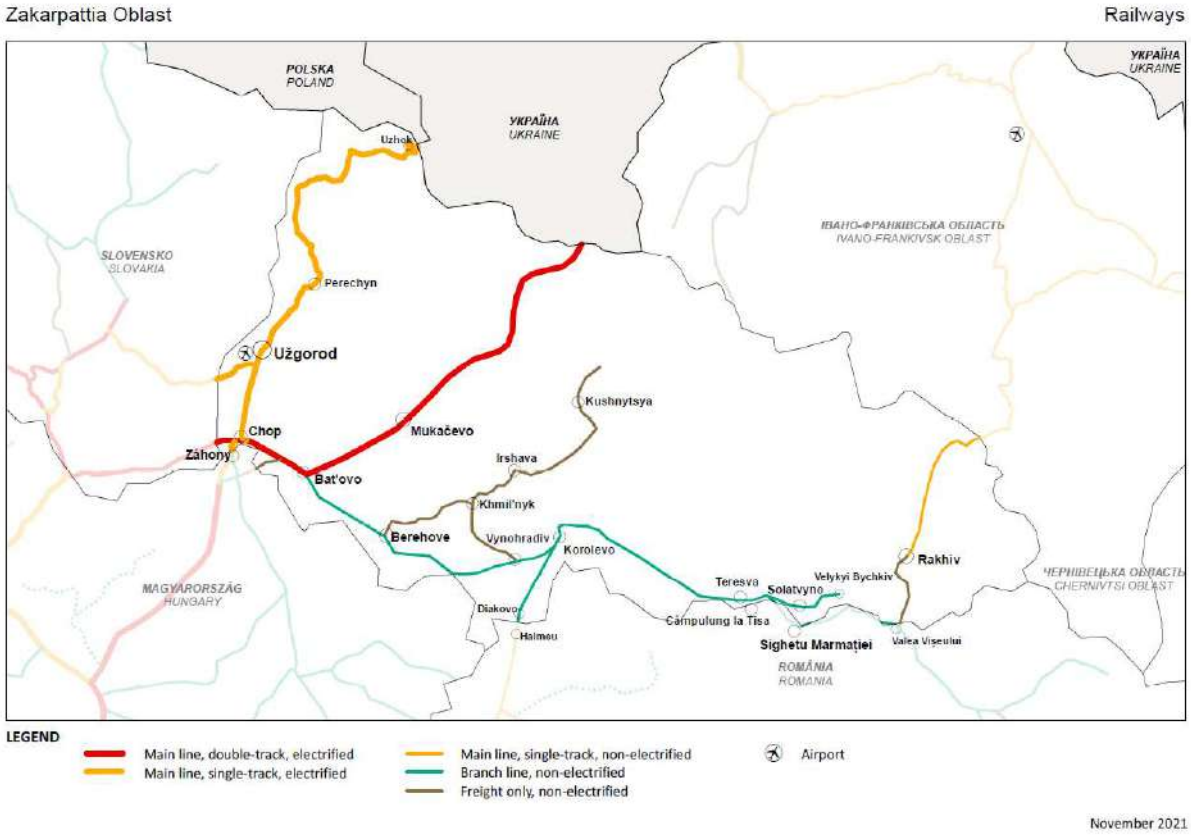

Figure 32: Railways map of Zakarpatya (Ukraine).

Zakarpatya region is situated in Eastern Europe and is a part of western Ukraine. It has borders with Romania in the south Hungary on the west, Slovakia in the northwest, Poland in the north and Ukraine in the east. It is located on the left side of the lower part of the Danube River. Its terrain is mostly mountainous, because it is located in the Carpathian Mountains and a small part of the state on the west side, is a part of Pannonian flatland.

3. RAILWAY INFRASTRUCTURE MANAGEMENT

Railway infrastructure consists of the following subsystems:

- **The Infrastructure Subsystem.**
  This subsystem includes railway tracks, switches, level crossings, buildings (eg bridges, tunnels), railway-related station elements (entrances, platforms, access areas, service points, toilets, information systems and access elements for disabled persons and persons with disabilities or limited mobility), safety and security equipment.
- **The Energy Subsystem.**
  This subsystem contains devices intended for electrification, including the rolling stock network and equipment for measuring and charging electricity consumption along the line.
- **The Control-Command and Signalling Trackside Subsystem**.
  It contains all trackside equipment necessary to ensure the safety, control and monitoring of trains running on the network.

3.1. Regular railway maintenance[54]

Railway subsystems must be regularly maintained and periodically inspected so that they function properly and ensure the safety of railway traffic.

Maintenance also includes substitution in the framework of maintenance, the control of subsystems, ensuring the establishment of transportability of lines in the event of natural and other disasters, keeping the registers and records and performing measurements of individual parameters or parts of the system.

Substitution in the framework of maintenance are carried out based on existing technical documentation or project documentation or their additions. You do not need new permissions for the operation.

Substitution in the framework of maintenance is any replacement of components in preventive or corrective maintenance with components or parts that have the same function and they function in the same way.

Action on the maintenance of railway infrastructure base on regular and continuous measurements of the following elements:

- Track geometry:
  - The immediate action limit, intervention limit and alert limit for alignment,
  - The immediate action limit, intervention limit and alert limit for longitudinal level,
  - The immediate action limit, intervention limit and alert limit for track twist,
  - The immediate action limit, intervention limit and alert limit for track gauge,
  - The immediate action limit, intervention limit and alert limit for cant,
  - The immediate action limit, intervention limit for switches and crossings.

The maintenance of other subsystems such as Energy, Control-Command and Maintenance Systems must also be constantly monitored. Measures are determined based on historical data and economics. These measures must also be determined with the provision of a basic function and safety in railway transport.

Based on the measurements, the following levels of action are generally taken into account:

[54] http://www.pisrs.si/Pis.web/pregledPredpisa?id=ZAKO7529

The main levels have to be considered:

- Immediate Action (IAL): refers to the value which, if exceeded, requires taking measures to reduce the risk of derailment to an acceptable level. This can be done either by closing the line, reducing speed or by correcting track geometry;
- Intervention Limit (IL): refers to the value which, if exceeded, requires corrective maintenance so that the immediate action limit shall not be reached before the next inspection:
- Alert Limit (AL): refers to the value, which, if exceeded, requires that track geometry condition is analysed and considered in the regularly planned maintenance operations.

The operator must constantly and regularly perform measurements and, based on the results, decide on interventions on the upper structure of the railways. In doing so, it must also monitor the economics of the measures.

When the economy shows that the measures on the upper structure are no longer appropriate, it decides for interventions on the lower structure.

3.2. Railway investment[55]

In this matter, it is appropriate to use a methodology for deciding on measures (eg Croatia). These solutions will be implemented using a decision support tool, which allows rail infrastructure managers to make rational investment choices, based on reliable data.

In the context of investment, there is often a need for improvement of some elements such as:

- Horizontal elements,
- The load capacity of the track,
- Noise protection fences,
- Increasing throughput and transport capacity,
- Increasing the power supply,
- Installation of ETCS system,
- Unity of the European railway system and interoperable development of railway transport,
- Upgrade or reconstruction of the railway network,
- Upgrade of signal safety devices on the existing lines,
- Arrangement of the railways' station,
- Modernization of traffic management centres.

All these improvements require prior analysis and project documentation.

To perform condition and risk assessment of the existing railway embankments, the following activities should be performed:

1. Collection and systematization of existing data. To assess the condition of the railway lower and upper structure and to design the rehabilitation measure all the available data for the observed section has to be collected:

- Existing project documentation (including geotechnical studies),
- Information about the traffic load and the type of trains that operate on this section,
- Information about the maintenance measures implemented to date and
- Specialized visual inspection, by using the unmanned aerial vehicle, so-called drones.

[55] https://cyberleninka.org/article/n/669413/viewer

2. Assessment of the lower structure condition with ground-penetrating radar (GPR). Measurement should be performed along at least three axes of the embankment cross-section, with a maximum distance of 20 cm in the longitudinal direction and a minimum depth of 2 m.

3. Geotechnical categorization of the railway lower structure (including embankment and subsoil), based on the results from the first two points and recorded irregularities.

4. Development of the detailed investigation program and monitoring project.

5. Development of the remediation and repair strategy for different risk categories.

3.2.1. Renewal

Renewal means any major substitution work on a subsystem or part subsystem which does not change the overall performance of the subsystem;

3.2.2. Upgrading

Upgrading means any major modification work on a subsystem or part subsystem which improves the overall performance of the subsystem; If a project includes the improvement of performance parameters axle load or gauge (or both) to meet the requirements of another traffic code according to the TSI Categories of Line, it shall be considered as an upgrade.

4. DESCRIPTION OF DANUBE REGION RAILWAYS

4.1. DESCRIPTION OF THE ENTIRE DANUBE REGION

1. Countries, federal lands and authorities in the region

The Danube region includes the following 18 countries, federal lands and authorities:

- **Austria**
- **Bosnia and Herzegovina**
- **Bulgaria**
- **Croatia**
- **Czech Republic**
- **Baden Wuertemberg – Germany**
- **Bavaria – Germany**
- **Hungary**
- **Moldova**
- **Montenegro**
- **Romania**
- **Serbia**
- **Slovakia**
- **Slovenia**
- **Odessa - Ukraine**
- **Ivano Frankivska – Ukraine**
- **Chernivitsi – Ukraine**
- **Zakarpatya – Ukraine**

2. General data

- Inhabitants / 2020: **114.113.386,00**
- GDP / 2020 in EUR million: **2.302.086,12**
- GDP per capita / 2020 in EUR: **20.162,47**
- Region area (km²): **1.092.662,32**
- Km of railways per million inhabitants: **585,71**
- Km of railways per km² of the land area: **0,06**

3. Description of the railway network*

- Length of railway lines (km): **66.873,99**
- Length of double-track railway lines (km): **16.907,83**
- Length of single-track railway lines (km): **49.392,25**
- Length of electrified railway lines (km): **31.680,55**
- Length of non-electrified railway lines (km): **34.282,44**

4. Main features of the railway network

The Danube Region consists of very different countries, with a differently developed railway infrastructure.

Regarding spatial surroundings, socio-economic unity and spatial interactions, 9 functional regions are defined:

- South Germany and Western Austria,
- Eastern Austria and Slovenia,
- Czech Republic and Slovakia,
- Hungary,
- Croatia and Bosnia and Herzegovina,
- Montenegro and Serbia,
- Bulgaria,
- Western Romania and
- Eastern Romania, Moldova and Ukraine.

Through this region, the following European TEN-t corridors take place:

- Baltic – Adriatic Corridor: Gdansk – Ravenna – Warsaw – Bratislava – Vienna - Ljubljana - Koper, Trieste, Venice – Ravenna.
- Mediterranean Corridor: Barcelona – Torino - Ljubljana – Zagreb – Budapest - Kiev – Sarajevo – Belgrade.
- Orient - East Mediterranean Corridor: Rostock – Prague – Bratislava – Budapest – Beograd – Sofia – Athens.
- Scandinavian – Mediterranean Corridor: Helsinki – Stockholm – Malmo – Berlin –Munich – Verona – Roma – Napoli.
- Rhine – Alpine Corridor: Hamburg – Frankfurt – Basel – Zurich – Genoa.
- Rhine – Danube Corridor: Frankfurt – Munich – Prague - Vienna – Bratislava - Uzhhorod.

These corridors are connecting main directions between north and south and east and west, linking southern ports to northern and eastern Europe.

The railway network in the Danube region is owned and managed by state-owned companies. The railway infrastructure is managed by the provisions of the Railway Transport Act of each country in the region.

5. General description of the transport characteristics of the railway network

The entire rail network operates to the track gauge of 1.435 millimetres.

5.1. Main nodes

The main traffic nodes in the region are the TEN-T corridor nodes. TEN-T corridor intersection in the Danube region are:

Table 6: TEN- T corridor nodes

	RHINE-DANUBE CORRIDOR	*ORIENT- EAST MED. CORRIDOR*	*MEDITERRANEAN CORRIDOR*
BALTIC- ADRIATIC CORRIDOR	- **Wien,** - **Bratislava,** - **Žilina.**	- **Prague** - runs in parallel from **Wien** and **Bratislava** through **Budapest**, **Timisoara** to **Calafat.**	- runs in parallel from Slovenia (**Maribor**) to Italy (Bologna).
ORIENT-EAST MED CORRIDOR	- runs in parallel from **Wien** to **Calafat** in Romania.		
SCANDINAVIAN-MEDITERRANEAN	- **Nürnberg,** - **München.**		

Note: While extension of TEN-T comprehensive and core network to the Western Balkans and Neighbouring countries (including Moldova and Ukraine) is defined, the extension of Core Network Corridors (CNCs) is yet to be defined.

5.2. Traffic

TEN-T and rail freight corridors are connecting main directions between north and south and east and west, linking southern ports to northern and eastern Europe. The main freight corridors in terms

of traffic congestion are from München, Nürnberg and Prague to Wien, Bratislava, Budapest to the Mediterranean ports in South West and to the Black Sea on the South East.

Rail's overall modal share of transport is relatively low with 7.8% for passengers and 18.7% for freight (data for EU 27). Progress over the years (2007 to 2018) has been slow with the share of passenger rail increasing in the EU by only 0.5% and for freight even sometimes taking a step back.[56]

In passenger transport the EU 27 average (data for the year 2018) is 7,8%. In Austria (12,1%) perform best with a modal share of over 10%, followed by Slovakia, Germany, the Czech Republic and Hungary, all above or at the EU 27 average.[57]

In freight transport the EU 27 average (data for the year 2018) is 18,7%. Slovenia, Slovakia and Austria, with freight volumes of over 30%. Romania, the Czech Republic, Hungary, Croatia, Germany, and Bulgaria are all above average.[58]

Data for inland transport modal split of rail freight transport for the year 2019 (Table 5: Rail transport statistic, Eurostat) summarized from Eurostat statistics[59] show the percentage of rail freight transport. The percentage ranges between 21.1 % (Bulgaria), 30.5 % (Austria) and 35.5 % (Slovenia).

6. Condition of railway infrastructure

From all aspects the Danube Region is very heterogeneous, also as far as the condition of the railway infrastructure is concerned. The condition of railway infrastructure is reflected in the differences between Upper Danube, Central Danube and Lower Danube region. Countries of Upper Danube (in particular Germany and Austria) have better developed and maintained rail networks, that are in good condition, in comparison to the Central and Lower Danube countries. Most of the Danube macro-region countries are still developing their rail networks, condition of railway infrastructure is in need of improvement.

7. Incompatibility in railway networks with TEN-T standards

This chapter contains a review of the most important parameters that have the highest impact on the capacity to identify bottlenecks, at the level of the entire region.

For this study, the inadequate condition of the railway infrastructure in the Danube Region shall be examined based on the network criteria set out for the entire network and some data for the TEN-T core network, in line with Article 39 of Regulation (EU) No 1315/2013[60]:

- to achieve the interoperability of TEN-T network;
- to provide full electrification of the line;
- at least 22,5 t axle load for freight transport;
- to provide at least 100 km/h line speed (freight train speed);
- to provide the possibility of running trains with a length of 740 m for freight transport;

[56] https://institutdelors.eu/wp-content/uploads/2021/03/PP261_210329_Rail-europeen_Ruete_EN.pdf
[57] https://institutdelors.eu/wp-content/uploads/2021/03/PP261_210329_Rail-europeen_Ruete_EN.pdf
[58] https://institutdelors.eu/wp-content/uploads/2021/03/PP261_210329_Rail-europeen_Ruete_EN.pdf
[59] Eurostat - Data Explorer (europa.eu)
[60] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32013R1316&from=EN

- full deployment of ERTMS (ETCS + GSM-R);
- nominal track gauge 1435 mm.

When listing areas of reduced capacities, border crossing areas should also be mentioned. Physical and non-physical barriers at rail border crossings cause excessive and often inordinate delays, high costs and uncertainties in the entire transport process. Border crossings are major bottlenecks for seamless international railway transport. Inefficient border crossing processes and procedures are one of the main causes for significant delays and increased transport costs and they reduce the comparative advantages of railway transport. In border crossing procedures, there is significant potential to implement specific improvements to facilitate cross-border train operations, including closer cooperation in border and customs controls at border stations. Many border procedures are duplicated at both border stations, the handover station and the station on the other side of the border. [61]

As part of the data collection for this study, we gathered information on the railway infrastructure of individual countries of the Danube region.

We obtained the following data:

- length of the electrified network for the entire network in each country,
- length of railway lines with less than 22,5 tons axle load for the entire network,
- countries where the maximum length of a freight train on TEN-T network 740 m is not accomplished,
- length of railway lines on the TEN-T network, where the line speed is less than 100 km / h,
- length of railway lines equipped with GSM-R system, as an integral part of ERTMS and length of railway lines equipped ETCS level 1 and level 2,
- nominal track gauge 1435 for the TEN-T network.

7.1. Electrification[62]

The traction system can be classified as non-electric (diesel, steam, hydrogen) or electric. According to the TEN-T core network standards, all the railway lines should be electrified.
In the Danube region there are three different electrification system in use:

- Direct current electrification system with: 1.500 and 3.000 KV
- Alternating current electrification system with: 15 and 25 kV, 16,7 Hz, 50 Hz.

TEN-T network in the Danube region is mostly electrified except for individual smaller sections.
The data obtained in this study also show that 47 % of all railway lines in the Danube region are electrified.
Individual shorter sections of the railway network are not electrified in Bavaria, Hungary, Slovakia, Bulgaria, Serbia, Romania and the four federal states in Ukraine. The countries where the share of the non-electrified network predominates are Croatia and Moldova.

7.2. Axle load

The maximum axle load is related to the strength of the track, which is determined by the weight of rails, density of sleepers and fixtures, train speeds, amount of ballast, and strength of bridges.
The data obtained in this study show that it is 67 % of the entire network in the region has an axle load of network smaller than 22,5 tons/axle.

[61] https://www.rfc-awb.eu/wp-content/uploads/2019/02/AWB-RFC_Bottleneck-study_final.pdf
[62] https://www.rfc-awb.eu/wp-content/uploads/2019/02/AWB-RFC_Bottleneck-study_final.pdf

There are large differences between countries in ensuring this criterion, adequate axle load capacity of 22,5 tons.

Almost all railway lines meet this criterion in the state of Baden – Wuerttemberg and Austria (more than 95% of routes). In Bulgaria, more than 90% of railway lines are suitable for bearing 22.5 tons of axle load. In Slovenia all main railway lines are also meet this criterion, except one section from Pivka to the border with Croatia.

On the other hand, there is Hungary, where 82% of the railway infrastructure does not meet the axle load capacity. This percentage is even higher in Romania, where 92% of routes are not suitable for bearing axle load of 22,5 tons.

7.3. Line speed

In terms of the maximum line speed, the rail lines are categorized as high-speed and conventional lines up to 160 km/h. According to the TEN-T core network standards, the railway lines should be available for the freight train speed of at least 100 km/h.

The potential bottlenecks for rail transport are speed restrictions. Such restrictions can be just temporary or in place for a longer time period. Speed restrictions are usually defined because of railway infrastructure conditions or maintenance works. If the speed restrictions due to the bad conditions of the railway infrastructure are long-term, this usually reflects the state of infrastructure in each country.

In the Danube region there are still 76 % length of railway lines on the TEN-T network where the line speed is less than 100 km/h. This means more than 6000 km of railway lines, where data for Croatia, Slovakia, Slovenia and Ukraine were not obtained and included in the calculation.

In Austria the entire network provides an adequate speed of 100 km/h, there are only some short sections along lines with speed less than 100 km/h. Hungary and the Czech Republic also stand out in this criterion, where only 4% of the network has a speed limit of less than 100 km/h.

7.3.1. High speed lines

High-speed railway lines are defined as railway lines at speeds of at least 200km/h for upgraded tracks and 250km/h or faster for new tracks.

There are 418 km* of high-speed railway lines in Danube region. They are present in Austria (225 km), Bavaria and Baden Württemberg (193 km).

A high-speed line between Belgrade and Budapest (350 km) is under construction. This project is a first stage, of the planned Budapest–Belgrade–Skopje–Athens railway international connection in Central and Southeast Europe, a Chinesee project, connecting the China-run Piraeus port in Greece with the "heart" of Europe.[63]

* The length of high-speed line in Bavaria is not specified.

7.4. Train length

[63]https://www.forbes.com/sites/wadeshepard/2017/02/25/another-silk-road-fiasco-chinas-belgrade-to-budapest-high-speed-rail-line-is-probed-by-brussels/?sh=2638ec533c00

The length of a train is measured in metres and includes wagons and locomotives. It depends on the usable lengths of the station tracks at starting and ending points (stations or marshalling yards). The EU standard is to operate freight trains with a length of 740 metres on the TEN-T core network.

Train length is very important in freight railway transport to ensure competitiveness with other modes and reduce the operational costs per unit. Many freight trains (container trains, empty trains, car trains…) could be extended with additional wagons, but the usable track length at many railway stations is not long enough.

According to the TEN-T core network standards, the rail lines should have the possibility of running freight trains with a length of 740 m.

This criterion is met only in Austria, Moldova, Slovakia and Slovenia (on around 12 % of railway lines).

7.5. Deployment of ERMTS

The European Rail Traffic Management System is the system of standards for the management and interoperation of signalling for railways developed by the EU. It is directed by the ERA and is the organizational umbrella for the separately managed parts of:

- European Train Control System (ETCS, signalling) and
- GSM–R (communication).

The main target of ERTMS is to promote the interoperability of trains in the EU. It aims to greatly enhance safety, increase the efficiency of train transport and enhance cross-border interoperability of rail transport in Europe. This is done by replacing former national signalling equipment and operational procedures with a single new Europe-wide standard for train control and command systems.

7.5.1. ETCS is specified at the following levels:

Data on the equipment of network in individual countries of the Danube region showed that the countries: Baden-Wuerttemberg, Bosnia and Herzegovina, Moldova, Montenegro and Serbia do not yet have railway lines equipped with ETCS.
In Slovenia there are 79 % of main railway lines equipped with ETCS Level 1.
Data for Croatia are missing in this analysis.

Of the other countries that provided data, there are 1.349,16 km of railways lines in the Danube Region equipped with ETCS Level 1 and 1218,13 km with ETCS Level 2.

7.5.2. GSM-R

The Global System for Mobile Communications – Railway, or GSM-Railway, is an international wireless communications standard for railway communication and applications. A sub-system of the ERTMS it is used for communication between train and traffic management/control centres. The system is based on GSM and EIRENE – MORANE specifications, which guarantee performance at speeds up to 500 km/h, without any communication loss.

Data for Bavaria and Ukraine are missing in this analysis.

Data on the equipment of network in individual countries of the Danube region show that the countries: Bosnia and Herzegovina, Croatia, Moldova, Montenegro and Serbia do not yet have railway lines equipped with GSM-R communications system. The railway lines in Slovenia are fully equipped with GSM-R communications system.

Of the other countries that provided data, there are 15.683,59 km of railways lines in the Danube region equipped with communications system GSM-R, which is 59 % of the TEN-T network in the region.

7.6. Track gauge

According to the TEN-T core network standards, the nominal track gauge for new railway lines is 1435 mm. In the region, the entire TEN-T network has an adequate track gauge of 1435 mm.

8. Traffic safety

In the region the environment, operating conditions, regulatory requirements and maintenance practices can differ, but in the field of safety, all the countries face the same risks.

The most common risks and causes of accidents on railway infrastructure are train collisions, derailments, level crossings and trespass.[64]

As the safety of passengers on trains increases, the greatest harm inflicted by the railways often arises at its external interfaces; boundaries, level crossings and stations. The warning devices provided at level crossings vary depending on location and usage and vary from simple signage to full barriers with sophisticated object detection.

The European Railway Agency (ERA) is active in the field of railway safety. Under the ERA accidents are investigated, which is crucial for the improvement of the safety performance of railways. For that reason, EU Member States are required to establish independent National Investigation Bodies (NIBs).

A worldwide initiative of International Level Crossing Awareness Day (ILCAD)[65] is improving awareness of level crossing safety. The campaign has been spearheaded by the UIC[66], the worldwide railway organisation with the support of the railway community around the world. Several countries of the Danube region are members of ILCAD: Austria, Croatia, Czech Republic, Germany, Hungary, Romania, Serbia, Slovakia and Slovenia.

Railway safety statistics in the EU showed a reduction of 32 % of railway accidents in 2019 compared with the year 2010. According to the type of accident. in 2019, almost two-thirds of the fatalities in the EU-27 (64.8 % of the total) were caused by “Accidents to persons by rolling stock in motion (excl. suicides)”, typically involving persons that are unauthorised on the railway tracks and are hit by a running train. Together with level-crossing accidents (33.0%), these two accident types were responsible for almost 97.8 % of all deaths occurring on railways in the EU-27 in 2019[67].

Table 5 is presenting the number of rail traffic accidents and the number of level crossing accidents in the Danube region for the years 2018, 2019 and 2020. The total number of accidents decreased during the observed period.

Table 5: Number of accidents

Rail traffic accidents in the	2018*	2019*	2020**

[64] https://international-railway-safety-council.com/common-risks-managed-railway-industry/
[65] https://ilcad.org/spip.php?page=participants
[66] https://uic.org/europe/
[67]https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Railway_safety_statistics_in_the_EU#Causes_of_railway_accident_fatalities

Danube Region			
All train accidents in the Danube region*	4.198,00	4.328,00	3.801,00
Accidents at a level crossing in the Danube region*	761	719	646**

*Data for Germany- Bavaria, Croatia and Ukraine were not available and are not taken into account.

** Data for Germany- Bavaria, Croatia, Slovenia and Ukraine were not available and are not taken into account.

Level crossing accidents, according to the obtained data, represent 25% of all railway accidents in the Danube region.

In The number of level crossings is declining, which means that individual countries are investing in the construction of off-level crossings.

Table 6: Number of level crossings of roads with railways in the Danube region, for years 2018, 2019 and 2020 are presented. The number of level crossings is declining, which means that individual countries are investing in the construction of off-level crossings.

Table 6: Number of level crossings

	2018	**2019**	**2020**
Number of all level crossings	35.950*	33.651 **	33.494 **

*Missing data for four regions of Ukraine.
**Missing data for Serbia and for all four regions of Ukraine.

Table 7: Number of fatalities in train accidents for the years 2018, 2019 and 2020. The countries whose data are not taken into account are listed below the table. The table shows that the number of fatalities is decreasing as a result of investments in railway infrastructure in the field of traffic safety.

Table 7: Number of fatalities

	2018	**2019**	**2020**
Total number of fatalities	471*	447*	393**

*Missing data for four regions of Ukraine and Germany- Bavaria.
**Missing data for Germany- Bavaria, Slovenia and for all four regions of Ukraine.

9. Environmental protection

Rail contributes to reducing the environmental burden of transport users to society with its exceptionally low total external costs.[68] The main directions of railway stakeholders in environmental protection are the following[69]:

- Ensuring sustainable energy supply and climate protection,
- connecting people and nature for generations,
- supporting biodiversity and nature conservation,
- responsibly using resources,
- reducing emissions in all areas,
- reducing our waste volumes,
- safely storing, handling and transporting of hazardous substances.

9.1. Emissions

The global railway sector is working extremely hard to maintain its environmental advantage by improving its energy efficiency and reducing its CO_2 emissions. For example, 28 European UIC members have collectively committed to reducing CO_2 emissions per passenger-kilometre and per tonne-kilometre by 50% by 2030, and are well on track to meet this target.[70]

The 2011 EU White Paper defines a long-term vision until 2050 for a transport sector that continues to serve the needs of the economy and citizens while meeting future constraints: oil scarcity, growing congestion and the need to cut CO_2 and pollutant emissions to improve air quality, particularly in cities. According to this vision, transport will have to cut emissions by 60% by 2050 to contribute to the overall target of 80% to 95% reduction for the entire economy. The strategy set out in the White Paper is to a substantial degree based on low CO_2 emission fuels, energy efficiency, better multimodality of transport and new technologies that should lead to optimised journeys.[71]

Improving energy efficiency is the most important aspect of the rail sector's strategies to reduce CO_2 emissions and offers significant business benefits as well as reducing costs.

Technical measures to improve energy efficiency include the use of more modern rolling stock with lower energy consumption, or innovative technologies such as regenerative braking – a system that harnesses the energy produced during braking, transferring it back into the rail system so that other trains can use it.

9.2. Noise protection

Noise is a critical environmental aspect of the railways. The public and their political representatives urge railway stakeholders to become quieter.

The Environmental Noise Directive (Directive 2002/49/ EC)[72] sets the general framework for environmental noise management.

[68] https://www.cer.be/key-policy-issues-railway-sector
[69] https://infrastruktur.oebb.at/en/company/eco-friendly-environment/environment
[70] https://uic.org/sustainability/energy-efficiency-and-co2-emissions/
[71] White Paper: Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system, European Commission, Brussels, March 2011
[72] https://ec.europa.eu/environment/noise/directive_en.htm

In the Danube region measures for the protection of the natural and residential environment against noise are gradually being implemented: equipment of new tracks, implementing freight wagon fleet with composite brake blocks, construction of noise barriers. According to the data obtained during the preparation of this task, we find that individual countries (Austria, Germany, Slovenia, Czech Republic) are very intensively introducing measures to reduce noise pollution in the natural and living environment.

9.3. Protection of water resources

Due to its comparative safety as a mode of transport, railways are often used for the carriage of dangerous goods such as chemicals, petrol, liquefied gasses and nuclear waste. These require a range of measures to control the risk which may include special train formations, improved maintenance of vehicles and track, routing away from heavily populated areas and special handling and security.

Requirements for the safe transport of dangerous goods by rail across borders are controlled by international laws.[73] The EU Water Framework Directive (WFD) aims to protect and improve the ecological status of water bodies to promote sustainable watershed use. This requires that 'good status' should be achieved for all surface and groundwater bodies by 2015 or 2027 at the latest. Consequently, the National Railway Administration of EU member countries must ensure that their water management practices meet the requirements of the WFD, thereby ensuring sustainable development of the railway network in their operational plans. It is also recommended that other countries in the Region comply with this Directive.

10. Investing spending and maintenance expenditures

10.1. Gross investment spending in road infrastructure

Data about gross investment spending was obtained for Austria, Czech Republic, Bavaria, Baden-Württemberg, Hungary, Montenegro and Slovakia. Gross investment spending in railway infrastructure varies from 292 Mio EUR/year per Mio inhabitants in Austria, 131 Mio EUR/year per Mio inhabitants in Czech Republic, to 14,81 Mio EUR/year per Mio inhabitants in Montenegro and 11,27 Mio EUR/year per Mio inhabitants in Slovakia.

10.2. Maintenance expenditures in road infrastructure

Data about maintenance expenditures in railway infrastructure was obtained for Czech Republic, Bavaria, Hungary, Montenegro and Slovakia.

Maintenance expenditures per km of railway network varies from 52,40 Mio EUR/year per Mio inhabitants in Czech Republic, to 23,52 Mio EUR/year per Mio inhabitants in Germany – Bavaria, 21 Mio EUR/year per Mio inhabitants in Slovakia and 7,88 Mio EUR/year per Mio inhabitants in Hungary.

11. Objectives of transport policy and future development of the railway network -Danube region Strategy

Priority area the European Union Strategy for the Danube Region (EUSDR 1b) - railway, road and air mobility faces transport challenges, that are very are complex, due to differences between transport

[73] https://international-railway-safety-council.com/common-risks-managed-railway-industry/

modes and development gaps between countries and regions in the Danube macro-region. Road maintenance and road safety, rail freight, which contribute to full modal integration and improved air connectivity, have been high on the EU's transport agenda for years, as well as on most national transport agendas. All modes of transport have common issues related to energy efficiency and emissions of conventional pollutants, which require comprehensive action at local, regional and global levels.

The transfer of freight from congested roads to railways is one of the key priorities in the countries of the Danube region.

Within the framework of strategic decisions in the field of railways in the Danube region, the following guidelines have been adopted[74]:

- To improve mobility and multimodality: rail, road and air connections.
- To bring to completion the TEN-T core network crossing the Danube Region, by 2030, overcoming the difficulties and the bottlenecks, and taking into account environmental, economic and political challenges, particularly in the cross-border sections.
- Elimination of cross-border administrative as well as operational and technical barriers to rail transport.
- To support the implementation of the Rail Freight Corridors (RFC) forming part of the European rail network for competitive freight (Reg. 913/2010) with extension to candidate and neighbouring countries.
- To ensure sustainable metropolitan transport systems and mobility.
- To improve the regional/ local cross-border infrastructure and the access to rural areas by facilitating secondary and tertiary transport infrastructure.
- Develop further modal planning to achieve multimodality between railways, roads and airports.
- Introduction of traffic management systems (ERTMS).
- Development of efficient multimodal terminals in sea, river and dry ports in the Danube region and ensure their connectivity and access by integrating all modes of transport and efficient logistics services by 2030. Increase the number of inland ports and transhipment points ("hubs") with sufficient water accessibility, railways and roads for ten “hubs” throughout the Danube by 2030

The progress of the EUSDR's objectives and orientations will be achieved through inclusion in the post-2020 programs, a new EUSDR governance document and enhanced cooperation with other macro-regional strategies.[75]

[74] https://danube-region.eu/wp-content/uploads/2020/04/EUSDR-ACTION-PLAN-SWD202059-final-1.pdf
[75]https://www.interreg-central.eu/Content.Node/SMACKER/02-Zepic-PA1b---Priority-Topics-SMACKER-final.pdf

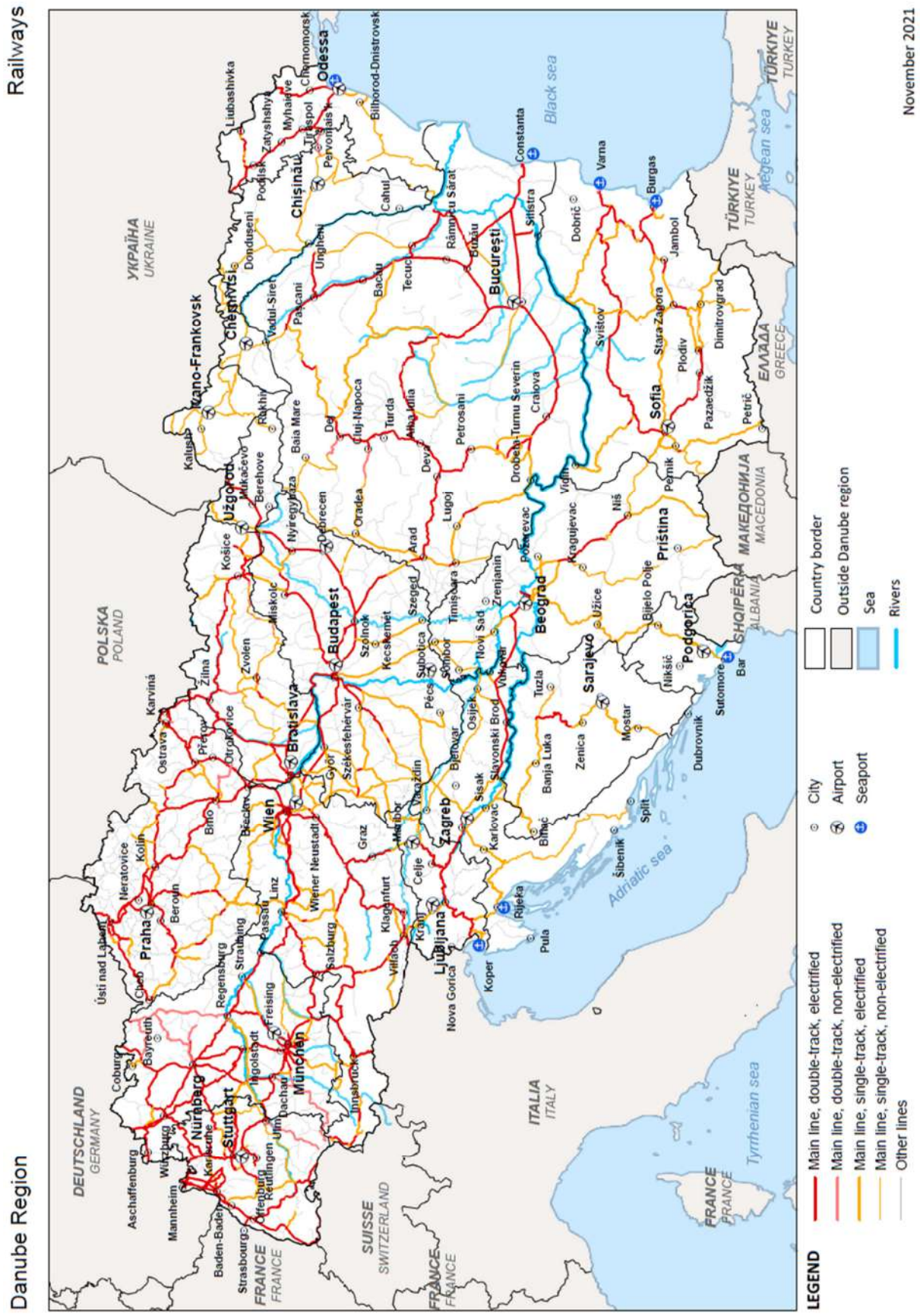

Figure 33:Common map of railway infrastructure of the Danube Region

4.2. DESCRIPTION OF EACH COUNTRY, FEDERAL LANDS AND AUTHORITIES OF THE DANUBE REGION

The order of countries follows the alphabet.

4.2.1. Danube region railways: REPUBLIC OF AUSTRIA

1. General data

- Inhabitants / 2020: **8.901.064**
- Membership in the EU: **1.01.1995**
- GDP / 2020 in EUR million: **377.297**
- GDP per capita / 2020 in EUR: **35.610**
- Capital city: **Wien**
- Land area (km²): **83.879**
- Km of railways per million inhabitants: **634,8**
- Km of railways per km² of the land area: **0,07**

2. Description of the railway network

- Length of railway lines (km): **5.650**
- Length of double-track railway lines (km): **2.193**
- Length of single-track railway lines (km): **3.457**
- Length of electrified railway lines (km): **3.917**
- Length of non-electrified railway lines (km): **1.733**
- Length of railway lines (km), axle load D4 (22,5 tons/axle): **4.097**
- Maximum length of freight train (m) on TEN-T network: **750**

3. Main features of railway network

3.1. General description of the transport characteristics of the railway network

The entire rail network operates to the track gauge of 1.435 millimetres with some narrow-gauge-branch lines, that are privately owned.

Depending on traffic volume, economic importance, number of tracks and the connecting role of railway transport line, the railway network is divided into main and regional lines and single-track and double-track lines.

The main nodes, as we call the areas where several railway lines merge or come together, are:

Wien	Intersection of Southern line State border at Bernhardsthal – Wien – Villach and Western line State border at Hegyeshalom – Wien – Salzburg
Innsbruck	Intersection of Arlberg Line (Innsbruck – Bregenz) and Brenner line (State border at Kufstein – State border at Brennero/Brenner)
Salzburg	Intersection of Western line Wien – Salzburg – State Border to Germany and Tauern line Salzburg – Villach – State Border to Slovenia/Italy

Electrified ÖBB-Infrastruktur AG lines are generally equipped with a 15 kV, 16.7 Hz AC electrical system.[76]

3.2. Traffic [77]

3.2.1. Number of trains

- Average number of all trains per day on TEN-T - core network: **2562**
- Average number of all trains per day on TEN-T - comprehensive network: **1963**
- Average number of all trains per day on the rest of the network: **1283**
- Average number of freight trains per day on TEN-T - core network: **633**
- Average number of freight trains per day per TEN-T – comprehensive network: **317**
- Average number of freight trains per day on the rest of the network: **231**

3.2.2. International railway corridors

The railway network of the Republic of Austria is very important, from the European Union point of view, as this network has a part of over 1,100 km which belongs to the TEN-T Core Network Corridors and international rail corridors for competitive freight transport.

Part of the trans-European railway network (TEN-T)[78] (core and comprehensive network), are the following four corridors in Republic of Austria:

- Scandinavian-Mediterranean Corridor crossing the western part of the country between the German (Kufstein) and the Italian border (Brenner), via Innsbruck.
- Baltic-Adriatic Corridor, crossing the eastern and southern part of the country, via Wien, Graz and Klagenfurt/Villach.
- The Orient/East – Med Corridor, which runs from the border with the Czech Republic through Wien to the border with the Republic of Hungary.
- Rhine-Danube Corridor, crossing the northern part of the country between the German and the Slovakian as well as Hungarian borders via Wels/Linz and Wien.

International freight rail corridors for competitive freight transport run through Republic of Austria in accordance with EU Regulation 913/2010 on European rail freight corridors (RFC):

- RFC 3 - Scandinavian - Mediterranean; (Stockholm/Oslo-Copenhagen - Hamburg - **Innsbruck** - Verona// Rome/Ancona-Bari// Palermo // Augusta)

- RFC 5[79] - Baltic – Adriatic; (Swinoujscie / Gdynia – Katowice – Ostrava / Žilina – Bratislava / **Wien** / **Klagenfurt** – Udine – Venice / Trieste / Bologna / Ravenna and /Graz – Maribor – Ljubljana – Koper / Trieste);

[76] infrastruktur.oebb.at/en/partners/rail-network/network-statement/network-statement-2021/network-statement-2021.pdf

[77] ÖBB Infra, only ÖBB-Infra data (estimated) for a year 2019

[78] https://transport.ec.europa.eu/transport-themes/infrastructure-and-investment_en

[79] https://www.rfc5.eu/

- RFC 7[80] – Orient/East-Med; (The main route of the corridor is: Prague – **Wien/**Bratislava – Budapest – Bucharest – Constanta, Arad – Craiova – Vidin – Sofia – Kulata – Thessaloniki – Athens and Sofia - Plovdiv - Svilengrad and the alternative routes Videle – Ruse Razpredelitelna – Sindel Razpredelitelna – Karnobat-Nova Zagora – Simeonovgrad – Svilengrad, Nova Zagora – Stara Zagora-Dimitrovgrad – Simeonovgrad, Plovdiv-Stara Zagora – Karnobat - Burgas).

- RFC 9[81] - Rhine - Danube; (Strasbourg–Mannheim–Frankfurt–Nürnberg–Wels; Strasbourg–Stuttgart–München–**Salzburg–Wels–Wien**–Bratislava–Budapest–Arad–Brașov/Craiova–București–Constanța; Čierna nad Tisou (Slovak/ Ukrainian border)–Košice–Žilina–Horní Lideč–Prague–München/Nürnberg)

- RFC 10[82] - Alpine - Western Balkan;(**Linz/ Wels**-Maribor-Zidani most; **Salzburg-Villach**-Ljubljana-Zidani Most-Zagreb-Vinkovci-Beograd-Niš-Dimitrovgrad-Svilengrad).

3.3. Railway infrastructure equipment

3.3.1. Length of railways equipped with GSM-R system

On the railways network of Republic of Austria, the GSM-R system is installed on a 3600 km of lines, ensuring radio signal coverage on the entire railway network, including tunnel coverage.

3.3.2. Length of railways equipped with ETCS level 1

The European safety system for train control ETCS Level 1, version 2.3.0d, which is one of the systems for ensuring the interoperability of the railway signalling safety system is installed on 155 km of railway infrastructure in Austria. Some of these are sections are Wels–Passau line (80 km) and a part of the western main line near Salzburg between Vöcklabruck and Strasswalchen (40 km).

