

Massive HSR expansion is the answer Europe needs

High-speed rail transport is strongly encouraged by European policies, and the states respond to this challenge by launching projects and plans to make these connections happen. The investments are high, but the calculated benefits are a significant added value for society and economy. Moreover, the projects and strategies are shaped around the integration of the European network, with cross-border links that meet international transport demands, drive passengers to choose these services to the detriment of flights and as a result contribute to the reduction of emissions. Europe's Rail, together with three important organisations of the European railway sector, have joined forces and published the latest study on the high-speed rail network which highlights the importance of the creation of this network for the economy and society and stresses its impact on reducing the level of emissions.

by Pamela Luica

Sustainable, accessible and digitised mobility that connects European cities quickly and efficiently is one of the important aspirations and ambitions of the European Union which, through the policies carried out, encourages the targeting of efforts towards the railway, the mode of transport with the least CO2 emissions that promises complete decarbonisation. Taking over the traffic from the other modes of transport and increasing its market share have become a starting point for the development of the railway system, which must face the challenges that turn into economic, social and environmental opportunities. Since December 2020, when the European Commission published the Sustainable and Smart Mobility Strategy, high-speed rail transport has acquired a new meaning - that of integrating all Member States by offering fast cross-border connections and successfully competing with air transport. The EC plan aims at two objectives that are vital for sustainable transport, namely: doubling high-

speed rail traffic by 2030 and tripling it by 2050, compared to the level of 2015.

From the moment when the future of the railway, especially high-speed, was outlined, the European states became even more involved in these projects thanks to the "signal" sent from Brussels that encouraged such investments both in terms of policies and in terms of financing.

With the current high-speed rail network, the objectives for 2030 and 2050 cannot be achieved, or, perhaps they can be achieved to a too small extent, because the system is still fragmented and covers too little of the "requirements" of the demand, preventing it from attracting more and more passengers to these services and from taking over air traffic. According to EU transport in figures 2022, the high-speed rail network of the EU-27 had a length of 11,526 km as at the end of 2020 with a traffic of 69.4 billion pkm, registering a sharp drop of 47.4% due to the pandemic. It should be mentioned that in 2019, the traffic



Source: SZ

was 132 billion pkm, increasing by 4.7 compared to the previous year, and in the period between 2012 and 2019, high-speed rail transport experienced increases, with the peak being recorded in 2017, with an increase of 8.7 % compared to the previous year. In 2020, the share of high-speed rail transport in the total passenger-kilometres of rail transport was 30.5%. Also, according to European statistics, in 2020 there were high-speed rail line projects under construction spanning a total of over 1,700 km, of which only 84 km represented cross-border connections (between Austria and Slovakia and Austria and Italy), the rest being projects started within the states (Austria, Germany, Italy, Spain and Sweden). It should be noted that in 2022, Spain put into operation four such lines with a total length of approximately 287 km, becoming the first European country to have a network of over 4,000 km of high-speed lines, surpassed only by China.

At the end of 2022, Germany put into operation the 60-km Wendlingen-Ulm line which is part of the Stuttgart-Ulm project that provides connection to Paris via Karlsruhe, Stuttgart, Ulm, Munich, as well as to Vienna and Bratislava. The Atlas High-Speed Rail 2022 report of the UIC mentions that over 3,000 km of high-speed rail line are under construction in Europe and projects are planned for more than 5,900 km; in the long term it is estimated that more than 3,300 km of new lines could be further built. The report states that France is the country that is preparing studies for the construction of the largest network (in terms of length compared to the other countries) and aims at 1,725 km, Sweden has 214 km of lines under construction and plans projects for another 338 km, while Germany is building 60 km of high-speed rail lines and plans include another 291 km, and in Austria 281 km of lines are under construction and another 71 km are planned. Italy is building 327 km of lines and in the Baltic region, Estonia, Lithuania, Latvia are working on the Rail Baltica corridor, which will have a total length of 870 km and which will be connected to Poland, which in turn has plans for the construction of 1,680 km. The Czech Republic has announced its plans for the construction of the high-speed network for which more than 830 km of lines are planned and in the long term it will build more than 170 km, the system being designed for connections with neighbouring countries that will give it access to the other high-speed systems of Europe. Currently, the Czech

railway infrastructure manager is in process of signing contracts for the development of various documents for several high-speed line sections.

