

Deliverable 7.1
Executive Summary

Electrified high speed rail society

1. Executive Summary

The vision components of SPIDER PLUS

The main objective of the SPIDER PLUS work package (WP) 7 was to develop and elaborate a SPIDER PLUS 2050 vision for a rail based European society and to assess and roughly verify the feasibility and achievability of the vision. The visioning has been carried out in five different components, comprising the five tasks of the WP 7. For each vision component a separate deliverable was produced. The work in WP 7 makes use of the results of the work packages 5 ("As-is situation") and 6 ("Mega Trends"). The necessary measures and impacts of the vision elements will be assessed in WP8 while concrete actions to be taken will be derived in WP9.

The vision for 2050 has been described from different perspectives but remaining in a coherent structure and providing a comprehensive picture of the preferred future of a society overwhelmingly served by rail.

The vision targets & development

It is important to note that the vision for 2050 cannot simply be described by observing past developments and current drivers of change. In the past, progress commonly came from revolutions instead of evolutionary and predictable developments. Greater structural changes provoked new solutions and services. Revolutionary ideas are driven by imagination and belief in innovative solutions, not by considering the past. Thus, the future of 2050 cannot be based only upon following trends; instead, it needs to be inspired by urgent needs, anticipated deficiencies and greater framework conditions that require future changes. Thinking about 40 years into the future enables revolutionary changes in some areas (e.g. technological solutions, communication) but also limits possible developments in others (e.g. infrastructure construction, rolling stock).

The first step in the vision development was the specification of targets for a preferred future. The primary target of the 2050 vision is a society overwhelmingly served by electrified rail. This implies that we need to describe a European society where the rail market share is greater than 50%. This value can be interpreted as an average across all relevant market segments. Thus, not every segment has to accomplish a 50% market share (for some this might be out of reach, even with vast improvements) but i.e. over the entire passenger and freight transport market (consisting of long and short range, commuter traffic, high speed etc.) this value shall be achieved. Background for specifying the targets are coming from the "White Paper on Transport" (European Commission, 2011).

The target specification was carried out primarily from the demand perspective considering the modal share. However, the offer side has to supply sufficient capacities, advanced technologies and comprehensive framework conditions.

The vision for task 7.1 – The electrified high speed rail society in 2050

Task 7.1 is the first vision component and deals with the electrified high speed rail society in 2050. The European HSR industry and RUs are among the leaders worldwide. In order to keep the current position, all fields of HSR have to follow a continuous development. Infrastructure, rolling stock, services and offer quality are playing a crucial role in shifting passengers from road to rail transport and in enabling the rail system to handle the consequential expected transport volumes. At the same time, the liberalisation of the HSR market and the European wide interoperability will give a further boost for international high speed rail connections up to 600 km substituting air and road transport and for distances of more than 600 km supplementing and cooperating with air

transport. With a seamless society as final aim, it is important to integrate conventional rail and local transport providers in the full mobility service offer.

Within the decades until 2050 external and internal market drivers will influence and change the HSR environment. Ongoing urbanisation and the coherent economic development will be two main drivers of the (HSR) traffic development within Europe. At the same time the concerns of an ageing society and environmental issues have to be taken into account. Internal drivers like technology, the regulation and the liberalisation of the market will affect the way HSR takes place in Europe.

This report contains an analysis about the potential transport demand shift (from road to HSR and from air to HSR) as well as an overview over the EU target objectives and other EU projects that will have an effect on HSR. Since HSR has higher energy consumption than conventional rail, there is a conflict between aiming at serving the transport market with an increase of HSR traffic and at the same time decreasing greenhouse gas emissions. This conflict could only be mitigated with increasing zero emission energy production.

The vision components summarise the comprehensive picture of electrified high speed rail in 2050, enabling the set and desired targets. The vision picture is further detailed in the described vision elements which can be found in the main part of this report, highlighting their development and impacts on rail share.