3.3.3. Length of railways equipped with ETCS level 2

The European safety system for train control ETCS Level 2 system is installed on a 329 km of railways lines in Republic of Austria, one of the most important section is the section of RFC 7 and RFC 5 Corridors from Czech border–Wien, RFC 9 section Wien –St. Pölten as well as the whole RFC 3 through Tyrol.

3.4. Condition of railway infrastructure

In general, the rail infrastructure in Austria is in a good condition.

3.5. Speed limits

3.5.1. The maximum speed limit for freight traffic (only for TEN-T corridors or main lines) is: **100 km/h.**

3.5.2. The maximum speed limit for passenger trains traffic (only for TEN-T corridors or main lines) is **250 km/h.**

3.5.3. Lengths of railway lines on the TEN-T network where the speed limit is less than

[80] https://www.rfc7.eu
[81] https://rfc-rhine-danube.eu/
[82] https://www.rfc-awb.eu/

100 km/h (in km): **0**[83]

3.6. Traffic safety[84]

The Federal Ministry of Transport is the Austrian national authority for railway issues[85] is responsible for safety issues on railway infrastructure in the Republic of Austria.

- Number of accidents in 2018, 2019 and 2020

Table 7: Number of accidents

Total number of emergencies	**2018**	**2019**	**2020**
Accidents	866	934	968
Accidents at level crossing	119	132	105

*N/A – not available data

There were 968 accidents on Austrian railways in 2020, which is 34 accidents more than in 2019.

- Number of level crossings, of roads with railways in 2018, 2019, 2020

Table 8: Number of level crossings

Number of level crossings	**2018**	**2019**	**2020**
Number of level-crossings on TEN-T network (core and comprehensive)	831	767	756
Number of all level crossings	5294	5197	5078

- Number of fatalities in accidents in 2018, 2019 and 2020

Table 9:Number of fatalities

	2018	**2019**	**2020**
Total number of fatalities	16	16	20

Between 2018 and 2020, the number of fatalities slightly rose. The number of fatalities for year 2020 represents 2,2 fatalities per million inhabitants.

3.7. The main weaknesses of the railway network

3.7.1. Missing sections

Within extensive rail infrastructure development in Austria, there are currently two major projects in planning or implementation for bridging missing links:

- Koralm railway line between Graz and Klagenfurt (under construction, entry into operation planned for 2025)

[83] Line speed >100 km/h; some (short) sections with speed <100 km/h along lines

[84] http://www.dicr.cz/o-drazni-inspekci

[85] https://www.bmk.gv.at/en.html

- Wien Airport Link connecting VIE and existing Eastern line in Bruck/Leitha (in planning, entry into operation expected by 2034).

3.7.2. Railway bottleneck

- Graz – Weitendorf; four-track upgrade in connection with new Koralm railway line
- Linz-Wels; need to upgrade two existing tracks with two new ones.
- Graz-Werndorf; increase in capacity.
- Werndorf-Border AT/SL; upgrade of existing single/double-track line.

3.7.3. Level crossing

The previous chapter 3.6. shows the number of level crossings is declining, Table 8 shows that there are still 5078 level crossings in Austria (on average 1 level crossing 0,89 km/), these level crossings need adequate protection to minimize the risk of collisions (for road and rail traffic) when crossing.

3.7.4. Inadequate environmental protection

According to EEA data in Europe, Austria is one of the countries that are heavily affected by railway noise, according to the share of their population that is affected by railway noise with more than 55 dB(A) LDEN.[86] On the busiest sections and in densely populated areas measures for the protection of the natural and residential environment against noise are gradually being implemented.

3.8. Connections with neighbouring countries

The boundaries of the railway, network operated by the public railway infrastructure manager, are the points of the national border on individual sections of lines.

Railway border crossings:

- With Germany:
  - Main routes: Lochau-Hörbranz, Kufstein, Salzburg Hbf, Schärding.
  - Regional route: Braunau am Inn, Vils, Ehrwald-Zugspitzbahn, Scharnitz.

- With Italy
  - Main routes: Arnoldstein, Sillian, Brenner.

- With Slovenia:
  - Main routes: Spielfeld-Straß, Rosenbach,
  - regional route: Bleiburg.

- With Hungary:
  - Main routes: Nickelsdorf, Loipersbach-Schattendorf,
  - regional routes: Deutschkreuz, Jennersdorf.

- With Slovakia:
  - Main routes: Kittsee, Marchegg.

- With Switzerland:

[86]https://www.europarl.europa.eu/RegData/etudes/etudes/join/2012/474533/IPOL-TRAN_ET(2012)474533_EN.pdf

- Main routes: Feldkirch (via Liechtenstein), Lustenau.

- With the Czech Republic:
  - Main routes: Summerau, Gmünd NÖ, Bernhardsthal,
  - regional route: Retz.

3.9. Environmental protection

The main directions of OEBB in environmental protection are the following[87]:

- Ensuring sustainable energy supply and climate protection,
- connecting people and nature for generations,
- supporting biodiversity and nature conservation,
- using resources in a responsible way,
- reducing emissions in all areas,
- reducing our waste volumes,
- safely storing, handling and transporting of hazardous substances.

3.9.1. Noise protection

According to EEA data in Europe, Austria is one of the countries that are heavily affected by railway noise, according to the share of their population that is affected by railway noise with more than 55 dB(A) LDEN.[88]

The Environmental Noise Directive (Directive 2002/49/ EC)[89] sets the general framework for environmental noise management.

On the existing railway lines, on the busiest sections and mountainous areas measures for the protection of the natural and residential environment against noise are gradually being implemented, an environmental noise plans implementing DIR 2002/49/EC have been prepared. Financial means amount to €16 – 25 million p.a.; 50% of the costs are covered by ÖBB and 50% by the federal states and the community; equipment of new tracks 100% funding by ÖBB. Equipment of 4,500 out of 31,000 wagons from Rail Cargo Austria and Rail Cargo Hungary with K-block brakes through new units. A decade ago, there was criticism of noise action plans: lag of new ways to deal with noise, no concrete specification[90].

3.9.2. Protection of water resources

The EU Water Framework Directive (WFD) aims to protect and improve the ecological status of water bodies in order to promote sustainable watershed use. This requires that 'good status' should be achieved for all surface and groundwater bodies by 2015 or 2027 at the latest. Consequently, NRAs must ensure that their water management practices meet the requirements of the WFD, thereby ensuring sustainable development of the railway network.

[87] https://infrastruktur.oebb.at/en/company/eco-friendly-environment/environment

[88] https://www.europarl.europa.eu/RegData/etudes/etudes/join/2012/474533/IPOL-TRAN_ET(2012)474533_EN.pdf

[89] https://ec.europa.eu/environment/noise/directive_en.htm

[90] https://www.europarl.europa.eu/RegData/etudes/etudes/join/2012/474533/IPOL-TRAN_ET(2012)474533_EN.pdf

In line with the objective of economic use and protection of natural resources protection of both surface and ground water is carried out in Austria.[91]

3.10. Harmonization of timetables and an integrated public passenger transport system

An integrated transport alliance (**Verkehrsverbund**) offers the passenger, under application of a uniform tariff system, the benefit of a joint ticket at a discounted rate covering all involved scheduled transport operators (rail, public and private bus operators, and municipal transport companies).[92] Starting from 26th October 2021, it is also possible to purchase one integrated ticket valid for all means of public transport in Austria.[93]

Overall, there are currently eight such integrated transport alliances in Austria that from the territory covered mostly align with the federal state boundaries.

3.11. Responsibility and managers of the railway infrastructure

Railway network in the Republic of Austria is mainly owned by the national rail company ÖBB[94]. A small part of the network is privately owned. ÖBB is the main national infrastructure manager. As an independent regulator for the railways in Austria, Schienen-Control ensures non-discriminatory, functional competition in the railway market.

The railway infrastructure is managed in accordance with the provisions of the Railway Transport Act, Ordinance No 41 dated 27 June 2001. The management of public railway infrastructure is carried out by the operator on the basis of a contract with the government.

In accordance with the Railway Transport Act, the operator must ensure the proper management and maintenance of railway infrastructure and the management of railway transport.

The maintenance of public railway infrastructure and the management of railway traffic on it, is a mandatory public utility service.

4. Investments and maintenance costs

AT invests on basis of rolling multiannual planning, in 6 years periods. The current financing framework of rail infrastructure investments is »ÖBB Rahmenplan 2021-2026« and next one »ÖBB Rahmenplan 2022-2027«, available on the BMK's website.[95]

Section/Station	Description	Period	EUR (mill)
Feldkirch – Buchs	Modernization	2027	100
Bludenz	Direction Arlberg adaptation of exit	2026	38
Brenner Basistunnel		2032	4.783
St.Margrethen – Lauterach	expansion for local traffic	2022	189

[91] https://ec.europa.eu/environment/eir/pdf/report_at_en.pdf
[92] https://www.bmk.gv.at/en/topics/mobility/transportation/publicpassenger.html
[93] https://www.klimaticket.at/en/
[94] https://www.oebb.at/en/
[95] Ausbauplan ÖBB (bmk.gv.at)

Wald a.Arlberg – Dalaas	Measures in the Lochwald area	2027	46
Großraum Innsbruck	Construction & renovation of traffic stations	2026	45
Brenner Nordzulauf	4-track expansion Schaftenau - Radfeld junction	2032	2.549
Steindorf b.Str. – Neumarkt-K.	3-track expansion & conversion	2021	60
Golling-Abtenau – Sulzau	Line improvement in the Golling area	2022	39
Linz – Wels	4-track expansion	2028	1.219
Linz Kleinmünchen – Linz Hbf	4-track expansion	2030	382
Hinterstoder – Pießling-Vorderstoder	2-track expansion	2034	204
Melk – Loosdor	Replacement tonnage	2028	43
Wien Hütteldorf – Wien Meidling	Connection railway Vienna	2027	317
Direktanbindung Horn	selective 2-track	2027	127
Ausbau Nordbahn		2030	1007
S-Bahn Stammstrecke	including projects in the greater Vienna area	2027	1.088
Stadlau - Marchegg	2-track expansion & electrification	2025	528
Wien Meidling – Mödling	4-track expansion	2034	1.213
Wien – Wr.Neustadt	Pottendorfer line	2023	629
Parndorf – Staatsgrenze n.Kittsee	2-track expansion (phase 1 & 2)	2023/2035	1.643
Flughafen Wien – Bruck a.d.Leitha	Establishment of a connecting line	2034	1.643
Ebenfurth	Establishment of a loop	2029	225
Semmering-Basistunne		2028	3.697
Bruck a.d.Mur – Graz	Station renovations	2027	220
Graz – Weitendorf	Integration of the Koralmbahn	2025	488

Koralmbahn Graz – Klagenfurt		2025	5.446
Terminal/GV-Bf Project	Güterzentrum Villach, Wörgl, Wels Vbf, Wien Süd, Wien Süd	2025 - 2028	232

4.1. Railway investments

In 2020, **2.600 mio EUR** were invested in new constructions and renovations of the railway network in Austria. (Eurostat)

The federal government adopted a framework plan for the period 2021-2026 worth 17.5 billion euros, which will create 5 billion euros worth of value for Austria as a business location annually and provide or create 15,000 jobs for every billion invested.[96]

The railway has put in place a comprehensive investment plan worth more than 25 billion euros for 2021-26, with 20.6 billion euros allocated funds for the expansion of rail infrastructure and renewable energies. Another 3.4 billion euros is being invested in the modernisation and expansion of the passenger train fleet. [97]

4.2. Investments in railway maintenance

N/A- Data about investments in the maintenance in year 2020 are not available.

As part of the funding adopted in a framework plan for the period 2021-2026 will support routine maintenance across all the regions in Austria, as well as make improvements to level crossings, platforms and other trackside infrastructure.[98]

4.3. Objectives of transport policy and future development of the railway network

The "Overall Transport Scheme" formulates objectives and strategies for a comprehensive transport policy up to 2025. Target Network 2025+ is a comprehensive overall concept with specific implementation measures for rail infrastructure in Austria. It provides answers to the challenges of tomorrow's transport policy and is implemented through framework plans and clear funding. Target Network 2025+ is a plan for a modern, efficient infrastructure and the basis for environmentally-friendly mobility for the next 100 years. It contains investment in expansion and modernisation beyond the year 2025. Target Network 2025+ is being implemented in several stages. The main foci for investment are demographic and economic factors. These are based on the Transport Prognosis 2025+ compiled by the institutes and universities. At the moment, the Target Network 2025+ is being updated to horizon 2040 in order to identify the strategic steps of development in the coming two decades.

The Austrian National Implementation Plan (NIP) was delivered in 2017 and it is fully compliant with the ERTMS European Deployment Plan.

According to the Austrian NIP:

[96]https://www.railjournal.com/financial/obb-breaks-even-in-2020-thanks-to-cost-savings-and-government-support/

[97]https://www.railjournal.com/financial/obb-breaks-even-in-2020-thanks-to-cost-savings-and-government-support/

[98] https://www.railjournal.com/financial/obb-outlines-e2-13bn-investment-in-eight-regions-in-2021/

- The entire network will be equipped with ERTMS level 2.
- For sections equipped with ETCS and PZB, the Class B system will be removed after three years of being equipped with ERTMS. On the contrary, LZB will be decommissioned as soon as ERTMS is deployed. Therefore, the full decommissioning of LZB is expected by 2030, and of PZB by the late 2030s. In addition, lines equipped with ETCS may be accessed by vehicles with ETCS onboard equipment only.

4.4. Main priorities in the development of railway infrastructure

Austrian Federal Railways (ÖBB) has announced plans to invest 2.13 billion euros in 2021 across its rail network in the Upper Austria, Lower Austria, Burgenland, Vorarlberg, Carinthia, Styria, Tyrol, Wien and Salzburg regions.[99]
The investments are part of the railway's 17.5 billion euros 2021-2026 framework plan, which was approved by Austria's council of ministers in October 2020. The framework outlines investments of around 3 billion euros per year over six years in support of ÖBB's Target Network 2025+ strategy plan. The funds are intended to contribute to the development of modern, high-performance infrastructure in Austria and increase the attractiveness and efficiency of rail travel for passengers and freight.[100]

5. Railway infrastructure management, regular maintenance measures and network modernization

The management of railway infrastructure is regulated by the Austrian Railway Act (Eisenbahngesetz – EisbG)

The management of public railway infrastructure is carried out by the operator on the basis of a contract with the government and includes in particular:

- preparation of a proposal for a maintenance plan for the existing public railway infrastructure;
- providing data and information for the preparation of expert bases for investments in public railway infrastructure;
- preparation of data and expert bases for new projects related to the implementation of the infrastructure manager's tasks;

concluding legal transactions related to the management of public railway infrastructure and station buildings, in the case and to the extent that they do not serve or are not necessary for the implementation of their basic purpose.

6. Map of railway network

[99] https://www.railjournal.com/financial/obb-outlines-e2-13bn-investment-in-eight-regions-in-2021/
[100] https://www.railjournal.com/financial/obb-outlines-e2-13bn-investment-in-eight-regions-in-2021/

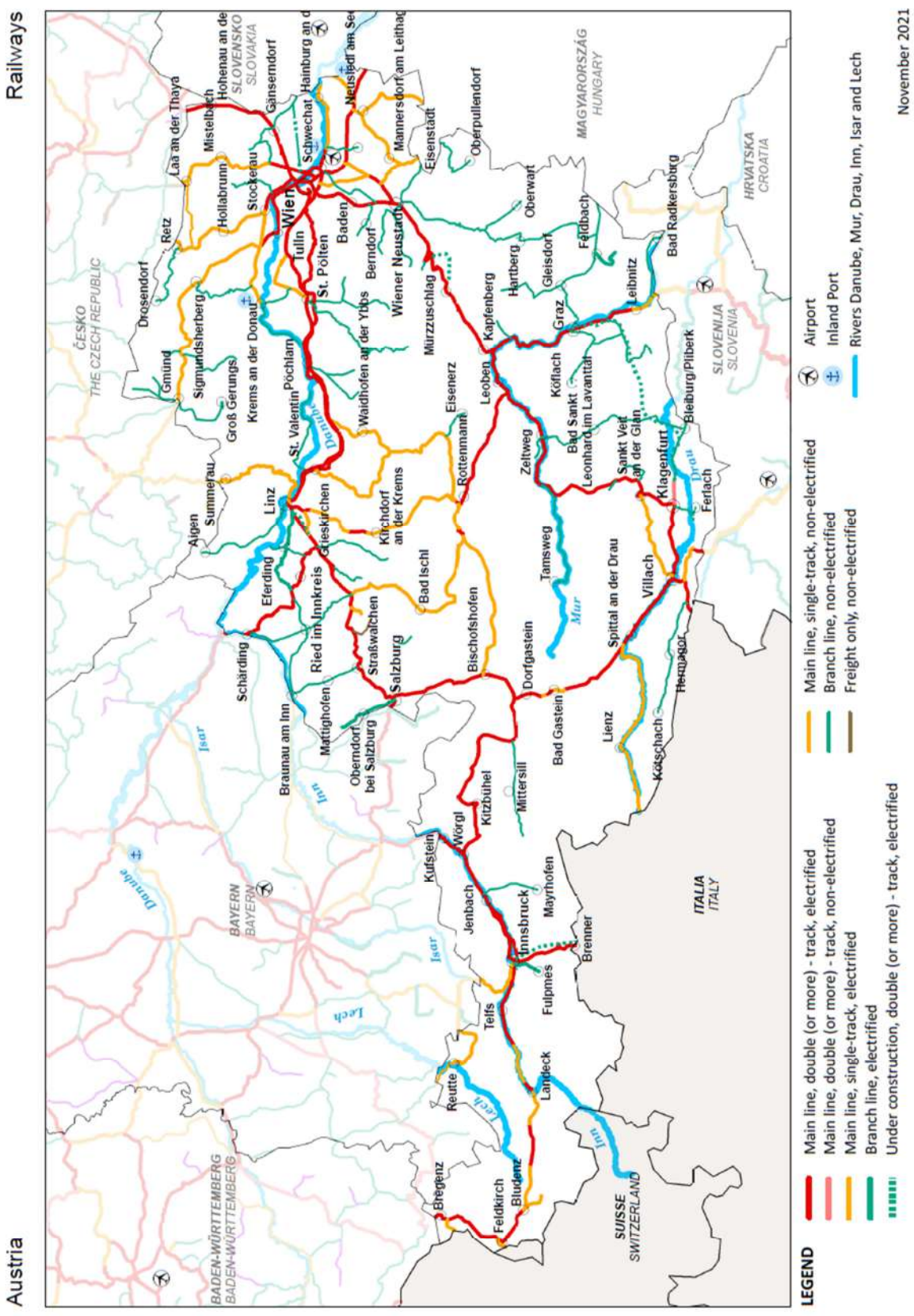

Figure 34:Map of railway network in Austria

4.2.2. Danube region railways: BOSNIA AND HERZEGOVINA

1. General data

- Inhabitants / 2020: **3.280.819,00**
- Membership in the EU: **applied for membership 15.2. 2016**
- GDP / 2020 in EUR million: **16.330**
- GDP per capita / 2020 in EUR**: 4.980**
- Capital city: **Sarajevo**
- Land area (km²): **51.197,00**
- Km of railways per million inhabitants: **319,432**
- Km of railways per km² of the land area: **0,02**

2. Description of the railway network

- Length of railway lines (km): **1.048,00**
- Length of double-track railway lines (km): **87,00**
- Length of single-track railway lines (km): **961,00**
- Length of electrified railway lines (km): **776,00**
- Length of non-electrified railway lines (km): **272,00**
- Length of railway lines (km), axle load D4 (22,5 tons/axle): **840,74**
- Maximum length of freight train (m) on TEN-T network: **535**

3. Main features of railway network

3.1. General description of the transport characteristics of the railway network

The Railway Network of B&H is 1048 km long, with standard gauge of 1.435 millimetres on a 1032 km of network.

Depending on traffic volume, economic importance, number of tracks and the connecting role of railway transport line, the railway network is divided into main and regional lines.

The main nodes, as we call the areas where several railway lines merge or come together are in: Sarajevo, Doboj and Novi Grad.

Electrified railway lines on the B&H railway network are equipped with 25 kV alternating voltage and 50 Hz frequency.

3.2. Traffic

3.2.1. Number of trains

- Average number of all trains per day on TEN-T - core network: **111**.
- Average number of all trains per day on TEN_T - comprehensive network: **15**.
- Average number of all trains per day on the rest of the network: **9**.
- Average number of freight trains per day on TEN-T - core network: **83**.
- Average number of freight trains per day per TEN_T – comprehensive network: **36.**
- Average number of freight trains per day on the rest of the network: **16**.

3.2.2. International railway corridors

Within the Trans- European Transport Network (TEN-T) Bosnia & Herzegovina is connected to the Rhine-Danube corridor[101]. The Rhine-Danube Core Network Corridor is the transport backbone linking central and south-eastern Europe. In two distinct branches, it comprises intermediate sections in nine EU Member States and connects them to neighbouring countries Serbia, Bosnia-Herzegovina, Moldova and Ukraine.

Following the TEN-T Mediterranean Corridor extension to the Western Balkans, the pan-European Corridor Vc starts in Budapest, runs via northern Croatia (Osijek), through Bosnia and Herzegovina via Doboj, Zenica, Sarajevo and Mostar, and ends in the Croatian port of Ploče. Corridor Vc is intended to connect the Adriatic port of Ploče in Croatia with Budapest in Hungary, via Bosnia and Herzegovina (BiH).[102] This corridor is the backbone of Bosnia and Herzegovina´s connectivity, strategically vital for its economic development and a top priority for the Western Balkans regional development.

Modernization and reconstruction of the existing (Corridor parallel to Corridor X) and construction new rail lines (Čapljina-Trebinje-Nikšić as a part of Adriatic Ionian corridor) of the BH Railway Network can contribute to major economic growth and becomes future connection to the Mediterranean corridor[103].

3.3. Railway infrastructure equipment

3.3.1. Length of railways equipped with GSM-R system

On the railway network of B&H the GSM-R system is not yet installed.

3.3.2. Length of railways equipped with ETCS level 1

The European safety system for train control ETCS Level 1, version 2.3.0d, which is one of the systems for ensuring the interoperability of the railway signalling safety system is not yet installed on railway infrastructure in Republic of B&H.

3.3.3. Length of railways equipped with ETCS level 2

The European safety system for train control ETCS Level 2 system is not yet installed on railway lines in Republic of B&H.

3.4. Condition of railway infrastructure

Years of irregular infrastructure maintenance during the wartime, cause poor performance on the most of the railway network in the country (maximal passenger train speed on the most of the sections is 70 km/h).[104]

[101] https://transport.ec.europa.eu/transport-themes/infrastructure-and-investment_en
[102] https://wbif.eu/corridor-vc-bosnia-and-herzegovina-road-europe
[103] https://unece.org/fileadmin/DAM/trans/doc/2019/TEM/15_Oct_2019_S2_Mustafa_Kovacevic.pdf
[104] https://www.slideshare.net/AmelKovacevic/the-railway-infrastructure-in-bosnia-and-herzegovina

3.5. Speed limits

3.5.1. The maximum speed limit for freight traffic (only for TEN-T corridors or main lines) is: **80 km/h**

3.5.2. The maximum speed limit for passenger trains traffic (only for TEN-T corridors or main lines): **100 km/h**

3.5.3. Lengths of railway lines on the TEN-T network where the speed limit is less than 100 km/h (in km): **500,7**

3.6. Traffic safety[105]

- Number of accidents in 2018, 2019 and 2020

Table 10: Number of accidents

Total nuber of emergencies	2018	2019	2020
Accidents	36	45	25
Accidents at level crossing	24	20	8

There were 25 accidents on railways in B&H in 2020, which is 20 accidents less than in 2019.

- Number of level crossings, of roads with railways in 2018, 2019, 2020

Table 11: Number of level crossings

	2018	2019	2020
Number of level-crossings on TEN-T network (core and comprehensive)	426	426	426
Number of all level crossings	443	443	443

- Number of fatalities in accidents in 2018, 2019 and 2020

Table 12:Number of fatalities

	2018	2019	2020
Total number of fatalities	16	14	9

Between 2018 and 2020, the number of fatalities decreased by more than 40%. The number of fatalities for year 2020 represents 2,7 fatalities per million inhabitants.

3.7. The main weaknesses of the railway network

3.7.1. Missing sections

- railway line Čapljina-Trebinje-Nikšić*

*The data about missing sections of the railway network of B&H were not obtained and confirmed by the representative of B&H.

[105] Railways of the Federation of B&H + Railwas of Republic of Srpska

3.7.2. Railway bottleneck

- Doboj – Sarajevo section (172 km) *

*The data about missing sections of the railway network of B&H were not obtained and confirmed by the representative of B&H.

3.7.3. Level crossing

The previous chapter 3.6. shows the steady number of level crossings. Table 11 shows that there are still 443 level crossings in Austria (on average 1 level crossing 0,42 km/1 level crossing), these level crossings need adequate protection to minimize the risk of collisions (for road and rail traffic) when crossing.

3.7.4. Inadequate environmental protection

In many sections, there is no noise barrier to protect the natural and living environment. In addition, some sections of railway lines, which run through water protection areas do not have adequate protection against spills of hazardous substances.

3.8. Connections to the neighbouring countries

The boundaries of the railway, network operated by the railway infrastructure manager, are the points of the national border on individual sections of lines.

Railway border crossings:

- With Croatia:
  - Main routes: Novi Grad, Čapljina, Bosanski Brod, Bosanski Šamac, Brčko.
  - regional route: Martin Brod, Dobrljin, Šamac.

- With Serbia:
  - regional route: Bijelina, Zvornik N.

- With Montenegro
  - regional routes: Jablanica, Strpci

3.9. Environmental protection

When providing railway transport services in the territory of the Republic of BIH, carriers must comply with all the rules necessary to prevent and reduce the burden on the environment. In case of an environmental accident, they must immediately inform the public railway infrastructure manager, who is responsible for notifying the relevant authorities and take urgent measures to reduce the harmful effects on the environment.

The data have not been confirmed by the country representative.

3.9.1. Noise protection

On the existing railway lines, on the busiest sections, measures for the protection of the natural and residential environment against noise are gradually being implemented, within the Operational Program for Noise Protection, a Railway Noise Protection Program has been prepared. It is designed to improve the quality of life of people living in areas close to the busiest railways in terms of noise pollution.

The data have not been confirmed by the country representative.

3.9.2. Protection of water resources

The data about protection of water resources in B&H were not obtained.

3.10. Harmonization of timetables and an integrated public passenger transport system

The data were not obtained.

3.11. Responsibility and managers of the railway infrastructure

There are two companies operating the railway network in Bosnia and Herzegovina. Republika Srpska Railways (ŽRS), which manages and maintaines railway infrastructure in Republika Srpska and Railways of the Federation of Bosnia and Herzegovina (ŽFBH) in the Federation of Bosnia and Herzegovina.

4. Investments and maintenance costs

4.1. Railway investments

N/A- Data about railway investments in the year 2020 are not available.

4.2. Investments in railway maintenance

N/A- Data about investments in the maintenance in the year 2020 are not available.

4.3. Objectives of transport policy and future development of the railway network

Rehabilitation and modernization of railway system is needed to alleviate the traffic burden on BiH's inadequate roads. The BiH rail system is divided by entity, weighed down by excess employees, and hampered by poor and aging infrastructure. The total length of operational railway tracks in BiH is 1.048 km. Major users of the railway transport system are large industrial plants (such as the chemical plant in Tuzla and Arcelor-Mittal Steel plant in Zenica), coal mines (Zenica, Tuzla, and Prijedor), the Aluminij aluminum plant in Mostar, and oil distributing companies. Passenger railway traffic is very limited but has been growing in the past couple of years since the railway companies purchased modern and comfortable coach cars.[106]

Modernization of the existing railway network and construction of new sections; improving of the regional and international cooperation through corridor connectivity and intramodality. EU integration with a view to obtaining candidate status that would provide access to funds for the design and construction of railway infrastructure. Implementation of the Transport Community Treaty. Opening

[106] https://www.trade.gov/country-commercial-guides/bosnia-and-herzegovina-rail-transportation

up the rail market and establishing competitiveness for the benefit of the state, service providers and users[107]

4.4. Main priorities in the development of railway infrastructure

Modernisation of the 172 km Doboj – Sarajevo section of Pan-European Corridor Vc.

5. Railway infrastructure management, regular maintenance measures and network modernization

The management of railway infrastructure is regulated by the Railway Transport Act.

The management of public railway infrastructure is carried out by the operator on the basis of a contract with the government and includes in particular:

- preparation of a proposal for a maintenance plan for the existing public railway infrastructure;
- providing data and information for the preparation of expert bases for investments in public railway infrastructure;
- preparation of data and expert bases for new projects related to the implementation of the infrastructure manager's tasks;
- concluding legal transactions related to the management of public railway infrastructure and station buildings, in the case and to the extent that they do not serve or are not necessary for the implementation of their basic purpose.

6. Map of railway network

[107] https://unece.org/fileadmin/DAM/trans/doc/2019/TEM/15_Oct_2019_S2_Mustafa_Kovacevic.pdf

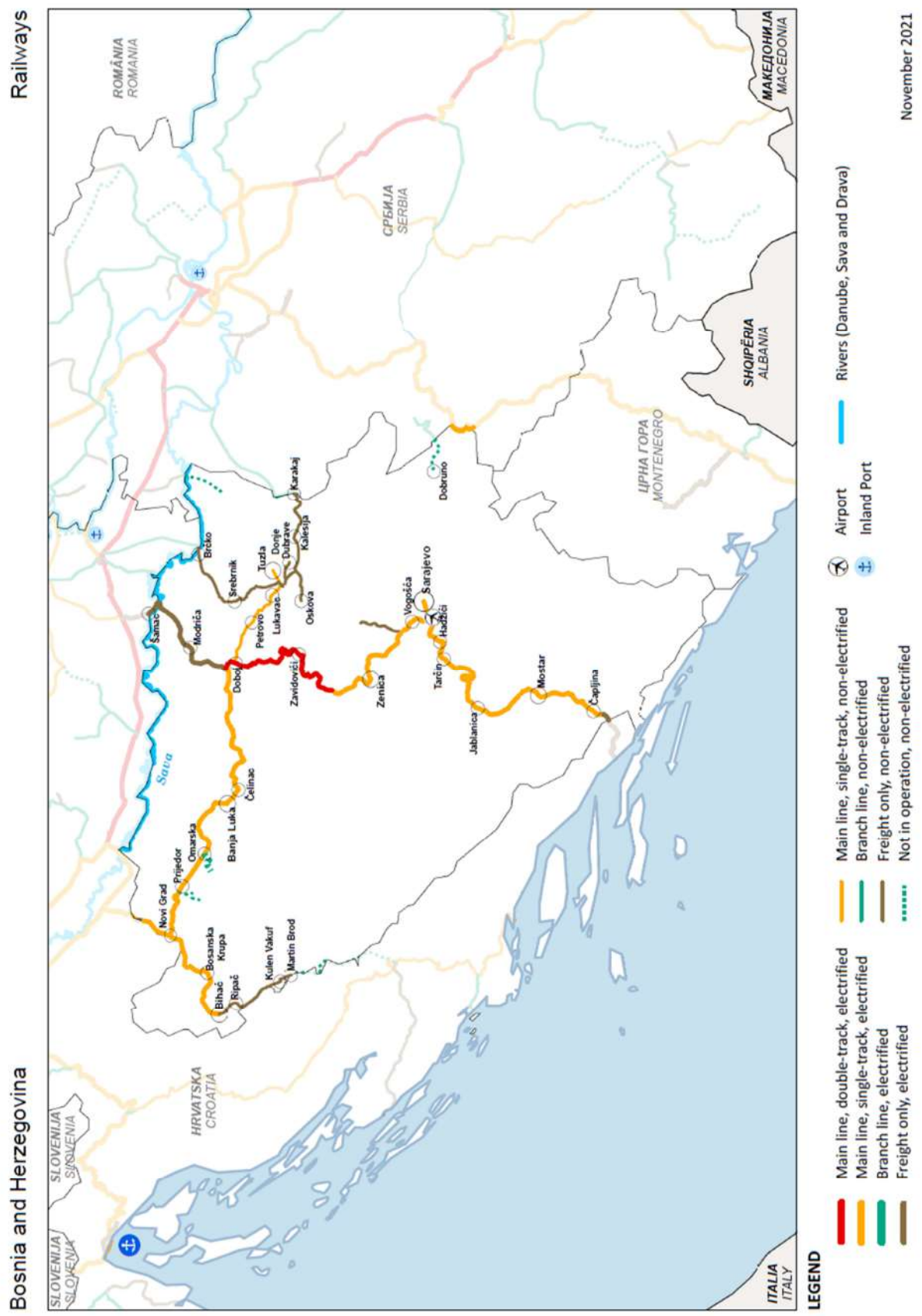

Figure 35:Map of railway network of B&H

4.2.3. Danube region railways: BULGARIA

1. General data

- Inhabitants / 2020: **6.916.548**
- Membership in the EU: **1.01.2007**
- GDP / 2020 in EUR million: **60.643**
- GDP per capita / 2020 in EUR: **8.750**
- Capital city: **Sofia**
- Land area (km²): **110.994**
- Km of railways per million inhabitants: **933,12**
- Km of railways per km² of the land area: **0,06**

2. Description of the railway network

- Length of railway lines (km): **6.454**
- Length of double-track railway lines (km): **990**
- Length of single-track railway lines (km): **5.464**
- Length of electrified railway lines (km): **4.719**
- Length of non-electrified railway lines (km): **1.735**
- Length of railway lines (km), axle load D4 (22,5 tons/axle): **4.572,11**
- Maximum length of freight train (m) on TEN-T network: **740**

3. Main features of railway network

3.1. General description of the transport characteristics of the railway network

The rail network operates to the track gauge of 1.435 millimetres.

There are also narrow-gauge railway lines (125 km) with track gauge of 760 mm and sidings in the pre-ferryboat park of the ferryboat complex in Varna with track gauge of 1,520 mm.[108]

Depending on traffic volume, economic importance, number of tracks and the connecting role of railway transport line, the railway network is divided into main and regional lines and single-track and double-track lines.

The main nodes, as we call the areas where several railway lines merge or come together, are:

Sofia	Intersecion of Orient/east-Med and Alpine-Westrn Balkan corridor.
Plodiv	Intersecion of line Mihajlovo-Plodviv (Orient/east-Med) and Sofia-Plodviv; Sofia-Dimotrovgrad (Orient/east-Med and Alpine-Westrn Balkan corridor).
Karnobat	Intersecion of line Karnobat-Burgas, Karnobat- Sindel Razpred and Stara Zagora-Karnobat on the Orient/east-Med corridor.

Electrified railway lines on the Bulgarian railway network, with the exception of junctions with foreign railway infrastructures, are equipped with alternating current electrification system with 25 kV and 50 Hz AC.

[108] https://www.era.europa.eu/sites/default/files/events-news/docs/ncp_bulgaria_taf_tsi_032018_en.pdf

3.2. Traffic

3.2.1. Number of trains

- Average number of trains per day on TEN-T core and comprehensive network: N/A*
- Average number of all trains per day on entire network (freight and passenger): **741**
- Average number of all trains per day on entire network (freight): **193**

* N/A – data not available

3.2.2International railway corridors

The railway network of the Republic of Bulgaria is very important, as several types of corridors and lines run through the territory of Bulgaria, the most important of which are Trans-European Railway Network Corridors (TEN-T) and international rail corridors for competitive freight transport.

Part of the trans-European railway network (TEN-T)[109] (core and comprehensive network), is the following corridor in Republic of Bulgaria:

- The Orient/East – Med Corridor, which runs from the border with the Republic of Serbia (Dragoman) and the Republic of Romania through Sofia to the border with the Republic of Greece (Kulata) and Turkey (Svilengrad) and to the Black Sea (Karnobat).

TEN-T Core Network in Bulgaria comprises the following axes:

- Vidin-Sofia-Kulata;
- Dragoman (Serbian border)-Sofia-Plovdiv-Burgas/Svilengrad (Turkish/Greek border);
- Sofia-Radomir-Gyueshevo (border with North Macedonia);
- Sofia-Mezdra-Gorna Oryahovitsa;
- Ruse-Stara Zagora-Dimitrovgrad.

Part of comprehensive network are the sections:

- Ruse-Varna;
- Gorna Oryahovitsa-Varna;
- Karnobat-Sindel.

International freight rail corridors for competitive freight transport run through Republic of Bulgaria in accordance with EU Regulation 913/2010 on European rail freight corridors (RFC):

- RFC 7[110] – Orient East-Med; The main route of the corridor is: Prague – Vienna/Bratislava – Budapest – Bucharest – Constanta, Arad – Craiova – Vidin – Sofia – Kulata – Thessaloniki – Athens and **Sofia - Plovdiv - Svilengrad** and the **alternative routes Videle – Ruse Razpredelitelna – Sindel Razpredelitelna – Karnobat - Nova Zagora – Simeonovgrad** – **Svilengrad, Nova Zagora – Stara Zagora-Dimitrovgrad – Simeonovgrad, Plovdiv-Stara Zagora – Karnobat-Burgas**.

[109] https://transport.ec.europa.eu/transport-themes/infrastructure-and-investment_en
[110] https://www.rfc7.eu/

- RFC 10[111] - Alps - Western Balkans. The main route of the corridor is: Salzburg – Fillah – Ljubljana – /Wels/Linz – Graz – Maribor –Zagreb – Vinkovci/Vukovar – Tovarnik – Belgrad – **Sofia – Svilengrad.**

3.3. Railway infrastructure equipment

In 2012, the Minister for Transport, Information Technology and Communications approved the Strategy and national plan for the deployment of the European Rail Traffic Management System (ERTMS) in the Republic of Bulgaria. The strategy defines the priority axes and hence the railway lines/sections of the rail infrastructure of the Republic of Bulgaria, on which ERTMS should be deployed. The following aspects were taken into account when determining the priority axes of overriding European interest: The Vidin-Sofia-Kulata axis; The Serbian border-Kalotina-Sofia-Plovdiv-Svilengrad-Kapicule (Turkish border) axis; The Plovdiv-Karnobat-Burgas axis. Priority axes of general European interest: The Radomir-Gyueshevo, Mezdra-Gorna Oryahovitsa and Karnobat-Sindel railway lines; The Ruse-Gorna Oryahovitsa-Stara Zagora-Dimitrovgrad axis; The Ruse-Kaspichan-Sindel-Varna axis. Priority axes of national interest: The Sofia-Karlovo-Zimnitsa axis; The Gorna Oryahovitsa-Kaspichan railway line.[112]

3.3.1. Length of railways equipped with GSM-R system

On the railways network of Republic of Bulgaria, the GSM-R system is installed on a 320 km of lines, ensuring radio signal coverage on the entire railway network, including tunnel coverage.

3.3.2. Length of railways equipped with ETCS level 1

The European safety system for train control ETCS Level 1, version 2.3.0d, which is one of the systems for ensuring the interoperability of the railway signaling safety system is installed on 229 km of railway infrastructure in Bulgaria.

3.3.3. Length of railways equipped with ETCS level 2

The European safety system for train control ETCS Level 2 system is not yet installed on railway lines in Republic of Bulgaria.

Vidin-Sofia railway line - the project 'Technical assistance for modernisation of the Vidin-Sofia railway line' has been drawn up and finalised. Construction on the Vidin-Mezdra/Ruska Byala section is scheduled to be implemented by 2023. The project should be carried out by the end of 2023. ETCS Level 1 + GSM-R has been specified, but it may be Level 2.[113]

3.4. Condition of railway infrastructure

*The data about condition of the railway infrastructure of Republic of Bulgaria were not available.

3.5. Speed limits[114]

3.5.1. The maximum speed limit for freight traffic (only for TEN-T corridors or main lines) is: **120 km/h.**

[111] https://www.rfc-awb.eu/
[112] https://ec.europa.eu/transport/sites/default/files/rail-nip/nip-ccs-tsi-bulgaria-en.pdf
[113] https://ec.europa.eu/transport/sites/default/files/rail-nip/nip-ccs-tsi-bulgaria-en.pdf
[114] National Railway Infrastructure Company, https://www.rail-infra.bg/en/310

3.5.2. The maximum speed limit for passenger trains traffic (only for TEN-T corridors or main lines) is **160 km/h.**

3.5.3. Lengths of railway lines on the TEN-T network where the speed limit is less than100 km/h (in km): **2217,64**

3.6. Traffic safety[115]

- Number of accidents in 2018, 2019 and 2020

Table 13: Number of accidents

Total nuber of emergencies	2018	2019	2020
Accidents	333	343	318
Accidents at level crossing	23	27	21

There were 318 accidents on Bulgarian railways in 2020, which is 25 accidents less than in 2019.

- Number of level crossings, of roads with railways in 2018, 2019, 2020

Table 14: Number of level crossings

	2018	2019	2020
Number of level-crossings on TEN-T network (core and comprehensive)	360	360	358
Number of all level crossings	757	757	758

- Number of fatalities in accidents in 2018, 2019 and 2020

Table 15: Number of fatalities

	2018	2019	2020
Total number of fatalities	52	53	54

Between 2018 and 2020, the number of fatalities slightly increased. The number of fatalities for year 2020 represents 7,8 fatalities per million inhabitants.

3.7. The main weaknesses of the railway network

3.7.1. Missing sections

*The data about missing sections of the railway network of Republic of Bulgaria were not obtained.

3.7.2. Railway bottleneck:

- Sofia-Septemvri
- Kalotina Zapad-Voluyak
- missing upgrade Voluyak-Dragoman (Serbian border)
- missing upgrade Sofia-Voluyak
- missing upgrade Elin Pelin-Kostenets

[115] http://www.dicr.cz/o-drazni-inspekci

- missing upgrade Sofia-Elin Pelin
- missing upgrade Kostenets-Septemvri
- Plovdiv (development of railway node)

3.7.3. Level crossing

The previous chapter 3.6. shows the number of level crossings is declining, Table 14 shows that there are still 785 level crossings in Bulgaria (on average 1 level crossing 0,12 km/1 level crossing), these level crossings need adequate protection to minimize the risk of collisions (for road and rail traffic) when crossing.

3.7.4. Inadequate environmental protection

In many sections, there is no noise barrier to protect the natural and living environment. In addition, some sections of railway lines, which run through water protection areas do not have adequate protection against spills of hazardous substances.

3.8. Connections with neighbouring countries

The boundaries of the railway, network operated by the public railway infrastructure manager, are the points of the national border on individual sections of lines. Connections with neighbouring countries networks are not very satisfactory. Currently there is one border crossing with Turkey, two with Greece, and one with Serbia, with Romania through the only bridge over the River Danube along the Bulgarian – Romanian section in Russe – Giurgiu and one land crossing. The Varna ferry complex ensures the transportation of railway wagons through the Black Sea. There is no railway connection with the FYRO Macedonia.[116]

Railway border crossings:

- With Greece:
  - Main route: Kulata
  - Regional route: Svilengrad

- With Turkey
  - Main routes: Svilengrad

- With Romania:
  - Main routes: Ruse
  - regional routes: Vidin

- With Serbia:
  - Main route: Dragoman

3.9. Environmental protection

In the urban transport planning and development Bulgaria conducts a policy orientated towards development of accessible infrastructure, usage of more environmentally friendly and secure vehicles, introduction of intelligent transport systems for urban traffic control, utilisation of integrated transport

[116] https://www.globalrailwayreview.com/article/600/boosting-railway-infrastructure-in-bulgaria/

schemes and charging schemes for overall improvement of the urban transport, connecting people and nature for generations[117].