In January 2023, Centralny Port Komunikacyjny (CPK), the Czech railway infrastructure manager, Správa železnic, and RB Rail AS signed an agreement whereby they intend to build the Three Seas Region high-speed rail network that will have a total length of 4,500 km for which investments of EUR 60 billion are estimated.

In Portugal, the recent launch of the new strategy with a vision for 2050 aims at creating a high-speed network that will link 10 large cities and have cross-border connections with the Spanish network. It is known that Portugal officially presented in 2022 the project of the Porto - Lisbon high-speed line which will span 336 km and will be connected via Valença to the Spanish network through the city of Vigo. The neighbouring country, Spain, plans to expand the network by more than 1,300 km of new lines.

According to the well-known report "A European high-speed rail network: not a reality but an ineffective patchwork" of the European Court of Auditors (ECA) of 2018, the high-speed rail network is characterised as "only a patchwork of national lines without proper coordination across borders, planned and built by Member States in isolation, resulting in poor connections." It also states that although the length of national high-speed rail lines is steadily growing, "the EU target of tripling the length of high-speed rail lines from currently some 10,000 km to 30,000 km by 2030 is unlikely to be reached."

The study

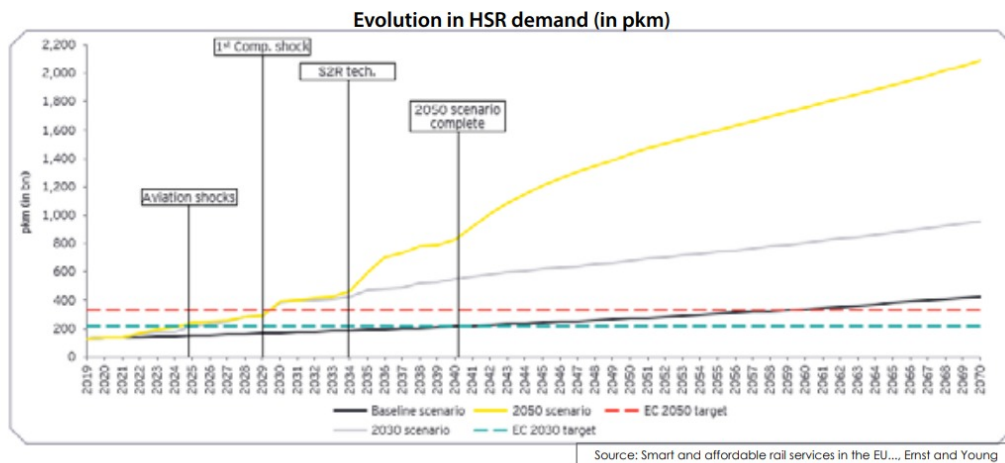
In June 2022, the renowned organisations CER, ALLRAIL, UNIFE and Europe's Rail Joint Undertaking (EU-RAIL) signed an agreement to initiate a study to highlight the importance of the high-speed network for society, the economy and the achievement of the EU's climate neutral objective. As part of this agreement, in January the four organisations published the report according to which the connection of all European capitals and large cities through the high-speed rail network needed investments of over EUR 550 billion, and the 2050 scenario showed the need to build a network that would reach 49,400 km according to the policies aiming at eliminating emissions, creating a railway network to bring the Member States together and offer fast, efficient and interconnected links, resulting in increasing the attractiveness of this mode of transport and moving away from air traffic where distance allowed.

The Smart and affordable rail services in the EU: a socio-economic and environmental study for High-Speed in 2030 and 2050 was prepared by Ernst and Young in cooperation with Università Bocconidin in Milan. The creation of a high-speed network at the level of Europe will require investments in the amount of EUR 550 billion, but in return the benefits delivered to the economy and society will be in the range of EUR 750 billion.

"The creation of an interoperable European high-speed network, linking European capitals and major cities,



Source: SZ



connecting urban nodes and airports, will reduce rail travel time between EU capitals and major cities to under 4 and 6 hours, and with affordable and comfortable trains rail will certainly become the preferred mode of transport. This is why it is essential to invest in high-speed rail," Alberto Mazzola, Executive Director at CER, said.