HSR vision for 2050

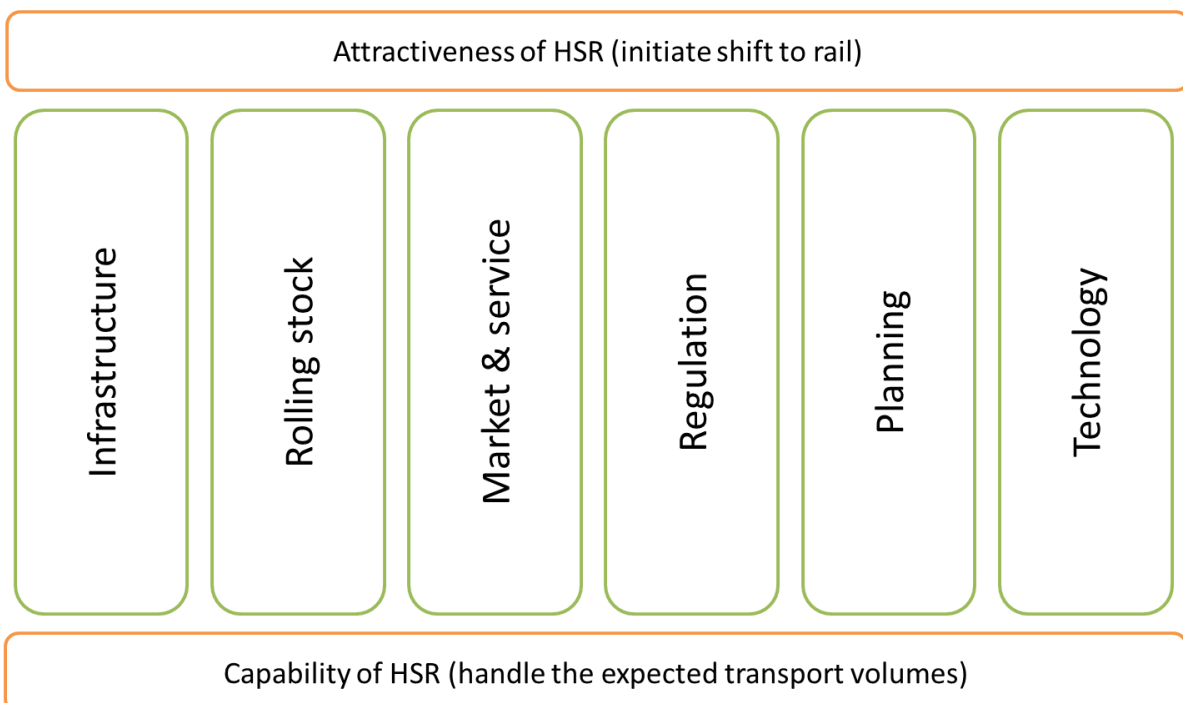


Figure 1: HSR vision for 2050

The vision for HSR infrastructure

Infrastructure and rolling stock can be seen as the mainstays of HSR operations. The infrastructure development until 2050 will be determined especially by harmonisation efforts, network development and investments and future stations as multimodal access points to support door-to-door transport chains. Thereby harmonisation aims especially at comprehensive interoperability which is a key to support international relations and the facilitation of operation in regions and areas only marginally served today. Besides the removal of bottlenecks and missing links in the operable network, harmonisation also affects control command and signalling. In consequence, an increase of capacity (e.g. by ETCS Level 3) can be achieved even on existing tracks. The development of the network is a central part of the 2050 vision. New or upgraded high speed lines will help to reduce travel times and thus increase the competitiveness of HSR compared to air. For distances over 600 km and intercontinental connections, HSR should play the main role as airport feeder connecting sub-centres to the main air travel hubs. For this reason major airports should have direct HSR access with attractive interchanges. Future stations will be transformed into central mobility hubs offering more than rail access. They have to play a more central role in the urban, local, regional and long distance mobility of the people than today. This is especially true in the light of a seamless society using the variety of mobility offers including HSR, local and regional services, car- and bike sharing among others at a station.

The vision for HSR rolling stock

The future rolling stock defines the second pillar of HSR operations. The above mentioned shift to rail will cause bottlenecks regarding train capacity. For this reason the use of double stock trains, the measure of coupling and more flexible train compositions will become the norm. An important topic for HSR is the maximum speed of the trains. Several steps led to a possible operation speed of 400km/h. While this high velocity might be feasible for only limited direct line connections in Europe, it seems as if the technical feasibility is contradicting economic feasibility on many central European lines through high density urbanised regions. For this reason, a remarkable increase of the current train speed is not likely to happen on the majority of lines, also considering environmental reasons. For customers it is not the maximum speed that makes HSR a preferred mean of transport but the average journey time. They also appreciate the comfort of the trains. The possibility to concentrate on office work or personal entertainment is a very important factor. For this reason the equipment of the trains with state of the art "Infotainment" as used in air transport is an essential point in attracting potential customers.