3.9.1. Noise protection

The Environmental Noise Directive (Directive 2002/49/ EC)[118] sets the general framework for environmental noise management.

On the existing railway lines, on the busiest sections, measures for the protection of the natural and residential environment against noise are gradually being implemented. It is designed to improve the quality of life of people living in areas close to the busiest railways in terms of noise pollution.

Measures proposed to reduce the impact of noise are organizational management measures, namely: to limit the impact of noise in residential areas in according with national legislation, construction activities have to be coordinated with local residents, restriction on idling time for machines and equipment, servicing and regular maintenance of heavy construction vehicles, to travel on predetermined routes and approaches to strictly comply with the permissible speed when crossing settlements, limiting working hours in time zones designated by local authorities, in the case of acoustic emission in a specific direction - to use acoustic barriers to break the line of impact from noise source to noise receiver.[119]

3.9.2. Protection of water resources

The EU Water Framework Directive (WFD) aims to protect and improve the ecological status of water bodies in order to promote sustainable watershed use. This requires that 'good status' should be achieved for all surface and groundwater bodies by 2015 or 2027 at the latest. Consequently, NRAs must ensure that their water management practices meet the requirements of the WFD, thereby ensuring sustainable development of the railway network.
In line with the objective of economic use and protection of natural resources protection of both surface and ground water is carried out in Bulgaria.

3.10. Harmonization of timetables and an integrated public passenger transport system

Bulgaria's capital city and its population have got more intelligent and integrated transport system, thanks to an investment from the European Regional Development Fund. As part of the project were reconstruction of two tramlines, the purchase of new trams, plus the upgrading of traffic management and passenger information systems.

3.11. Responsibility and managers of the railway infrastructure

Railway network in the Republic of Bulgaria is owned and operated by the national railway company Balgarski darzhavni zheleznitsi – Bulgarian State Railways.

The management of public railway infrastructure is carried out by the operator on the basis of a contract with the government.

[117]https://sustainabledevelopment.un.org/content/documents/dsd/dsd_aofw_ni/ni_pdfs/NationalReports/bulgaria/TRANSPORT.pdf
[118] https://ec.europa.eu/environment/noise/directive_en.htm
[119]https://documents1.worldbank.org/curated/en/387361468006616983/pdf/E23770EA0P10711MP1Final1eng0April12.pdf

In accordance with the Railway Transport Act, the operator must ensure the proper management and maintenance of railway infrastructure and the management of railway transport.

The maintenance of public railway infrastructure and the management of railway traffic on it, is a mandatory public utility service.

4. Investments and maintenance costs

The removal of the bottlenecks regarding the capacity along the territory of Bulgaria is planned as follows:

- Sofia-Septemvri until 2025
- Voluyak-Sofia until 2025
- Kalotina Zapad-Voluyak until 2030.

Planned investments in Bulgaria are:[120]*

Section/Station	Description	Period	EUR (mill)
Voluyak-Dragoman Serbian border	Modernisation of the 49,5 km Voluyak DragomanSerbian border line, identified by the EU Council as a priority cross-border section	N/A	132
Sofia-Voluyak	Modernisation and upgrade of the existing double-track railway section, in line with requirements for Core Network Corridors as set by Regulation 1315/2013 and repealing Decision 661/2010/EU. Development of Sofia Railway Junction: Sofia-Voluyak Railway Section	2016- 2024	104
Elin Pelin-Kostenets	Modernisation of railway infrastructure in accordance with the requirements for the railway infrastructure of the core TEN-T network as specified in Regulation 1315/2013	2019- 2026	476
Sofia-Elin Pelin	Modernisation of the railway section Sofia-Elin Pelin	2021	64
Kostenets-Septemvri	Modernisation of railway infrastructure in accordance with the requirements for the railway infrastructure of the core TEN-T network as specified in Regulation 1315/2013	2019- 2023	168
Plovdiv	Development of Plovdiv railway node	ongoing - 2020	103

* The projects on the RFC AWB corridor are listed. Data about other planned investments nationwide were not available.

[120] https://www.rfc-awb.eu/wp-content/uploads/2019/02/AWB-RFC_Bottleneck-study_final.pdf

4.1. Railway investments

N/A- Data about railway investments in the year 2020 are not available.

4.2. Investments in railway maintenance

N/A- Data about investments in the maintenance in the year 2020 are not available.

4.3. Objectives of transport policy and future development of the railway network[121]

The Integrated Transport Strategy of MTITC in the period up to 2030 has been approved by Decision No 336/23.06.2017 of the Council of Ministers.

The framework of definition of the strategic objectives and priorities for the development of the transport system in the period up to 2030 is determined by the strategic objectives and the priorities laid down in the EU transport policy, the national transport policy and the relevant strategic and normative documents.

Additional data about national transport policy and future development were not obtained.

4.4. Main priorities in the development of railway infrastructure

Bulgaria will invest some 3.3 billion euro in the construction of railway infrastructure on its territory jointly with the European Union (EU) between 2021 and 2027.[122]

Some of the projects that will benefit from EU financing under the future operational programme Transport Connectivity 2021-2027 are the second stage of the modernisation of the Elin Pelin-Kostenets railway section, revamp of the railway line connecting Sofia to the town of Pernik, as well as the additional railway infrastructure construction on the Karnobat-Sindel line.[123]

5. Railway infrastructure management, regular maintenance measures and network modernization

The management of railway infrastructure is regulated by the Railway Transport Act.

The management of public railway infrastructure is carried out by the operator on the basis of a contract with the government and includes in particular:

- preparation of a proposal for a maintenance plan for the existing public railway infrastructure;
- providing data and information for the preparation of expert bases for investments in public railway infrastructure;
- preparation of data and expert bases for new projects related to the implementation of the infrastructure manager's tasks;
- concluding legal transactions related to the management of public railway infrastructure and station buildings, in the case and to the extent that they do not serve or are not necessary for the implementation of their basic purpose.

[121] https://www.era.europa.eu/sites/default/files/events-news/docs/ncp_bulgaria_taf_tsi_032018_en.pdf

[122] https://seenews.com/news/bulgaria-to-invest-33-bln-euro-in-railway-infrastructure-with-eu-help-by-2027-report-705737

[123] https://seenews.com/news/bulgaria-to-invest-33-bln-euro-in-railway-infrastructure-with-eu-help-by-2027-report-705737

6. Map of railway network

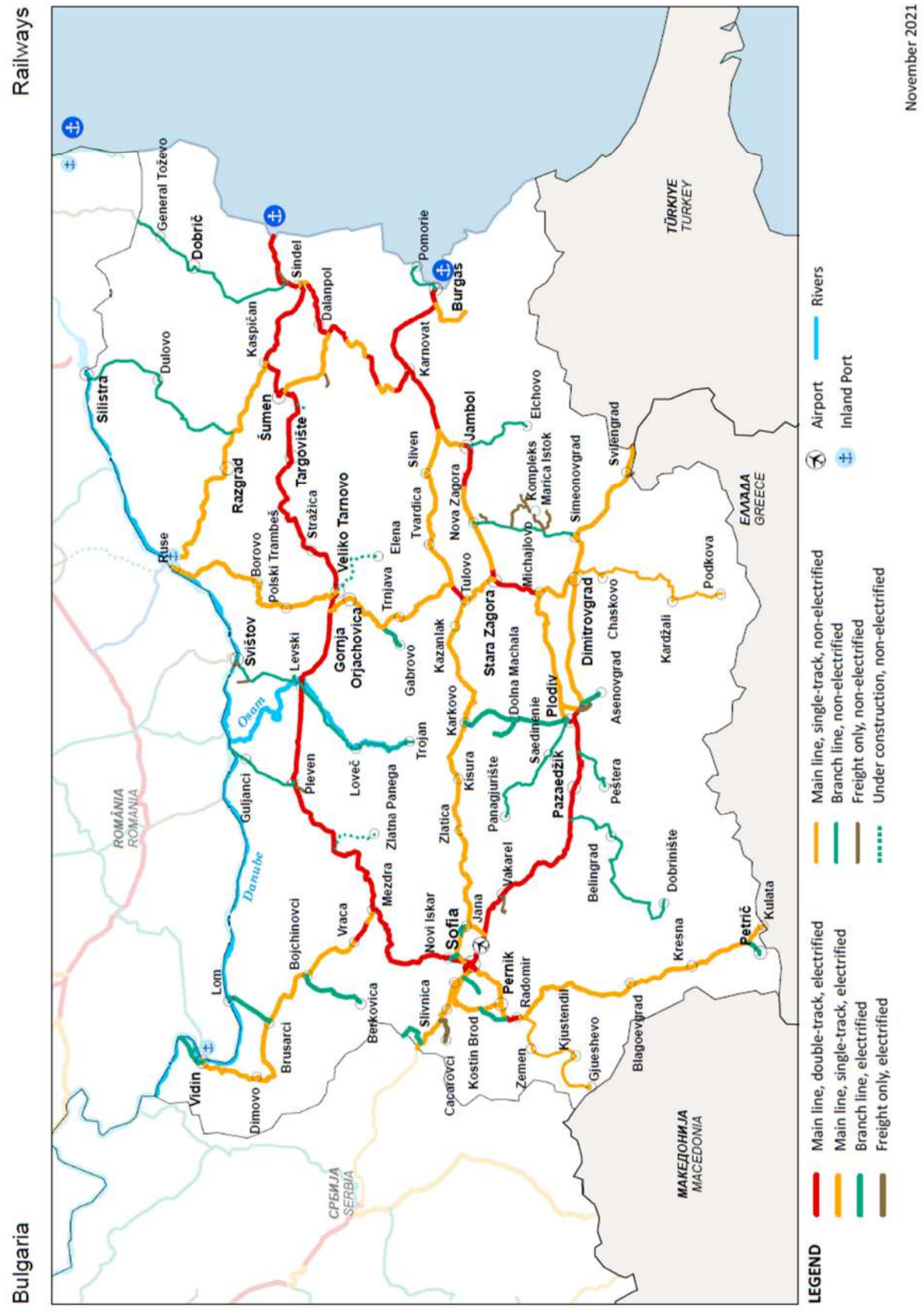

Figure 36: Map of railway network of Bulgaria

4.2.4. Danube region railways: CROATIA

1. General data[124]

- Inhabitants / 2020: **4.058.165**
- Membership in the EU: **1.07.2013**
- GDP / 2020 in EUR million: **49,28**
- GDP per capita / 2020 in EUR: **11.987,00**
- Capital city: **Zagreb**
- Land area (km²): **56.594,00**
- Km of railways per million inhabitants: **637,5**
- Km of railways per km² of the land area: **0,05**

2. Description of the railway network

- Length of railway lines (km): **2.617,00**
- Length of double-track railway lines (km): **274,00**
- Length of single-track railway lines (km): **2.343,00**
- Length of electrified railway lines (km): **994,00**
- Length of non-electrified railway lines (km): **1.623,00**
- Length of railway lines (km), axle load D4 (22,5 tons/axle): **N/A**
- Maximum length of freight train (m) on TEN-T network: **N/A**

3. Main features of railway network

3.1. General description of the transport characteristics of the railway network

The entire rail network operates to the track gauge of 1,435 millimetres.

Depending on traffic volume, economic importance, number of tracks and the connecting role of railway transport line, the railway network is divided into main and regional lines and single-track and double-track lines.

The main nodes, as we call the areas of several railway stations. According to the needs of railway transport system and traffic regulation, are: Zagreb, Vinkovci, Varaždin, Osjek, Koprivnica, Rijeka.

There are 994 km of electrified railway lines on the Croatian railway network. They are equipped with 50 Hz frequency AC system, with an alternating voltage of 25 kV, except on a state border with Croatia, there is 3 km line, equiped with 3kV DC system.

3.2. Traffic

3.2.1. Number of trains

- Average number of trains per day on TEN-T core and comprehensive network: N/A*
- Average number of all trains per day on TEN-T - core network: N/A.
- Average number of all trains per day on TEN_T - comprehensive network: N/A.
- Average number of all trains per day on the rest of the network: N/A.
- Average number of freight trains per day on TEN-T - core network: N/A.
- Average number of freight trains per day per TEN_T – comprehensive network: N/A.

[124] c.europa.eu/info/sites/default/files/food-farming-fisheries/farming/documents/agri-statistical-factsheet-hr_en.pdf

- Average number of freight trains per day on the rest of the network: N/A.

* N/A – data not available.

3.2.2. International railway corridors

Several corridors run through the territory of the Republic of Croatia.

Part of the trans-European railway network (TEN-T)[125] (core and comprehensive network), is the following corridor:

- The Mediterranean corridor, which runs from the border with the Republic of Croatia-Savski Marof, through Zagreb to Koprivnica in direction to Budapest.

Part of comprehensive network are the sections:

- From Šapjane through Ogulin to Zagreb.
- From Središče to Čakovec to the border with the Republic of Hungary.

International freight rail corridors for competitive freight transport run through Croatia in accordance with EU Regulation 913/2010 on European rail freight corridors (RFC):

- RFC 6 - Mediterranean; (Almeria - Valencia / Algeciras / Madrid - Zaragoza / Barcelona - Marseille - Lyon - Turin - Milan - Verona - Padua / Venice - Trieste / Koper - Ljubljana - Budapest and Ljubljana / **Rijeka - Zagreb** - Budapest - Zahony (Hungarian-Ukrainian border); established in November 2013.

- RFC 10[126] - Alps - Western Balkans;(Linz/ Wels-Maribor-Zidani most; Salzburg-Villach-Ljubljana-Zidani Most-**Zagreb-Vinkovci**-Beograd-Niš-Dimitrovgrad-Svilengrad).

3.3. Railway infrastructure equipment

The Croatian National Implementation Plan (NIP) was delivered in 2018. It is compliant with the ERTMS European Deployment Plan with some exceptions, because the ERTMS deployment will take place beyond 2023 and the upgrade to ERTMS of the existing lines is planned to be finished before 2030. The newly constructed Horvati - Dugo Selo line is not included.

According to the Croatian NIP:

- ETCS Level 1 will be installed initially in the Croatian network. Once GSM-R and ETCS Level 2 have been installed, ETCS Level 1 will remain in use as a backup system.
- There are two possible strategies for implementing ERTMS. Trains and/or infrastructure may be 'dually' equipped with both the ERTMS and the Class B national system. The railway vehicle strategy has been selected for the implementation of ERTMS in Croatia. Where vehicles equipped with ETCS/ERTMS run on lines equipped with the autostop device currently in operation in Croatia, the train system will require a specific transmission module (STM).[127]

[125] https://transport.ec.europa.eu/transport-themes/infrastructure-and-investment_en
[126] https://www.rfc-awb.eu/
[127] https://ec.europa.eu/transport/modes/rail/ertms/countries/croatia_en

3.3.1. Length of railways equipped with GSM-R system

On the Croatian Railways network, the GSM-R system is installed N/A km of lines, ensuring radio signal coverage on the entire railway network, including tunnel coverage. The radio signal also covers border areas with neighbouring countries.

* N/A – data not available

3.3.2. Length of railways equipped with ETCS level 1

The European safety system for train control ETCS Level 1, version 2.3.0d, which is one of the systems for ensuring the interoperability of the railway signalling safety system is being installed on railway infrastructure in Croatia on a N/A km of lines are already equipped with the ETCS Level 1 system and N/A km of lines are in preparation for the upgrade.

The Vinkovci – Tovarnik section of the Pan European Corrridor X was the first section on a Croatian railways, with ERMTS Level 1 technology installed.

* N/A – data not available

3.3.3. Length of railways equipped with ETCS level 2

At this moment, the lines are not equipped with the ETCS level 2 system.

3.4. Condition of railway infrastructure

Condition of the infrastructure is summarized according to the Development Strategy of the Republic of Croatia 2017-2030, where the key findings are, that insufficient investments caused deterioration of the technical state of the electric traction system and particular facilities are now in critical condition. Prescribed renewal of the system every 8 to 10 years has not been carried out due to lack of funds in the past 35 years. For all these reasons, it is necessary to thoroughly revitalize the entire system to maintain the functionality and traffic safety.
Due to deterioration and overall technical state of open track superstructure regarding operational safety requirements, normal or increased maintenance procedures can be implemented only on 45.6% of total track length. On remaining 54.4%, it is necessary to carry out investment projects or more extensive maintenance procedures. Current tracks condition enables achieving maximum travelling speed equal to designed speed value on 18% of the network. Because of the safety reasons, train speed of 160 km/h is allowed only on 7.14% of open tracks, and train speed of 100 km/h is allowed on 12.2%.

12.4 % of the tracks have speed limits under 60 km/h. The above mentioned speed limits are conditioned by the state of the infrastructure.[128]

*The data about condition of the railway infrastructure of Republic of Croatia were not confirmed by the representative of Croatia.

3.5. Speed limits

3.5.1. The maximum speed limit for freight traffic (only for TEN-T corridors or main lines) is **160 km/h.**

3.5.2. The maximum speed limit for passenger trains traffic (only for TEN-T corridors or main lines) is (N/A) km/h.

3.5.3. Lengths of railway lines on the TEN-T network where the speed limit is less than

128

https://mmpi.gov.hr/UserDocsImages/dokumenti/INFRASTRUKTURA/Infrastruktura%2010_19/Transport%20Development%20Strategy%20of%20the%20Republic%20of%20Croatia%202017-2030%2029-10_19.pdf

100 km/h (in km): N/A

* N/A – data not available

3.6. Traffic safety

- Number of accidents in 2018, 2019 and 2020

Table 16: Number of accidents

Total nuber of emergencies	2018	2019	2020
Accidents	N/A	N/A	N/A
Accidents at level crossing	30	25	26

*N/A – not available data

- Number of level crossings, of roads with railways in 2018, 2019, 2020

Table 17: Number of level crossings

	2018	2019	2020
Number of level-crossings on TEN-T network (core and comprehensive)	N/A	N/A	N/A
Number of all level crossings	1.512	1.505	1.499

*N/A – not available data

- Number of fatalities in accidents in 2018, 2019 and 2020

Table 18:Number of fatalities

	2018	2019	2020
Total number of fatalities	7	6	4

3.7. The main weaknesses of the railway network

The Croatian rail network on the AWB RFC, faces bottlenecks on the section line Dugo Selo- Novska and at the station Dugo Selo, and to a lesser extent at Sesvete station. The line section Dugo Selo-Novska is a single-track line with speeds of 60 km/h (2/3 of the section line) and 80 km/h (1/3 of section line), and with a number of stations with low track capacity in terms of track number and length. Due to these infrastructure capacities, the capacity is 79 trains per day, although according to the timetable it is 86, which represents a capacity utilisation of 109%. Dugo Selo station primarily, and to a lesser extent Sesvete station, both represent bottlenecks. The section line Savski Marof-Zagreb ZK, although a double-track railway line, has a reduced capacity utilisation due to the condition of the infrastructure and consequently the lower infrastructural speeds.[129]

3.7.1. Missing sections

The data about missing sections of the railway network of Republic of Croatia are not available.

3.7.2. Railway bottleneck

[129] https://www.rfc-awb.eu/wp-content/uploads/2019/02/AWB-RFC_Bottleneck-study_final.pdf

- Dugo Selo-Novska
- Station Dugo Selo
- Savski Marof – Zagreb

* The bottlenecks of the RFC AWB corridor are listed. Data about other bottlenecks nationwide were not available.

3.7.3. Level crossing

The previous chapter 3.6. shows the number of level crossings is declining, Table 17 shows that there are still 1.499 level crossings in Croatia (on average 0,57 km/1), these level crossings need adequate protection to minimize the risk of collisions (for road and rail traffic) when crossing.

3.7.4. Inadequate environmental protection

In many sections, there is no noise barrier to protect the natural and living environment. In addition, some sections of railway lines, which run through water protection areas do not have adequate protection against spills of hazardous substances.

*The data have not been confirmed by the country representative.

3.8. Connections with neighbouring countries

The boundaries of the railway, network operated by the railway infrastructure manager, are the points of the national border on individual sections of lines, with four neighbouring countries: Hungary, Serbia, and Bosnia and Herzegovina, Slovenia.

Railway border crossings:

- With Slovenia:
  - **Main routes:** Svaski Marof, Čakovec(Središće), Šapjane,
  - **regional routes:** Đurmanec, Kumrovec, Kamanje, Lupoglav/Buzet.

- With Hungary:
  - **Main route:** Koprivnica, Beli Manastir,
  - **regional route:** Kotoriba.
- With Serbia:
  - **Main route:** Tovarnik,
  - **regional route:** Erdut.

- With Bosnia and Herzegovina:
  - **Main routes**: Slavonski Šamac, Metković,
  - **regional routes**: Drenovci, Volinja, Ličko Dugo Polje.

3.9. Environmental protection

When providing railway transport services in the territory of the Republic of Croatia, carriers must comply with all the rules necessary to prevent and reduce the burden on the environment. In case of an environmental accident, they must immediately inform the public railway infrastructure manager,

who is responsible for notifying the relevant authorities and take urgent measures to reduce the harmful effects on the environment.

*The data have not been confirmed by the country representative.

3.9.1. Noise protection

The Environmental Noise Directive (Directive 2002/49/ EC)[130] sets the general framework for environmental noise management.

On the existing railway lines, on the busiest sections, measures for the protection of the natural and residential environment against noise are gradually being implemented, within the Operational Program for Noise Protection, a Railway Noise Protection Program has been prepared. It is designed to improve the quality of life of people living in areas close to the busiest railways in terms of noise pollution. *

*The data have not been confirmed by the country representative.

3.9.2. Protection of water resources

The EU Water Framework Directive (WFD) aims to protect and improve the ecological status of water bodies in order to promote sustainable watershed use. This requires that 'good status' should be achieved for all surface and groundwater bodies by 2015 or 2027 at the latest. Consequently, NRAs must ensure that their water management practices meet the requirements of the WFD, thereby ensuring sustainable development of the railway network.

*The data have not been confirmed by the country representative.

3.10. Harmonization of timetables and an integrated public passenger transport system

Zagreb is the only city where they have set up the system of Integrated Public Passenger Transport (IPPT), which enables the purchase of a single ticket and travel by all means of public passenger transport. A joint ticket allows passengers to travel by tram, bus and use urban and suburban trains operated by Croatian Railways.

Croatia is also involved in an international project that promotes international conectivity and improvement of public transport in the region, CONNECT2CE.

Croatian Railways in connection with Croatian Railways are participating in a pilot project for the development of an integrated ticket.

3.11. Responsibility and managers of the railway infrastructure

The entire railway network is 100 % owned by the Republic of Croatia and managed by the company HŽ Infrastruktura Ltd.

The management of public railway infrastructure is carried out by the operator on the basis of a contract with the government.

[130] https://ec.europa.eu/environment/noise/directive_en.htm

4. Investments and maintenance costs

The national development strategy until 2030 and the national recovery and resilience plan 2021-2023 presents the investments in the railway infrastructure as a generator of recovery and development of railway infrastructure over the next 10 years.[131]

HZ is the biggest user of EU grants in the Croatian transport sector. It aims to revitalise the entire railway network according to EU standards by increasing the capacity of the railway lines, the speed of travel and safety.

Between 2020 and 2030 HZ plans to upgrade as many as 750 kilometres of railway lines. The projected speed of passenger trains is 160 kilometres an hour, while freight trains will be able to develop a speed of 120 km/h.

*The data have not been confirmed by the country representative.

4.1. Railway investments

N/A- Data about railway investments in the year 2020 are not available.

Between 2010 and 2019 HZ invested €935 million in the modernisation of railway lines, train stations and other infrastructural facilities. It plans to invest €1.8 billion in 2020-2024, of which 78.7% refers to projects co-financed from European structural and investment funds and the Connecting Europe Facility.[132]

*The data have not been confirmed by the country representative.

4.2. Investments in railway maintenance

N/A- Data about investments in the maintenance in the year 2020 are not available.

4.3. Objectives of transport policy and future development of the railway network

The Republic of Croatia is located on two corridors of the Core Transport Network – on the Mediterranean Corridor and on the Rhine-Danube Corridor. One of the key goals of HŽ Infrastructure is to modernise and renovate the rail network under its management, as well as the supporting infrastructure as much as possible. The focus is on modernising corridor routes with the financial support of the European Union (EU).

The ultimate goal of HŽ Infrastructure projects is to revitalise railway infrastructure in accordance with European standards, which will increase railway capacity, increase the speed of train operations to 160km/h, shorten journey times, and enhance the level of safety. The purpose of all investments is to improve and upgrade railway infrastructure in Croatia, aimed at achieving a greater railway sector traffic share by increasing the capacities and services on major transport corridors and regional railway infrastructure.

[131] https://www.croatiaweek.com/e4-5-billion-to-be-spent-on-croatian-railways-modernisation-until-2030/
[132] https://www.croatiaweek.com/e4-5-billion-to-be-spent-on-croatian-railways-modernisation-until-2030/

4.4. Main priorities in the development of railway infrastructure

Development projects on Croatian railway infrastructure are based on the Transport Development Strategy of the Republic of Croatia (2017 - 2030).[133]
The objectives pursued by the infrastructure development plans are:

- load capacity upgrade to (class) D4 (22.5 t) on RFC corridors,
- upgrade the maximum enabled speed on corridor lines, to 160 km/h,
- construction of a second track or an additional single-track line on single-track sections of lines on RFC corridors,
- improving safety at level crossings,
- modernization of signal safety devices with the aim to enable the traffic in both directions on double-track lines,
- modernization of signal safety devices with the aim to remote by control traffic.

Projects that are already in progress or will be implemented are:

- Reconstruction of existing and construction of a second track on the section Dugo Selo to Križevci[134]
- Reconstruction of existing and construction of a second track on the section: Hrvatski Leskovac – Karlovac
- Upgrade od Rijeka Brajdica Station and Braidica Container Terminal[135]
- Reconstruction of existing and construction of a second track on the section Križevci–Koprivnica–state border (Hungary)
- Upgrade and electrification of the Vinkovci – Vukovar railway line
- Modernisation and renewal of the line - works on reconstruction of stations and tracks, changeing of switches and rehabilitation of level crossing safety devices

In the 2019-2023 period, HŽ Infrastructure is planning to invest €1.26 billion, of which 59 per cent is related to the EU co-financed projects.

5. Railway infrastructure management, regular maintenance measures and network modernization

The management of public railway infrastructure is carried out by the operator on the basis of a contract with the government and includes in particular:

- preparation of a proposal for a maintenance plan for the existing public railway infrastructure;
- providing data and information for the preparation of expert bases for investments in public railway infrastructure;
- preparation of data and expert bases for new projects related to the implementation of the infrastructure manager's tasks;
- concluding legal transactions related to the management of public railway infrastructure and station buildings, in the case and to the extent that they do not serve or are not necessary for the implementation of their basic purpose.

6. Map of railway network

[133] https://mmpi.gov.hr/UserDocsImages/dokumenti/INFRASTRUKTURA/Infrastruktura%2010_19/Transport%20Development%20Strategy%20of%20the%20Republic%20of%20Croatia%202017-2030%2029-10_19.pdf

[134] https://www.globalrailwayreview.com/article/92883/investing-in-infrastructure-to-rejuvenate-croatias-railways/

[135] https://www.globalrailwayreview.com/news/79886/rijeka-port-croatia-rail-cargo-group/

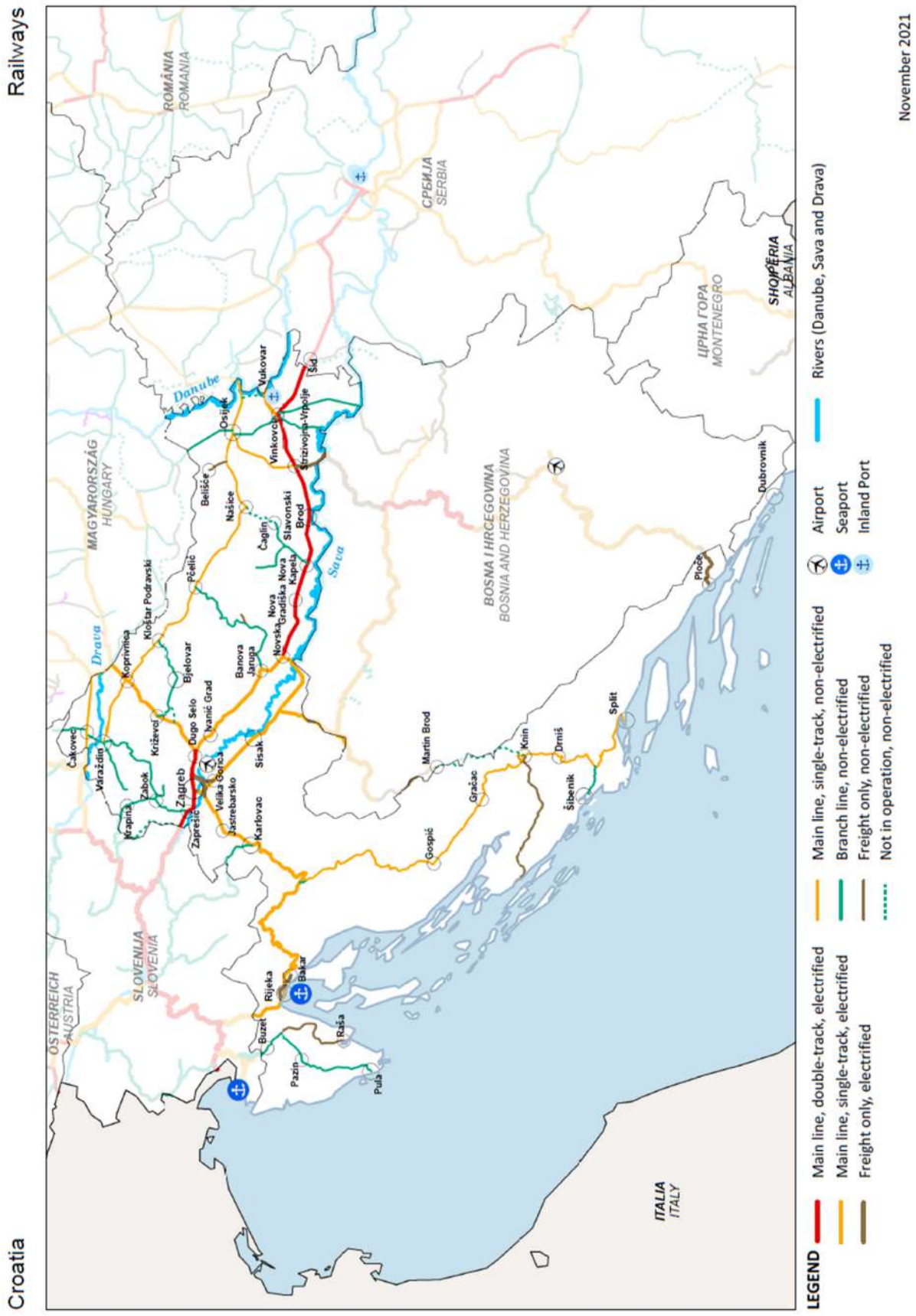

Figure 37: Map of railway network of Croatia.

4.2.5. Danube region railways: CZECH REPUBLIC

1. General data

- Inhabitants / 2020: **10.693.939**
- Membership in the EU: **01. 05. 2004**
- GDP / 2020 in EUR million: **213.661**
- GDP per capita / 2020 in EUR: **17.250**
- Capital city: **Prague**
- Land area (km²): **78.868**
- Km of railways per million inhabitants: **876,8**
- Km of railways per km² of the land area: **0,12**

2. Description of the railway network

- Length of railway lines (km): **9.377**
- Length of double-track railway lines (km): **1.981**
- Length of single-track railway lines (km): **7.337**
- Length of electrified railway lines (km): **3.217**
- Length of non-electrified railway lines (km): **6.159**
- Length of railway lines (km), axle load D4 (22,5 tons/axle): **3.656,50**
- Maximum length of freight train (m) on TEN-T network: **720**

3. Main features of railway network

3.1. General description of the transport characteristics of the railway network

The entire rail network operates to the track gauge of 1.435 millimetres.

Depending on traffic volume, economic importance, number of tracks and the connecting role of railway transport line, the railway network is divided into main and regional lines and single-track and double-track lines.

The main nodes, as we call the areas where several railway lines merge or come together, are in Prague, Brno, Ostrava.

There are two main electrification systems in the Czech Republic, 3 kV DC in the northern part, and 25 kV 50 Hz AC in the south. In next decades, the Czech Republic is planning to unify the main electrification system and use primarily 25 kV 50 Hz AC.

There are also:

- 24 km long historical line using 1.5 kV DC electrification system.
- short local line to Austria using 15 kV 16.7 Hz AC electrification system.

3.2. Traffic

3.2.1. Number of trains per day

- Average number of all trains per day on TEN-T - core network: **4084**
- Average number of all trains per day on TEN_T - comprehensive network: **1363**
- Average number of all trains per day on the rest of the network: N/A
- Average number of freight trains per day on TEN-T - core network: **3479**
- Average number of freight trains per day per TEN_T – comprehensive network: **1213**

- Average number of freight trains per day on the rest of the network: N/A

3.2.2. International railway corridors

The railway network of the Czech Republic is very important, from the European Union point of view, as several types of corridors and lines run along it, the most important of which are Trans-European Railway Network Corridors (TEN-T) and international rail corridors for competitive freight transport.

Part of the trans-European railway network (TEN-T)[136] (core and comprehensive network), are the following corridors in the Czech Republic:

- Baltic-Adriatic Corridor, which runs from the border with the Republic of Poland (near Bohumin) through Ostrava and Brno, to the border with the Republic of Austria (Břeclav).

- The Orient/East – Med Corridor, which runs from the border with the Republic of Germany, through Ústi nad Labem, Prague, Kolín, Pardubice and Brno to the borders with the Republic of Austria and Slovakia. Along the route, there are several high-speed projects planned (new lines Prague – Ústí nad Labem – Dresden and Prague – Brno – Břeclav).

- Rhine - Danube Corridor, which runs from the border with the Republic of Germany (near Cheb and Domažlice border crossings) through Plzeň, Prague, Pardubice, Přerov Ostrava and Český Těšín to the border with the Republic of Slovakia (near Jablunkov).

International freight rail corridors for competitive freight transport run through the Czech Republic in accordance with EU Regulation 913/2010 on European rail freight corridors (RFC):

- RFC 5[137] - Baltic – Adriatic; (Swinoujscie / Gdynia – Katowice **– Ostrava** / Žilina – Bratislava / Vienna / Klagenfurt – Udine – Venice / Trieste / Bologna / Ravenna and /Graz – Maribor – Ljubljana – Koper / Trieste).

- RFC 7[138] – Orient/East-Med; (The main route of the corridor is: **Prague** – Wien/Bratislava – Budapest – Bucharest – Constanta, Arad – Craiova – Vidin – Sofia – Kulata – Thessaloniki – Athens and Sofia - Plovdiv - Svilengrad and the alternative routes Videle – Ruse Razpredelitelna – Sindel Razpredelitelna – Karnobat-Nova Zagora – Simeonovgrad – Svilengrad, Nova Zagora – Stara Zagora-Dimitrovgrad – Simeonovgrad, Plovdiv-Stara Zagora – Karnobat - Burgas).

- RFC 8[139] - North Sea-Baltic[140] ; (runs through eight of EU Member States: starting in North Sea ports of Antwerpen, Rotterdam, Amsterdam, Wilhelmshaven, Bremerhaven and Hamburg spreading in central Germany through Aachen – Hannover/Hamburg – Magdeburg with a northern branch through Berlin to Poznan - Warsaw – Terespol (Poland-Belarus border)/Elk (Poland-Lithuania border) -Kaunas with broad gauge extension from Kaunas to Riga and further to Tallinn including Baltic Sea ports of Ventspils, Liepāja, Paldiski, Muuga and a southern branch to Falkenberg – Wroclaw – Katowice/Dresden – **Prague**).

[136] https://transport.ec.europa.eu/transport-themes/infrastructure-and-investment_en
[137] https://www.rfc5.eu/
[138] https://www.rfc7.eu
[139] https://rfc8.eu/corridor/geographical-outline/
[140] https://rfc8.eu/

- RFC 9[141]- Rhine - Danube;(Strasbourg–Mannheim–Frankfurt–Nürnberg–Wels; Strasbourg–Stuttgart–München–Salzburg–Wels–Wien–Bratislava–Budapest–Arad–Brașov/Craiova–București–Constanța; Čierna nad Tisou (Slovak/ Ukrainian border)–Košice–Žilina–**Horní Lideč**–**Prague**–München/Nürnberg)

3.3. Railway infrastructure equipment

3.3.1. Length of railways equipped with GSM-R system

On the railways network of the Czech Republic, the GSM-R system is installed on a 1901 km of lines, ensuring radio signal coverage on the entire railway network, including tunnel coverage.

3.3.2. Length of railways equipped with ETCS level 1

The European safety system for train control ETCS Level 1, version 2.3.0d, which is one of the systems for ensuring the interoperability of the railway signalling safety system is not installed on railway infrastructure in Czech Republic. It is planned to install ETCS Level 1 on part of regional lines.

3.3.3. Length of railways equipped with ETCS level 2

The European safety system for train control ETCS Level 2 system is installed on a 562 km of railways lines in the Czech Republic. Under construction it is currently approx. 180 km of lines.

3.4. Condition of railway infrastructure

The condition of the railway infrastructure of the Czech Republic is good / appropriate depending on the line category. The corridor lines have been modernized for speed up to 160 km/h. The main problem of the Czech Railway network is capacity constraints on some sections and at the main railway junctions.

3.5. Speed limits

3.5.1. The maximum speed limit for freight traffic (only for TEN-T corridors or main lines) is: **100 km/h.**

6.1.1. The maximum speed limit for passenger trains traffic (only for TEN-T corridors or main lines) is **160 km/h (possible increasing up to 200 km/h on some sections).**

3.5.2. Lengths of railway lines on the TEN-T network where the speed limit is less than 100 km/h (in km): **412,7**

3.6. Traffic safety[142]

- Number of accidents in 2018, 2019 and 2020

Table 19: Number of accidents

Total number of emergencies	2018	2019	2020

[141] https://rfc-rhine-danube.eu/

[142] http://www.dicr.cz/o-drazni-inspekci

Accidents	1171	1228	1147
Accidents at level crossing	170	181	146

There were 1147 accidents on Czechian railways in 2020, which is 81 accidents less than in 2019.

- Number of level crossings, of roads with railways in 2018, 2019, 2020

Table 20: Number of level crossings

	2018	**2019**	**2020**
Number of level-crossings on TEN-T network (core and comprehensive)	880	879	877
Number of all level crossings	7858	7825	7784

- Number of fatalities in accidents in 2018, 2019 and 2020

Table 21:Number of fatalities

	2018	**2019**	**2020**
Total number of fatalities (*only on level crossings)	33	43	39

Between 2018 and 2020, the number of fatalities decreased. The number of fatalities for year 2020 represents 3,6 fatalities per million inhabitants.

3.7. The main weaknesses of the railway network

3.7.1. Missing sections

Railway connection between the Václav Havel Airport and the centre of Prague.

3.7.2. Railway bottleneck

- Prague – Česká Třebová line
- Přerov – Ostrava line
- Prague railway junction
- Brno railway junction
- Brno – Přerov line
- Plzeň – Domažlice – Regensburg line

3.7.3. Level crossing

The previous chapter 3.6. shows the number of level crossings is declining, Table 20 shows that there are still 7784 level crossings in Czechia (on average 1 level crossing 0,83 km/), these level crossings need adequate protection to minimize the risk of collisions (for road and rail traffic) when crossing.

3.7.4. Inadequate environmental protection

In many sections, there is no noise barrier to protect the natural and living environment.

3.8. Connections with neighbouring countries

The boundaries of the railway, network operated by the public railway infrastructure manager, are the points of the national border on individual sections of lines.

Railway border crossings:

- With Germany:
  - Main route: Děčín, Cheb, Česká Kubice,
  - Regional route: Železná Ruda, Varnsdorf, Dolní Poustevna, Vejprty, Potůčky, Kraslice, Vojtanov/Plesná, Aš.

- With Austria:
  - Břeclav, Horní Dvořiště, České Velenice,
  - Regional route: Znojmo.

- With Slovakia:
  - Main routes: Břeclav/Lanžhot, Horní Lideč, Mosty u Jablunkova,
  - regional routes: Hodonín, Sudoměřice, Velká nad Veličkou, Brumov-Bylnice/Vlárský průsmyk.

- With Poland:
  - Main route: Petrovice, Bohumín, Lichkov,
  - regional routes: Mikulovice, Jindřichov, Český Těšín, Meziměstí, Královec, Harrachov, Černousy, Hrádek nad Nisou.

3.9. Environmental protection

The main directions of Správa železnic in environmental protection are the following[143]:

- Fulfil legal obligations applying to different environmental components
- Continuously eliminate past environmental impacts of the railway and reduce the environmental burden of existing sources of pollution, including such issues as the clean-up of leaked hazardous material in the environment and old noise burden
- Design future railway infrastructure projects in a way that their environmental impact is as small as possible.

Správa železnic pays due attention to all components of the environment to avoid threats and damage to the environment or public health caused by its operations. The innovative change of heating units in boiler houses (a source of air pollution), waste restrictions and more recycling, and implementation of noise insulation in the railway infrastructure as part of modernization are only some examples.

*The data have not been confirmed by the country`s representative.

3.9.1. Noise protection

[143] https://www.spravazeleznic.cz/web/en/our-railway/environmental-protection-at-sprava-zeleznic

On the existing railway lines, on the busiest sections, measures for the protection of the natural and residential environment against noise are gradually being implemented. Action plans for END (Directive 2002/49/EC) are forming a framework of noise abatement programmes: noise abatement compulsory for new railway lines, upgrading of existing lines with noise barriers, implementing use of LL brake blocks.[144]

3.9.2. Protection of water resources

The EU Water Framework Directive (WFD) aims to protect and improve the ecological status of water bodies in order to promote sustainable watershed use. This requires that 'good status' should be achieved for all surface and groundwater bodies by 2015 or 2027 at the latest. Consequently, NRAs must ensure that their water management practices meet the requirements of the WFD, thereby ensuring sustainable development of the railway network.

3.10. Harmonization of timetables and an integrated public passenger transport system[145]

Responsible authorities – Ministry of Transport (express services) and regional authorities (regional and suburban services) are working in close cooperation in order to harmonize timetables across the network. On most of long-distance and regional lines, a regular interval timetable has been introduced, which has positive effect on timetable stability and connections among various level of services.

With development of liberalization of railway transport and several undertakings operating the same line, there was a growing need for integrated tariff valid for all PSO operators. Commercial open-access operators can join the system too. The system called One Ticket was launched in 2020 and it has been gradually evolving with a future goal to encompass also regional bus services.