In order to forecast the future demand for high-speed rail, the study includes 10 demand shocks applied to a baseline demand forecast based on previous demand growth and forecasted population and GDP growth. The effects of new technologies and the policies and measures that are to be introduced are included in these shocks. A combination of these 10 demand shocks were applied to simulate the impact of future possible policy measures and investments in new infrastructure and technologies. The shocks include high-speed infrastructure, rail and bus competition, shared mobility, highway toll tax, aviation ticket tax and fuel tolls, short-haul flight ban, rising fuel prices, and Shift2Rail technologies.

The analyses of the study state that without new investment in high-speed rail, the demand and the market share of this segment will only increase slightly, and the EU objectives will not be achieved. The study considers three scenarios, where the one for 2030 involves the completion of the Core Network with HSR lines which will lead to a limited increase of about 16% in the market share of HSR, which would be expected to double in EU's mobility strategy.

The scenario for 2050 would encourage seeing all major urban agglomerations connected through a comprehensive high-speed rail network, in addition to the expansion of the Core and Comprehensive networks (the latter being estimated to be completed in 2050), with significant expansions especially in the Eastern part of Europe. In this scenario, all ten demand shocks would make high-speed rail the main mode of transport beyond 2050, especially in a context where the effects of railway market competition and further investments allocated to railway technologies, particularly the ones promoted by Europe's Rail, will be seen. "The study confirms the expected results of the investment in a HSR network to connect the capitals of Europe and major cities. HSR network is not wishful-thinking but, together with all the ongoing investments, including in EU-Rail R&I, the answer of rail to reaching

COP's targets for passenger mobility as translated in the European Commission's Smart and Sustainable Mobility Strategy," Carlo M Borghini, Executive Director at EU-RAIL said when announced the launching of the study.

The application of the ten shocks in the case of the three scenarios shows that if no investment is made in HSR, the demand will increase very little, which will lead to an increase in the share of more polluting forms of transport. Also, the expansion of the HSR network together with the measures proposed by the study will be able to reach the objectives, perhaps even in advance, while the baseline scenario indicates that the objectives for 2030 could only be reached in 2040, whereas the objectives for 2050 could only be reached in 2058, more specifically, with a delay of almost a decade for each scenario.

Moreover, a limited investment in HSR as analysed by the 2030 scenario foresees a future with only a limited growth in high-speed rail traffic compared to the baseline scenario, reaching 958 billion pkm in 2070 - the horizon addressed by the study because it allows the implementation of all the effects of the high-speed network infrastructure provided that the network for 2050 is completed in 2040.

This increase in traffic would result in a market share for HSR of 32% (by 2070), while demand for short-haul aviation would reach an 8% share (by 2070). Instead, the acceleration of investments for the completion of the European HSR network will result in the increase of the share to 54% with a traffic of 2089 billion pkm in 2070 from 138 billion pkm in 2021.

In order to address investments and cost-benefit analyses, the study applies three values for line constructions per km. One of them is EUR 12 million per km put forward as the cost base specified by the United Nations Economic Commission for Europe in 2021. EUR 16.5 million per km is applied because, as the ECA report states, it was the completion cost (per km) for LGV Est Européenne between Paris and Strasbourg (406 km) which had an initial cost of EUR 12.9 million/km and reached EUR 16.5 million/km, and eventually the costs reached over EUR 6.7 billion. The third cost taken into account by the study is EUR 25 million per km as the average final construction costs also addressed by the ECA report which analyses costs and cost estimates for ten high-speed lines

in Europe. The ECA report mentions final costs per km between EUR 13.7 million (calculated on a section of the Medina del Campo - Galicia HSR) and EUR 49.7 million (highest final cost) calculated for the Stuttgart - Munich line. Analysing the two studies (of ECA and UNECE), the study published in January 2023 by the four organisations assumes construction costs of EUR 16.5 million per km.