The vision for HSR market and services

The development of HSR traffic is dependent on the general transport market development. A sustainable market growth is only achievable through comprehensive services. Therefore, service-oriented architecture has to be introduced caring about internal (Railway Undertakings (RU), Infrastructure Managers (IM)) as well as external (customers/passengers) relationships. Operators have to fulfil the needs of a highly mobile society. Therefore mobile solutions and travel assistance is a key to success, travelling in a transport chain with integrated rail has to be the most convenient option on the market. In combination with extended services on the basis of today's mobile services a huge part of the society can be convinced to use high speed rail. In addition, RUs are focussing the accessibility of their rolling stock and their networks across the entire society: all age groups, social classes and customers with special needs or disabilities.

Railway Undertakings have the task to develop innovative business models, with a new understanding of cooperation. Cooperation among the RUs and cooperation between rail and air operators will be an integral part of future HSR business models. Sophisticated customer relationship management (CRM) using ICT and big data is part of a successful business model in which privacy concerns of the customers are respected.

The vision for HSR regulation

The business models are strongly depending on the market and the framework that is given through regulation and liberalisation. While HSR does not receive direct subsidies public funding is limited to infrastructure construction and maintenance. With the regulatory body for RUs and IMs localised in one European governance body a more coherent planning across borders and in communication between infrastructure and service operators is enabled. Homologation of trains is simplified across Europe lowering market entry barriers and freeing market capital.

The management of transports is centralised under a single European transport area (SETA), similar to the European air transport market. The liberalisation processes is supported by access charging which is close to the marginal costs in 2050. This enables fair competition among all operators and a flourishing market. Financing and managing of infrastructure is subsidised in order to facilitate efficient development without risking higher service costs. These processes are mainly based on the clear will to bolster the rail, and especially the high speed rail market.

The vision for HSR planning

The design of high speed lines has very high construction and thus planning requirements regarding the gradients, the curve radii, safety requirements and the direct connection between major urban areas. The high requirements lead to high conflict potential with other land uses of non-urban (e.g. agriculture) and urban areas (e.g. housing, industrial zones). It is therefore very important to secure the rail lines in European and national transport plans at a very early stage. The integration of railway lines in transport and land use plans is a pre-condition for an expedient realisation of new high speed railway connections, limiting needed resources and time to market for new connections. The rail access to inner city areas is usually complicated with high density and line capacity restrictions. Therefore, infrastructure managers focus on higher speeds for lines by running tangential to city centres avoiding the inner city. This is possible with good interchange connections towards the central mobility hub stations with public transport and dedicated feeder lines. Such satellite stations also create benefits for the agglomeration and diversify the high density pressure of traditional centres.

The vision for HSR technology

The vision considers alternative high speed technologies which can achieve considerable higher speeds than common HS electric trains. New materials are used to make higher speeds of more than 400 km/h economically and environmentally feasible. The "Superconducting magnetic levitation" technology allows travelling at speeds up to 500 km/h and is superior to common HSR in its maximum speed, acceleration, deceleration and grade climbing. The "Hyperloop" concept entails steel capsules that are transported at a speed of 1,220 km/h throughout the length of a low pressure tube so that frictional resistances are thereby almost excluded. Although new technologies provide innovative solutions they will be implemented only for special purpose connections until 2050. The exploitation of alternative means of transport is limited, in parallel to common HSR not

pursued at all. Investments are majorly channelled towards HSR network development which provides significant economy of scale effects versus new modes.

The prevalence of personal devices (next level “2050 Smartphones”) leads to the implementation of customised ICT solutions. Passengers are supplied with constant streams of information about their trip via fast, reliable mobile network connections and Wi-Fi. Furthermore, the liberalised markets intensified the competition between different RUs leading to higher efforts to meet the needs of customers and to satisfy them through innovative ICT on board solutions.

Conclusion

Considering all the fields in this deliverable, a comprehensive and integrated vision of an electrified high speed rail society is created. The interaction of infrastructure, rolling stock, market and service has to be coordinated in order to

- build upon the attraction potential of HSR and to achieve the desired shift to rail
- enable all components of the HSR system to be capable of the expected transport volume

The development of new business models together with state of the art ICT and the trend towards a highly mobile society is giving a further boost to the realisation of the vision and the creation of seamless high speed rail travelling all across Europe.