Regional authorities are entitled to organize regional public transport in the Czech Republic. The regional services are connected to the express services in the nodes. Timetables are harmonized among the regions and bus transport is in most cases connected to rail services. Regions have developed the integrated transport systems with various levels of integration.

Most of them, such as Prague Integrated Transport (Czech: Pražská integrovaná doprava, PID) or Integrated Public Transport System of the South Moravian Region (Czech: Integrovaný dopravní systém Jihomoravského kraje, IDS JMK) have introduced a single fare and tickets together with unified regulations, route numbering plan, some parts of the information system, transfer facilities improving mixed-mode commuting, and also unified service subsidy system. is an integrated public transport system including metro, tramways, railways, city bus and coach services, river boat services, the Petřín funicular and park and ride services. PID operates in Prague and in most of the Central Bohemian Region.

Integration represents introducing a single fare and tickets together with unified regulations, route numbering plan, some parts of the information system, transfer facilities improving mixed-mode commuting, and also unified service subsidy system.

3.11. Responsibility and managers of the railway infrastructure

[144]https://www.europarl.europa.eu/RegData/etudes/etudes/join/2012/474533/IPOL-TRAN_ET(2012)474533_EN.pdf

[145]https://www.dataplan.info/img_upload/7bdb1584e3b8a53d337518d988763f8d/b13-00298_ministerstvo_dopravy_2014_2020_eng-05_1.pdf

Správa železnic is a state-owned organisation that ensures the operability and development of the Czech railway network, including the negotiation of public service obligations and the supervision of the use and operation of the railway network, especially capacity allocation. Established in 2003 through transformation of the original state organisation České dráhy, it focuses solely on infrastructure management whereas the joint-stock company České dráhy, a.s. provides transport services.

4. Investments and maintenance costs

Správa železnic is responsible for the construction, renovation and maintenance of public railway infrastructure. Ministry of Transport is responsible for financing and supervising. Projects are financed from the budget of the Czech Republic or with EU co-financing (European Cohesion Fund, European Regional Development Fund and Connecting Europe Facility).

4.1. Railway investments

In 2020, **1.400 mio EUR** (35 mld CZK) were invested in new constructions and renovations of the railway network in Czechia.

Investment grants for construction and modernisation primarily include funds from the Operational Programme Transport ("OPT2"), the CEF infrastructure fund, funds from the European Investment Bank ("EIB") loan provided through the MF, and grants from SFTI. SFTI ensures the payment of European subsidies and at the same time, it partly participates in co-financing. In 2020, funds of TCZK 15 469 065 were drawn from SFTI from national sources, including sources to cover national shares of European investment projects. In 2020, funds amounting to TCZK 9 113 382 were provided from OPT2, TCZK 4 472 881 from CEF, and a loan of TCZK 582 042 was provided by the EIB.[146]

4.2. Investments in railway maintenance

In 2020, **560,4 mio EUR (**14,4 mld CZK) were invested in the maintenance of the railway network in Czechia. [147]

4.3. Objectives of transport policy and future development of the railway network

The capacity of the network is the main obstacle for further development of railway transport in the Czech Republic. Main railway lines are overloaded with mix of passenger transport (express, regional and suburban) and freight transport, especially around main urban nodes. The Czech Republic is also missing second quality connection towards Germany – link to Bavaria.

The aim of the Czech Republic is to build new railways to the most congested directions, such as Prague-Dresden, Prague-Brno-Vienna/Budapest, Brno-Ostrava-Katowice, so called Rapid Services Programme. It will create a high-speed network in the Czech Republic with competitive travel times in comparison to the other modes of transport. On top of that, conventional network would be able to accommodate more freight transport.

4.4. Main priorities in the development of railway infrastructure

[146] 4cf14d13-e766-4c6b-9dbf-5b181a36b10c (spravazeleznic.cz)
[147] 4cf14d13-e766-4c6b-9dbf-5b181a36b10c (spravazeleznic.cz)

Development projects on Czech railway infrastructure are based on the Transport Policy of the Czech Republic for 2021–2027 with an outlook to 2050 and Transport Sector Strategies.
The objectives pursued by the infrastructure development plans are:

- upgrade the maximum enabled speed on corridor lines, to 160 km/h or 200 km/h
- development of the high-speed network, according to the Rapid Services Programme
- improving safety at level crossings and the rail transport in general by deployment of the ETCS
- capacity improvements for freight transport (increase of capacity of the line Velký Osek – Hradec Králové – Choceň – Ústí nad Orlicí)
- Modernisation of the Plzeň – Domažlice – DE border railway line.
- Modernisation of selected sections of the railway line Prague-Česká Třebová.
- Modernisation of the Prague – České Budějovice railway line
- Deployment of ERTMS/ETCS onboard components compliant with Baseline 3 in ČESKÉ DRÁHY, a.s. vehicles on the Core Network Corridors.
- Upgrade of the Praha – Lysá nad Labem railway line.
- Removing selected bottlenecks on pre-identified sections of the Core Network Corridors.

5. Railway infrastructure management, regular maintenance measures and network modernization

The management of railway infrastructure is regulated by the Railway Systems Act.

The management of public railway infrastructure is carried out by the operator on the basis of a contract with the government and includes in particular:

- preparation of a proposal for a maintenance plan for the existing public railway infrastructure;
- providing data and information for the preparation of expert bases for investments in public railway infrastructure;
- preparation of data and expert bases for new projects related to the implementation of the infrastructure manager's tasks;
- concluding legal transactions related to the management of public railway infrastructure and station buildings, in the case and to the extent that they do not serve or are not necessary for the implementation of their basic purpose.

6. Map of railway network

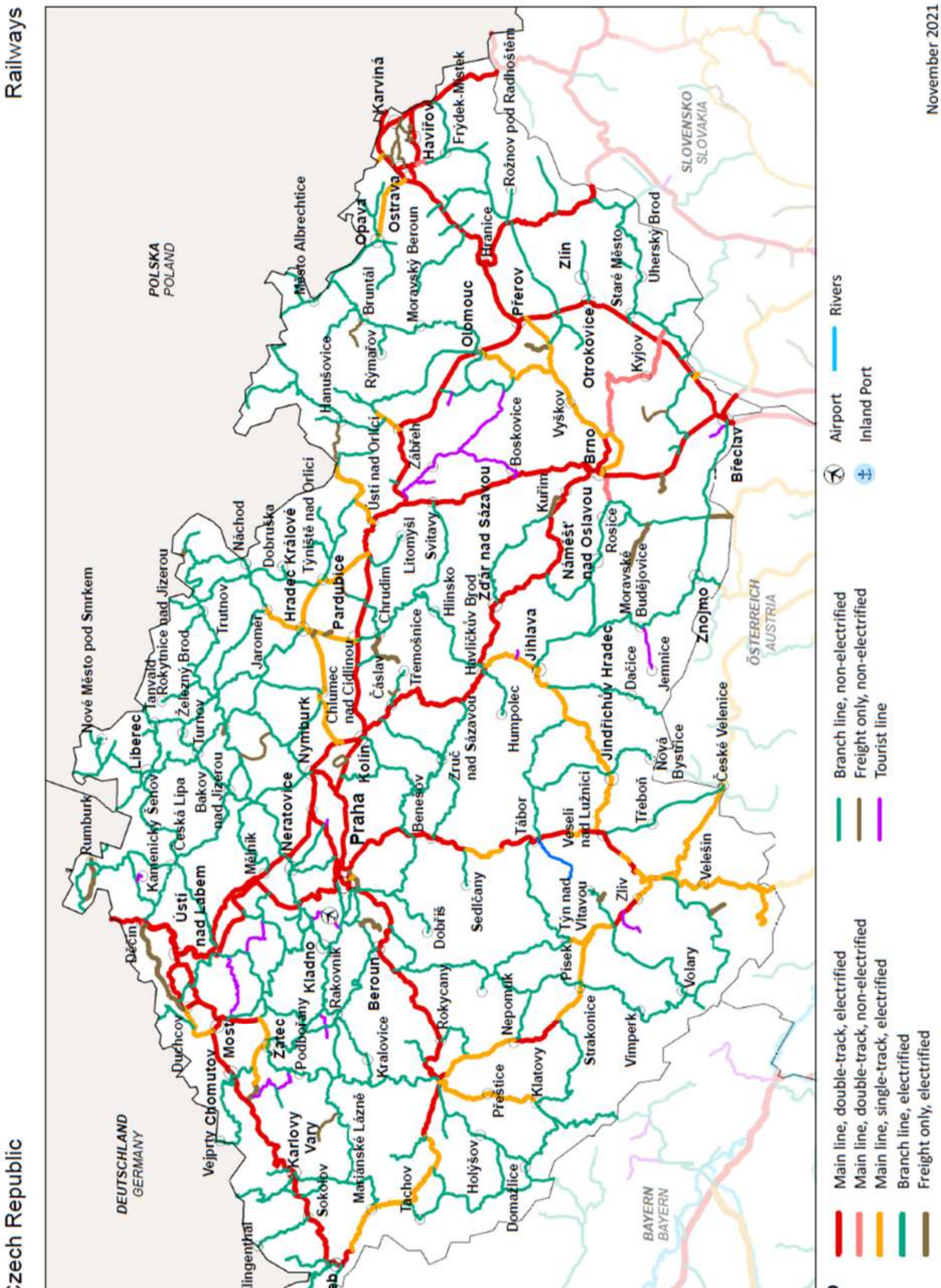

Figure 38: Map of railway network of Czechia

4.2.6. Danube region railways: GERMANY – BADEN WUERTTEMBERG

1. General data

- Inhabitants / 2020: **11.100.394***
- Membership in the EU: **jan. 1958**
- GDP / 2020 in EUR million: **500.790**[148]
- GDP per capita / 2020 in EUR: **45.108**[149]
- Capital city: **Stuttgart**
- Land area (km²): **35.748**
- Km of railways per million inhabitants: **389,72**
- Km of railways per km² of the land area: **0,12**

*Year of data: 2019

2. Description of the railway network[150]

- Length of railway lines (km): **4.326***
- Length of double-track railway lines (km): **1.936****
- Length of single-track railway lines (km): **2.378****
- Length of electrified railway lines (km): **2.717****
- Length of non-electrified railway lines (km): **1.597****
- Length of railway lines (km), axle load D4 (22,5 tons/axle): **1.921**
- Maximum length of freight train (m) on TEN-T network: N/A.

***** Year of data: 2019
****** Year of data: 2015

3. Main features of railway network

3.1. General description of the transport characteristics of the railway network

The entire rail network operates to the track gauge of 1.435 millimetres.

Depending on traffic volume, economic importance, number of tracks and the connecting role of railway transport line, the railway network is divided into main and regional lines and single-track and double-track lines.

The main nodes, as we call the areas of several railway stations. According to the needs of railway transport system and traffic regulation, are in Stuttgart, Mannheim, Ulm.

The nodes of the main lines are also in Freiburg, Offenburg, Bretten, Karlsruhe, Heidelberg, Heilbronn.

Main electrified railway lines on the Baden-Wuerttemberg railway network are equipped with a 15 kV 16 2/3 Hz.

Other electrification systems are also emerging at light rail systems in Stuttgart, Karlsruhe, Mannheim, Heidelberg, Heilbronn, Ulm. These networks are equipped with a 750 V DC.

[148] Bruttoinlandsprodukt und Bruttowertschöpfung in Baden-Württemberg nach Wirtschaftsbereichen in jeweiligen Preisen (statistik-bw.de)
[149] Bruttoinlandsprodukt und Bruttowertschöpfung in Baden-Württemberg nach Wirtschaftsbereichen in jeweiligen Preisen (statistik-bw.de)
[150] Federal Statistical Office (Destatis)

3.2. Traffic

3.2.1. Number of trains

Average number of trains per day are not available.

3.2.2. International railway corridors

Part of the trans-European railway network (TEN-T)151 (core and comprehensive network), are the following corridors in Baden Wuerttemberg:

- Rhine-Alpine-Corridor (Running from the Netherlands to Genova, Italy; in Baden-Wuerttemberg from Heidelberg/Mannheim to the Swiss-German border in Basel)
- Rhine-Danube-Corridor (Running in Baden-Württemberg from Straßburg/Offenburg/Karlsruhe to Ulm)

International freight rail corridors for competitive freight transport run through Baden Wuerttemberg in accordance with EU Regulation 913/2010 on European rail freight corridors (RFC):

- RFC 1[152] - Rhine – Alpine Corridor; (Rotterdam, Amsterdam, Antwerp, Ghent, Liège, Duisburg, Cologne, Frankfurt, **Mannheim**, Basel, Zurich, Milan and Genoa).
- RFC 9[153] - Rhine - Danube; (Strasbourg–Mannheim–Frankfurt–Nürnberg–Wels; Strasbourg–**Stuttgar**t–**München**–Salzburg–Wels–Wien–Bratislava–Budapest–Arad–Brașov/Craiova–București–Constanța; Čierna nad Tisou (Slovak/ Ukrainian border)–Košice–Žilina–Horní Lideč–Prague–München/Nürnberg)

3.3. Railway infrastructure equipment

With the "Digital Rail Germany" program, Deutsche Bahn AG intends to equip the entire German rail network with new control and safety technology (ETCS - European Train Control System) and digital interlockings (DSTW). The aim is to increase the capacity of the rail network by up to 20 percent. This would improve operational quality and punctuality on the overall network and enable additional traffic.

The **Stuttgart node,** in the centre of Baden-Wuerttemberg, is included in this program as a pilot project. A modern traffic management system (TMS), which is expected to be available by the end of 2030, will further improve operational quality by optimally guiding trains depending on the operating situation.

3.3.1. Length of railways equipped with GSM-R system

On the Baden Wuerttemberg Railways network, the GSM-R system is installed on 1.921 km of lines, ensuring radio signal coverage, including tunnel coverage. The radio signal also covers border areas with neighbouring countries.

3.3.2. Length of railways equipped with ETCS level 1

[151] nodes
[152] https://www.corridor-rhine-alpine.eu/home.html
[153] https://rfc-rhine-danube.eu/

The European safety system for train control ETCS Level 1, version 2.3.0d, which is one of the systems for ensuring the interoperability of the railway signalling safety system is not installed on railway infrastructure in Baden Wuerttemberg.

3.3.3. Length of railways equipped with ETCS level 2

At this moment, the lines are not equipped with the ETCS level 2 system. Plans for the future upgrade are the "Digitaler Bahnknoten Stuttgart", the implementation of ETCS Level 2 is planned.

3.4. Condition of railway infrastructure

The condition of the infrastructure on Baden Wuerttemberg railways:

In general, the rail infrastructure in BW is in a good condition.

3.5. Speed limits

3.5.1. The maximum speed limit for freight traffic (only for TEN-T corridors or main lines) is **120 km/h.**

3.5.2. The maximum speed limit for passenger trains traffic (only for TEN-T corridors or main lines) is **280 km/h**.

3.5.3. Lengths of railway lines on the TEN-T network where the speed limit is less than 100 km/h (in km): In general, only connecting curves and feeders to Gv systems are driven at lower speeds.[154]

3.6. Traffic safety

The Federal Authority for Railway Accident Investigation (in German: Bundesstelle für Eisenbahnunfalluntersuchung, BEU) is an agency of the Government of Germany charged with investigating rail accidents.

- Number of accidents in 2018, 2019 and 2020

Table 22: Number of accidents[155]*

Total number of emergencies	***2018***	***2019***	***2020***
Accidents	*294*	*293*	*232*
Accidents at level crossing	*27*	*24*	*27*

There were 232 accidents on Baden Wuerttemberg railways in 2020, which is 61 accidents less than in 2019.

- Number of level crossings, of roads with railways in 2018, 2019, 2020.

Table 23: Number of level crossings[156]

	2018	**2019**	**2020**

[154] DB Netz

[155] Accidents on non-federal railroads are not included. Source: BEU.

[156] Only Non-federal railroads

Number of level-crossings on TEN-T network (core and comprehensive)	N/A	N/A	N/A
Number of all level crossings	1506	1512	1512

*N/A – not available data

- Number of fatalities in accidents in 2018, 2019 and 2020

Table 24: Number of fatalities in accidents

	2018	***2019***	***2020***
Total number of fatalities	*23*	*21*	*30*

Between 2019 and 2020, the number of fatalities rose. The number of fatalities for year 2020 represents 2,7 fatalities per million inhabitants.

3.7. The main weaknesses of the railway network

3.7.1. Missing sections

There are no important missing railway sections in Baden Wuerttemberg. However, there are several railway infrastructure elements that have been out of use for years. The state of Baden-Württemberg has set itself the goal of doubling local public transport by 2030. An important contribution to this is the reactivation of disused railway lines. Successful reactivations in recent years show that some rail routes are much more attractive than previously assumed. A total of 42 railway lines in Baden-Württemberg were recentöy examined with regard to their passenger potential. A relevant passenger potential was certified on more than 30 routes. Baden-Wuerttemberg is now pursuing the reactivation of these lines with attractive funding programmes.

3.7.2. Railway bottleneck

Baden-Württemberg's ambition is to become a pioneer and trailblazer for sustainable and citizen-oriented mobility. At present, the most heavily used rail axes in Baden-Württemberg are already electrified. This is around 74 percent of the train kilometres in regional rail transport. There is therefore still great potential to electrify the share of electrified rail lines and thus to provide additional transport services in regional rail transport.

3.7.3. Level crossing

The previous chapter 3.6., The number of level crossings is declining, which means that individual countries are investing in the construction of off-level crossings.

Table 6 shows that there are still 1512 level crossings in Baden Wuerttemberg, on average level crossing: 0,35 km/), these level crossings need adequate protection to minimize the risk of collisions (for road and rail traffic) when crossing.

3.7.4. Inadequate environmental protection

According to EEA data[157], Germany is one of the states in Europe, that are mostly affected by railway noise according to the share of their population that is affected by railway noise with more than

[157] https://www.europarl.europa.eu/RegData/etudes/etudes/join/2012/474533/IPOL-TRAN_ET(2012)474533_EN.pdf

55 dB (A) LDEN, for Germany is this share 4,3 %. On the busiest sections measures for the protection of the natural and residential environment against noise are gradually being implemented.

3.8. Connections with neighbouring countries and federal state

The boundaries of the railway, network operated by the public railway infrastructure manager, are the points of the national border on individual sections of lines.

Railway border crossings:

- With France:
    - Main routes: Kehl / Straßburg
    - regional route: Müllheim - Mulhouse

- With the Swiss Confederation:
    - Main route: Waldshut, Konstanz, Weil am Rhein / Basel.

- With other German federal states:
- Rheinland-Pfalz (Karlsruhe, Mannheim)
- Hessen (Heidelberg)
- Bavaria (Lauda-Koenigshofen, Crailsheim, Bopfingen, Ulm, Wangen im Allgaeu)

3.9. Environmental protection

When providing railway transport services in the territory of the Federal state of Baden Wuerttemberg, carriers must comply with all the rules necessary to prevent and reduce the burden on the environment.

3.9.1. Noise protection

The Environmental Noise Directive (Directive 2002/49/ EC)[158] sets the general framework for environmental noise management.

Noise abatement is and remains a central issue for the state government with regard to environmentally compatible, sustainable mobility. The goal is to achieve an area-wide limitation of noise pollution by the various modes of transport to a tolerable level.
The Ministry of Transport is therefore working intensively on measures and projects to reduce noise.

3.9.2. Protection of water resources

The EU Water Framework Directive (WFD) aims to protect and improve the ecological status of water bodies in order to promote sustainable watershed use. This requires that 'good status' should be achieved for all surface and groundwater bodies by 2015 or 2027 at the latest. Consequently, NRAs must ensure that their water management practices meet the requirements of the WFD, thereby ensuring sustainable development of the railway network.

3.10. Harmonization of timetables and an integrated public passenger transport system

[158] https://ec.europa.eu/environment/noise/directive_en.htm

In 2018, the state-wide *Baden-Württemberg tariff* (“bwtarif” for short) was launched. With this tariff, the use of public transport in Baden-Württemberg is simplified and made more attractive. The *bwtarif* applies to almost all journeys by public transport in Baden-Württemberg that go beyond the boundaries of a transport association. Passengers can use all local and regional trains (including commuter trains), regional buses, and city, streetcar as well as bus lines at the starting point and destination of their trip ("integrated connecting mobility"). There is no longer any need to purchase separate tickets for local public transport at the destination at the start and end of the journey. Since the introduction of the *bwtarif*, every trip in Baden-Württemberg has been based on the simple principle of the simple principle of "one destination, one ticket": either within one of the 22 transport consortium tickets - or with a bwtarif ticket for journeys with a ticket from the bwtarif.

3.11. Responsibility and managers of the railway infrastructure

The main part of the railway network in Baden-Wuerttemberg is owned and managed by *DB Netz AG*, which is a wholly owned subsidiary of *Deutsche Bahn AG* and, as a railroad infrastructure company, operates around 87,5 % of the German rail network.

4. Investments and maintenance costs

The Ministry of Transport, together with the NVBW, a public regional transport agency, is responsible for the construction, renovation and maintenance of public railway infrastructure. Projects are financed from the budget of the federal state budget as well as Bundesmittel.

For the use of public railway infrastructure, carriers are obliged to pay a usage fee. The usage fee is intended to cover part of the maintenance costs, expressed by the public railway infrastructure manager.

4.1. Railway investments

In 2020, 65,5 million EUR were invested in new constructions and renovations of the railway network in Baden-Württemberg.

The state of Baden-Württemberg currently orders and finances regional transport services of approx. 65.5 million train-kilometers per year.

4.2. Investments in railway maintenance

In 2020, N/A* EUR were invested in the maintenance of the railway network in Baden-Württemberg.

*The number of total investments in maintenance is not available.

4.3. Objectives of transport policy and future development of the railway network

Baden-Württemberg wants to become the number one rail state in Germany. The state government is therefore continuing to systematically drive forward the expansion of local transportation and has now approved attractive funding rates for major rail projects. This means that more projects can be tackled than before.

In the coming years, the priority areas of transport infrastructure policy are the modernization, reconstruction and upgrading of railway lines. One of the basic goals will be the increase of freight and passenger traffic from roads to railways.

4.4. Main priorities in the development of railway infrastructure

Main goals and priorities for Baden Wuerttemberg railway infrastructure are:

- Construction of a rapid line between Wendlingen and Ulm. Construction works began in 2010 and their finalisation was delayed with commissioning estimated for 2024.

Other projects that are already in progress or will be implemented are:

- Neckar Alb Tram Train Network. The value of this project amounts to 2.1 billion Euros.
- Digital rail junction of Stuttgart, which means the Roll-out of ETCS and ATO. The value amounts to 130 Million Euros.
- Several current studies investigating the electrification or reactivation of railway lines are running.

5. Railway infrastructure management, regular maintenance measures and network modernization

The management of public railway infrastructure is carried out by the operator on the basis of a contract with the government and includes in particular:

- preparation of a proposal for a maintenance plan for the existing public railway infrastructure;
- providing data and information for the preparation of expert bases for investments in public railway infrastructure;
- preparation of data and expert bases for new projects related to the implementation of the infrastructure manager's tasks;
- Concluding legal transactions related to the management of public railway infrastructure and station buildings, in the case and to the extent that they do not serve or are not necessary for the implementation of their basic purpose.

6. Map of railway network

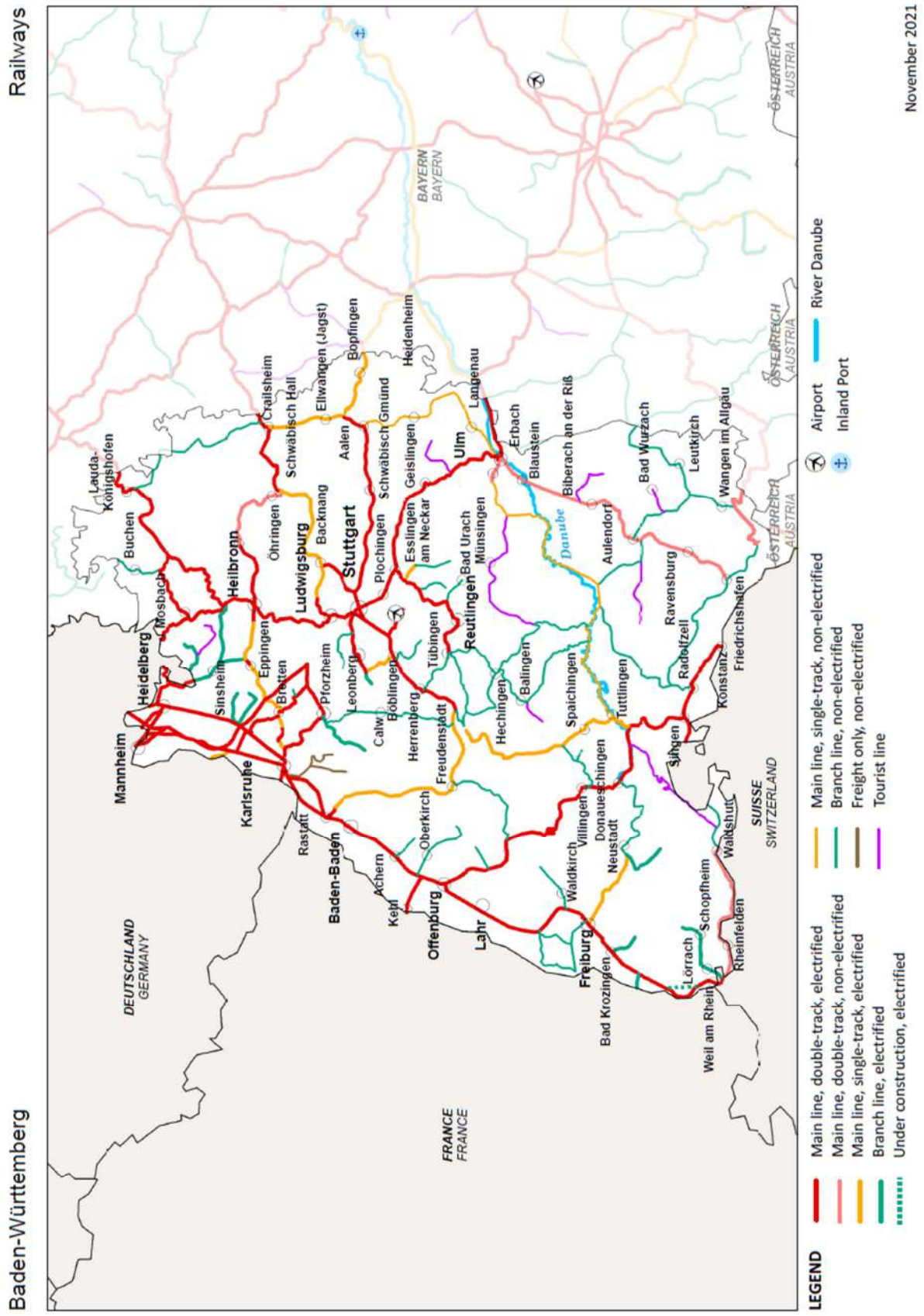

Figure 39: Map of railway network of Baden Wuerttemberg.

4.2.7. Danube region railways: GERMANY – BAVARIA

1. General data

- Inhabitants / 2020: **13.140.138**
- Membership in the EU: **jan. 1958**
- GDP / 2020 in EUR million: **610.220**
- GDP per capita / 2020 in EUR: **48.000 (2019)**
- Capital city: **Munich**
- Land area (km²): **70.542**
- Km of railways per million inhabitants: **527,54**
- Km of railways per km² of the land area: **0,10**

2. Description of the railway network[159]

- Length of railway lines (km): **6.932**
- Length of double-track railway lines (km): **2.987**
- Length of single-track railway lines (km): **3.440**
- Length of electrified railway lines (km): **3.567**
- Length of non-electrified railway lines (km): **2.466***
- Length of railway lines (km), axle load D4 (22,5 tons/axle): **N/A**
- Maximum length of freight train (m) on TEN-T network: **N/A**.

***** No current data available for non-federally owned railways.

3. Main features of railway network

3.1. General description of the transport characteristics of the railway network

The entire rail network operates to the track gauge of 1.435 millimetres.

Depending on traffic volume, economic importance, number of tracks and the connecting role of railway transport line, the railway network is divided into main and regional lines and single-track and double-track lines.

The main nodes as we call the areas where several railway lines merge or come together, are in München, Nürnberg, Würzburg.

The nodes of the main lines are also in Ingolstadt, Augsburg, Regensburg, Fürth, Donauwoerth.

Main electrified railway lines on Bavaria railway network are equipped with a 15 kV and 16 2/3 Hz system.

3.2. Traffic

3.2.1. Number of trains per day:

Average number of freight trains per day are not available.

3.2.2. International railway corridors

Part of the trans-European railway network (TEN-T)[160] (core and comprehensive network), are the following corridors in Bavaria:

- Scandinavian – Mediterranean, (Running from Finland and Sweden trough Central and Southern Germany to the southern Italian ports).

[159] Eisenbahnverkehr - Betriebsdaten des Schienenverkehrs - Fachserie 8 Reihe 2.1 - 2019 (destatis.de)
[160] https://transport.ec.europa.eu/transport-themes/infrastructure-and-investment_en

- Rhine – Danube (Running in Bavaria trough Nürnberg and München to the border with Austria).

International freight rail corridors for competitive freight transport run through Bavaria in accordance with EU Regulation 913/2010 on European rail freight corridors (RFC)[161]:

1. RFC 3: Scandinavian – Mediterranean;(Stockholm/Oslo/Trelleborg-Malmö-Copenhagen-Hamburg - **München** - Innsbruck - Verona-La Spezia /Livorno Ancona /Taranto /Augusta / Palermo)
2. RFC 9[162]: Rhine – Danube; (Strasbourg–Mannheim–Frankfurt–**Nürnberg**–Wels; Strasbourg–Stuttgart–**München**–Salzburg–Wels–Wien–Bratislava–Budapest–Arad–Brașov/Craiova–București–Constanța; Čierna nad Tisou (Slovak/ Ukrainian border)–Košice–Žilina–Horní Lideč–Prague–**München/Nürnberg**)

3.3. Railway infrastructure equipment

With the "Digital Rail Germany" program, Deutsche Bahn AG intends to equip the entire German rail network with new control and safety technology (ETCS - European Train Control System) and digital interlockings (DSTW). The aim is to increase the capacity of the rail network by up to 20 percent. This would improve operational quality and punctuality on the overall network and enable additional traffic.

3.3.1. Length of railways equipped with GSM-R system

On the German- Bavaria Railways network, the GSM-R system is installed on 5.289 km of lines, ensuring radio signal coverage, including tunnel coverage. The radio signal also covers border areas with neighbouring countries.

3.3.2. Length of railways equipped with ETCS level 1

The European safety system for train control ETCS Level 1, version 2.3.0d, which is one of the systems for ensuring the interoperability of the railway signalling safety system is not installed on railway infrastructure in Bavaria.

3.3.3. Length of railways equipped with ETCS level 2

The European safety system for train control ETCS Level 2 is installed on 50 km railway infrastructure in Bavaria (section Breitengüßbach – Bavarian border to Thuringia). According to the strategy of Digitale Schiene Deutschland ETCS Level 2 will be installed on the entire infrastructure in Bavaria.

In the "starter package" of DSD are located in Bavaria: the TEN Scandinavia-Mediterranean corridor (Sections Nuremberg – Augsburg – Munich and Munich – Rosenheim – Kiefersfelden / Freilassing) the TEN-Corridor Scan-Med in the area of Munich, Augsburg and Nuremberg ERTMS is planned within. In the for entry into the digital world Rail Germany

3.4. Condition of railway infrastructure

In general, the rail infrastructure in Bavaria is in a good condition.

3.5. Speed limits

[161] https://rne.eu/rail-freight-corridors/rail-freight-corridors-general-information/
[162] https://rfc-rhine-danube.eu/

3.5.1. The maximum speed limit for freight traffic (only for TEN-T corridors or main lines) is **100 km/h.**

3.5.2. The maximum speed limit for passenger trains traffic (only for TEN-T corridors or main lines) is **300 km/h.**

3.5.3. Lengths of railway lines on the TEN-T network where the speed limit is less than 100 km/h (in km): In general, only connecting curves and feeders to Gv systems are driven at lower speeds.[163] There is no railway line on the TEN-T network in Bavaria with speed limit less than 100 km/h.

3.6. Traffic safety

The Federal Authority for Railway Accident Investigation (German: Bundesstelle für Eisenbahnunfalluntersuchung, BEU) is an agency of the Government of Germany charged with investigating rail accidents.

- Number of accidents in 2018, 2019 and 2020

*Table 25: Number of accidents**

Total number of emergencies	**2018**	**2019**	**2020**
Accidents	N/A	N/A	N/A
Accidents at level crossing	N/A	N/A	N/A

*N/A – not available data

- Number of level crossings, of roads with railways in 2018, 2019, 2020.

Table 26: Number of level crossings

	2018	**2019**	**2020**
Number of level-crossings on TEN-T network (core and comprehensive)	248	251	256
Number of all level crossings	2688	2684	2708

- Number of fatalities in accidents in 2018, 2019 and 2020

Table 27: Number of fatalities in accidents

Total number of emergencies	**2018**	**2019**	**2020**
Serious accidents (fatalities)	N/A	N/A	N/A

*N/A – not available data

3.7. The main weaknesses of the railway network

3.7.1. Missing sections

[163] DB Netz

There are no missing railway sections in Bavaria. Nevertheless, a few more new construction routes are planned to further improve the existing infrastructure.

3.7.2. Railway bottleneck

- the need to upgrade the capacity on major (international) lines: nodes improvements, ensuring adequate train length (740 m), ERMTS implementation and strenghtening.
- Electrification of non electrified track.

3.7.3. Level crossing

The previous chapter 3.6. shows that there are still 2708 level crossings in Bavaria (on average level crossing 0,39 km/), these level crossings need adequate protection to minimize the risk of collisions (for road and rail traffic) when crossing.

3.7.4. Inadequate environmental protection

According to EEA[164] data, Germany is one of the states in Europe, that are mostly affected by railway noise according to the share of their population that is affected by railway noise with more than 55 dB(A) LDEN, for Germany is this share 4,3 %. On the busiest sections measures for the protection of the natural and residential environment against noise are gradually being implemented.

3.8. Connections with neighbouring countries and federal state

The boundaries of the railway network, operated by the public railway infrastructure manager, are the points of the national border on individual sections of lines.

Railway border crossings:

- With the Czech Republic:
  - Regional routes: Furth im Wald, Schirnding, Selb-Ploessberg.
- With Austria:
  - Main route: Garmisch-Partenkirchen, Oberaudorf, Freilassing, Passau, Lindau,
  - regional route: Burghausen.
- With other German federal states:
  - Thueringen,
  - Hessen,
  - Baden-Wuerttemberg.

3.9. Environmental protection

When providing railway transport services in the territory of the Federal state of Bavaria carriers must comply with all the rules necessary to prevent and reduce the burden on the environment.

3.9.1. Noise protection

[164]https://www.europarl.europa.eu/RegData/etudes/etudes/join/2012/474533/IPOL-TRAN_ET(2012)474533_EN.pdf

The Environmental Noise Directive (Directive 2002/49/ EC)[165] sets the general framework for environmental noise management.

3.9.2. Protection of water resources

The EU Water Framework Directive (WFD) aims to protect and improve the ecological status of water bodies in order to promote sustainable watershed use. This requires that 'good status' should be achieved for all surface and groundwater bodies by 2015 or 2027 at the latest. Consequently, NRAs must ensure that their water management practices meet the requirements of the WFD, thereby ensuring sustainable development of the railway network.

3.10. Harmonization of timetables and an integrated public passenger transport system

State-wide “Bayern-Takt”: local trains run almost everywhere in the Free State at least once an hour. There are short transfer times at the junction stations.

Depending on the time of day, Bavaria offers the Bayern-Ticket (during day time) and the Bayern-Ticket Nacht for 1st or 2nd class. With all tickets, four passengers can be taken along (up to 3 children aged between 6 years and 14 years inclusive free of charge). Additional children over six years of age count as a full person. With the Bayern-Ticket it is possible to travel for as many journeys as you like on all local trains of all railway companies in Bavaria, on all interconnected means of transport and almost all scheduled buses in Bavaria as well as on the local trains of the Austrian Federal Railways (ÖBB) on the route Freilassing - Salzburg Hbf. In addition, the Bayern-Tickets are valid as far as Salzburg Hbf, Kufstein, Ulm Hbf, Crailsheim, Lauda, Sonneberg (Thür.) Hbf as well as on the sections Pfronten-Steinach - Griesen (Oberbay.), Memmingen - Kißlegg - Hergatz and Ulm Hbf - Thalfingen (b. Ulm) as well as on the Bayerische Zugspitzbahn between Garmisch-Partenkirchen and Grainau.

The Free State of Bavaria is planning to introduce a state tariff and a Bavaria-wide electronic ticket based on the principle of "one click - one ticket".

In the future, it will be possible to purchase and pay for an electronic ticket for supraregional, interconnected journeys using an app. Passengers will then be able to view a connection throughout Bavaria and purchase the appropriate ticket for the journey in the same app. Where several tickets were previously necessary for cross-network journeys, in future only one electronic ticket will be sufficient.

3.11. Responsibility and managers of the railway infrastructure

The railway network in Bavaria is owned and managed by DB Netze. In addition, there are non-federally owned railways that are held by private investors or by the public sector (e.g. municipalities).

The management of public railway infrastructure is carried out by the operator on the basis of a contract with the government.

4. Investments and maintenance costs

The DB Netz AG is responsible for the construction, renovation and maintenance of public railway infrastructure. Projects are mostly financed from the budget of the federal or state government.

[165] https://ec.europa.eu/environment/noise/directive_en.htm

4.1. Railway investments

In 2020, **743 Mio EUR** were invested in new constructions and renovations of the railway network in Bavaria, from the budget of the LuFV contract. Approximately 64 Mio Euro of the 743 Mio Euro were invested from the budget of LuFV 8.7 and therefore directly allocated by the federal state of Bavaria. (Without investments of "DB Station und Service" (e.g. construction of new stations) and "DB Energie").

4.2. Investments in railway maintenance

In 2020 **309 Mio EUR** were invested in the maintenance of the railway network in Bayern, divided into the following categories:

- 58 Mio. € for preventive projects
- 142 Mio. € for individual short-term projects
- 78 Mio. € for inspections
- 31 Mio. € for the elimination of failures.

The sources were own funds of the DB Netz AG.

4.3. Objectives of transport policy and future development of the railway network

To support the modal shift to rail DB invests in a **great number of infrastructure projects** until 2040,

- Extension of capacity on main line sections with international impact, essential development within the nodes and the improvement of our 740 m network is beside strengthening of ERTMS our focus
- In line with the realization of the infrastructure projects the reduction of traveltime will come along, which is focus to realize the so called "Deutschlandtakt" und the goals of the "Starke Schiene"
- Until 2030 the investment volume in rail infrastructure in Germany will be approximately EUR 170 bn. This investment level or even a higher one is necessary to reach the goals also in the next decade.
- TEN-T Corridor Rhine-Danube :
- For rail, the Corridor Rhine – Danube runs in the west-east-direction from France via Germany, Austria, Czech Republic, Slovakia and Hungary to Romania.
- In Germany, the Corridor Rhine – Danube, starting from Strasbourg, extends for a length of about 1,860 km and is divided into a northern and a southern branche.

- ERTMS: The consideration of ERTMS is an integral part in the planning of the new planned measures of the demand plan. In the area of Stuttgart, Munich and Nuremberg ERTMS is planned within the starter pack of DSD.

- In the CEF I funding period (2014 - 2020), Germany has received a grant of about EUR 1,400 mio EUR on the Corridor Rhine – Danube for the projects line upgrade/new line Karlsruhe – Basel (EUR 354 m), line upgrade/new line Stuttgart – Ulm – Augsburg (incl. Stuttgart21 + new line Wendlingen – Ulm, EUR 1,027 mio EUR) and Munich – Mühldorf – Freilassing (15 mio EUR) incl. planning and realization. (ZDF noch CEF I, Stand 2019)

4.4. Main priorities in the development of railway infrastructure

Development projects on Bavaria railway infrastructure are based on the Bundesverkehrswegeplan.

Bavaria and DB are planning investment in Bavarian rail network, the package of investments largely focuses on projects on smaller regional routes. The funding has been allocated to Bavaria under the LuFV III government funding agreement, which provides 2.8 billion euros to the federal states.[166]

The projects include:

- the construction of new stations, including in Lindau, Würzburg, Regensburg and Brunnen
- accessibility improvements, including in Senden, Marktoberdorf and Seefeld-Hechendorf
- the integration of reactivated routes into the DB network
- smaller electrification measures on the routes from Wasserburg to Ebersberg and from Pfronten-Steinach to the German-Austrian border, along with track doubling on the line to Lindau, and
- route improvements and line speed increases on routes such as the Rottal line (Mühldorf – Passau), the Gäuboden line (Neufahrn – Bogen), the Gräfenberg line (Nuremberg – Gräfenberg), the Aischgrund line (Neustadt ad Aisch – Steinach), the Paartal line (Augsburg – Ingolstadt) and the Oberland network, which runs to Bayrischzell and Lenggries.

In the new financial perspective, the European Union will place special emphasis on the European Green Deal, where sustainable mobility will be the key in achieving the climate goals in the field of transport, with a greater role for rail transport.

In the coming years, the priority areas of transport infrastructure policy are the modernization, reconstruction and upgrading of railway lines. One of the basic goals will be the increase of freight and passenger traffic from roads to railways.

5. Railway infrastructure management, regular maintenance measures and network modernization

The management of railway infrastructure is regulated by the Gesetz über den Ausbau der Schienenwege des Bundes.

The management of public railway infrastructure is carried out by the operator on the basis of a contract with the government and includes in particular:

- preparation of a proposal for a maintenance plan for the existing public railway infrastructure;
- providing data and information for the preparation of expert bases for investments in public railway infrastructure;
- preparation of data and expert bases for new projects related to the implementation of the infrastructure manager's tasks;
- concluding legal transactions related to the management of public railway infrastructure and station buildings, in the case and to the extent that they do not serve or are not necessary for the implementation of their basic purpose.