Baseline scenario

The baseline scenario considers only the lines that are currently in operation (without extensions) according to the revision of the TEN-T guidelines for which an agreement was reached between the EC and the Council in December 2022, which allows the EU to continue the construction of the transport network connecting 430 large European cities with ports, airports and railway terminals. This agreement consolidates the proposal to complete the core network by 2030, the extended core network by 2040 and the comprehensive network by 2050. This scenario can be looked at in theory as the worst case since all infrastructure projects, including those under construction, would not be completed and new technologies or important legislative frameworks would not be introduced, and the increase in demand is mainly attributed to the increase in GDP and population.

The high-speed network in this scenario is 15,200 km and supports speeds of 250 km/h for lines dedicated to high-speed traffic, and 200 km/h for lines that are upgraded to these standards. The scenario applies the assumption that there will be no expansion of conventional or high-speed

rail infrastructure. In this scenario, which does not apply any of the ten shocks, there are developments at a small level, but a doubling of the market share to 16% is noticed - in 2021 rail transport had a share of 18% of which high-speed accounted for 8%.

2030 scenario

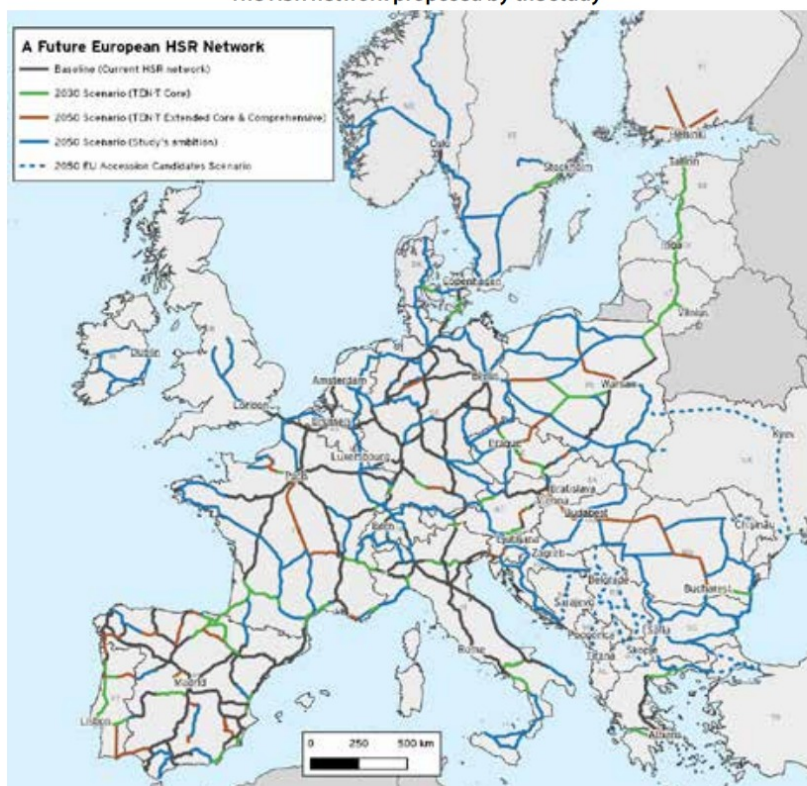
The 2030 scenario is one with a conservative estimate regarding the future growth of Europe's high-speed network and in this case the network is not uniform at the level of the continent, it is generally fragmented and present more in the western part of the continent.

In this assumption, due to a short period (less than a decade), the shocks considered to be introduced before 2030 are included and involve the increase in fuel prices and the introduction of highway tolls in Europe - to ensure the maintenance and development of the infrastructure the EU has created a framework to encourage Member States to use taxation and track access charges to promote the "polluter pays" and "user pays" principles. Also included here is the shock relating to the aviation ticket tax, a concept proposed by the Danish government according to which, from 2025, passengers should pay an additional tax of DKK 13 (EUR 1.75, in current prices) for a flight ticket, and the money from this tax would be used for the development of innovative and clean technologies so that from 2030 domestic airplanes will be climate-neutral.

The network will have 20,500 km of high-speed lines including the core network and all lines currently under construction (according to the UIC HSR Atlas) and should be operational by 2030, it includes lines dedicated to high-speed traffic (with 250 km/h) and upgraded lines, as well as the expansion of the infrastructure for other modes of transport according to the increase in demand. In this assumption, compared to the existing network, another 5,300 km of new lines should be built, which would require investments of EUR 87.4 billion (calculated at EUR 16.5 million per km). The expansion of the infrastructure would allow an additional 86 million people to be connected to these transport services. The market share of HSR services in this case will increase to 18% (compared to 8% in 2021) and to 26% in 2050, reaching 32% in 2070 and, just by introducing the effects of network construction, high-speed services would reach a share of 30% in 2070.