6. Map of railway network

[166] Bavaria and DB agree €436m investment in the Bavarian rail network | International Railway Journal (railjournal.com)

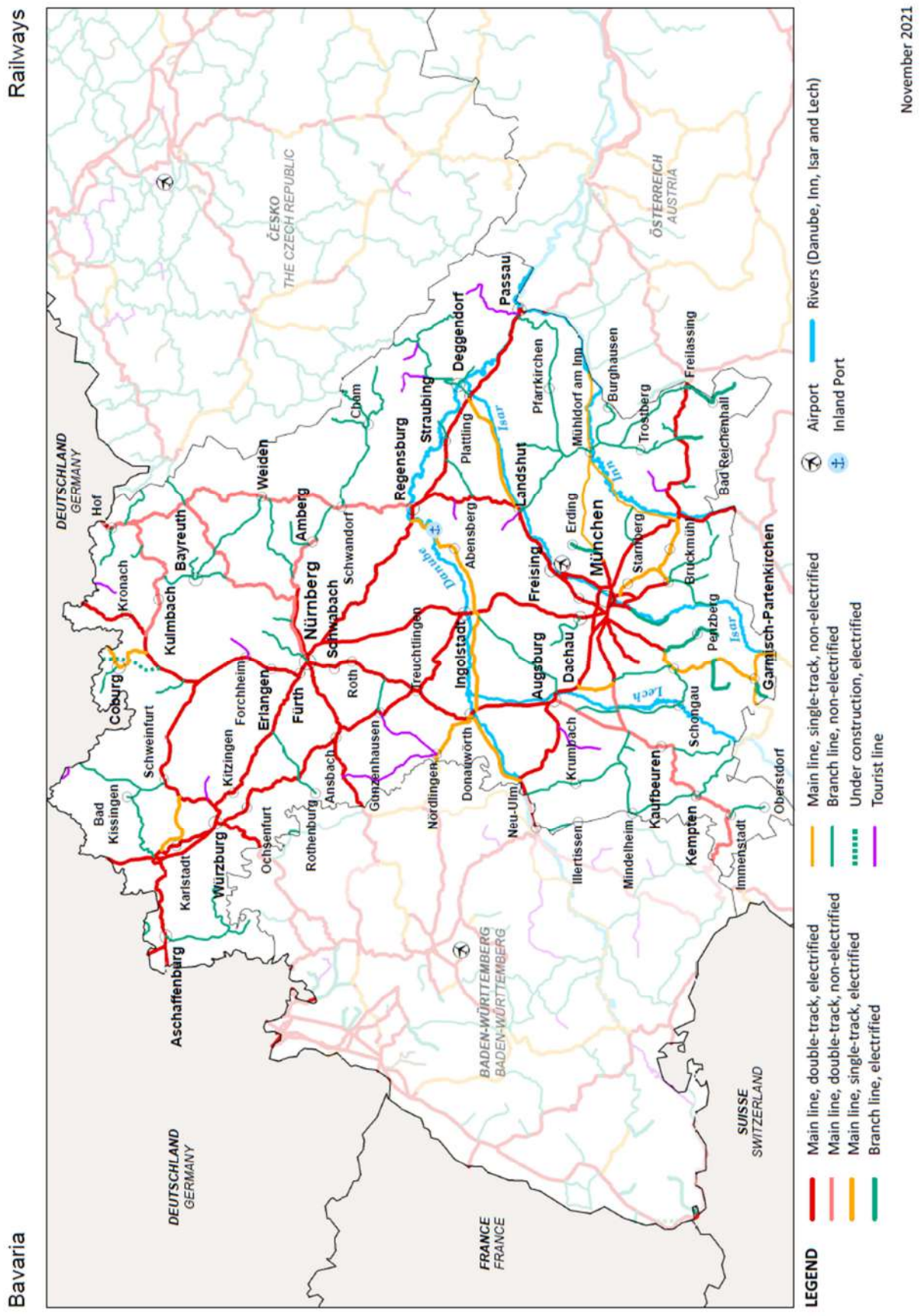

Figure 40:Map of railway network of Bavaria

4.2.8. Danube region railways: HUNGARY

1. **General data**
    - Inhabitants / 2020: **9.769.526**
    - Membership in the EU: **1. 5. 2004**
    - GDP / 2020 in EUR million: **134.840**
    - GDP per capita / 2020 in EUR: **13.715,16**
    - Capital city: **Budapest**
    - Land area (km²): **93.030**
    - Km of railways per million inhabitants: **789,4**
    - Km of railways per km² of the land area: **0,08**

2. **Description of the railway network**

    - Length of railway lines (km): **7.712**
    - Length of double-track railway lines (km): **1.252**
    - Length of single-track railway lines (km): **6.460**
    - Length of electrified railway lines (km): **3.124**
    - Length of non-electrified railway lines (km): **4.588**
    - Length of railway lines (km), axle load D4 (22,5 tons/axle): **598,7**
    - Maximum length of freight train (m) on TEN-T network: **750**

3. **Main features of railway network**

3.1. General description of the transport characteristics of the railway network

The rail network operates to the track gauge of 1.435 millimetres. Exceptions are:

- near the Ukrainian border, where there is 157 km-long broad/Russian (1.520 millimetres) gauge, and
- the touristic lines (ca. 459 km-long), which are built mainly with 760 millimetres gauge

Depending on traffic volume, economic importance, number of tracks and the connecting role of railway transport line, the railway network is divided into main and regional lines and single and double-track lines.

The main nodes, as we call the areas where several railway lines merge or come together is Budapest.

Electrified railway lines on the Hungarian railway network, with the exception of junctions with some foreign railway infrastructures, are equipped with 25 kV, 50 Hz electrification system.

Other electrification systems are also emerging at the following border crossing stations:

- Hegyeshalom-Nickelsdorf (Hungarian/Austrian border), where 15 kV 16 2/3 Hz is also available
- Hidasnémeti/Čaňa (Hungarian/Slovakian border), where 3 kV, direct current is also available
- Őriszentpéter/Hodoš (Hungarian/Slovenian border), where 3 kV, direct current is also available

3.2. Traffic

3.2.1. Number of trains per day

- Average number of all trains per day on TEN-T - core network: **2034**
- Average number of all trains per day on TEN_T - comprehensive network: **1366**
- Average number of all trains per day on the rest of the network: **1691**
- Average number of freight trains per day on TEN-T - core network: **319**
- Average number of freight trains per day per TEN_T – comprehensive network: **163**
- Average number of freight trains per day on the rest of the network: **160**.

3.2.2. International railway corridors

The railway network of Hungary is very important, from the European Union point of view, as several types of corridors and lines run along it, the most important of which are Trans-European Railway Network Corridors (TEN-T) and international rail corridors for competitive freight transport.

Part of the Trans-European railway Network (TEN-T)[167] (core and comprehensive network), are the following corridors in Hungary:

- The Mediterranean Core Network Corridor, which runs from the border with Ukraine (Záhony/Чоп), through Miskolc/Debrecen to Budapest, to the border with the Republic of Croatia (Gyékényes/Koprivnica) and to the border with the Republic of Slovenia (Őriszentpéter/Hodoš).

- Orient / East-Med Core Network Corridor, which runs from the border with the Republic of Slovakia (Rajka/Rusovce) and border with Republic of Austria (Hegyeshalom/Nickelsdorf), through Budapest to the border with the Republic of Romania (Lőkösháza/Curtici).

- Rhine – Danube Core Network Corridor, which runs from the border with the Republic of Slovakia (Rajka/Rusovce) and border with Republic of Austria (Hegyeshalom/Nickelsdorf), through Budapest to the border with the Republic of Romania (Lőkösháza/Curtici).

Part of comprehensive network are the sections:

- Székesfehérvár – Murakeresztúr – Gyékényes,
- Dombóvár – Pécs – Magyarbóly,
- Cegléd-Szeged-Röszke,
- Püspökladány-Biharkeresztes,
- Miskolc-Hidanémeti,
- Budapest-Szob,
- Komárom-Székesfehérvár-Pusztaszabolcs,
- Győr-Sopron,
- Győr-Celldömölk-Szombathely,
- Szombathely-Szentgotthárd,
- Hegyeshalom-Porpác,
- Sopron-Szombathely-Nagykanizsa.

International freight rail corridors for competitive freight transport run through Hungary in accordance with EU Regulation 913/2010 on European rail freight corridors (RFC):

- RFC 6[168] - Mediterranean; (Almeria - Valencia / Algeciras / Madrid - Zaragoza / Barcelona - Marseille - Lyon - Turin - Milan - Verona - Padua / Venice - Trieste / Koper - Ljubljana - **Budapest** and Ljubljana / Rijeka - Zagreb - **Budapest** - Zahony (Hungarian-Ukrainian border).

[167] https://transport.ec.europa.eu/transport-themes/infrastructure-and-investment_en
[168] https://www.railfreightcorridor6.eu/RFC6/web.nsf/OnePager/index.html

- RFC 7[169] – Orient/East-Med; (The main route of the corridor is: Prague – Vienna**/**Bratislava – **Budapest** – Bucharest – Constanta, Arad – Craiova – Vidin – Sofia – Kulata – Thessaloniki – Athens and Sofia - Plovdiv - Svilengrad and the alternative routes Videle – Ruse Razpredelitelna – Sindel Razpredelitelna – Karnobat-Nova Zagora – Simeonovgrad – Svilengrad, Nova Zagora – Stara Zagora-Dimitrovgrad – Simeonovgrad, Plovdiv-Stara Zagora – Karnobat - Burgas).

- RFC 9[170] - Rhine - Danube; (Strasbourg–Mannheim–Frankfurt–Nürnberg–Wels; Strasbourg–Stuttgart–München–Salzburg–Wels–Wien–Bratislava–**Budapest**–Arad–Brașov/Craiova–București–Constanța; Čierna nad Tisou (Slovak/ Ukrainian border)–Košice–Žilina–Horní Lideč–Prague–München/Nürnberg).

- RFC 11[171] – Amber; (Koper — Ljubljana –/Zalaszentiván — Sopron/Csorna –/(Hungarian-Serbian border) — Kelebia — **Budapest** –/– Komárom — Leopoldov/Rajka — Bratislava — Žilina — Katowice/Kraków — Warszawa/Łuków — Terespol — (Polish-Belarusian border)).

3.3. Railway infrastructure equipment

3.3.1. Length of railways equipped with GSM-R system

On the Hungarian railway network, the GSM-R system is installed on 935 km of railway lines, ensuring radio signal coverage on the entire railway network, including tunnel coverage. The GSM-R is under construction on another 2255 km-long sections and it will be finished by 2023.

3.3.2. Length of railways equipped with ETCS level 1

The European safety system for train control ETCS Level 1, version 2.3.0d, which is one of the systems for ensuring the interoperability of the railway signalling safety system is being installed on railway infrastructure in Hungary. 168,6 km of lines are already equipped with the ETCS Level 1 system.

3.3.3. Length of railways equipped with ETCS level 2

On the Hungarian railway network there is a 222,9 km of railway lines equipped with the ETCS level 2 system. It is installed on (Budapest/Ferencváros-Székesfehérvár, Bajánsenye-Boba) section.

3.4. Condition of railway infrastructure

The condition of the infrastructure on Hungarian railways is, if we see the last track renewals:

- good (last renewal after 2010): 9,7 %
- appropriate (last renewal between 2000 and 2009): 8,9 %
- inadequate (last renewal between 1990 and 1999): 1,6 %,
- poor (last renewal before 1990) 79,8 %.

[169] https://www.rfc7.eu
[170] https://rfc-rhine-danube.eu/
[171] https://rfc-amber.eu/

3.5. Speed limits[172]

3.5.1. The maximum speed limit for freight traffic (only for TEN-T corridors or main lines) is **60-120 km/h** (It depends on the given section of TEN-T).

3.5.2. The maximum speed limit for passenger trains traffic (only for TEN-T corridors or main lines) is **60 - 160 km/h** (It depends on the given section of TEN-T).

3.5.3. Lengths of railway lines on the TEN-T network where the speed limit is less than 100 km/h (in km): **303,6 km** (based on calculations - Network statement).

3.6. Traffic safety

- Number of accidents in 2018, 2019 and 2020[173].

Table 28: Number of accidents

Total number of emergencies	2018	2019	2020
Accidents	179	181	98
Accidents at level crossing	82	69	62

There were 98 accidents on Hungarian railways in 2020, which is 83 accidents less than in 2019.

- Number of level crossings, of roads with railways in 2018, 2019, 2020[174].

Table 29: Number of level crossings

	2018	2019	2020
Number of level-crossings on TEN-T network (core and comprehensive)	1405	1394	1392
Number of all level crossings	5649	5638	5632

- Number of fatalities in accidents in 2018, 2019 and 2020

Table 30:Number of fatalities

	2018	2019	2020
Total number of fatalities in accidents	92	87	34

Between 2018 and 2020, the number of fatalities decreased by more than 30%. The number of fatalities for year 2020 represents 3,5 fatalities per million inhabitants.

[172] https://www2.vpe.hu/document/7584/NS%202020-2021%20M10B.zip
[173] http://www.ksh.hu/stadat_files/sza/hu/sza0032.html
[174] Based on data from MÁV and GYSEV

3.7. The main weaknesses of the railway network

3.7.1. Missing section

- Missing railway section to Budapest Liszt Ferenc International Airport Terminal 2.

3.7.2. Railway bottleneck

The main bottleneck in the Hungarian railway network is Budapest, where:

- A bypass freight railway line (V0) is missing.
- A missing tunnel/section between Budapest-Nyugati and Budapest-Déli railway stations would significantly improve the level of passenger transport.

3.7.3. Level crossing

There are still 5632 level crossings in Hungary (on average 1,4 km/1 level crossing), these level crossings need adequate protection to minimize the risk of collisions (for road and rail traffic).

3.7.4. Inadequate environmental protection

In many sections, there is no noise barrier to protect the natural and living environment. In addition, some sections of railway lines, which run through water protection areas do not have adequate protection against spills of hazardous substances. Separate level crossing for animals are also missing on majority of the railway lines.

3.8. Connections with neighbouring countries

The boundaries of the railway, network operated by the public railway infrastructure manager, are the points of the national border on individual sections of lines.

Railway border crossings in operation are the following:

- With Austria:
  - Main routes: Hegyeshalom/Nickelsdorf, Sopron/Baumgarten, Szentgotthárd/Jennersdorf,
  - regional routes: Fertőszentmiklós/Pamhagen, Sopron/Loipersbach-Schattendorf, Harka/Deutschkreutz.

- With Slovakia:
  - Main route: Rajka/Rusovce, Szob/Štúrovo, Hidasnémeti/Čaňa,
  - regional route: Komárom/Komárno, Nógrádszakál/Malé Straciny, Ipolytarnóc/ Lučenec, Somoskőújfalu/Fil'akovo, Bánréve/Lenartovce.

- With Ukraine:
  - Main routes: Záhony/ Чоп, Eperjeske/ Соловка,
  - regional routes: -.

- With Romania:
  - Main route: Lőkösháza/Curtici, Biharkeresztes/Episcopia Bihor,
  - regional routes: Kötegyán/Salonta, Nyírábrány/Valea lui Mihai, Tiborszállás/Carei.

- With Croatia:
  - Main route: Gyékényes/Koprivnica,

- regional routes: Murakeresztúr/Kotoriba, Magyarbóly/Beli Manastir.

- . With Slovenia:
  - Main route: Őriszentpéter/Hodoš,
  - regional routes: -.

- With Serbia:
  - Main route: Kelebia/Subotica
  - regional routes: Röszke/Horgoš.

3.9. Environmental protection

The railway infrastructure managers (MAV and GYSEV) in Hungary pay constant attention to compliance with legislation in the field of ecology and its application in the company environment.

Environmental protection in the operating conditions of MAV, GYSEV concerns the following areas:

- water protection and management,
- waste management,
- nature and landscape protection,
- air protection,
- protection of the earth's ozone layer and protection against the effects of greenhouse gases,
- protection of health against the effects of excessive noise and vibration (physical fields),
- elimination of environmental burdens and environmental damage,
- flood protection.

3.9.1. Noise protection

The Environmental Noise Directive (Directive 2002/49/ EC)[175] sets the general framework for environmental noise management.

In the framework of the 3rd noise mapping cycle, noise maps for railway lines (total 1.020 km) above 30000 vehicles/year were made. Quieter routes were designated on Hungarian railway lines in line with Commission Regulation (EU) No. 1304/2014. On the existing railway lines, on the busiest sections, measures for the protection of the natural and residential environment against noise are gradually being implemented Between 2015 and 2020 noise protecting walls of 155 thousand m^2 were built along the railway lines.

3.9.2. Protection of water resources

Nearly third of the Hungarian railway lines are on flood-prone areas. The EU Water Framework Directive (WFD) aims to protect and improve the ecological status of water bodies in order to promote sustainable watershed use. This requires that 'good status' should be achieved for all surface and groundwater bodies by 2015 or 2027 at the latest. Consequently, NRAs must ensure that their water management practices meet the requirements of the WFD, thereby ensuring sustainable development of the railway network.

[175] https://ec.europa.eu/environment/noise/directive_en.htm

3.10. Harmonization of timetables and an integrated public passenger transport system

Hungary participates in the international program CONNECT2CE[176], which focuses on improving the efficiency of public transport in regional, peripheral and cross-border areas of Central Europe to urban areas (where main transport nodes are located).

3.11. Responsibility and managers of the railway infrastructure

The entire railway network is owned by Hungary and managed by the company MÁV Hungarian State Railways (Hungarian: MÁV Magyar Államvasutak Zrt., MÁV ~ 95% of the network) and GYSEV (Hungarian: Győr-Sopron-Ebenfurti Vasút Zrt. ~ 5% of the network). In the territory of Hungary, they manage the railway infrastructure owned by the state and at the same time provide public passenger transportation services.

The management of the open access railway infrastructure is carried out by the operators on the basis of a 2016-2025 multi annual contracts for railway infrastructure operation with the central government.

The maintenance of the open-access railway infrastructure and the management of railway traffic on it, is a mandatory public utility service.

4. Investments and maintenance costs

Ministry responsible for transport: Ministry for Innovation and Technology is responsible for the construction, renovation and maintenance of open-access railway infrastructure. Prime Minister's Office and Budapest Development Centre prepare the railway developments in Budapest and its agglomeration. Projects are financed from the central budget of Hungary or with EU co-financing (Cohesion Fund, European Regional Development Fund, Connecting Europe Facility, Recovery and Resilience Facility).

For the use of open-access railway infrastructure, railway undertakings (carriers) are obliged to pay a track access charges. Ca. 80% of the track access charges is paid by passenger carriers in Hungary. Track access charges covers only 60% of network operating and maintenance costs, the remaining part has to be paid by the central budget of Hungary (in 2020 it was EUR 303 million).

4.1. Railway investments

In 2020**, 618 million EUR** were invested in new constructions and developments of the railway network in Hungary. Railway developments are managed mainly by NIF National Infrastructure Development Plc.

4.2. Railway maintenance

In 2020, **77 million EUR** were invested in the maintenance of the railway network in Hungary by MÁV and GYSEV. The source for these funds was the central budget of Hungary.

4.3. Objectives of transport policy and future development of the railway network

The current transport infrastructure is not up to the required technical condition due to long term lack of funds for maintenance and in particular reconstruction; adaptations leading to removal of

[176] https://www.interreg-central.eu/Content.Node/CONNECT2CE.html

deficiencies in safety, capacity and environmental burden are not carried out in sufficient scope. Many important road transport routes still pass-through urban areas, the railway network (in particular the regional one) inadequately responds to the needs for public transport services.

Investment in transport infrastructure has a huge potential in boosting growth and jobs. Member State performance is measured in indicators such as the perceived efficiency of transport services and progress towards completion of the TEN-T core network.[177]

4.4. Main priorities in the development of railway infrastructure

Development projects on Hungarian railway infrastructure are based on the National Transport Infrastructure Strategy in the Hungary for the period until 2030.
The objectives pursued by the rail infrastructure developments are:

- axle load capacity upgrade to (225 kN) on TEN-T core network,
- increase the maximum enabled speed in line with timetables (ITF),
- improving safety at level crossings,
- modernization of signal safety devices (e.g. GSM-R, ETCS, central/remote traffic control),
- eliminating capacity bottlenecks.

Projects that are already in progress or will be implemented are:

- Electrification and modernization of Püspökladány-Biharkeresztes-HU/RO border railway line,
- Upgrading Budapest Southern Danube railway bridge,
- Development of GSM-R network on a further 2255 km-long railway line,
- Upgrading Debrecen-Nagymacs railway section and building a new container terminal
- Building 3rd track between Budapest-Keleti and Kőbánya-felső,
- Renewal of Szombathely-Kőszeg line,
- Development of Hungarian section of Budapest-Belgrade railway section (2nd track, 120-160 km/h, GSM-R, ETCS L2)
- Development of Békéscsaba-Lőkösháza-HU/RO border section (e.g. 2nd track)
- Electrification and modernization of Hungarian section of Szeged-Subotica railway line
- Development of 3rd track between Budapest-Kelenföld and Budapest-Ferencváros and building 2 new stops.

The value of all development projects is estimated at 4.5 billion EUR.

5. Railway infrastructure management, regular maintenance measures and network modernization

The management and development of railway infrastructure is regulated by the Railway Transport Act (183/2005).

The management of open access railway infrastructure is carried out by the operators (MÁV and GYSEV) on the basis of the multi annual contracts for rail track operation with the government and includes in particular:

- preparation of a proposal for a maintenance plan for the existing public railway infrastructure;

[177] https://ec.europa.eu/transport/facts-fundings/scoreboard/countries/Hungary/investmentinfrastructure_en

- providing data and information for the preparation of expert bases for investments in public railway infrastructure;
- preparation of data and expert bases for new projects related to the implementation of the infrastructure manager's tasks;
- concluding legal transactions related to the management of public railway infrastructure and station buildings, in the case and to the extent that they do not serve or are not necessary for the implementation of their basic purpose.

6. Map of railway network

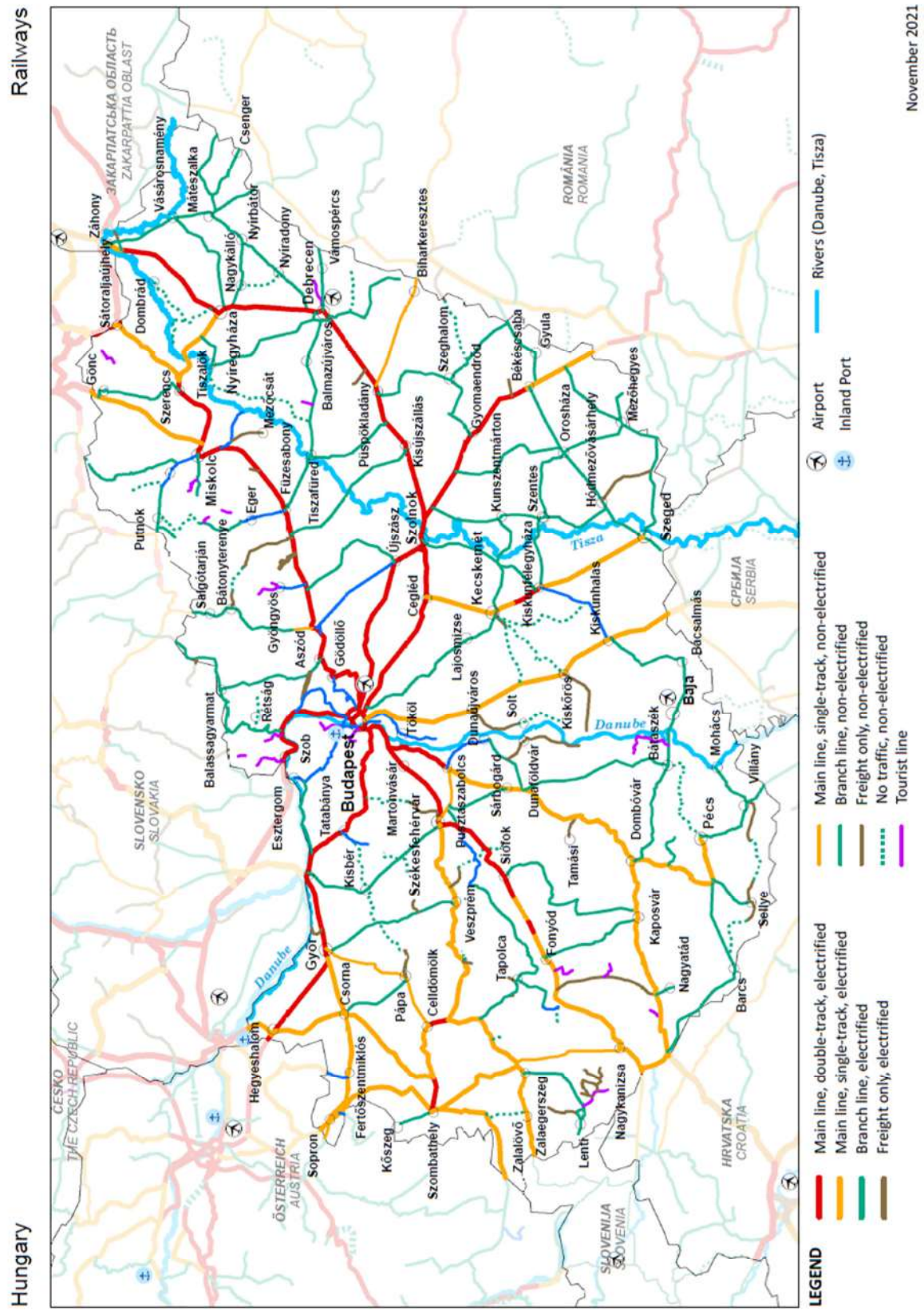

Figure 41: Map of railway network of Hungary

4.2.9. Danube region railways: MOLDOVA

1. General data

- Inhabitants / 2020: **4.033.963**
- Membership in the EU: **neighbouring country**
- GDP / 2020 in EUR million: **10.541,29**
- GDP per capita / 2020 in EUR: **4.551,00**
- Capital city: **Chișinău**
- Land area (km²): **33.843,50**
- Km of railways per million inhabitants: **286,815**
- Km of railways per km² of the land area: **0,034**

2. Description of the railway network

- Length of railway lines (km): **1.157,00**
- Length of double-track railway lines (km): **77,00**
- Length of single-track railway lines (km): **1.080,00**
- Length of electrified railway lines (km): **0**
- Length of non-electrified railway lines (km): **1.157,00**
- Length of railway lines (km), axle load D4 (22,5 tons/axle): **1.157**
- Maximum length of freight train (m) on TEN-T network: **798**

3. Main features of railway network

3.1. General description of the transport characteristics of the railway network

The rail network operates to the track gauge of 1.435 and 1.520 mm.

Depending on traffic volume, economic importance, number of tracks and the connecting role of railway transport line, the railway network is divided into main and regional lines and single-track and double-track lines.

The main nodes, as we call the areas where several railway lines merge or come together, are in: Chisinau, Balti, Ocnita, Cainari, Bender.

On the railway network in Moldova, there are no electrified railway lines.

3.2. Traffic

3.2.1. Number of trains per day

- Average number of all trains per day on TEN-T - core network: 10,1*
- Average number of all trains per day on TEN_T - comprehensive network: N/A
- Average number of all trains per day on the rest of the network: N/A
- Average number of freight trains per day on TEN-T - core network: N/A
- Average number of freight trains per day per TEN_T – comprehensive network: N/A
- Average number of freight trains per day on the rest of the network: N/A.

* Only passenger trains.

3.2.2. International railway corridors

The railway network of Moldova has a big transport potential, as new transport opportunities need to be acquired also from countries outside the corridor and EU member states. Based on the acquisition of new transports, an analysis of transport potential of the countries of Central Asia and Caucasus

region, so-called third countries belonging to TRACECA (Transport Corridor Europe – Caucasus – Asia) corridor, was carried out. The TRACECA corridor includes also the Republic of Moldova.[178]

3.3. Railway infrastructure equipment

3.3.1. Length of railways equipped with GSM-R system

On the Moldovan Railways network, the GSM-R system is not yet installed.

3.3.2. Length of railways equipped with ETCS level 1

The European safety system for train control ETCS Level 1, version 2.3.0d, which is one of the systems for ensuring the interoperability of the railway signalling safety system not installed on railway infrastructure in Moldova.

3.3.3. Length of railways equipped with ETCS level 2

On the Moldovan railway network there is no railway lines equipped with the ETCS level 2 system.

3.4. Condition of railway infrastructure

Data about condition of the railway infrastructure of Moldova were not available.

3.5. Speed limits

3.5.1. The maximum speed limit for freight traffic (only for TEN-T corridors or main lines) is **100** km/h

3.5.2. The maximum speed limit for passenger trains traffic (only for TEN-T corridors or main lines) is **60** km/h

3.5.3. Lengths of railway lines on the TEN-T network where the speed limit is less than 100 km/h (in km): **210** km.

3.6. Traffic safety[179]

- Number of accidents in 2018, 2019 and 2020.

Table 31: Number of accidents

Total number of emergencies	2018	2019	2020
Accidents	15	9	N/A
Accidents at level crossing	10	8	6

* N/A – data not available

There were 9 accidents on Moldovan railways in 2019, which is 6 accidents less than in 2018.

[178] https://www.interreg-central.eu/Content.Node/CORCAP/RFC7-Transport-Market-Study.pdf
[179] Moldova Railway SE data

- Number of level crossings, of roads with railways in 2018, 2019, 2020.

Table 32: Number of level crossings

	2018	2019	2020
Number of level-crossings on TEN-T network (core and comprehensive)	34	34	34
Number of all level crossings	226	226	226

* N/A – data not available

- Number of fatalities in accidents in 2018, 2019 and 2020

Table 33: Number of fatalities

	2018	2019	2020
Total number of fatalities in accidents	6	7	16

Between 2018 and 2020, the number of fatalities rose. The number of fatalities for year 2020 represents 4 fatalities per million inhabitants.

3.7. The main weaknesses of the railway network

3.7.1. Missing sections

*The data about missing sections of the railway network of Moldova were not obtained.

3.7.2. Railway bottleneck

In Moldova, the railway lines are not electrified. This represents the bottleneck in international rail transport.

*The data about railway bottleneck of the railway network of Moldova were not available and confirmed by the representative of Moldova.

3.7.3. Level crossing

Table 32 shows that there are 226 level crossings in Moldova (on average 0,19 km/), these level crossings need adequate protection to minimize the risk of collisions (for road and rail traffic) when crossing.

3.7.4. Inadequate environmental protection

In many sections, there is no noise barrier to protect the natural and living environment. In addition, some sections of railway lines, which run through water protection areas do not have adequate protection against spills of hazardous substances.

*The data were not confirmed by the representative of Moldova.

3.8. Connections with neighbouring countries

The boundaries of the railway, network operated by the public railway infrastructure manager, are the points of the national border on individual sections of lines.

Railway border crossings:

- With Hungary
    - Main routes: Arad,
    - Regional route: Carei, Sacueni.

- With Serbia:
    - Main route: Deta,
    - regional route: Jimbolia.

- With Bulgaria:
    - Main routes: Calafat.

- With Ukraine- Zakarpatia Oblast.
- With Ukraine- Chernivitsi Oblast.
- With Ukraine- Odessa Oblast.

3.9. Environmental protection

The railway infrastructure manager in Moldova pays constant attention to compliance with legislation in the field of ecology and its application in the company environment.

- water protection and management;
- waste management,
- nature and landscape protection;
- air protection;
- protection of the earth's ozone layer and protection against the effects of greenhouse gases;
- protection of health against the effects of excessive noise and vibration (physical fields);
- elimination of environmental burdens and environmental damage;
- flood protection.

*The data have not been confirmed by the country representative.

3.9.1. Noise protection

On the existing railway lines, on the busiest sections, measures for the protection of the natural and residential environment against noise are gradually being implemented.

The data have not been confirmed by the country representative.

3.9.2. Protection of water resources

The data about protection of water resources in Moldova were not available.

3.10. Harmonization of timetables and an integrated public passenger transport system

The data were not available.

3.11. Responsibility and managers of the railway infrastructure

The entire railway network is owned by the Republic of Moldova and managed by the National Railway Operator- CFM (Moldovan: Calea Ferată din Moldova, CFM).

The management of public railway infrastructure is carried out by the operator on the basis of a contract with the government.

The maintenance of public railway infrastructure and the management of railway traffic on it, is a mandatory public utility service.

4. Investments and maintenance costs

4.1. Railway investments

N/A- Data about railway investments in the year 2020 are not available.

4.2. Investments in railway maintenance

N/A- Data about investments in the railway maintenance in the year 2020 are not available.

4.3. Objectives of transport policy and future development of the railway network

The railway assets in Moldova suffer from a legacy of chronic underinvestment that has resulted in today's significantly degraded infrastructure. The low-quality railway infrastructure is the main obstacle to attracting more railway clients. The railway infrastructure is old and completely depreciated. About 45 percent of the railway tracks were installed over 30-40 years ago. 77 percent of the automatic block equipment and 87 percent of the semi-automatic block equipment are over 41 years old. 62 percent of interlocking systems are also over 41 years old. The infrastructure's obsolete and poor state is one of the main factors of poor operational performance. Currently, the average technical speed on the railway network is 34.5 km/h. Huge transport capacity is lost due to low speed, with many customers preferring road transport because of its better-quality services. CFM had identified in 2013 the main line sections requiring maintenance. These accounted for over one third of the network, including 163 km with 84 speed restrictions. Ever since then, CFM has been making efforts to complete the scheduled maintenance, but the needs by far exceed the possible allocations. There is currently a backlog, with 24 percent of the main network requiring periodic maintenance. Additionally, 17 percent of the main track require renewal. The deterioration has resulted in 27 percent of the network having speed limitations.[180]

4.4. Main priorities in the development of railway infrastructure

The Transport and Logistic Strategy is aimed at creating a regulatory framework for opening the railway market and restructuration of CFM (Moldovan Railway SE) The Strategy establish the actions needed for enhancing the investments for rehabilitation of railway infrastructure and improving the locomotives and wagons pool.[181]

Implementation of the Association Agreement between the European Union and Moldova in accordance with the provisions of Chapter 15 "Transport", provides for the implementation:

- Directive 2012/34/EU on establishing a single European railway area,
- Directive 2016/798/EU on railway safety,

[180] https://openknowledge.worldbank.org/bitstream/handle/10986/35700/Tracks-from-the-Past-Connectivity-for-the-Future-Revitalizing-Moldova-s-Railway-Sector.pdf?sequence=1&isAllowed=y

[181] https://unece.org/fileadmin/DAM/trans/doc/2019/TEM/15_Oct_2019_S2_Vasile_Condreanu.pdf

• Directive 2008/57/EC on the interoperability of the rail system within the Community,
• Directive 2007/59/EC on the certification of train drivers operating locomotives and trains on the railway system in the Community,
• Regulation (EC) No 1370/2007 on public passenger transport services by rail and by road,
• Regulation (EC) No 1371/2007 on rail passengers' rights and obligations,
• Regulation (EU) No 913/2010 concerning a European rail network for competitive freight.

5. Railway infrastructure management, regular maintenance measures and network modernization

The management of public railway infrastructure is carried out by the operator on the basis of a contract with the government and includes in particular:

- preparation of a proposal for a maintenance plan for the existing public railway infrastructure;
- providing data and information for the preparation of expert bases for investments in public railway infrastructure;
- preparation of data and expert bases for new projects related to the implementation of the infrastructure manager's tasks;
- concluding legal transactions related to the management of public railway infrastructure and station buildings, in the case and to the extent that they do not serve or are not necessary for the implementation of their basic purpose.

6. Map of railway network

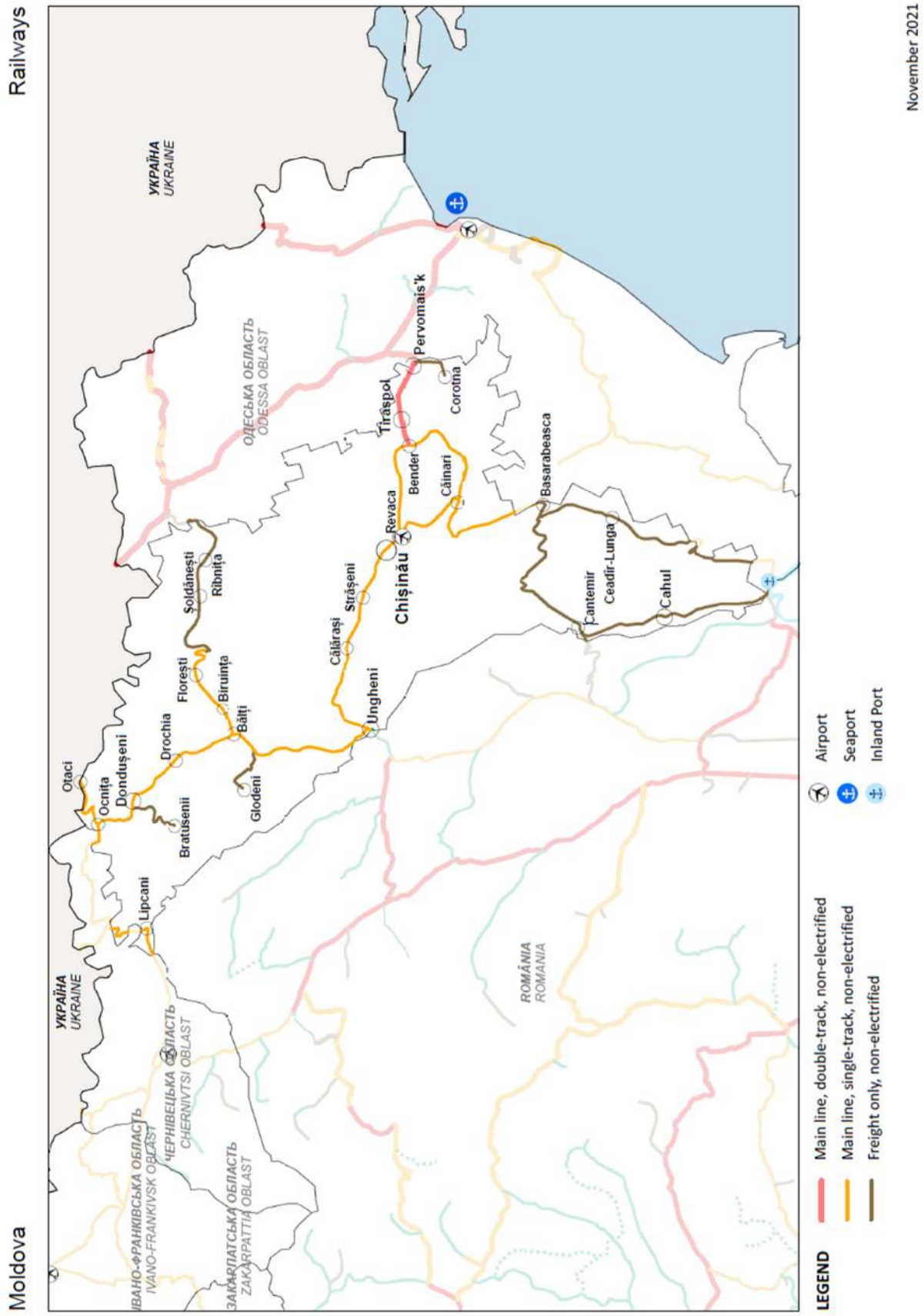

Figure 42: Map of railway network in Moldova.

4.2.10. Danube region railways: MONTENEGRO

1. General data

- Inhabitants / 2020: **628.066**
- Membership in the EU: **candidate country, applied 15.12. 2008**
- GDP / 2020 in EUR million: **4.170**
- GDP per capita / 2020 in EUR: **6.243,46**
- Capital city: **Podgorica**
- Land area (km²): **13.812,00**
- Km of railways per million inhabitants: **394,9**
- Km of railways per km² of the land area: **0,02**

2. Description of the railway network

- Length of railway lines (km): **248**
- Length of double-track railway lines (km): **0**
- Length of single-track railway lines (km): **248**
- Length of electrified railway lines (km): **223**
- Length of non-electrified railway lines (km): **25**
- Length of railway lines (km), axle load D4 (22,5 tons/axle): **248**
- Maximum length of freight train (m) on TEN-T network: **700**

3. Main features of railway network

3.1. General description of the transport characteristics of the railway network

The rail network operates to the track gauge of 1.435 millimetres.

Depending on traffic volume, economic importance and the connecting role of railway transport line, the railway network is divided into main and regional lines. All the railway lines are single-track lines.

The main node, as we call the areas where several railway lines merge or come together is in Podgorica.

Electrified railway lines on the Montenegrin railway network are equipped with 25kV, 50 Hz system.

3.2. Traffic

3.2.1. Number of trains per day

- Average number of all trains per day on TEN-T - core network:**46**
- Average number of all trains per day on TEN_T - comprehensive network: **46**
- Average number of all trains per day on the rest of the network: **14**
- Average number of freight trains per day on TEN-T - core network:**24**
- Average number of freight trains per day per TEN_T – comprehensive network: **24**
- Average number of freight trains per day on the rest of the network: **N/A**

3.2.2. International railway corridors

The railway network of the Republic of Montenegro is important, linking the Adriatic Sea, countries of the Western Balkan and the EU. The most important corridor is the extension of the Orient/East-Med Corridor into the Western Balkans along Route 4.

- Route 4 - extension of Orient/East-Med Corridor is approximately 580 km long and runs from Vrsac (Serbia – Romania border) to Belgrade (Serbia) and then to **Podgorica** and **Bar** (Montenegro).

3.3. Railway infrastructure equipment

3.3.1. Length of railways equipped with GSM-R system

On the railways network of Republic of Montenegro, the GSM-R system is not yet installed.

The candidacy of the study for ITS on the railway is being prepared.

3.3.2. Length of railways equipped with ETCS level 1

The European safety system for train control ETCS Level 1, version 2.3.0d, which is one of the systems for ensuring the interoperability of the railway signalling safety system is not yet installed on railway infrastructure in Montenegro.

The candidacy of the study for ITS on the railway is being prepared.

3.3.3. Length of railways equipped with ETCS level 2

The European safety system for train control ETCS Level 2 system is not yet installed on railway lines in Republic of Montenegro.

3.4. Condition of railway infrastructure

The condition of the railway infrastructure of Republic of Montenegro is:

- good: 52 %
- appropriate:30 %
- inadequate: 18 %,
- poor: 0 %.

3.5. Speed limits[182]

3.5.1. The maximum speed limit for freight traffic (only for TEN-T corridors or main lines) is: **80 km/h.**
3.5.2. The maximum speed limit for passenger trains traffic (only for TEN-T corridors or main lines) is **80 km/h.**
3.5.3. Lengths of railway lines on the TEN-T network where the speed limit is less than100 km/h (in km): **192 km**

3.6. Traffic safety[183]

- Number of accidents in 2018, 2019 and 2020

[182]http://www.zicg.me/AdminCMS/public/pdf/izjavaomrezi/IZJAVA%20O%20MRE%C5%BDI%20%202021%20%20%20%20sa%20I%20%20izmjenama%20i%20dopunama.pdf
[183] https://www.transport-community.org/wp-content/uploads/2019/12/TCT-Railroad-level-crossingsV2.pdf

Table 34: Number of accidents

Total number of emergencies	2018	2019	2020
Accidents	47	60	37
Accidents at level crossing	4	3	1

There were 37 accidents on Montenegro's railways in 2020, which is 23 accidents less than in 2019.

- Number of level crossings, of roads with railways in 2018, 2019, 2020

Table 35: Number of level crossings

	2018	2019	2020
Number of level-crossings on TEN-T network (core and comprehensive)	10	10	10
Number of all level crossings	23	23	23

- Number of fatalities in accidents in 2018, 2019 and 2020

Table 36: Number of fatalities

	2018	2019	2020
Total number of fatalities	2	6	1

Between 2018 and 2020, the number of fatalities decreased. The number of fatalities for year 2020 represents 1,67 fatalities per million inhabitants.

3.7. The main weaknesses of the railway network

3.7.1. Missing sections

Preliminary technical documentation has been prepared for the railway in the north of the country, Pljevlja-Bijelo Polje-Berane-border with Kosovo.