In this scenario, the share of road transport would be reduced, reaching 57% (by 2050) from 74% in 2021, and air traffic will experience a slight increase due to the non-introduction of

The HSR network proposed by the study



Source: Smart and affordable rail services in the EU... /Ernst and Young



Photo: ÖBB

a ban on short-haul transport, or specific taxes (mentioned in the shocks proposed by the study). "We want to see it [high-speed rail] displace the private individual motor car as a product for the masses, for everyone from the budget conscious to very affluent travellers. High-speed rail must form the backbone of speedy door-to-door travel across the EU," Nick Brooks, Secretary General at ALLRAIL said.

The 2030 scenario would bring benefits to society of EUR 400 - 447 billion, and the reduction of CO2 emissions would be limited to 1.5 billion tonnes, almost as in the case of the baseline scenario.

In 2050

Compared to the other scenarios, it includes lines planned to be completed after 2030 and additional HSR lines envisaged by the study for the completion of the comprehensive network connecting all major European cities. All lines in this scenario are assumed to be new construction although some lines may be planned to be an upgrade of existing ones. This scenario calls for the quadrupling of the high-speed rail system reaching 49,400 km and connecting all urban areas with over 250,000 inhabitants with lines dedicated to high-speed traffic as part of the extended core and comprehensive networks and also includes planned lines that are not part of the TEN-T such as the HS2 corridor in the UK. In this scenario, 34,200 km of high-speed lines would be built, which would require EUR 564.3 billion in investments (calculated at EUR 16.5 million per km). Under this scenario, about 216 million people will benefit from the connection to the network and to the high-speed rail transport services.

The application of the shocks in this scenario - relating to competitiveness or the deployment of new technologies - indicates that the market share will reach 54% of the total passenger traffic in 2070. Since the environmental side is of extreme importance in the approach of the future transport system, the level of reduced emissions will triple relative to the 2030 scenario and will contribute to reducing emissions by 5 billion tonnes of CO2 by 2070.

"By demonstrating the major economic and environmental benefits of a European high-speed

rail network, the study will underpin the Sustainable and Smart Mobility Strategy and of its ambitious objective to double traffic on high-speed rail by 2030 and to triple it by 2050, in full coherence with the Trans-European Transport Network (TEN-T)," Philippe Citroën, Director General at UNIFE said.

Compared to the other scenarios, by constructing new and dedicated lines for speeds from 250 km/h, the network will provide connectivity across the continent, creating a unitary network, with cross-border connections that can meet a growing transport demand and accommodate traffic shifting from polluting modes of transport.

Also, in this scenario, short-haul flights would disappear (due to the ban on short-haul aviation) where high-speed services are available, and in 2070, passenger cars will have a market share of 32% because, in general, potential high-speed service passengers, especially families, would tend to favour road transport. As far as long-distance conventional rail traffic is concerned, it will benefit from the indirect effects of high-speed traffic and will represent 13% of passenger traffic in 2070. The economic and social benefits caused by this scenario will be between EUR 561 and EUR 836 billion computed based on saved external costs and the travel time savings.

Also for this year (2050), lines with a total of 4,300 km of the states that have the status of EU candidate countries are included, the investments being EUR 70.9 billion (also calculated at EUR 16.5 million per km). It is estimated that thanks to this network, approximately 40 million people will benefit from high-speed services in 2050.

The lines built are those dedicated to high-speed traffic, some of which will be completed after 2030, such as in Serbia, which will connect Belgrade to Budapest through a line that allows speeds of over 200 km/h.

The study includes the states of the Western Balkans, Turkey, Moldova and Ukraine; if they are completed, the market share of high-speed rail transport in these states will increase steadily from 2041, reaching 14% in 2070. During this time, conventional rail transport will also register increases, however, over long distances, private car transport will dominate.



Photo: DB/ Armin Kilgus