3.7.2. Railway bottleneck

- missing upgrade of the line Trebešica-Podgorica-Bar and Podgorica-Tuzi-border to Albania,
- Old signal system on TNT lines.

3.7.3. Level crossing

Table 35: Number of level crossings shows that there are still 23 level crossings in Montenegro (on average 0,09 km/1 level crossing), these level crossings need adequate protection to minimize the risk of collisions (for road and rail traffic).

3.7.4. Inadequate environmental protection

In many sections, there is no noise barrier to protect the natural and living environment. In addition, some sections of railway lines, which run through water protection areas do not have adequate protection against spills of hazardous substances.

3.8. Connections with neighbouring countries

The boundaries of the railway, network operated by the railway infrastructure manager, are the points of the national border on individual sections of lines.

Railway border crossings:

- With Serbia:
  - Main route: Bijelo Polje.
- With Bosnia and Herzegovina:

  No railway border crossing.
- With Albania:
  - Regional route: Tuzi.

3.9. Environmental protection

National Climate Change Strategy" adopted in 2015, which defines the wider strategic framework and action plan of Montenegro for sustainable development, including vulnerability assessment for different regions within the country (coastal area, mountains).[184]

3.9.1. Noise protection

On the existing railway lines, on the busiest sections, measures for the protection of the natural and residential environment against noise are gradually being implemented.

3.9.2. Protection of water resources

*The data about protection of water resources in Montenegro were not available.

3.10. Harmonization of timetables and an integrated public passenger transport system

A project for a new reservation system for ticket sales has been made, but no equipment has been procured yet.

3.11. Responsibility and managers of the railway infrastructure

Railway network in Montenegro is owned and operated by the national railway company Željeznička Infrastruktura Crne Gore (ŽICG)). It is a joint-stock company that handles operation and maintenance of the railway infrastructure in Montenegro.

[184] https://ec.europa.eu/transport/sites/default/files/oem_wb6_finalreport.pdf

The management of public railway infrastructure is carried out by the operator on the basis of a contract with the government.

In accordance with the Railway Transport Act, the operator must ensure the proper management and maintenance of railway infrastructure and the management of railway transport.

The maintenance of public railway infrastructure and the management of railway traffic on it, is a mandatory public utility service.

4. Investments and maintenance costs

Planned investments in Montenegro are:

- Reconstruction and Modernization Railway Line (Beograd) - Vrbnica – Bar[185]
- Rehabilitation of 13 bridges and 8 tunnels is in progress.
- overhaul of 20 km of railway on Route 4 is in preparation.

4.1. Railway investments

In 2020, **9,3 mio EUR** were invested in new constructions and renovations of the railway network in Montenegro.

4.2. Investments in railway maintenance

In 2020, **6,7 mio EUR** were invested in the maintenance of the railway network in Montenegro. The sources for these funds were: WBIF, IPA, credits EIB, EBRD.

4.3. Objectives of transport policy and future development of the railway network

The overall objective of the programme "Regional Development" in Montenegro is to improve living standards and the state of environment in Montenegro in accordance with national policies and strategies as well as with EU policies and standards. This objective is to be achieved through the improvement of transport system by promoting environmentally friendly transport modes with special emphasis on rail infrastructure in order to provide better services. One of the improvements on the way to achieving goals is improvement of the existing railway infrastructure by elimination of the existing safety risks which currently jeopardise the rail transport in Montenegro.[186]

4.4. Main priorities in the development of railway infrastructure[187]

As Montenegro intends to integrate its railway infrastructure with the European railway network, the country has launched several projects to modernize and develop its transport infrastructure. The National investment company adopted at the end of 2015 a list of priority infrastructure projects for 2020, which included two railway projects: Route 2, envisaging the reconstruction and electrification Podgorica-Tuzi-border with Albania and Route 4, involving the modernisation of signalling and safety systems, refurbishment of superstructure and substructure on Bar-Vrbnica line.

[185] https://ec.europa.eu/transport/sites/default/files/oem_wb6_finalreport.pdf
[186] https://ec.europa.eu/regional_policy/et/funding/ipa/montenegro/
[187] https://www.railwaypro.com/wp/montenegro-modernizes-its-railways/

Under the project for Route 4, according to SEETO network, the Port of Bar will be connected to corridors X and VII, and routes 2 and 2b will provide crossing with route 4 and transversal connecting of corridors Vc and VIII across the territory of Montenegro. With implementation of these objectives the railway network of Montenegro would be fully integrated in corridors of TEN-T network. *

Projects worth over 170 million euros have been realized, while at least another 250 million euros are needed to complete all the necessary overhauls, repairs and modernization of the railway and equipment.

5. Railway infrastructure management, regular maintenance measures and network modernization

The management of railway infrastructure is regulated by the Railway Transport Act (From 2013. New act is under public hearing under IV package (Recast 34/2012)).

The management of public railway infrastructure is carried out by the operator on the basis of a contract with the government and includes in particular:

- preparation of a proposal for a maintenance plan for the existing public railway infrastructure (The National Infrastructure Maintenance Program 2021-2023 is in force, and is implemented through annual infrastructure maintenance contracts)
- providing data and information for the preparation of expert bases for investments in public railway infrastructure;
- preparation of data and expert bases for new projects related to the implementation of the infrastructure manager's tasks;
- concluding legal transactions related to the management of public railway infrastructure and station buildings, in the case and to the extent that they do not serve or are not necessary for the implementation of their basic purpose.
-

6. Map of railway network.

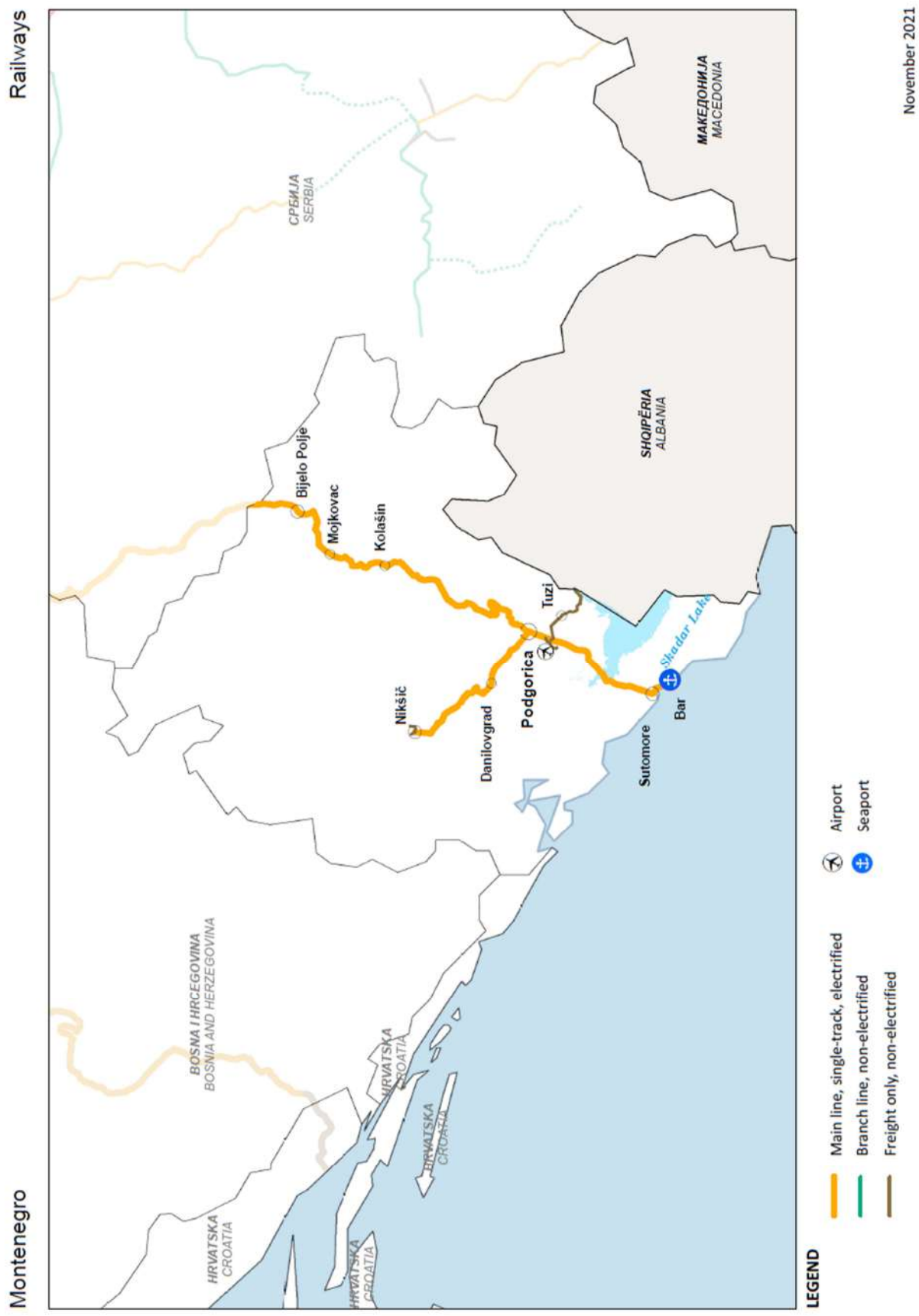

Figure 43: Map of railway network of Montenegro.

4.2.11. Danube region railways: ROMANIA

1. General data

- Inhabitants / 2020: **19.317.984**
- Membership in the EU: **1. 01. 2007**
- GDP / 2020 in EUR million: **289.130**
- GDP per capita / 2020 in EUR: **14.968**
- Capital city: **Bucharest**
- Land area (km²): **238.397**
- Km of railways per million inhabitants: **550,3**
- Km of railways per km² of the land area: **0,04**

2. Description of the railway network

- Length of railway lines (km): **10.630**
- Length of double-track railway lines (km): **2.921**
- Length of single-track railway lines (km): **7.709**
- Length of electrified railway lines (km): **4.032**
- Length of non-electrified railway lines (km): **6.598**
- Length of railway lines (km), axle load D4 (22,5 tons/axle): **840**
- Maximum length of freight train (m) on TEN-T network: **650**.

3. Main features of railway network

3.1. General description of the transport characteristics of the railway network

The rail network operates to the track gauge of 1.435 millimetres.

Depending on traffic volume, economic importance, number of tracks and the connecting role of railway transport line, the railway network is divided into main and regional lines and single-track and double-track lines.

The main nodes, as we call the areas where several railway lines merge or come together are in: Bucharest, Buzau, Arad, Brasov.

Electrified railway lines on the Romanian railway network, with the exception of junctions with foreign railway infrastructures, are equipped with 25kV, 50 Hz AC system.

3.2. Traffic

3.2.1. Number of trains per day:

- Average number of all trains per day on TEN-T - core network: **850**
- Average number of all trains per day on TEN_T - comprehensive network: **670**
- Average number of all trains per day on the rest of the network: **168**
- Average number of freight trains per day on TEN-T - core network: **171**
- Average number of freight trains per day per TEN_T – comprehensive network: **134**
- Average number of freight trains per day on the rest of the network: **23**.

3.2.2. International railway corridors

The railway network of Romania is very important, from the European Union point of view, as several types of corridors and lines run along it, the most important of which are Trans-European Railway Network Corridors (TEN-T) and international rail corridors for competitive freight transport.

Part of the trans-European railway network (TEN-T)[188] (core and comprehensive network), are the following corridors in Romania:

- Orient – East Med Corridor, from the Hungarian border to the Bulgarian border, via Arad, Timisoara and Craiova.

- Rhine – Danube Corridor, divided into many branches. It enters the country from the Hungarian border and goes through Arad, Brasov, Craiova and Bucharest, ending at the Sulina and Constanta ports.

International freight rail corridors for competitive freight transport run through Romania in accordance with EU Regulation 913/2010 on European rail freight corridors (RFC):

- RFC 7 [189]– Orient East-Med; (Prague–Vienna/Bratislava–Budapest–**Bucharest**–**Constanta** and Vidin–Sofia–Thessaloniki–Athens).

- RFC 9[190] - Rhine - Danube; (Strasbourg–Mannheim–Frankfurt–Nürnberg–Wels; Strasbourg–Stuttgart–München–Salzburg–Wels–Wien–Bratislava–Budapest–**Arad**–**Brașov/Craiova**–**București–Constanța**; Čierna nad Tisou (Slovak/ Ukrainian border)–Košice–Žilina–Horní Lideč–Prague–München/Nürnberg).

3.3. Railway infrastructure equipment

3.3.1. Length of railways equipped with GSM-R system

On the Romanian Railways network, the GSM-R system is installed on 75,75 km of railway lines, ensuring radio signal coverage on the entire railway network, including tunnel coverage.

3.3.2. Length of railways equipped with ETCS level 1

The European safety system for train control ETCS Level 1, version 2.3.0d, which is one of the systems for ensuring the interoperability of the railway signalling safety system is being installed on railway infrastructure in Romania. 219,37 km of lines are already equipped with the ETCS Level 1 system.

3.3.3. Length of railways equipped with ETCS level 2

[188] https://transport.ec.europa.eu/transport-themes/infrastructure-and-investment_en
[189] https://www.rfc7.eu
[190] https://rfc-rhine-danube.eu/

On the Romanian railway network there is a 75,75 km of railway lines equipped with the ETCS level 2 system.

3.4. Condition of railway infrastructure

The data about condition of the railway infrastructure of Romania were not available.

3.5. Speed limits

3.5.1. The maximum speed limit for freight traffic (only for TEN-T corridors or main lines) is **120** km/h

3.5.2. The maximum speed limit for passenger trains traffic (only for TEN-T corridors or main lines) is **160** km/h

3.5.3. Lengths of railway lines on the TEN-T network where the speed limit is less than 100 km/h (in km): **695** km.

3.6. Traffic safety

There were 280 accidents on Romanian railways in 2020, which is 7 accidents less than in 2019.

- Number of accidents in 2018, 2019 and 2020.

Table 37: Number of accidents

Total number of emergencies	2018	2019	2020
Accidents	302	287	280
Accidents at level crossing	160	139	163

There were 280 accidents on Romanian railways in 2020, which is 7 accidents less than in 2019.

- Number of level crossings, of roads with railways in 2018, 2019, 2020.

Table 38: Number of level crossings

	2018	2019	2020
Number of level-crossings on TEN-T network (core and comprehensive)	N/A	N/A	N/A
Number of all level crossings	5033	5038	5038

* N/A – data not available

- Number of fatalities in accidents in 2018, 2019 and 2020

Table 39: Number of fatalities

	2018	2019	2020
Total number of fatalities in accidents	68	83	78

Between 2018 and 2020, the number of fatalities increased for 14 %. The number of fatalities for year 2020 represents 4,1 fatalities per million inhabitants.

3.7. The main weaknesses of the railway network

3.7.1. Missing sections

The data about missing sections of the railway network of Republic of Romania were not available.

3.7.2. Railway bottleneck[191]

The following sections of the railway network in Romania are listed as bottlenecks because of technical requirements and need to be rehabilitated*:

- Simeria – Braşov: Vintu de Jos – Coşlariu
- Simeria – Braşov Sighisoara – Aţel
- Simeria – Braşov Micăsasa – Coşlariu
- Simeria – Braşov Simeria – Vinţu de Jos
- Bucuresti – Constanta Feteşti – Medgidia
- Craiova – Bucuresti Chiajna- Grădinari

*Only sections of the RFC 7 corridor.

**The data about other bottlenecks of the railway network of Romania were not available.

3.7.3. Level crossing

The previous chapter 3.6. shows , that there are still 5038 level crossings in Romania, (on average 0,47 km/), these level crossings need adequate protection to minimize the risk of collisions (for road and rail traffic).

3.7.4. Inadequate environmental protection

In many sections, there is no noise barrier to protect the natural and living environment. In addition, some sections of railway lines, which run through water protection areas do not have adequate protection against spills of hazardous substances.

*The data were not confirmed by the representative of Romania.

3.8. Connections with neighbouring countries

The boundaries of the railway, network operated by the public railway infrastructure manager, are the points of the national border on individual sections of lines.

Railway border crossings:

- With Hungary
    - Main routes: Arad,
    - Regional route: Carei, Sacueni.

- With Serbia:
    - Main route: Deta,
    - regional route: Jimbolia.

- With Bulgaria:
    - Main routes: Calafat.

[191] https://www.interreg-central.eu/Content.Node/CORCAP/RFC7-Transport-Market-Study.pdf

- With the Republic of Moldova:
    - regional routes: Lasi, Galati.

- With Ukraine- Zakarpatia Oblast.
- With Ukraine- Chernivitsi Oblast.
- With Ukraine- Odessa Oblast.

3.9. Environmental protection

When providing railway transport services in the territory of the Republic of Romania, carriers must comply with all the rules necessary to prevent and reduce the burden on the environment. In case of an environmental accident, they must immediately inform the public railway infrastructure manager, who is responsible for notifying the relevant authorities and take urgent measures to reduce the harmful effects on the environment.

*The data have not been confirmed by the country representative.

3.9.1. Noise protection

On the existing railway lines, on the busiest sections, measures for the protection of the natural and residential environment against noise are gradually being implemented.

*The data have not been confirmed by the country representative.

3.9.2. Protection of water resources

*The data about protection of water resources in Romania were not available.

3.10. Harmonization of timetables and an integrated public passenger transport system

The data were not available.

3.11. Responsibility and managers of the railway infrastructure

The entire railway network is owned by the Republic of Romania and managed by the National Railway Company - CFR (Romanian: Compania Naţională de Căi Ferate, CFR).

The management of public railway infrastructure is carried out by the operator on the basis of a contract with the government.

In accordance with the Railway Transport Act, the operator must ensure the proper management and maintenance of railway infrastructure and the management of railway transport.

The maintenance of public railway infrastructure and the management of railway traffic on it, is a mandatory public utility service.

4. Investments and maintenance costs

4.1. Railway investments

N/A- Data about railway investments in the year 2020 are not available.

4.2. Investments in railway maintenance

N/A- Data about investments in the maintenance in the year 2020 are not available.

4.3. Objectives of transport policy and future development of the railway network

The current transport infrastructure is not up to the required technical condition due to long term lack of funds for maintenance and in particular reconstruction; adaptations leading to removal of deficiencies in safety, capacity and environmental burden are not carried out in sufficient scope. The railway network (in particular the regional one) inadequately responds to the needs for public transport services.

Investment in transport infrastructure has a huge potential in boosting growth and jobs. Member State performance is measured in indicators such as the perceived efficiency of transport services and progress towards completion of the TEN-T core network.[192]

*The data have not been confirmed by the country representative.

4.4. Main priorities in the development of railway infrastructure

Development projects on Romanian railway infrastructure are based on the NIP (National Implementation Plan) in the Romania for the period until 2030.[193]
The objectives pursued by the infrastructure development plans are*:

- load capacity upgrade to (class) D4 (22.5 t) on RFC corridors,
- upgrade the maximum enabled speed on corridor lines, to 160 km/h,
- improving safety at level crossings,
- modernization of signal safety devices with the aim to enable the traffic in both directions on double-track lines,
- modernization of signal safety devices with the aim to remote by control traffic.

The data about value of all development projects were not available.

*The data have not been confirmed by the country representative.

5. Railway infrastructure management, regular maintenance measures and network modernization

The management of public railway infrastructure is carried out by the operator on the basis of a contract with the government and includes in particular:

- preparation of a proposal for a maintenance plan for the existing public railway infrastructure;
- providing data and information for the preparation of expert bases for investments in public railway infrastructure;
- preparation of data and expert bases for new projects related to the implementation of the infrastructure manager's tasks;
- concluding legal transactions related to the management of public railway infrastructure and station buildings, in the case and to the extent that they do not serve or are not necessary for the implementation of their basic purpose.

[192]https://ec.europa.eu/transport/facts-fundings/scoreboard/countries/Romania/investments-infrastructure_en
[193]https://ec.europa.eu/transport/sites/default/files/rail-nip/nip-ccs-tsi-romania-en.pdf

6. Map of the railway network

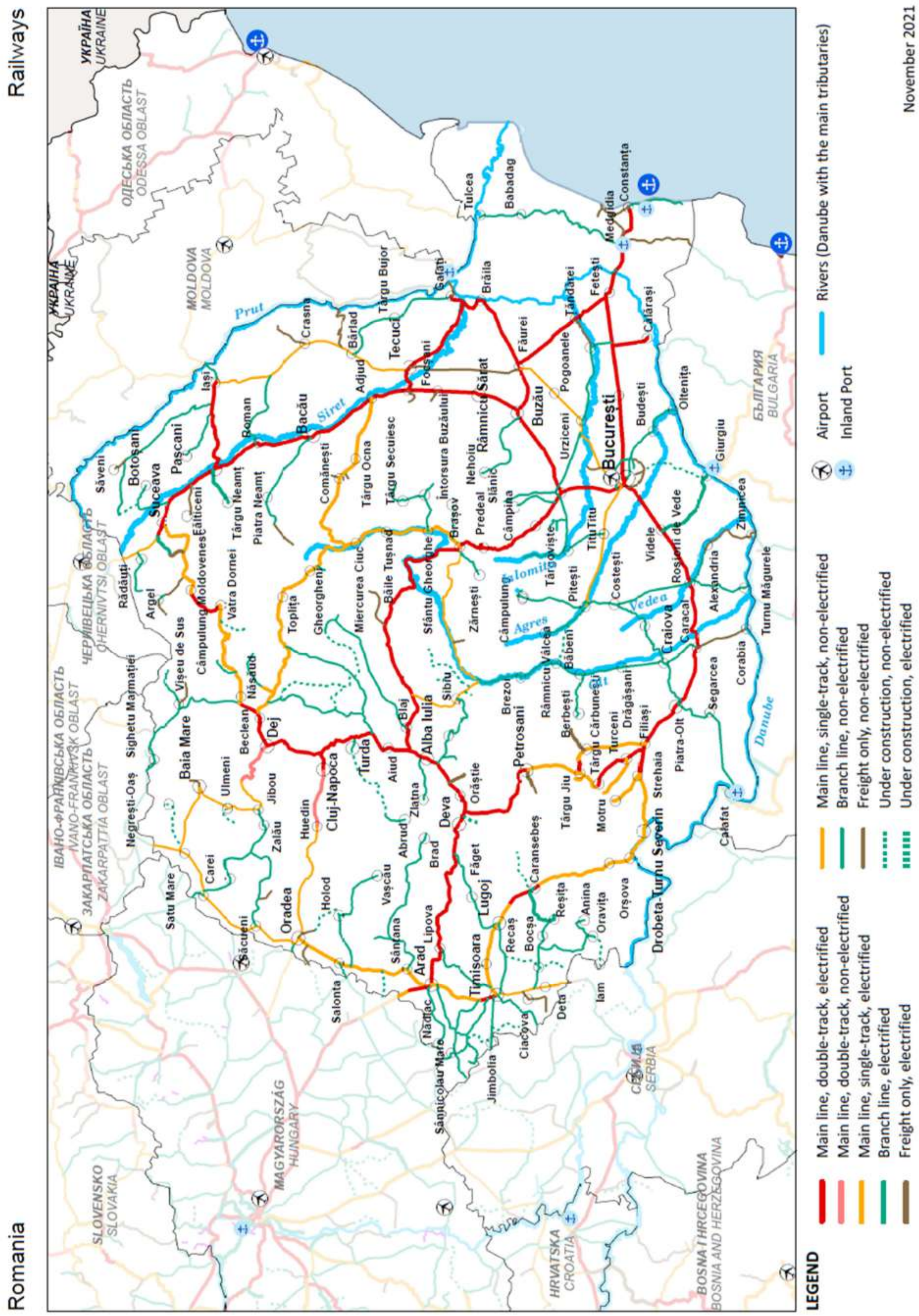

Figure 44: Map of railway network of Romania.

4.2.12. Danube region railways: SERBIA

1. General data

- Inhabitants / 2020: **8.737.371**
- Membership in the EU: **candidate country, applied 22.12. 2009**
- GDP / 2020 in EUR million: **45.842**
- GDP per capita / 2020 in EUR: **7.666**
- Capital city: **Belgrade**
- Land area (km²): **88.361,00**
- Km of railways per million inhabitants: **383,2**
- Km of railways per km² of the land area: **0,04**

2. Description of the railway network

- Length of railway lines (km): **3.348,077**
- Length of double-track railway lines (km): **288,686**
- Length of single-track railway lines (km): **3.059,390**
- Length of electrified railway lines (km): **1.273,7**
- Length of non-electrified railway lines (km): **2.074,4**
- Length of railway lines (km), axle load D4 (22,5 tons/axle): **1.202**
- Maximum length of freight train (m) on TEN-T network: **600.**

3. Main features of railway network

3.1. General description of the transport characteristics of the railway network

The rail network operates to the track gauge of 1.435 millimetres.

There are also narrow-gauge railway lines with track gauge of 760 mm (tourist, museum railway).

Depending on traffic volume, economic importance, number of tracks and the connecting role of railway transport line, the railway network is divided into main and regional lines and single-track and double-track lines.

The main nodes, as we call the areas where several railway lines merge or come together are in: Belgrade, Novi Sad, Subotica, Niš and Lapovo.

Electrified railway lines on the Serbian railway network are equipped with 25kV, 50 Hz system.

3.2. Traffic

3.2.1. Number of trains per day:

- Average number of all trains per day on TEN-T - core network: **412**
- Average number of all trains per day on TEN_T - comprehensive network: **38**
- Average number of all trains per day on the rest of the network: **113**
- Average number of freight trains per day on TEN-T - core network: **192**
- Average number of freight trains per day per TEN_T – comprehensive network: **13**
- Average number of freight trains per day on the rest of the network: **56**

3.2.2. International railway corridors

The railway network of the Republic of Serbia is important, linking the countries of the Western Balkan and the EU. The most important corridor running through the territory of Serbia is extention to EU TEN-T network and the international rail corridor for competitive freight transport.

Part of the trans-European railway network (TEN-T)[194], is Corridor X with all extensions (Šid – Begrade, Subotica – Belgrade, Niš – Dimitrovgrad, Niš - Preševo).

International freight rail corridors for competitive freight transport run through Republic of Serbia in accordance with EU Regulation 913/2010 on European rail freight corridors (RFC):

- RFC 10[195]- Alps - Western Balkans. The main route of the corridor is: Zalzburg – Fillah – Ljubljana – /Wels/Linz – Graz – Maribor –Zagreb – Vinkovci/Vukovar – Tovarnik – Belgrade – Sofia – Svilengrad.

- Route 4 – extension of Orient/East-Med Corridor is approximately 580 km long and runs from Vrsac (Serbia – Romania border) to Belgrade (Serbia) and then to Podgorica and Bar (Montenegro).

3.3. Railway infrastructure equipment

3.3.1. Length of railways equipped with GSM-R system

On all rail lines where deployment of ERTMS is envisaged, GSM-R system will be applied. For example, the first line with such a system will be Belgrade Center – Novi Sad, and upon construction, Novi Sad – Subotica also.

3.3.2. Length of railways equipped with ETCS level 1

The European safety system for train control ETCS Level 1, version 2.3.0d, which is one of the systems for ensuring the interoperability of the railway signalling safety system is not yet installed on railway infrastructure in Serbia.

3.3.3. Length of railways equipped with ETCS level 2

The European safety system for train control ETCS Level 2 system is not yet installed on railway lines in Republic of Serbia.

Under construction it is currently 74,9 km of lines (Belgrade Center – Novi Sad), where ETCS level 2 will be deployed and works should be completed by the end of 2021. Also, on the section Novi Sad – Subotica in the length of 108 km the works are expected to start by the end of October 2021, and it also envisages deployment of ETCS level 2 system.

The same system is planned for Niš – Dimitrovgrad modernization project, where the works should start in March 2022 (108 km), and also Belgrade – Niš (230 km) which is in the phase of preparation of project documentation.

[194] https://transport.ec.europa.eu/transport-themes/infrastructure-and-investment_en
[195] https://www.rfc-awb.eu/

3.4. Condition of railway infrastructure

According to the Transport Community report[196], it can be concluded that most of the network on Western Balkans and in Serbia is still in poor condition at the moment.

3.5. Speed limits

3.5.1. The maximum speed limit for freight traffic (only for TEN-T corridors or main lines) is: **80 km/h.**
3.5.2. The maximum speed limit for passenger trains traffic (only for TEN-T corridors or main lines) is **120 km/h.**
3.5.3. Lengths of railway lines on the TEN-T network where the speed limit is less than100 km/h (in km): **1.668,291**

3.6. Traffic safety[197]

Ministry of Construction, Transport and Infrastructure is in charge for developing legal framework in the field of railway safety as well control of implementation of legal framework.

In accordance with the Law on Railways and Law on safety in railway traffic, Directorate for Railways is the national safety authority (NSA). Its tasks and competences related to safety are prescribed by the Art. 124 of the Law on Railways.

- Number of accidents in 2018, 2019 and 2020

Table 40: Number of accidents

Total number of emergencies	2018	2019	2020
Accidents	548	595	401
Accidents at level crossing	55	43	45

There were 401 accidents on Serbian railways in 2020, which is 194 accidents less than in 2019.

- Number of level crossings, of roads with railways in 2018, 2019, 2020

Table 41: Number of level crossings

	2018	2019	2020
Number of level-crossings on TEN-T network (core and comprehensive)	897	N/A	N/A
Number of all level crossings	2138	N/A	N/A

*N/A – not available data

[196] : https://www.transport-community.org/wp-content/uploads/2021/08/TEN-T-report-2020.pdf
[197] https://www.transport-community.org/wp-content/uploads/2019/12/TCT-Railroad-level-crossingsV2.pdf

- Number of fatalities in accidents in 2018, 2019 and 2020

Table 42:Number of fatalities

	2018	2019	2020
Total number of fatalities	50	21	27

Between 2018 and 2020, the number of fatalities decreased by more than 40%. The number of fatalities for year 2020 represents 3,1 fatalities per million inhabitants.

3.7. The main weaknesses of the railway network

3.7.1. Missing sections

Beli Potok –Vinča – Pancevo a bypass around Belgrade.

3.7.2. Railway bottleneck

In serbia, the following railway sections are marked as a priority s infrstructure projects and not bottlenecks in strick traffic terms:

- Batajnica-Surčin (section Batajnica-Beograd Ranžirna),
- Border-Šid-Golubinci (Reconstruction and modernisation of the existing doubletrack line for a speed up to 160 km/h),
- Stara Pazova-Beograd Centar (reconstruction and modernisation of the existing doubletrack line for a speed up to 200 km/h),
- Beograd (Batajnica): New intermodal terminal,
- Ostružnica-Beograd Ranž (Second track on the bypass line Beograd),
- Beograd Ranžirna Station reconstruction with a container terminal,
- Jajinci-Mala Krsna (Reconstruction of existing single-track line),
- Belgrade - Niš (Reconstruction and modernisation of the Belgrade - Niš railway line with construction of the second track for a speed up to 200 km/h)
- Niš-Dimitrovgrad (Reconstruction and modernisation with electrification:
- Construction of Niš bypass

* only sections of the RFC AWB corridor.

3.7.3. Level crossing

The previous chapter 3.6. shows that there are 2138 level crossings in Serbia (on average 0,64 km/), these level crossings need adequate protection to minimize the risk of collisions (for road and rail traffic) when crossing.

3.7.4. Inadequate environmental protection

In many sections, there is no noise barrier to protect the natural and living environment. In addition, some sections of railway lines, which run through water protection areas do not have adequate protection against spills of hazardous substances. Adequate environmental protection is provided in the projects of modernization of certain rail lines in accordance with project.

3.8. Connections with neighbouring countries

The boundaries of the railway, network operated by the public railway infrastructure manager, are the points of the national border on individual sections of lines.

Railway border crossings:

- With Croatia:
  - Main route: Šid,
  - Regional route: Bogojevo.
- With Bosnia and Herzegovina:
  - Regional route: Brasina, Sremska Rača (Not operational anymore).

- With Montenegro:
  - Main route: Prijepolje/Vrbnica (bilateral agreement has been signed to perform all border procedures at one station after completion of works in the station Bijelo Polje).
- With Hungary
  - Main routes: Subotica, Horgoš.

- With Romania:
  - Regional routes: Kikinda, Vršac.

- With Macedonia
  - Main routes: Preševo (bilateral agreement has been signed to perform all border procedures at one station after completion of works in the station Tabanovce).

- With Albania:
  /
- With Bulgaria:
  - Main routes: Dimitrovgrad.

3.9. Environmental protection

Within the Transport Community Sustainable and Smart Mobility strategy and its goals, Sofia Declaration on Green Agenda for Western Balkans, Serbia conducts a policy orientated towards development of accessible infrastructure, usage of more environmentally friendly and secure vehicles, introduction of intelligent transport systems for urban traffic control, utilisation of integrated transport schemes. Also, as part of the WB Project Modernization of Rail Sector in Serbia, Resilience plans on climate change for railway infrastructure will be developed.

3.9.1. Noise protection

On the existing railway lines, on the busiest sections, measures for the protection of the natural and residential environment against noise are gradually being implemented. In accordance with the existing project documentation, on certain sections of reconstructed and modernized railway lines, noise barriers will be installed in urban areas.

3.9.2. Protection of water resources

Within the preparation of project documentation for each reconstruction and modernization of railway lines, the Environmental Impact Assessment is being developed, and which is the subject of approval of the Ministry of Environmental Protection.

3.10. Harmonization of timetables and an integrated public passenger transport system

In Serbia, currently, there is no possibility in practice to use one ticket for different transport modes, except for the public urban transportation in the city of Belgrade where the trains of urban railways are integrated into urban transit system.

International project promoting international connectivity and improvement of public transport in the region is project between Hungarian – Serbian railways, which envisages modernization of the railway line between Belgrade and Budapest. Part of that project is reconstruction and modernization of the Belgrade Center – Novi Sad – Subotica for 200 km/h.

3.11. Responsibility and managers of the railway infrastructure

Railway infrastructure is owned by the Republic of Serbia (in accordance with Law on Railways), it is operated and managed by Serbian Railways Infrastructure.

The management of public railway infrastructure is carried out by the operator on the basis of a contract with the government.

In accordance with the Railway Transport Act, the operator must ensure the proper management and maintenance of railway infrastructure and the management of railway transport.

The maintenance of public railway infrastructure and the management of railway traffic on it, is a mandatory public utility service.

4. Investments and maintenance costs[198]

On the Serbian railway network there are two sections representing bottlenecks: Batajnica-Surčin (section Batajnica-Beograd Ranžirna) with a capacity of 43 trains/day and Čiflik-Staničenje (section Niš Ranžirna-Dimitrovgrad) with a capacity of 46 trains/day. These two sections have the lowest capacity due to the speed limits and single-track traffic. On the horizon until 2024, during the reconstruction of a part of the line Niš Ranžirna Dimitrovgrad, some stations will be reconstructed, which will enable the traffic of longer trains. In addition, the train speed will be increased on this section. On the horizon until 2024 the whole section Niš Ranžirna-Dimitrovgrad will be electrified.

Planned investments in Serbia are:

Section/Station	Description	Period	EUR (mill)
Border-Šid-Golubinci (92,2 km)	Reconstruction and modernisation of the existing doubletrack line	2023- 2027	400
Stara Pazova-Beograd Centar (34,5 km)	Reconstruction and modernisation of the existing doubletrack line for a speed up to 200 km/h	2018- 2022	868,2
Stara Pazova – Novi Sad (40,4 km)	Reconstruction and modernisation of the existing doubletrack line for a speed up to 200 km/h with construction of viaduct and tunnel „Čortanovci“	2017 - 2022	621,39

[198] https://www.rfc-awb.eu/wp-content/uploads/2019/02/AWB-RFC_Bottleneck-study_final.pdf

Novi Sad – Subotica (108 km)	Reconstruction and modernisation of the Novi Sad - Subotica railway line or a speed up to 200 km/h with construction of the second track	2021 - 2024	988,38
Beograd (Batajnica)	New intermodal terminal	2020 - 2022	15,1
Ostružnica-Beograd Ranž. (20 km)	Second track on the bypass line Beograd RanžirnaOstružnica-Surčin-Batajnica	2023- 2025	52
Beograd Ranžirna	Station reconstruction with a container terminal	2019- 2021	5,5
Jajinci-Mala Krsna (59 km)	Reconstruction of existing single track	2019- 2021	39,2
Belgrade - Niš (240 km)	Reconstruction and modernisation of the Belgrade - Nis railway line with construction of the second track for a speed up to 200 km/h	2024- 2027	1.800
Stalać – Đunis (17,7 km)	Reconstruction and modernisation of the Stalać - Đunis railway line with construction of the second track	2022 - 2025	180
Niš – Brestovac (23,4 km)	Reconstruction and modernisation of the Niš - Brestovac railway line	2021 - 2023	59,85
Brestovac – Preševo (135,5 km)	Reconstruction and modernisation of the Brestovac - Preševo railway line	2023 - 2027	400
Niš-Dimitrovgrad (108km)	Reconstruction and modernisation with electrification: • Construction of Niš bypass (22 km) for a speed up to 160 km/h • Reconstruction and modernisation of railway section Sicevo-Dimitrovgrad (80 km) for a speed up to 120 km/h • Niš-Dimitrovgrad Railway line electrification (86 km)	2022- 2024	268,28

4.1. Railway investments

In 2020, **15,36 million EUR** were invested in new constructions and renovations of the railway network in in Serbia.

During 2020, works were completed on the section Subotica - Senta, with a total length of 28.4 km, worth 15.36 million euros. In addition, during 2020, work began on the construction of the Intermodal Terminal in Batajnica, with a total value of 15.1 million euros.

4.2. Investments in railway maintenance

In 2020, **37,17 million EUR** were invested in the maintenance of the railway network in Serbia. The sources for these funds were the budget of the Republic of Serbia, SRI' own funds and loans.

4.3. Objectives of transport policy and future development of the railway network[199]

Competitiveness of the economy and trade is deeply connected with the effectiveness of the transport system as a whole and with the efficiency of transport services provided. Setting up a proper transport system requires implementation of policy measures which should go hand in hand with modernization of transport infrastructure. It is important to have modern, reliable and safe infrastructure to restore market share from the past. Effects of institutional reforms are summarised as follows:

- Restructuring of the public enterprises working in the transport sector and introduction of result-oriented management;
- Contractual relationship between IM and GoS (Multi Annual Infrastructure Contract;
- Introduction of railway infrastructure maintenance on the basis of the track condition analyses;
- Market opening;
- Simplification of the border crossing procedures aiming at reduction of travelling time;
- Implementation of the measures, which would improve intramodality features of Serbian transport system.

4.4. Main priorities in the development of railway infrastructure

- Elimination of slow runs and "bottlenecks" and reconstruction of existing rail lines with the aim of returning to the projected level;
- Electrification of the Corridor Xc and some main and regional lines.
- Overhauled regional and local railway line using materials obtained by reconstruction of main lines;
- The modernized double track electrified line along the whole length of Corridor X and Xb through Serbia in accordance with the required European standards of safety and interoperability;
- Design speed of 160 km/h respectively 200 km/h on Corridor 10 on the sections where it is economically justified;
- Improve the efficiency of the main nodes (Belgrade, Niš, Novi Sad), in order to increase their capacity;
- Developed intermodal transport with intermodal terminals in key locations;
- Increased safety and security of the railway system;
- Making railway lines as a part of Rail Freight Corridors network (RFC 10 Alpine- Western Balkan);
- Deployment of ERTMS.

The total value of the ongoing projects is 978.1 million euros. The total value of the projects in preparation is 1,436.2 million euros. The total value of the planned projects is 4,149.5 million euros.

5. Railway infrastructure management, regular maintenance measures and network modernization

The management of railway infrastructure is regulated by the Law on Railways, Law on Safety in Railway Traffic.

[199]https://unece.org/fileadmin/DAM/trans/doc/2018/wp5/6_Mr._Marko_Jeremic_Serbia_Rail_Connectivity_Workshop_29Nov18.pdf

The management of public railway infrastructure is carried out by the operator on the basis of a contract with the government and includes in particular:

- preparation of a proposal for a maintenance plan for the existing public railway infrastructure;
- providing data and information for the preparation of expert bases for investments in public railway infrastructure;
- preparation of data and expert bases for new projects related to the implementation of the infrastructure manager's tasks;
- concluding legal transactions related to the management of public railway infrastructure and station buildings, in the case and to the extent that they do not serve or are not necessary for the implementation of their basic purpose.
- National Program of Public Railway Infrastructure, Multi annual infrastructure contract between the IM and the Government, annual maintenance programs of IM.

6. Map of the railway network

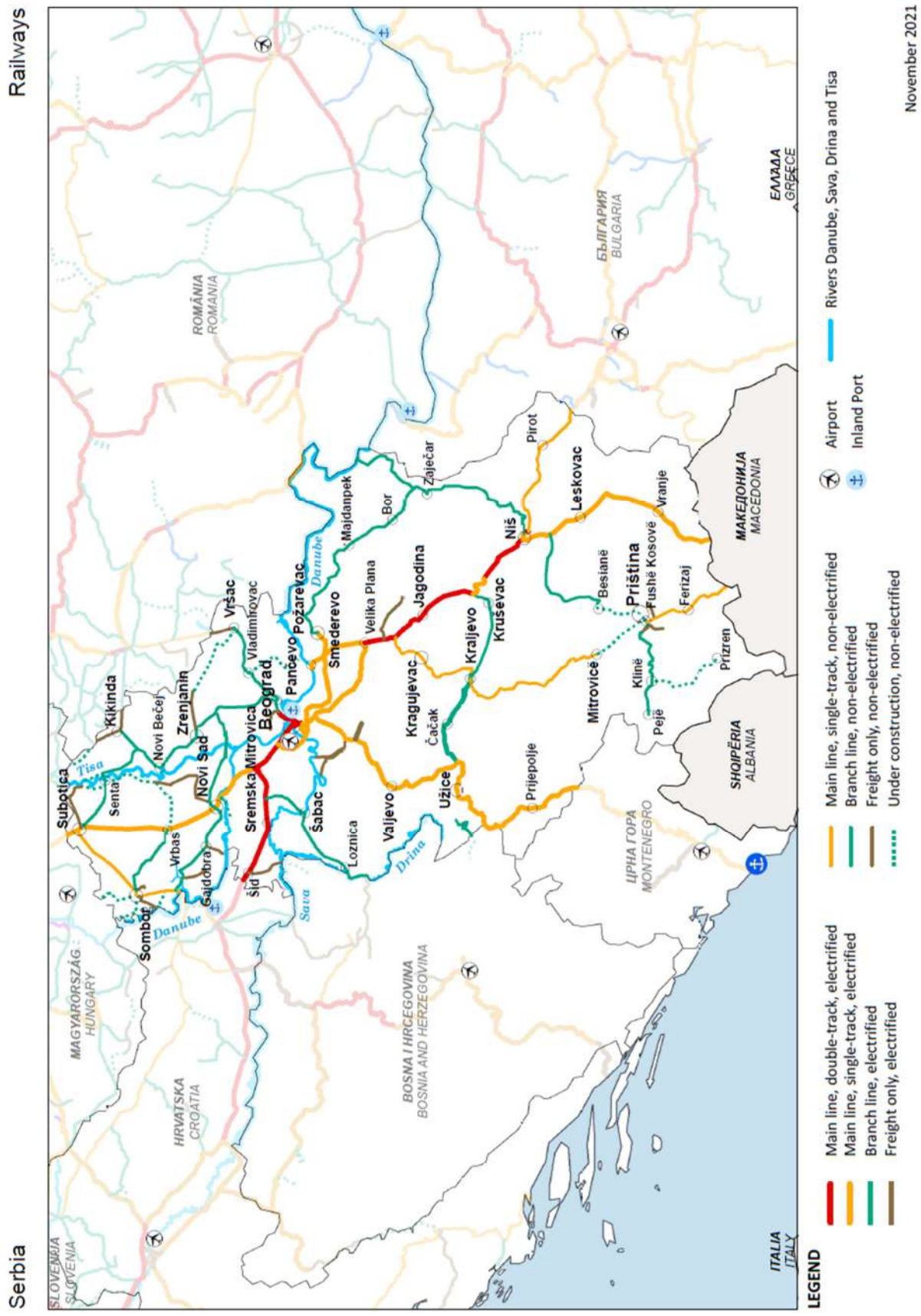

Figure 45: Map of the railway network of Serbia.

4.2.13. Danube region railways: SLOVAKIA

1. General data

- Inhabitants / 2020: **5.547.873**
- Membership in the EU: **1. 5. 2004**
- GDP / 2020 in EUR million: **91.55**
- GDP per capita / 2020 in EUR: **15.090**
- Capital city: **Bratislava**
- Land area (km²): **49.035**
- Km of railways per million inhabitants: **653,76**
- Km of railways per km² of the land area: **0,07**

2. Description of the railway network

- Length of railway lines (km): **3.627**
- Length of double-track railway lines (km): **1.017**
- Length of single-track railway lines (km): **2.610**
- Length of electrified railway lines (km): **1588**
- Length of non-electrified railway lines (km): **2.039**
- Length of railway lines (km), axle load D4 (22,5 tons/axle): **2511,75**
- Maximum length of freight train (m) on TEN-T network: **740**

3. Main features of railway network

3.1. General description of the transport characteristics of the railway network

The most rail network operates to the track gauge of 1.435 millimetres. Two lines connecting to Ukraine are "Russian broad gauge" of 1,520 mm.

Depending on traffic volume, economic importance, number of tracks and the connecting role of railway transport line, the railway network is divided into main and regional lines and single-track and double-track lines.

The main nodes, as we call the areas where several railway lines merge or come together, are in Bratislava, Žilina, Košice, Zvolen, Nové Zámky, Humenné.

Electrified railway lines on the Slovakian railway network and on junctions with foreign railway infrastructures, are equipped with 3 kV DC and 25 kV, 50Hz, AC system.

3.2. Traffic

3.2.1. Number of trains per day

- Average number of all trains per day on TEN-T - core network: **1118**
- Average number of all trains per day on TEN_T - comprehensive network: **540**
- Average number of all trains per day on the rest of the network: **1323**
- Average number of freight trains per day on TEN-T - core network: **383**
- Average number of freight trains per day per TEN_T – comprehensive network: **181**
- Average number of freight trains per day on the rest of the network: **273**.

3.2.2. International railway corridors

The railway network of the Republic of Slovakia is very important, from the European Union point of view, as several types of corridors and lines run along it, the most important of which are Trans-European Railway Network Corridors (TEN-T) and international rail corridors for competitive freight transport.

Part of the trans-European railway network (TEN-T)[200] (core and comprehensive network), are the following corridors in Slovakia[201]:

- Baltic-Adriatic Corridor, which runs from the border with the Poland, through Žilina, Trenčin, Trnava, Bratislava to the border with the Republic of Austria.

- Orient – East Med Corridor, which runs from the border with the Czech Republic, through Bratislava to the border with the Republic of Austria and Hungary.

- Rhine – Danube Corridor, which runs from the border with the Czech Republic (border crossing), through Žilina and Košice to the border with Ukraine (border crossing).

Part of comprehensive network are the sections:

- Orient – East Med Corridor, which continues from Bratislava through Galanta – Nové Zámky – Štúrovo to Hungaria and section Nové Zámky – Zvolen – Košice.

International freight rail corridors for competitive freight transport run through Slovakia in accordance with EU Regulation 913/2010 on European rail freight corridors (RFC):

- RFC 5[202]- Baltic – Adriatic; (Swinoujscie / Gdynia – Katowice – Ostrava / **Žilina** – **Bratislava** / Vienna / Klagenfurt – Udine – Venice / Trieste / Bologna / Ravenna and Graz – Maribor – Ljubljana – Koper / Trieste).

- RFC 7[203] – Orient East-Med; (The main route of the corridor is: Prague – Vienna/**Bratislava** – Budapest – Bucharest – Constanta, Arad – Craiova – Vidin – Sofia – Kulata – Thessaloniki – Athens and Sofia - Plovdiv - Svilengrad and the alternative routes Videle – Ruse Razpredelitelna – Sindel Razpredelitelna – Karnobat-Nova Zagora – Simeonovgrad – Svilengrad, Nova Zagora – Stara Zagora-Dimitrovgrad – Simeonovgrad, Plovdiv-Stara Zagora – Karnobat - Burgas.)

- RFC 9[204]- Rhine - Danube; (Strasbourg–Mannheim–Frankfurt–Nürnberg–Wels; Strasbourg–Stuttgart–München–Salzburg–Wels–Wien–**Bratislava**–Budapest–Arad–Brașov/Craiova–București–Constanța; **Čierna nad Tisou** (Slovak/ Ukrainian border)–**Košice**–**Žilina**–Horní Lideč–Prague–München/Nürnberg).

[200] https://transport.ec.europa.eu/transport-themes/infrastructure-and-investment_en
[201]https://www.researchgate.net/publication/311883399_Role_of_Railway_Transport_in_Tourism_Selected_Problems_and_Examples_in_Slovakia
[202] https://www.rfc5.eu/
[203] https://www.rfc7.eu
[204] https://rfc-rhine-danube.eu/

3.3. Railway infrastructure equipment

3.3.1. Length of railways equipped with GSM-R system

On the Slovakian Railways network, the GSM-R system is installed on 389,585 km of railway lines, ensuring radio signal coverage on the entire railway network, including tunnel coverage.

3.3.2. Length of railways equipped with ETCS level 1

The European safety system for train control ETCS Level 1, version 2.3.0d, which is one of the systems for ensuring the interoperability of the railway signalling safety system is being installed on railway infrastructure in Slovakia. 168,798 km of lines are already equipped with the ETCS Level 1 system.

3.3.3. Length of railways equipped with ETCS level 2

The first section, on the Slovakian railway network, which is equipped with the ETCS level 2 system, is Žilina - Čadca with the length of 28, 476 km.

3.4. Condition of railway infrastructure

The data about condition of the railway infrastructure were not available.

3.5. Speed limits

3.5.1. The maximum speed limit for freight traffic (only for TEN-T corridors or main lines) is **120 km/h**.

3.5.2. The maximum speed limit for passenger trains traffic (only for TEN-T corridors or main lines) is **160 km/h**.

3.5.3. Lengths of railway lines on the TEN-T network where the speed limit is less than 100 km/h (in km): **N/A**

3.6. Traffic safety

- Number of accidents in 2018, 2019 and 2020

Table 43: Number of accidents

Total number of emergencies	2018	2019	2020
Accidents	388	337	286
Accidents at level crossing	48	41	36

There were 286 accidents on Slovakian railways in 2020, which is 51 accidents less than in 2019.

- Number of level crossings, of roads with railways in 2018, 2019, 2020

Table 44: Number of level crossings

	2018	2019	2020
Number of level-crossings on TEN-T network (core and comprehensive)	N/A	N/A	N/A
Number of all level crossings	2085	2082	2079

*N/A – not available data

- Number of fatalities in accidents in 2018, 2019 and 2020[205]

Table 45: Number of fatalities

	2018	2019	2020
Total number of fatalities in accidents	101	88	81

Between 2018 and 2020, the number of fatalities decreased by 20%. The number of fatalities for year 2020 represents 14,7 fatalities per million inhabitants.

3.7. The main weaknesses of the railway network

3.7.1. Missing sections

*We were unable to obtain data on the missing sections of the Slovak railway network.

3.7.2. Railway bottleneck

*We were unable to obtain data on the missing sections of the Slovak railway network.

3.7.3. Level crossing

The previous chapter 3.6. shows the number of level crossings is declining, Table 44 shows that there are still 2079 level crossings in Slovakia (0,57 level crossing km/), these level crossings need adequate protection to minimize the risk of collisions (for road and rail traffic) when crossing.

3.7.4. Inadequate environmental protection

In many sections, there is no noise barrier to protect the natural and living environment. In addition, some sections of railway lines, which run through water protection areas do not have adequate protection against spills of hazardous substances. Protection against the leakage of harmful substances is addressed as a matter of priority by measures on rolling stock.

[205] Railways of the Slovak republic, department No 440

3.8. Connections with neighbouring countries

The boundaries of the railway, network operated by the public railway infrastructure manager, are the points of the national border on individual sections of lines.

Railway border crossings:

- With Austria:
  - Main routes: 2,

- With Czech Republic:
  - Main route: 3
  - regional route: 4.

- With Hungary:
  - Main routes: Rajka/Rusovce, Szob/Štúrovo, Hidasnémeti/Čaňa
  - regional routes: Komárom/Komárno, Nógrádszakál/Malé Straciny, Ipolytarnóc/ Lučenec, Somoskőújfalu/Fil'akovo, Bánréve/Lenartovce.

- With Poland:
  - Main route: 2
  - regional routes: 1

- . With Ukraine:
  - Main route: 2.

3.9. Environmental protection

The railway infrastructure manager in Slovakia pays constant attention to compliance with legislation in the field of ecology and its application in the company environment.[206]

Environmental protection in the operating conditions of ŽSR concerns the following areas:

- water protection and management;
- waste management,
- nature and landscape protection;
- air protection;
- protection of the earth's ozone layer and protection against the effects of greenhouse gases;
- protection of health against the effects of excessive noise and vibration (physical fields);
- elimination of environmental burdens and environmental damage;
- flood protection.

3.9.1. Noise protection

Measures to protect the natural and residential environment from noise are gradually being implemented on existing railway lines, on the busiest sections and program for protection against noise from railway and transport has been implemented within the Integrated Infrastructure Operational Program. The measures are designed to improve the quality of life of people living in areas close to the busiest railways in terms of noise pollution. It is always a combination of measures on infrastructure as well as on rolling stock (eg. Measures according to the NOIS TSI on freight wagons).

[206] https://www.zsr.sk/files/o-nas/vyrocne-spravy/vyrocnasprava2020.pdf

3.9.2. Protection of water resources

As part of the modernization of railway lines, measures are applied to prevent the leakage of oil and other pollutants in railway accidents (oil traps on railway station drainage facilities) and biodegradable lubricants are used to lubricate moving parts of switches and other infrastructure components. Biodegradable lubricants are also used to lubricate the rims of rolling stock. Also, rail vehicles without a closed toilet waste system are gradually being phased out of passenger transport.

3.10. Harmonization of timetables and an integrated public passenger transport system

Within the Slovak republic, there are several separate integrated systems connected to the railway. E. g. in Bratislava you can travel on one ticket by rail, suburban buses and public transport in Bratislava (trolleybuses, buses, trams). Within international transport within the neighbouring regions of Austria and Slovakia, the longest applied support is in regional rail transport between the cities of Vienna and Bratislava (use of preferential tariffs, combined use of rail and urban transport). Within the framework of cross – border transport between neighbouring regions of the state, especially preferential "small cross – border traffic" tariffs are used to support public transport.

3.11. Responsibility and managers of the railway infrastructure

The entire railway network is owned by the Republic of Slovakia and managed by the company Železnice Slovenskej republiky. In the territory of the Slovak Republic, they manage the railway infrastructure owned by the state the transport and transportation services are mainly provide by Železničná spoločnosť Slovensko, a. s. and. Železničná spoločnosť Cargo Slovakia, a.s. that correspond to the interests of the state transport policy and market requirements, including related activities.

The management of the operation of public railway infrastructure is performed by the operator by law (ŽSR) on the basis of a contract with the state. According to the Railway Act, the infrastructure manager must ensure the management, maintenance of railway infrastructure and management of railway traffic. The maintenance of public railway infrastructure and the management of railway traffic are considered to be services in the public interest.

4. **Investments and maintenance costs** The Railway of the Slovak republic as the infrastructure manager are responsible for the construction, renovation and maintenance of public railway infrastructure. Projects are financed from the budget of the Republic of Slovakia or with EU co-financing (European Cohesion Fund, European Regional Development Fund, co-financing in accordance with the Connecting Europe Facility and the Trans-European Transport Network TEN-T).

For the use of public railway infrastructure, carriers are obliged to pay a usage fee. The usage fee is intended to cover part of the maintenance costs, expressed by the public railway infrastructure manager.

4.1. Railway investments

In 2020, **62,5 million EUR** were invested in new constructions and renovations of the railway network in Slovakia.

Sources were invested to ongoing modernisation of to project between Puchov – Považská Teplá. Modernised section includes new bridge and two new tunnels. Part of the track are in new alignment. It is continuation of investment from EU funds. Modernization of the track between Lučivná – Poprad

funded from CEF fund and modernization of cog railway in High Tatras funded from own sources. The biggest project concerning modernization is planned from 2021 to 2024 with many other important sections.

4.2. Investments in railway maintenance

In 2020, investment projects were implemented in the total amount of **116, 6 million EUR**. The investments have been modernized railway infrastructure components - railway stations, railway undercarriage, superstructure, traction lines, security devices, retaining walls and construction of railway bridges.

4.3. Objectives of transport policy and future development of the railway network

The current transport infrastructure is not up to the required technical condition due to long term lack of funds for maintenance and in particular reconstruction; adaptations leading to removal of deficiencies in safety, capacity and environmental burden are not carried out in sufficient scope. Many important road transport routes still pass-through urban areas, the railway network (in particular the regional one) inadequately responds to the needs for public transport services.

Investment in transport infrastructure has a huge potential in boosting growth and jobs. Member State performance is measured here in indicators such as the perceived efficiency of transport services and progress towards completion of the TEN-T core network.

4.4. Main priorities in the development of railway infrastructure

Development projects on Slovakian railway infrastructure are based on the (National Transport Development Program) in the Slovakia for the period until 2030 (2050).
The objectives pursued by the infrastructure development plans are:

- load capacity upgrade to (class) D4 (22.5 t) on RFC corridors,
- upgrade the maximum enabled speed on corridor lines, to 160 km/h,
- improving safety at level crossings,
- modernization of signal safety devices with the aim to enable the traffic in both directions on double-track lines,
- modernization of signal safety devices with the aim to remote by control traffic.

5. Railway infrastructure management, regular maintenance measures and network modernization

The management of railway infrastructure is regulated by the Railway Transport Act (Railway Act no. 513/2009 Coll. – and decrees of the Ministry of Transport).

The management of public railway infrastructure is carried out by the operator on the basis of a contract with the government and includes in particular:

- preparation of a proposal for a maintenance plan for the existing public railway infrastructure;
- providing data and information for the preparation of expert bases for investments in public railway infrastructure;
- preparation of data and expert bases for new projects related to the implementation of the infrastructure manager's tasks;

- concluding legal transactions related to the management of public railway infrastructure and station buildings, in the case and to the extent that they do not serve or are not necessary for the implementation of their basic purpose.

6. Map of railway network.

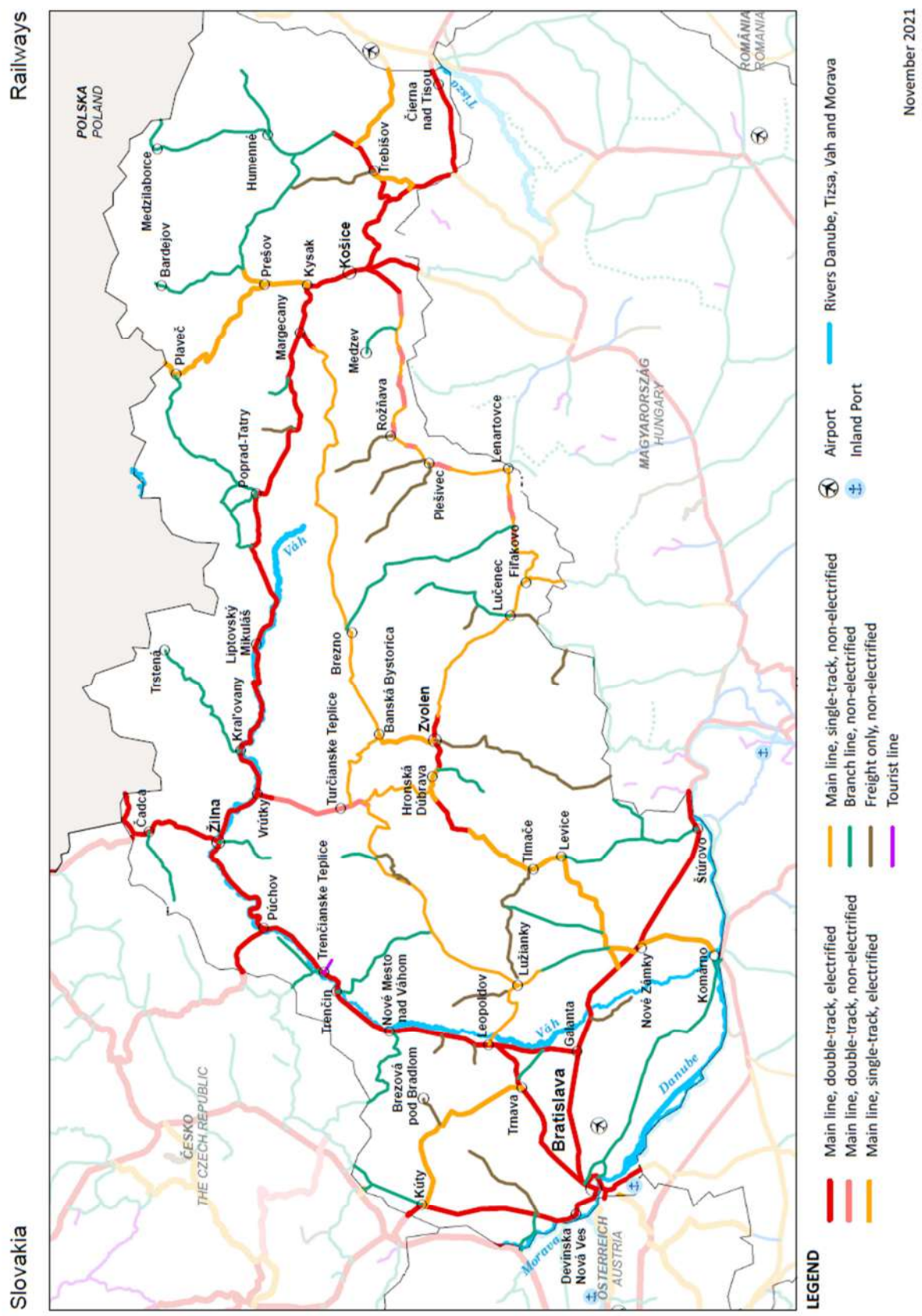

Figure 46:Map of railway network of Slovakia.

4.2.14. Danube region railways: SLOVENIA

1. General data

- Inhabitants / 2020: **2.111.461**
- Membership in the EU: **1. 5. 2004**
- GDP / 2020 in EUR million: **44,93**
- GDP per capita / 2020 in EUR: **21.909**
- Capital city: **Ljubljana**
- Land area (km²): **20.271**
- Km of railways per million inhabitants: **572,0**
- Km of railways per km² of the land area: **0,06**

2. Description of the railway network

- Length of railway lines (km): **1.207,70**
- Length of double-track railway lines (km): **333,54**
- Length of single-track railway lines (km): **874,16**
- Length of electrified railway lines (km): **609,70**
- Length of non-electrified railway lines (km): **598,00**
- Length of railway lines (km), axle load D4 (22,5 tons/axle): **270**
- Maximum length of freight train (m) on TEN-T network: **740**

3. Main features of railway network

3.1. General description of the transport characteristics of the railway network

The entire rail network operates to the track gauge of 1.435 millimetres.

Depending on traffic volume, economic importance, number of tracks and the connecting role of railway transport line, the railway network is divided into main and regional lines and single-track and double-track lines.

The main nodes, as we call the areas where several railway lines merge or come together, are in Divača, Koper, Ljubljana and Maribor.

Electrified railway lines on the Slovenian railway network, with the exception of junctions with foreign railway infrastructures, are equipped with a single DC system, with a nominal voltage of 3 kV.

Other electrification systems are also emerging at junctions with foreign railway infrastructures:

- with the Republic of Croatia at the Dobova station and at the Šapjane station - 25 kV AC, frequency 50 Hz,
- with the Republic of Hungary at the Hodoš station - 25 kV AC, frequency 50 Hz,
- with the Republic of Austria at the Jesenice station - 15 kV AC, frequency 16 2/3 Hz.[207]

3.2. Traffic

3.2.1. Number of trains per day

- Average number of all trains per day on TEN-T - core network: N/A
- Average number of all trains per day on TEN_T - comprehensive network: N/A
- Average number of all trains per day on the rest of the network: N/A

[207] https://www.slo-zeleznice.si/sl/infrastruktura/javna-zelezniska-infrastruktura/elektroenergetika

- Average number of freight trains per day on TEN-T - core network: N/A
- Average number of freight trains per day per TEN_T – comprehensive network: N/A
- Average number of freight trains per day on the rest of the network: N/A

* N/A – data not available

3.2.2. International railway corridors

The railway network of the Republic of Slovenia is very important, from the European Union point of view, as several types of corridors and lines run along it, the most important of which are Trans-European Railway Network Corridors (TEN-T) and international rail corridors for competitive freight transport.

Part of the trans-European railway network (TEN-T)[208] (core and comprehensive network), are the following corridors in Slovenia:

- Baltic-Adriatic Corridor, which runs from the border with the Republic of Austria (Šentilj) through Zidani Most, Ljubljana, to Koper or borders with the Republic of Italy (Sežana).

- The Mediterranean Corridor, which runs from the border with the Republic of Hungary (Hodoš), through Ormož, Pragersko, Zidani Most, Ljubljana, to Koper or borders with the Republic of Italy (Sežana), with the branch Zidani Most, R. Croatia (Dobova).

Part of comprehensive network are the sections:

- Border with the Republic of Austria (Jesenice) to Ljubljana.

- From Pivka to the border with the Republic of Croatia (Ilirska Bistrica).

- From Ormož to the border with the Republic of Croatia (Središče).

International freight rail corridors for competitive freight transport run through Slovenia in accordance with EU Regulation 913/2010 on European rail freight corridors (RFC):[209]

- RFC 5[210] - Baltic – Adriatic; (Swinoujscie / Gdynia – Katowice – Ostrava / Žilina – Bratislava / Vienna / Klagenfurt – Udine – Venice / Trieste / Bologna / Ravenna in Graz – Maribor – Ljubljana – Koper / Trieste); established in November 2015.

- RFC 6 [211]- Mediterranean; (Almeria - Valencia / Algeciras / Madrid - Zaragoza / Barcelona - Marseille - Lyon - Turin - Milan - Verona - Padua / Venice - Trieste / Koper - Ljubljana - Budapest and Ljubljana / Rijeka - Zagreb - Budapest - Zahony (Hungarian-Ukrainian border); established in November 2013.

- RFC 10 - Alps - Western Balkans. The main route of the corridor is: Salzburg – Fillah – **Ljubljana** – /Wels/Linz – Graz – Maribor –Zagreb – Vinkovci/Vukovar – Tovarnik – Belgrad – Sofia – Svilengrad.

[208] https://transport.ec.europa.eu/transport-themes/infrastructure-and-investment_en
[209] Smernice za železniške strukturne in funkcionalne podsisteme, Program omrežja 2022, Slovenske železnice
[210] https://www.rfc5.eu/
[211] https://www.railfreightcorridor6.eu/RFC6/web.nsf/OnePager/index.html

- RFC 11[212] - Amber Corridor. **Koper — Ljubljana** –/Zalaszentiván — Sopron/Csorna –/(Hungarian-Serbian border) — Kelebia — Budapest –/– Komárom — Leopoldov/Rajka — Bratislava — Žilina — Katowice/Kraków — Warszawa/Łuków — Terespol — (Polish-Belarusian border)).

3.3. Railway infrastructure equipment

3.3.1. Length of railways equipped with GSM-R system

On the Slovenian Railways network, the GSM-R system is installed on all main and regional lines in length of 1.207,70 km, ensuring radio signal coverage on the entire railway network, including tunnel coverage. The radio signal also covers border areas with neighbouring countries.[213]

3.3.2. Length of railways equipped with ETCS level 1

The European safety system for train control ETCS Level 1, version 2.3.0d, which is one of the systems for ensuring the interoperability of the railway signalling safety system is being installed on railway infrastructure in Slovenia. 407,9 km of lines are already equipped with the ETCS Level 1 system and 82,9 km of lines are in preparation for the upgrade.

3.3.3. Length of railways equipped with ETCS level 2

At this moment, the lines are not equipped with the ETCS level 2 system. The first section, on the Slovenian railway network, which will be equipped with the ETCS level 2 system, will be the second track to the port of Koper. This track, which is 27.1 km long, will run between Divača and Koper. It is currently under construction.

3.4. Condition of railway infrastructure

The condition of the infrastructure on Slovenian railways is (appropriate, inadequate, poor, good; in percent)

3.5. Speed limits

3.5.1. The maximum speed limit for freight traffic (only for TEN-T corridors or main lines) is **100 km/h.**

3.5.2. The maximum speed limit for passenger trains traffic (only for TEN-T corridors or main lines) is **140 km/h**.

3.5.3. Lengths of railway lines on the TEN-T network where the speed limit is less than 100 km/h : N/A

* N/A – data not available

3.6. Traffic safety

[212] https://rfc-amber.eu/

[213] Program omrežja 2022, Slovenske železnice

- Number of accidents in 2018, 2019 and 2020[214]

Table 46: Number of accidents

Total nuber of emergencies	2018	2019	2020
All train accidents	14	10	N/A
Accidents at level crossing	9	7	N/A

*N/A – not available data

There were 10 accidents on Slovenian railways in 2019, which is 4 accidents less than in 2018.

- Number of level crossings, of roads with railways in 2018, 2019, 2020[215]

Level crossings are regulated in accordance with the prescribed conditions in the valid regulations of the Republic of Slovenia together with road operators.

Table 47: Number of level crossings

	2018	2019	2020
Number of level-crossings on TEN-T network (core and comprehensive)	N/A	N/A	N/A
Number of all level crossings	735	721	714

*N/A – not available data

- Number of fatalities in accidents in 2018, 2019 and 2020

Table 48:Number of fatalities:

	2018	2019	2020
Total number of fatalities	5	2	N/A

*N/A – not available data

Between 2018 and 2019, the number of fatalities decreased by 40%. The number of fatalities for year 2019 represents 1 fatality per million inhabitants.

3.7. The main weaknesses of the railway network

3.7.1. Missing sections

There are no important missing railway sections in Slovenia. However, there are several railway infrastructure sections that have to be upgraded.

3.7.2. Railway bottleneck

- Unarranged railway split and station Pragersko,
- single track of the line No. 20: Ljubljana - Jesenice,

[214] https://www.gov.si/teme/varnost-v-zelezniskem-prometu/

[215] https://www.gov.si/teme/varnost-v-zelezniskem-prometu/

- single-track Divača - Koper (port),
- single-track Maribor - Šentilj,
- missing upgrade of line the line No. 50 Ljubljana - Divača,
- unarranged railway hub Ljubljana,
- unarranged railway splitting and station Grosuplje.

3.7.3. Level crossing

The previous chapter 3.6. shows the number of level crossings is declining, Table 47 shows that there are still 714 level crossings in Slovenia, (on average 0,59 km/), these level crossings need adequate protection to minimize the risk of collisions (for road and rail traffic) when crossing.

3.7.4. Inadequate environmental protection

In many sections, there is no noise barrier to protect the natural and living environment. In addition, some sections of railway lines, which run through water protection areas do not have adequate protection against spills of hazardous substances.

3.8. Connections with neighboring countries

The boundaries of the railway ,network operated by the public railway infrastructure manager, are the points of the national border on individual sections of lines.

Railway border crossings:

- With Austria:
  - Main routes: Jesenice in Šentilj,
  - regional route: Prevalje

- With Hungary:
  - Main route: Hodoš,
  - regional route: Lendava.

- With Croatia:
  - Main routes: Dobova, Središče in Ilirska Bistrica,
  - regional routes: Rogatec, Imeno, Metlika, Rakitovec.

- With Italy:
  - Main route:Sežana,
  - regional routes: Repentabor, Vrtojba.

3.9. Environmental protection

When providing railway transport services in the territory of the Republic of Slovenia, carriers must comply with all the rules necessary to prevent and reduce the burden on the environment. In case of an environmental accident, they must immediately inform the public railway infrastructure manager, who is responsible for notifying the relevant authorities and take urgent measures to reduce the harmful effects on the environment.

In Slovenia, in 2002 the railway infrastructure manager established an environmental management system within the framework of the ISO 14001 standard and obtained the ISO 14001 certificate, which is renewed periodically[216].

In the field of energy management, which is one of the most important factors in the management of international and domestic rail transport and maintenance of railway infrastructure, the operator regularly takes care of optimization and reduction of energy consumption, which is proved by obtaining the certificate DIN EN ISO 50001: 2011 standard.

3.9.1. Noise protection

On the existing railway lines, on the busiest sections, measures for the protection of the natural and residential environment against noise are gradually being implemented, within the Operational Program for Noise Protection, a Railway Noise Protection Program has been prepared. It is designed to improve the quality of life of people living in areas close to the busiest railways in terms of noise pollution.

3.9.2. Protection of water resources

The EU Water Framework Directive (WFD) aims to protect and improve the ecological status of water bodies in order to promote sustainable watershed use. This requires that 'good status' should be achieved for all surface and groundwater bodies by 2015 or 2027 at the latest. Consequently, NRAs must ensure that their water management practices meet the requirements of the WFD, thereby ensuring sustainable development of the railway network.

3.10. Harmonization of timetables and an integrated public passenger transport system

To ensure the goal of better mobility, the state has set up an Integrated Public Passenger Transport (IJPP) project, which enables the purchase of a single ticket and travel by all means of public passenger transport.[217]

Slovenia is also involved in an international project that promotes international conectivity and improvement of public transport in the region, CONNECT2CE.

Slovenia and Italy are participating in a pilot project for the development of an integrated ticket on the Ljubljana-Trieste route, which will connect train and bus passenger transport. Similar cooperation has been established with the Croatian Railways.

3.11. Responsibility and managers of the railway infrastructure

The entire railway network is owned by the Republic of Slovenia. The infrastructure is managed and maintained by the company Slovenske železnice-Infrastruktura, a company for the management and maintenance of railway infrastructure and railway traffic management, ltd.

The railway network in the Republic of Slovenia is defined in the Railway Transport Act[218] and regulation Decree on categorization of lines.

The management of public railway infrastructure is carried out by the operator Slovenske železnice infrastruktura, on the basis of a contract with the government.

[216] https://www.slo-zeleznice.si/en/skupina-slovenske-zeleznice/predstavitev/certifikati
[217] https://www.ap-ljubljana.si/splosna-enotna-vozovnica-ijpp/
[218] http://pisrs.si/Pis.web/pregledPredpisa?id=ZAKO1614

In accordance with the Railway Transport Act, the operator must ensure the proper management and maintenance of railway infrastructure and the management of railway transport.

The maintenance of public railway infrastructure and the management of railway traffic on it, is a mandatory public utility service.

4. Investments and maintenance costs

Slovenian Infrastructure Agency is responsible for the construction, renovation and maintenance of public railway infrastructure. Projects are financed from the budget of the Republic of Slovenia or with EU co-financing (European Cohesion Fund, European Regional Development Fund, co-financing in accordance with the Connecting Europe Facility and the Trans-European Transport Network TEN-T).

Section/Station	Description	Period	EUR (mill)
Jesenice-border-Rosenbach (AT)	Security-technical upgrading of the Karavanke railway tunnel	2020-2021	115
Ljubljana-Jesenice	Upgrade of line, stations and stop points, construction of second track, speed increase, tracks for 740 m trains	N/A	1.140
Maribor-Šentilj, Stations Maribor, Mb. Tezno, Pesnica, Šentilj	Upgrade of axle load category, track extensions, increase speed and capacity, new signal-safety devices, improve electric supply, new platforms and accesses	2018-2022	254
Pragersko	Upgrade of axle load category, track extensions, increase speed and capacity, new signal-safety devices, improve electric supply, new platforms and accesses	until 2025	89
Zidani Most-Šentilj	Upgrading signal safety devices, remote traffic control at all stations on the section	2019-2023	71,4
Pragersko-MariborŠentilj; Dobova-Zidani Most	ETCS Level 1 implementation	2017-2023	19
Maribor-Šentilj	New double-track line with new tunnel and viaduct between Maribor and Pesnica	2020 2027	101

Ljubljana-Jesenice	ETCS Level 1 implementation	until 2024	10
Divača - Koper	Construction of the second track Divača - Koper		940
Ljubljana - Divača	Upgrade of section of line Ljubljana - Divača		N/A

4.1. Railway investments

N/A- Data about railway investments in the year 2020 are not available.

4.2. Investments in railway maintenance

N/A- Data about investments in the railway maintenance in the year 2020 are not available.

4.3. Objectives of transport policy and future development of the railway network

Slovenia's strategic advantage, due to its favorable traffic position, is not a guarantee that traffic flows will in fact pass through Slovenia. The current infrastructure does not yet meet modern connectivity standards. Therefore, the quality public passenger transport services are not sufficient, because they do not yet enable the implementation of a tact timetable and consequently a higher density of passenger transport trains. In its strategy, the Republic of Slovenia emphasizes the need to upgrade and renovate the routes on the priority freight corridors RFC 5, RFC 6, RFC 11 and RFC 10, which ensures its long-term competitiveness. In the new financial perspective, the European Union will place special emphasis on the European Green Deal, where sustainable mobility will be the key in achieving the climate goals in the field of transport, with a greater role for rail transport.

In the coming years, the priority areas of transport infrastructure policy are the modernization, reconstruction and upgrading of railway lines [219]. One of the basic goals will be the transfer of freight and passenger traffic from roads to railways (load-bearing capacity of the superstructure, modernization of the rolling stock for passenger traffic, tact timetables, etc.).

4.4. Main priorities in the development of railway infrastructure

Development projects on Slovenian railway infrastructure are based on the Resolution on the National Transport Development Program in the Republic of Slovenia for the period until 2030.
The objectives pursued by the infrastructure development plans are:

- load capacity upgrade to (class) D4 (22.5 t) on RFC corridors,
- upgrade the maximum enabled speed on corridor lines, to 160 km/h,
- construction of a second track or an additional single-track line on single-track sections of lines on RFC corridors,
- improving safety at level crossings,
- modernization of signal safety devices with the aim to enable the traffic in both directions on double-track lines,
- modernization of signal safety devices with the aim to remote by control traffic.

[219]https://www.slo-zeleznice.si/images/infrastruktura/predpisi/d2020/PN_2021-2023_S-Infra_potrjen.pdf

5. Railway infrastructure management, regular maintenance measures and network modernization

The management of railway infrastructure is regulated by the Railway Transport Act (ZZelP-NPB17).

The management of public railway infrastructure is carried out by the operator on the basis of a contract with the government and includes in particular:

- preparation of a proposal for a maintenance plan for the existing public railway infrastructure;
- providing data and information for the preparation of expert bases for investments in public railway infrastructure;
- preparation of data and expert bases for new projects related to the implementation of the infrastructure manager's tasks;
- concluding legal transactions related to the management of public railway infrastructure and station buildings, in the case and to the extent that they do not serve or are not necessary for the implementation of their basic purpose.

6. Map of the railway network

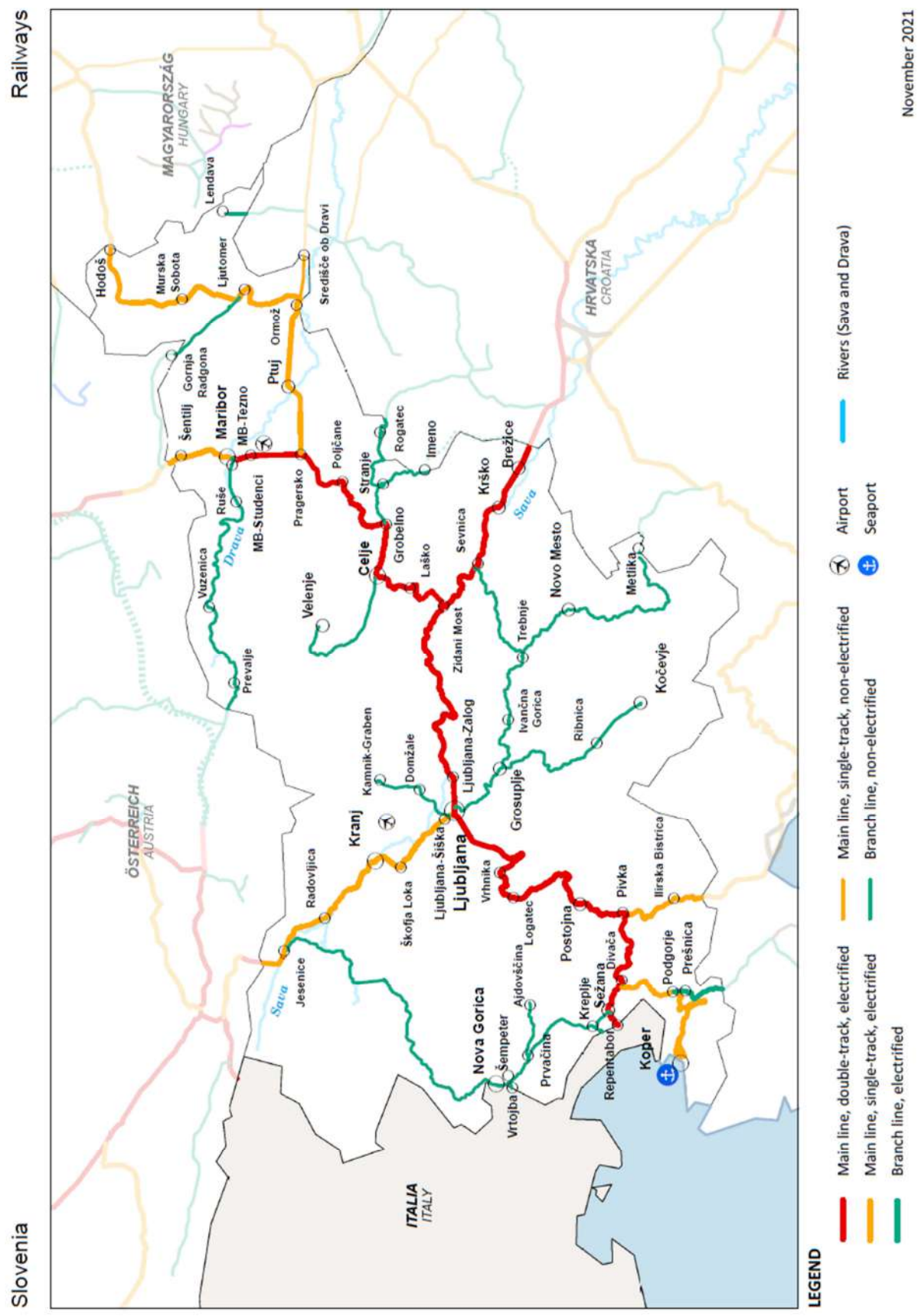

Figure 47: Map of railway network of Slovenia

4.2.15. Danube region railways: UKRAINE – ODESSA

1. General data

- Inhabitants / 2020: **2.387.282 (2020)**
- Membership in the EU: **not a member EU - neighbouring country**
- GDP / 2020 in EUR million: **5.255 (2016)**
- GDP per capita / 2020 in EUR: **2.206 (2016)**
- Capital city: **Odessa**
- Land area (km²): **33.310**
- Km of railways per million inhabitants: **432,79**
- Km of railways per km² of the land area: **0,03**

2. Description of the railway network

- Length of railway lines (km): **1.033,20**
- Length of double-track railway lines (km): **453,3**
- Length of single-track railway lines (km): **579,50**
- Length of electrified railway lines (km): **663,10**
- Length of non-electrified railway lines (km): **370,10**
- Length of railway lines (km), axle load D4 (22,5 tons/axle): N/A
- Maximum length of freight train (m) on TEN-T network: N/A.

*N/A data not available.

3. Main features of railway network

3.1. General description of the transport characteristics of the railway network

The entire rail network operates to the track gauge of 1.520 millimetres[220].

Odessa railways account for about 20% of freight and more than 16% of passenger traffic of Railways of Ukraine. In the region of Odessa Railways there are large sea and river ports, which ensure high traffic load.

Depending on traffic volume, economic importance, number of tracks and the connecting role of railway transport line, the railway network is divided into main and regional lines and single-track and double-track lines.

The main nodes, as we call the areas of several railway stations. According to the needs of railway transport system and traffic regulation, are in Odessa, Borshchi and Rozdil`na.

3.2. Traffic

3.2.1. Number of trains per day

Average number of trains per day data are not available.

3.2.2. International railway corridors

[220] https://en.wikipedia.org/wiki/Ukrainian_Railways

Part of the trans-European railway network (TEN-T)[221] (core and comprehensive network), are the following corridors in Odessa:/

International freight rail corridors for competitive freight transport run through Odessa in accordance with EU Regulation 913/2010 on European rail freight corridors (RFC)[222]: /

3.3. Railway infrastructure equipment

3.3.1. Length of railways equipped with GSM-R system

On the Ukrainian- Odessa Railways network the GSM-R system is not yet installed.

3.3.2. Length of railways equipped with ETCS level 1

The European safety system for train control ETCS Level 1, version 2.3.0d, which is one of the systems for ensuring the interoperability of the railway signalling safety system is not yet installed on railway infrastructure in Odessa.

3.3.3. Length of railways equipped with ETCS level 2

The European safety system for train control ETCS Level 2 system is not yet installed on railway lines in Odessa.

3.4. Condition of railway infrastructure

Data about condition of the railway infrastructure in Odessa were not obtained.

3.5. Speed limits

3.5.1. The maximum speed limit for freight traffic (only for TEN-T corridors or main lines) is N/A km/h.

3.5.2. The maximum speed limit for passenger trains traffic (only for TEN-T corridors or main lines) is N/A km/h.

3.5.3. Lengths of railway lines on the TEN-T network where the speed limit is less than 100 km/h (in km): N/A.

*N/A data not available.

3.6. Traffic safety

*Data about traffic safety on Ukrainian railways were not available.

3.7. The main weaknesses of the railway network

3.7.1. Missing sections

- Line Berezy ne- Serpneve.

*The data about missing sections of the railway network were not confirmed by the representative of Ukraine - Odessa Oblast.

3.7.2. Railway bottleneck

[221] https://transport.ec.europa.eu/transport-themes/infrastructure-and-investment_en
[222] https://rne.eu/rail-freight-corridors/rail-freight-corridors-general-information/

*Data about railway bottleneck of the railway network were not available.

3.7.3. Level crossing

*Data about railway level crossings were not available.

3.7.4. Inadequate environmental protection

In many sections, there is no noise barrier to protect the natural and living environment. Adequate protection against spills of hazardous substances is provided.

*The data about environmental protection of the railway network of Odessa were not confirmed by the representative of Ukraine - Odessa.

3.8. Connections with neighbouring countries and administrative divisions of Ukraine

The boundaries of the railway, network operated by the public railway infrastructure manager, are the points of the national border on individual sections of lines.

Railway border crossings:

- With the Republic of Moldova:
  - Main routes: Serpneve, Kuchurhan, Bolhrad, Reni
  - regional route: Slobidka

- With Romania:
  - Main route: Izmail
  - regional route:

1. With other administrative divisions of Ukraine:

- Mykolaiv Oblast
- Kirovohrad Oblast
- Vinnytsia Oblast

3.9. Environmental protection

When providing railway transport services in the territory of the Odessa oblast carriers must comply with all the rules necessary to prevent and reduce the burden on the environment. In case of an environmental accident, they must immediately inform the public railway infrastructure manager, who is responsible for notifying the relevant authorities and take urgent measures to reduce the harmful effects on the environment.

3.9.1. Noise protection

On the existing railway lines, on the busiest sections, measures for the protection of the natural and residential environment against noise are (gradually) being implemented.

*The data were not confirmed by the representative of Ukraine - Odessa Oblast.

3.9.2. Protection of water resources

*Data were not available.

3.10. Harmonization of timetables and an integrated public passenger transport system

*Data were not available.

3.11. Responsibility and managers of the railway infrastructure

The railway network in Odessa Oblast managed by Odessa Railways. Odessa Railways is a rail operator in Ukraine. It is a territorial branch company of Ukrainian Railways.

The management of public railway infrastructure is carried out by the operator on the basis of a contract with the government.

4. Investments and maintenance costs

4.1. Railway investments

N/A- Data about railway investments in year 2020 are not available.

4.2. Investments in railway maintenance

N/A- Data about investments in the maintenance of railways in year 2020 are not available.

4.3. Objectives of transport policy and future development of the railway network

As important as the railways are today for Ukraine's inclusive and sustainable growth, their significance is expected to further increase in the future.[223]

*The data have not been confirmed by the Oblast representative.

4.4. Main priorities in the development of railway infrastructure

Under the "Drive Ukraine 2030", the National Transport Strategy for the period up to 2030, 39 infrastructure projects are included in the Indicative TEN-T Investment Action Plan. The total value of the projects is EUR 4.5 billion and are co-financed under mixed funds, from the European Investment Bank, the World Bank and PPPs.[224]

*The data have not been confirmed by the Oblast representative.

5. Railway infrastructure management, regular maintenance measures and network modernization

The management of railway infrastructure is regulated by the (Railway Transport Act??).

The management of public railway infrastructure is carried out by the operator on the basis of a contract with the government and includes in particular:

- preparation of a proposal for a maintenance plan for the existing public railway infrastructure;
- providing data and information for the preparation of expert bases for investments in public railway infrastructure;
- preparation of data and expert bases for new projects related to the implementation of the infrastructure manager's tasks;

[223] https://documents1.worldbank.org/curated/en/380921613465958258/pdf/Concept-Project-Information-Document-PID-Modernizing-Ukrainian-Railways-P173448.pdf
[224] https://www.railwaypro.com/wp/ukraines-ten-t-projects-valuated-at-eur-4-5-billion/

- concluding legal transactions related to the management of public railway infrastructure and station buildings, in the case and to the extent that they do not serve or are not necessary for the implementation of their basic purpose.
-

6. Map of railway network

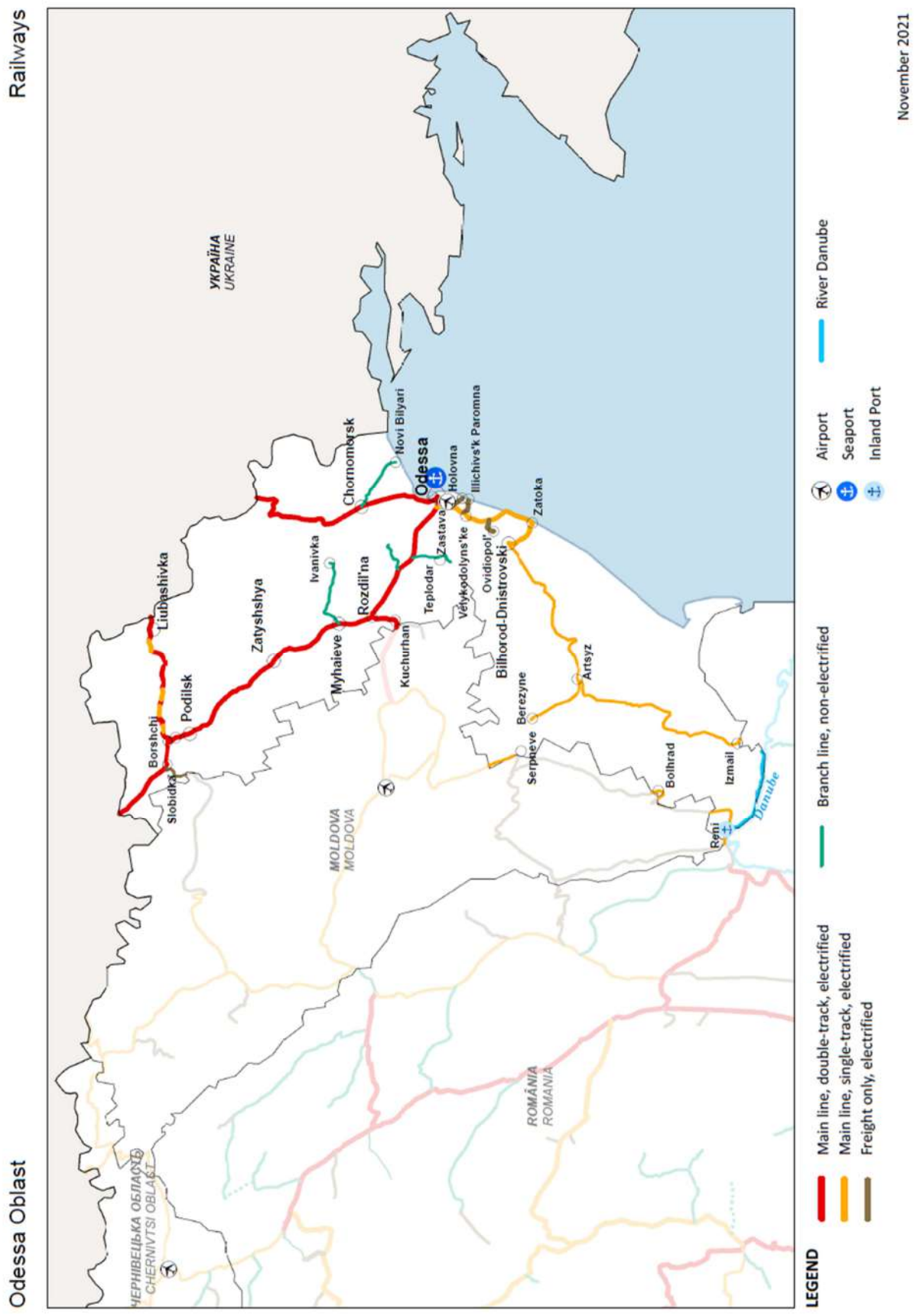

Figure 48: Map or railway network of Odessa

4.2.16. Danube region railways: UKRAINE – IVANO – FRANKIVSK

1. General data

- Inhabitants / 2020: **1.361.109 (2021)**
- Membership in the EU: **not a member EU - neighbouring country**
- GDP / 2020 in EUR million: **3.101 (2016)**
- GDP per capita / 2020 in EUR: **2.206 (2016)**
- Capital city: **Ivano- Frankivsk**
- Land area (km²): **13.900**
- Km of railways per million inhabitants: **356,98**
- Km of railways per km² of the land area: **0,04**

2. Description of the railway network

- Length of railway lines (km): **493,60**
- Length of double-track railway lines (km): **0,00**
- Length of single-track railway lines (km): **493,60**
- Length of electrified railway lines (km): **0,00**
- Length of non-electrified railway lines (km): **493,60**
- Length of railway lines (km), axle load D4 (22,5 tons/axle): **N/A**
- Maximum length of freight train (m) on TEN-T network: **N/A**.

*N/A data not available.

3. Main features of railway network

3.1. General description of the transport characteristics of the railway network

The entire rail network operates to the track gauge of 1.520 millimetres[225].

The main, single-track and non-electrified railway lines run through the Ivano-Frankivsk Oblast. Doble-track railway line runs from Morshyn to the North of Ukraine.

The main nodes, according to the needs of railway transport system and traffic regulation, are in Ivano-Frankivsk, Khryplyn, Ugryniv, Kolomyya, Delyatyn, Dolyna.

3.2. Traffic

3.2.1. Number of trains per day

Average number of trains per day are not available.

3.2.2. International railway corridors

Part of the trans-European railway network (TEN-T)[226] (core and comprehensive network), are the following corridors in Ivano- Frankivsk: /

International freight rail corridors for competitive freight transport run through Ivano- Frankivsk in accordance with EU Regulation 913/2010 on European rail freight corridors (RFC)[227]: /

3.3. Railway infrastructure equipment

[225] https://en.wikipedia.org/wiki/Ukrainian_Railways
[226] https://transport.ec.europa.eu/transport-themes/infrastructure-and-investment_en
[227] https://rne.eu/rail-freight-corridors/rail-freight-corridors-general-information/

3.3.1. Length of railways equipped with GSM-R system

On the Ukrainian- Ivano- Frankivsk Railways network the GSM-R system is not yet installed.

3.3.2. Length of railways equipped with ETCS level 1

The European safety system for train control ETCS Level 1, version 2.3.0d, which is one of the systems for ensuring the interoperability of the railway signalling safety system is not yet installed on railway infrastructure in Ivano- Frankivsk.

3.3.3. Length of railways equipped with ETCS level 2

The European safety system for train control ETCS Level 2 system is not yet installed on railway lines in Ivano- Frankivsk.

3.4. Condition of railway infrastructure

Data about condition of the railway infrastructure in Ivano- Frankivsk were not available.

3.5. Speed limits

3.5.1. The maximum speed limit for freight traffic (only for TEN-T corridors or main lines) is N/A km/h.

3.5.2. The maximum speed limit for passenger trains traffic (only for TEN-T corridors or main lines) is N/A km/h.

3.5.3. Lengths of railway lines on the TEN-T network where the speed limit is less than 100 km/h (in km): In general, only connecting curves and feeders to Gv systems are driven at lower speeds: N/A.

*N/A data not available.

3.6. Traffic safety

*Data about traffic safety on Ukrainian railways were not available.

3.7. The main weaknesses of the railway network

3.7.1. Missing sections

*The data about missing sections of the railway network were not available.

3.7.2. Railway bottleneck

*The data about railway bottleneck of the railway network were not available.

3.7.3. Level crossing

*Data about railway level crossings were not available.

3.7.4. Inadequate environmental protection

In many sections, there is no noise barrier to protect the natural and living environment. Adequate protection against spills of hazardous substances is provided.

*The data about environmental protection of the railway network of Ivano-Frankivsk were not confirmed by the representative of Ukraine - Ivano-Frankivsk Oblast.

3.8. Connections with neighbouring countries administrative divisions of Ukraine

The boundaries of the railway, network operated by the public railway infrastructure manager, are the points of the national border on individual sections of lines.

Railway border crossings:

- With Romania:
    - No railway border crossing.

7. With other administrative divisions of Ukraine:
    - Chernivitsi Oblast
    - Zakarpattia Oblast
    - Ternopil Oblast
    - Lviv Oblast

3.9. Environmental protection

When providing railway transport services in the territory of the Ivano- Frankivsk oblast carriers must comply with all the rules necessary to prevent and reduce the burden on the environment. In case of an environmental accident, they must immediately inform the public railway infrastructure manager, who is responsible for notifying the relevant authorities and take urgent measures to reduce the harmful effects on the environment.
*The data were not confirmed by the representative of Ukraine - Ivano-Frankivsk Oblast.

3.9.1. Noise protection

On the existing railway lines, on the busiest sections, measures for the protection of the natural and residential environment against noise are (gradually) being implemented.

*The data were not available and confirmed by the representative of Ukraine - Ivano-Frankivsk Oblast

3.9.2. Protection of water resources

*****The data were not available.

3.10. Harmonization of timetables and an integrated public passenger transport system

*The data were not available.

3.11. Responsibility and managers of the railway infrastructure

The railway network in Ivano- Frankivsk Oblast managed by Ukrainian Railways, as state-owned joint-stock company of rail transport in Ukraine, a monopoly that controls the vast majority of the railroad transportation in the country.[228]

The management of public railway infrastructure is carried out by the operator on the basis of a contract with the government.

4. Investments and maintenance costs

[228] https://en.interfax.com.ua/news/economic/683559.html

4.1. Railway investments

N/A- Data about railway investments in year 2020 are not available.

4.2. Investments in railway maintenance

N/A- Data about investments in the maintenance of railways in year 2020 are not available.

4.3. Objectives of transport policy and future development of the railway network

As important as the railways are today for Ukraine's inclusive and sustainable growth, their significance is expected to further increase in the future.[229]

*The data have not been confirmed by the Oblast representative.

4.4. Main priorities in the development of railway infrastructure

Under the "Drive Ukraine 2030", the National Transport Strategy for the period up to 2030, 39 infrastructure projects are included in the Indicative TEN-T Investment Action Plan. The total value of the projects is EUR 4.5 billion and are co-financed under mixed funds, from the European Investment Bank, the World Bank and PPPs.[230]

*The data have not been confirmed by the Oblast representative.

5. Railway infrastructure management, regular maintenance measures and network modernization

The management of public railway infrastructure is carried out by the operator on the basis of a contract with the government and includes in particular:

- preparation of a proposal for a maintenance plan for the existing public railway infrastructure;
- providing data and information for the preparation of expert bases for investments in public railway infrastructure;
- preparation of data and expert bases for new projects related to the implementation of the infrastructure manager's tasks;
- concluding legal transactions related to the management of public railway infrastructure and station buildings, in the case and to the extent that they do not serve or are not necessary for the implementation of their basic purpose.

6. Map of railway network

[229] https://documents1.worldbank.org/curated/en/380921613465958258/pdf/Concept-Project-Information-Document-PID-Modernizing-Ukrainian-Railways-P173448.pdf

[230] https://www.railwaypro.com/wp/ukraines-ten-t-projects-valuated-at-eur-4-5-billion/

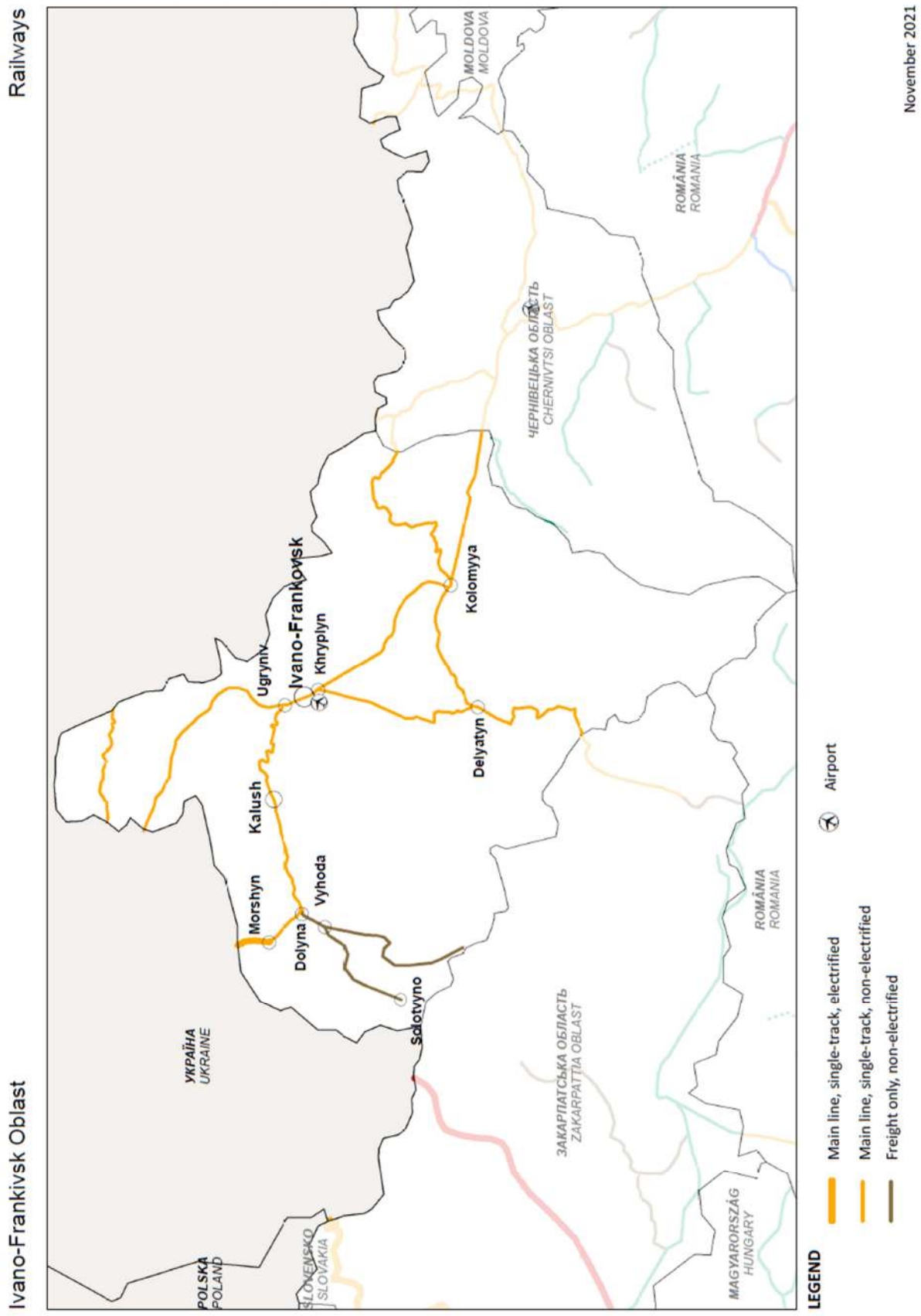

Figure 49: Map of railway network of Ivano- Frankivsk Oblast

4.2.17. Danube region railways: UKRAINE – CHERNIVITSI

1. General data

- Inhabitants / 2020: **901.632 (2020)**
- Membership in the EU: **not a member EU - neighbouring country**
- GDP / 2020 in EUR million: **2.035 (2016)**
- GDP per capita / 2020 in EUR: **2.206 (2016)**
- Capital city: **Chernivtsi**
- Land area (km²): **8.097**
- Km of railways per million inhabitants: **453,74**
- Km of railways per km² of the land area: **0,05**

2. Description of the railway network

- Length of railway lines (km): **412,90**
- Length of double-track railway lines (km): **0,00**
- Length of single-track railway lines (km): **412,90**
- Length of electrified railway lines (km): **0,00**
- Length of non-electrified railway lines (km): **412,90**
- Length of railway lines (km), axle load D4 (22,5 tons/axle): **N/A**
- Maximum length of freight train (m) on TEN-T network: **N/A.**

*N/A data not available.

3. Main features of railway network

3.1. General description of the transport characteristics of the railway network

The entire rail network operates to the track gauge of 1.520 millimetres[231].

Railway lines in the Chernivtsi Oblast are single-track and non-electrified. The main railway lines run through the city of Chernivtsi to the border with Romania and Moldova.

The main nodes of railway lines are in Stefaneshty, Luzhany and Larga.

3.2. Traffic

3.2.1. Number of trains per day:

*Data of average number of trains per day are not available.

3.2.2. International railway corridors

Part of the trans-European railway network (TEN-T)[232] (core and comprehensive network), are the following corridors in Chernivtsi: /

International freight rail corridors for competitive freight transport run through Chernivtsi in accordance with EU Regulation 913/2010 on European rail freight corridors (RFC)[233]:

/

3.3. Railway infrastructure equipment

[231] https://en.wikipedia.org/wiki/Ukrainian_Railways
[232] https://transport.ec.europa.eu/transport-themes/infrastructure-and-investment_en
[233] https://rne.eu/rail-freight-corridors/rail-freight-corridors-general-information/

3.3.1. Length of railways equipped with GSM-R system

On the Ukrainian- Chernivtsi railway network the GSM-R system is not yet installed.

3.3.2. Length of railways equipped with ETCS level 1

The European safety system for train control ETCS Level 1, version 2.3.0d, which is one of the systems for ensuring the interoperability of the railway signalling safety system is not yet installed on railway infrastructure in Chernivtsi.

3.3.3. Length of railways equipped with ETCS level 2

The European safety system for train control ETCS Level 2 system is not yet installed on railway lines in Chernivtsi.

3.4. Condition of railway infrastructure

*Data about condition of the railway infrastructure in Chernivtsi were not available.

3.5. Speed limits

3.5.1. The maximum speed limit for freight traffic (only for TEN-T corridors or main lines) is N/A km/h.

3.5.2. The maximum speed limit for passenger trains traffic (only for TEN-T corridors or main lines) is N/A km/h.

3.5.3. Lengths of railway lines on the TEN-T network where the speed limit is less than 100 km/h (in km): N/A.

*N/A data not available

3.6. Traffic safety

*Data about traffic safety on Ukrainian railways were not available.

3.7. The main weaknesses of the railway network

3.7.1. Missing sections

*The data about missing sections of the railway network of Chernivitsi were not available.

3.7.2. Railway bottleneck

*The data about railway bottleneck of the railway network of Chernivitsi were not available.

3.7.3. Level crossing

*Data about railway level crossings were not available.

3.7.4. Inadequate environmental protection

In many sections, there is no noise barrier to protect the natural and living environment. Adequate protection against spills of hazardous substances is not provided.

*The data about environmental protection of the railway network of Chernivitsi were not confirmed by the representative of Ukraine – Chernivitsi.

3.8. Connections with neighbouring countries and administrative divisions of Ukraine

The boundaries of the railway, network operated by the public railway infrastructure manager, are the points of the national border on individual sections of lines.

Railway border crossings:

- With Moldova:
  - Main routes: Larha, Mamalyha, Sokyrjany.

- With Romania:
  - Main route: Vadul-Siret.

- With other administrative divisions of Ukraine:
  - Ivano-Frankivsk Oblast,
  - Ternopil Oblast,
  - Khmelnytskyi Oblast,
  - Vinnytsia Oblast.

3.9. Environmental protection

When providing railway transport services in the territory of the Chernivtsi Oblast carriers must comply with all the rules necessary to prevent and reduce the burden on the environment. In case of an environmental accident, they must immediately inform the public railway infrastructure manager, who is responsible for notifying the relevant authorities and take urgent measures to reduce the harmful effects on the environment.
*The data were not confirmed by the representative of Ukraine – Chernivitsi Oblast.

3.9.1. Noise protection

On the existing railway lines, on the busiest sections, measures for the protection of the natural and residential environment against noise are (gradually) being implemented.

*The data were not available and confirmed by the representative of Ukraine – Chernivitsi Oblast.

3.9.2. Protection of water resources

*The data were not available.

3.10. Harmonization of timetables and an integrated public passenger transport system

*The data were not available.

3.11. Responsibility and managers of the railway infrastructure

The railway network in Chernivtsi Oblast is managed by Ukrainian Railways, as state-owned joint-stock company of rail transport in Ukraine, a monopoly that controls the vast majority of the railroad transportation in the country.[234]

[234] https://en.interfax.com.ua/news/economic/683559.html

The management of public railway infrastructure is carried out by the operator on the basis of a contract with the government.

4. Investments and maintenance costs

4.1. Railway investments

N/A- Data about railway investments in year 2020 are not available.

4.2. Investments in railway maintenance

N/A- Data about investments in the maintenance of railways in year 2020 are not available.

4.3. Objectives of transport policy and future development of the railway network

As important as the railways are today for Ukraine's inclusive and sustainable growth, their significance is expected to further increase in the future.[235]

*The data have not been confirmed by the Oblast representative.

4.4. Main priorities in the development of railway infrastructure

Under the "Drive Ukraine 2030", the National Transport Strategy for the period up to 2030, 39 infrastructure projects are included in the Indicative TEN-T Investment Action Plan. The total value of the projects is EUR 4.5 billion and are co-financed under mixed funds, from the European Investment Bank, the World Bank and PPPs.[236]

*The data have not been confirmed by the Oblast representative.

5. Railway infrastructure management, regular maintenance measures and network modernization

The management of railway infrastructure is regulated by the (Railway Transport Act??).

The management of public railway infrastructure is carried out by the operator on the basis of a contract with the government and includes in particular:

- preparation of a proposal for a maintenance plan for the existing public railway infrastructure;
- providing data and information for the preparation of expert bases for investments in public railway infrastructure;
- preparation of data and expert bases for new projects related to the implementation of the infrastructure manager's tasks;
- concluding legal transactions related to the management of public railway infrastructure and station buildings, in the case and to the extent that they do not serve or are not necessary for the implementation of their basic purpose.
-

6. Map of railway network

[235] https://documents1.worldbank.org/curated/en/380921613465958258/pdf/Concept-Project-Information-Document-PID-Modernizing-Ukrainian-Railways-P173448.pdf

[236] https://www.railwaypro.com/wp/ukraines-ten-t-projects-valuated-at-eur-4-5-billion/

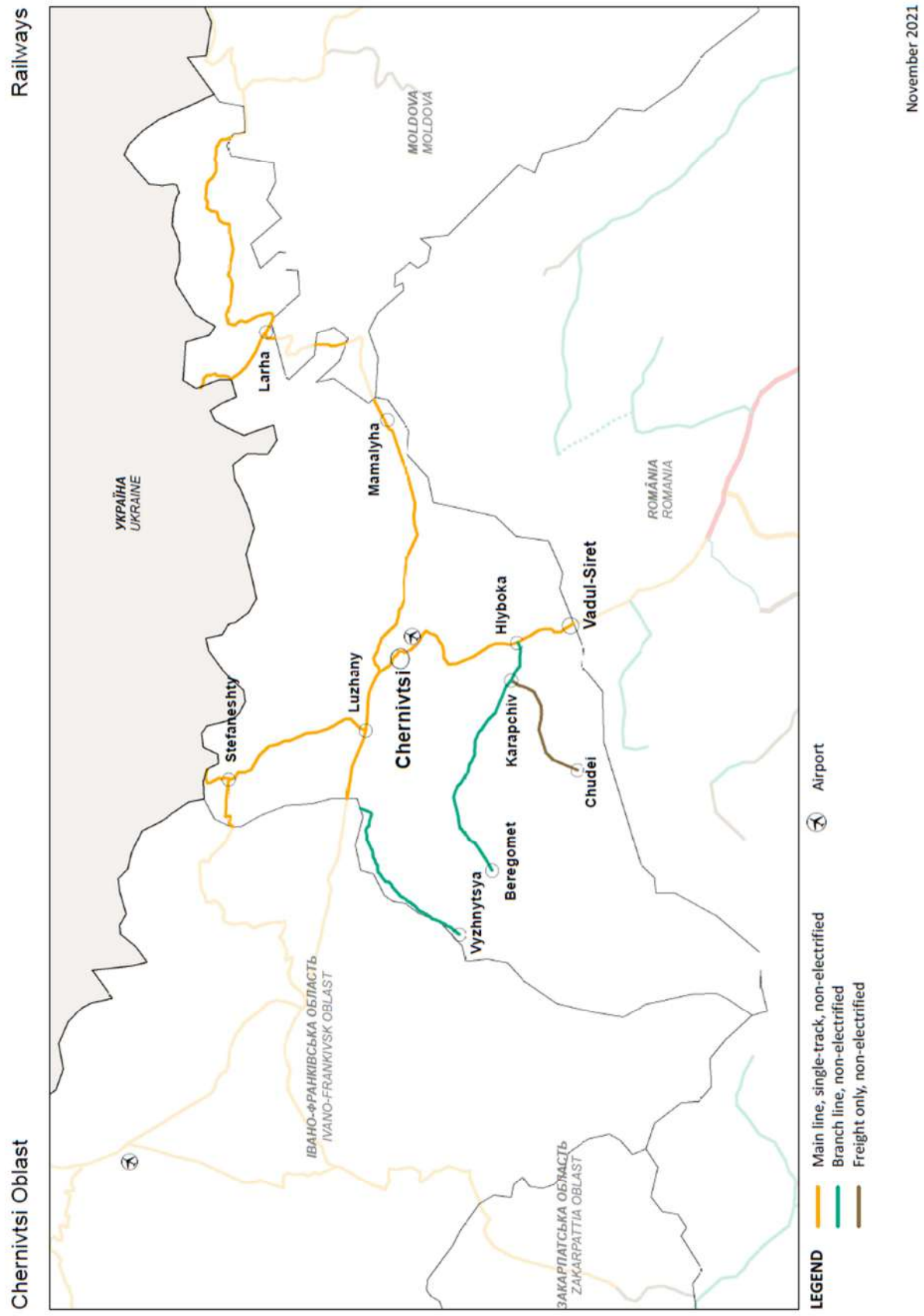

Figure 50:Map of railway network of Chernivitsi

4.2.18. Danube region railways: UKRAINE - ZAKARPATTIA

1. General data

- Inhabitants / 2020: **1.260.129 (2021)**[237]
- Membership in the EU: **not a member EU - neighbouring country**
- GDP / 2020 in EUR million: **2.840 (2016)**
- GDP per capita / 2020 in EUR: **2.206 (2016)**
- Capital city: **Uzhorod**
- Land area (km²): **12.735**
- Km of railways per million inhabitants: **477,17**
- Km of railways per km² of the land area: **0,05**

2. Description of the railway network

- Length of railway lines (km): **601,00**
- Length of double-track railway lines (km): **117,20**
- Length of single-track railway lines (km): **482,70**
- Length of electrified railway lines (km): **259,90**
- Length of non-electrified railway lines (km): **341,10**
- Length of railway lines (km), axle load D4 (22,5 tons/axle): **N/A**
- Maximum length of freight train (m) on TEN-T network: **N/A**.

*N/A data not available.

3. Main features of railway network

3.1. General description of the transport characteristics of the railway network

The entire rail network operates to the track gauge of 1.520 millimetres[238].

The main, electrified double-track runs from border with Slovakia to the Ukraine inland. This line is also a connection to the TEN-t Mediterranean corridor.

Other lines in the Zakarpattia Oblast are single-track and non-electrified railway lines.

The main nodes, according to the needs of railway transport system and traffic regulation, are in Chop and Batovo.

3.2. Traffic

3.2.1. Number of trains per day

Data of average number of trains per day data are not available.

3.2.2. International railway corridors

Part of the trans-European railway network (TEN-T)[239] (core and comprehensive network), are the following corridors in Zakarpattia:

[237] https://en.wikipedia.org/wiki/Zakarpattia_Oblast
[238] https://en.wikipedia.org/wiki/Ukrainian_Railways

[239] https://transport.ec.europa.eu/transport-themes/infrastructure-and-investment_en

- Mediterranean TEN-T corridor

International freight rail corridors for competitive freight transport run through Zakarpattia in accordance with EU Regulation 913/2010 on European rail freight corridors (RFC)[240]:

- RFC 6[241] - Mediterranean; (Almeria - Valencia / Algeciras / Madrid - Zaragoza / Barcelona - Marseille - Lyon - Turin - Milan - Verona - Padua / Venice - Trieste / Koper - Ljubljana - Budapest and Ljubljana / Rijeka - Zagreb - Budapest - **Zahony (Hungarian-Ukrainian border)**.

3.3. Railway infrastructure equipment

3.3.1. Length of railways equipped with GSM-R system

On the Ukraine - Zakarpattia railways network, the GSM-R system is not yet installed.

3.3.2. Length of railways equipped with ETCS level 1

The European safety system for train control ETCS Level 1, version 2.3.0d, which is one of the systems for ensuring the interoperability of the railway signalling safety system is not yet installed on railway infrastructure in Zakarpattia.

3.3.3. Length of railways equipped with ETCS level 2

The European safety system for train control ETCS Level 2 system is not yet installed on railway lines in Zakarpattia.

3.4. Condition of railway infrastructure

Data about condition of the railway infrastructure in Zakarpattia were not available.

3.5. Speed limits

3.5.1. The maximum speed limit for freight traffic (only for TEN-T corridors or main lines) is N/A km/h.

3.5.2. The maximum speed limit for passenger trains traffic (only for TEN-T corridors or main lines) is N/A km/h.

3.5.3. Lengths of railway lines on the TEN-T network where the speed limit is less than 100 km/h (in km): In general, only connecting curves and feeders to Gv systems are driven at lower speeds: N/A.

*N/A data not available.

3.6. Traffic safety

*Data about traffic safety on Ukrainian railways were not available.

3.7. The main weaknesses of the railway network

3.7.1. Missing sections

[240] https://rne.eu/rail-freight-corridors/rail-freight-corridors-general-information/
[241] https://www.railfreightcorridor6.eu/RFC6/web.nsf/OnePager/index.html

*The data about missing sections of the railway network were not available.

3.7.2. Railway bottleneck

*The data about railway bottleneck of the railway network were not available.

3.7.3. Level crossing

*Data about railway level crossings were not available.

3.7.4. Inadequate environmental protection

In many sections, there is no noise barrier to protect the natural and living environment. Adequate protection against spills of hazardous substances is provided.

*The data about environmental protection of the railway network of Zakarpattia were not available and confirmed by the representative of Ukraine - Zakarpattia Oblast.

3.8. Connections with neighbouring countries and administrative divisions of Ukraine

The boundaries of the railway, network operated by the public railway infrastructure manager, are the points of the national border on individual sections of lines.

In Zakarpattia Oblast there are railway border crossings with: Slovakia, Hungary and Romania.

- With Romania:
  - Regional route: Diakovo, Valea Viseului.
- With Hungary
- With Slovakia
- With Poland:
  There are no railway border crossings with Poland.
- With other administrative divisions of Ukraine:
  - Ivano-Frankivsk Oblast,
  - Lviv Oblast.

3.9. Environmental protection

When providing railway transport services in the territory of the Zakarpattia oblast carriers must comply with all the rules necessary to prevent and reduce the burden on the environment. In case of an environmental accident, they must immediately inform the public railway infrastructure manager, who is responsible for notifying the relevant authorities and take urgent measures to reduce the harmful effects on the environment.
*The data were not available and confirmed by the representative of Ukraine - Zakarpattia Oblast.

3.9.1. Noise protection

On the existing railway lines, on the busiest sections, measures for the protection of the natural and residential environment against noise are (gradually) being implemented.

*The data were not available and confirmed by the representative of Ukraine - Zakarpattia Oblast.

3.9.2. Protection of water resources

*The data were not available.

3.10. Harmonization of timetables and an integrated public passenger transport system

*****The data were not available.

3.11. Responsibility and managers of the railway infrastructure

The railway network in Zakarpattia Oblast managed by Ukrainian Railways, is a state-owned joint-stock company of rail transport in Ukraine, a monopoly that controls the vast majority of the railroad transportation in the country.[242]

The management of public railway infrastructure is carried out by the operator on the basis of a contract with the government.

4. Investments and maintenance costs

4.1. Railway investments

N/A- Data about railway investments in year 2020 are not available.

4.2. Investments in railway maintenance

N/A- Data about investments in the maintenance of railways in year 2020 are not available.

4.3. Objectives of transport policy and future development of the railway network

As important as the railways are today for Ukraine's inclusive and sustainable growth, their significance is expected to further increase in the future.[243]

*The data have not been confirmed by the Oblast representative.

4.4. Main priorities in the development of railway infrastructure

Under the "Drive Ukraine 2030", the National Transport Strategy for the period up to 2030, 39 infrastructure projects are included in the Indicative TEN-T Investment Action Plan. The total value of the projects is EUR 4.5 billion and are co-financed under mixed funds, from the European Investment Bank, the World Bank and PPPs.[244]

*The data have not been confirmed by the Oblast representative.

5. Railway infrastructure management, regular maintenance measures and network modernization

The management of public railway infrastructure is carried out by the operator on the basis of a contract with the government and includes in particular:

- preparation of a proposal for a maintenance plan for the existing public railway infrastructure;
- providing data and information for the preparation of expert bases for investments in public railway infrastructure;
- preparation of data and expert bases for new projects related to the implementation of the infrastructure manager's tasks;

[242] https://en.interfax.com.ua/news/economic/683559.html
[243]https://documents1.worldbank.org/curated/en/380921613465958258/pdf/Concept-Project-Information-Document-PID-Modernizing-Ukrainian-Railways-P173448.pdf
[244] https://www.railwaypro.com/wp/ukraines-ten-t-projects-valuated-at-eur-4-5-billion/

- concluding legal transactions related to the management of public railway infrastructure and station buildings, in the case and to the extent that they do not serve or are not necessary for the implementation of their basic purpose.

6. Map of railway network

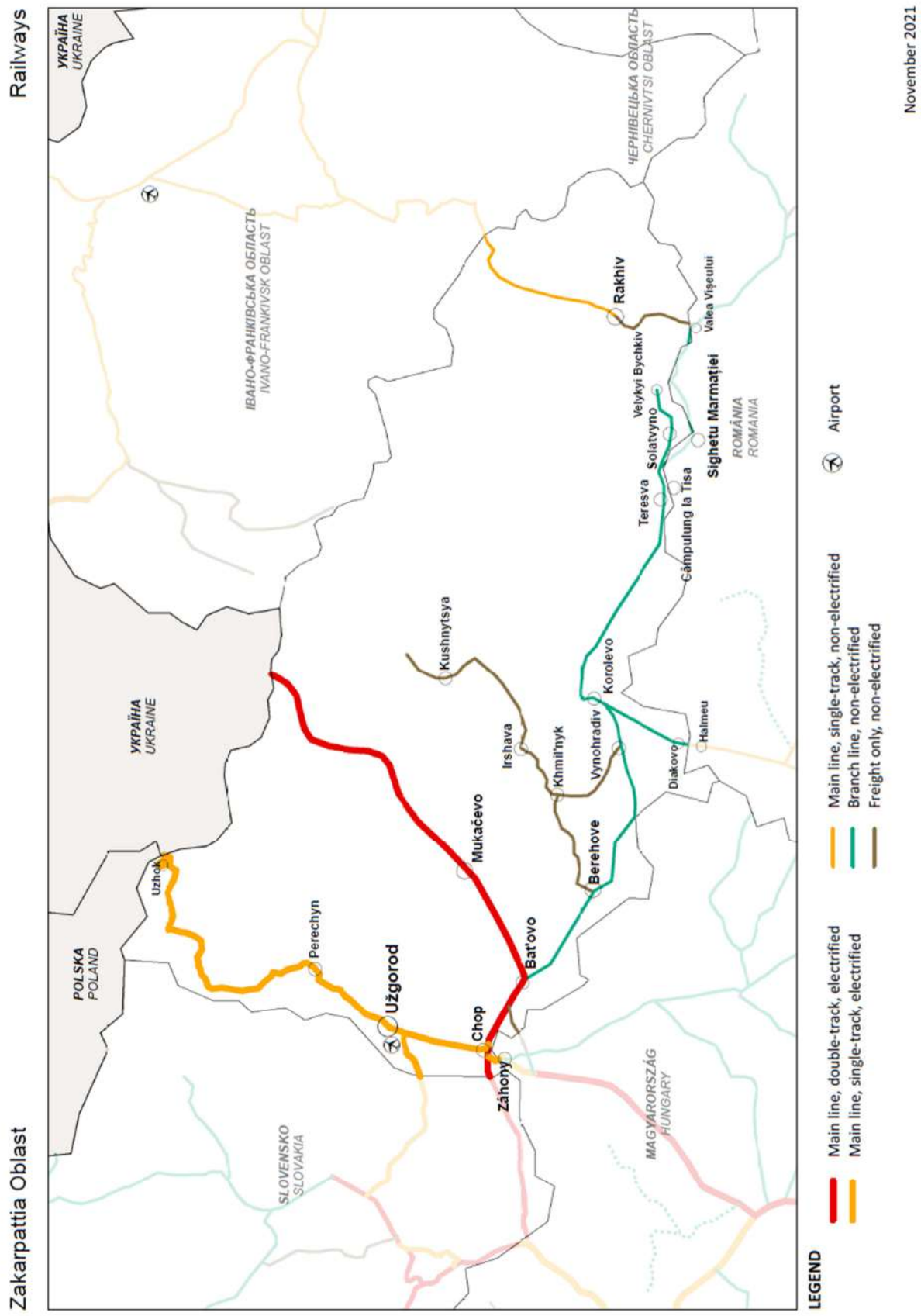

Figure 51: Map of railway network of Zakarpattia

5. CONCLUSION

The Transport Infrastructure Study in the Danube region - railways links, shows the basic data on the network in the Danube region.

The study is based on a number of data from available EU databases. In addition, data from individual countries were obtained in three rounds. In doing so, involving experts from various countries.

The diversity of development, landscape and climatic conditions are also conditioned by the diversity of the approach to railway problems in each country. Nevertheless, the study shows the characteristics of railways in the Danube Region. The collected data revealed a large difference in the size, condition and development of the railway network between the countries in the region.

The study will serve to a number of purposes, an especially contribute to a further joint treatment of railway policy in the Danube Region. It represents a useful database for further cooperation and decision making on railways in this region. On the basis of the data from the study, it will be possible to expand the knowledge of railways in the Danube Region with additional contents.

Based on the European Union Strategy for the Danube Region (EUSDR 1b), joint planning in the region in the field of railway maintenance and development will be important in the coming years. This will take into account the uniform approach of the standard on TEN-T and freight corridors. Measures will be taken to remove obstacles to better passenger and freight traffic. Great emphasis will be placed on the protection of the natural and living environment from the negative effects of rail transport. Interoperability is one of the basic goals of the future development and interconnection of railway networks in an individual country.

Railway network is a national treasure to the country and to the whole region. Therefore, this infrastructure should be properly maintained. Proper maintenance is presented in a chapter about Railway infrastructure management. A well-maintained network is the basic condition for a smooth mobility in a country and also for the whole region. In this area there are a lot of possibilities for further cooperation between the countries of the region.

Priority area the European Union Strategy for the Danube Region (EUSDR 1b) - railway, road and air mobility faces transport challenges, which are complex in nature due to differences between transport modes and development gaps between countries and regions in the Danube macro-region. Road maintenance and road safety, rail freight, which contribute to full modal integration and improved air connectivity, have been high on the EU's transport agenda for years, as well as on most national transport agendas. All modes of transport have common issues related to energy efficiency and emissions of conventional pollutants, which require comprehensive action at local, regional and global levels.

Railways are an infrastructure element which has to be, for the satisfaction of users and functionality of the state, open for traffic all hours in a year. This is the reason why full attention has to be given to railway networks. Basic condition for effective management is a good database, which can give as a well-defined overview of the condition and scale of road network.

The transfer of freight from congested roads to railways is one of the key priorities in the countries of the Danube region.

This elaborate gives as one of the steps to better overview of the railways of the Danube region and can be useful to anyone who is dealing with this subject.