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EVALUATION

Interim Evaluation of the Horizon Europe Framework Programme for Research and Innovation (2021 - 2024)

Accompanying the document

Communication from the Commission to the European Parliament and the Council

Horizon Europe: Research and Innovation at the heart of competitiveness

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Annex 15: Evaluation of Europe's Rail JU

Annex to the Commission's interim evaluation of Horizon Europe

Contents

Europe's Rail (EU-Rail) JU was set up in November 2021 under the Horizon Europe programme for the period ending on 31 December 2031. The EU-Rail JU replaced and succeeded the Shift2Rail (S2R) JU that was set up in June 2014 under the Horizon 2020 programme for the period until 31 December 2024.

1. Effectiveness

The design and implementation of Europe's Rail Joint Undertaking (EU-Rail) under Horizon Europe, and of its predecessor Shift2Rail (S2R) under Horizon 2020, was structured around the general objectives of developing rail solutions and services for clean, competitive, safe, smart, and resilient transport and mobility. These general objectives will contribute to the EU policies of the European Green Deal, the Digital Decade, the Sustainable and Smart Mobility strategy and the Industrial strategy. These general objectives were translated into specific and operational objectives.

EU-Rail and S2R have fundamentally changed the landscape of European rail research and innovation, achieving a coordinated partnership between the supply and operating industry and the EU delivering European solutions transforming the European rail system, benefiting passengers and freight customers in Europe and strengthening European industry competitiveness. This is a notable achievement given that rail is a long-established network industry, which is fragmented structurally (between operators and infrastructure providers) and geographically. Historically, each European railway developed standards and technologies independently of its neighbours.

The JU provides a vital and unique structure in which all these issues can be addressed cooperatively by the EU rail sector and its suppliers working together in a coordinated fashion. This enables finding European approaches and solutions, and ensuring seamless rail transport across Europe, in place of expensive bespoke national solutions.

Assessing the effectiveness of S2R and EU-Rail against their objectives and the objectives of Horizon 2020 and Horizon Europe, and of the long term scientific, societal, economic and technological impacts is summarised below, first for S2R, and then for EU-Rail.

Effectiveness of S2R (2014-2021)

The objectives of S2R defined in its basic act were to modernise the European rail system by developing, integrating, demonstrating and validating innovative technologies and solutions for rail, and consolidating rail research programmes across Europe.

With the work of S2R, the EU was for the first time able to gather the sector together and increase the technological readiness level (TRL) of the innovation needed to create a Single European Area common across EU countries.

Under S2R, 695 prototype testing activities were carried out across the programme up to 2023[1], with an average TRL reaching 5 out of 6, i.e. technology validated or demonstrated in relevant environment. Many technologies reached higher TRLs and those are well disseminated in the EU-Rail catalogue of solutions for market uptake. Moreover, it is reported that, with further private development, 72 new products, processes and methods have been launched into the market[2].

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[1] See EU-Rail Annual Activity report 2023, scoreboard of Horizon 2020 KPIs: https://rail-research.europa.eu/wp-content/uploads/2024/06/Annex_GB-Decision_10_24_CAAR_2023-signed.pdf.
[2] See EU-Rail Annual Activity report 2023, scoreboard of Horizon 2020 KPIs.

For estimating the effects of the S2R innovations on the KPIs Life Cycle Costs (LCC), Reliability & Punctuality and Capacity, three individual sub-models[3] have been developed for passenger transport (High Speed, Regional and Metro) and for freight transport.

Each sub model generates in the first step a baseline scenario describing a defined representative scenario for the European railway system. In the second step, the effects of the S2R innovations are analysed within the IPs by their so-called Technical Demonstrators (TDs) in terms of the expected impacts on the three Key Performance Indicators (KPIs). Each impact is applied and the overall effect on each KPI calculated. The target is the maximum achievable improvement as a priority for the respective KPI. Hereby, calculating a scenario for a future railway system in which the roll out of all S2R innovations is completed. In the following, specifics for the three high-level KPIs are described and then specifics for each IP which are relevant for the understanding of the results are given.

The LCC model, calculates the effects of the developed S2R technical innovations on the total cost of the railway system. For the passenger transport scenarios, the measuring unit chosen is EUR/passenger-km and for the freight transport scenarios respectively EUR/ton-km. To account for the different lengths of life cycles of the assessed components of the railway system, an assessment period of 30 years and a discount rate of 3% have been chosen. The developed LCC model does not only capture direct cost effects of individual components but also system effects.

The calculation of the capacity KPI is a multiplication of the three aspects: track capacity, train capacity and coupling ability. The track capacity calculates the number of trains per time and corridor. For passenger transport scenarios, the track capacity is calculated for a peak hour, whereas for freight transport, it is calculated per day. The train capacity captures the increase of passengers per train or respectively tons per train. Coupling ability, hence the coupling of different units of different manufacturers, classes and series is the third factor.

The punctuality model calculates the number of delay minutes caused by a specific failure as well as the frequency of its occurrence. The delay threshold chosen to include trains into the delay statistic is different for each SPD. The delay minutes are then all added up to the sum of delay minutes within the network.

Based on the models described above, it can be said that the programme generally reached the targets (where the innovations for the programme are implemented on the rail network, with variation depending on the use case and rail segments – high speed, mainline/regional, urban, freight – application) including[4]:

- a 20-41% reduction in life cycle costs (LCC),
- a 58-96% increase in capacity, and
- a 39-57% improvement in reliability and punctuality.

More specifically, for the aforementioned use cases and rail segments, the application of all the technologies and solutions successfully developed by S2R[5] will lead to the following results:

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[3] For freight, the model is further split into three sub-scenarios (i.e., single wagon train, block train and combined transport train) to better capture the operational differences. Hence, there are in total six scenarios (these are also referred to as System Platform Demonstrator, in short SPD, in the
context of Shift2Rail) with an individual model for each of the three defined KPI LCC, Punctuality and Capacity which sums up to a total of 18 sub-models which have continuously been improved, developed and fed with data from the TDs to monitor the target achievement of the various
Shift2Rail projects. As far as possible similar modelling approaches and algorithms have been used for all of them.
[4] More information on the methodology calculation can be found in the Deliverable 4.7 of this project: https://projects.shift2rail.org/s2r_ipcc_n.aspx?p=IMPACT-2.
[5] To note that on the increasing the attractiveness and demand side, large parts of positive effects especially for the passenger transport are not adequately measurable through LCC, capacity and punctuality. The effects of the works in

	High Speed	Regional	Urban	Freight
LCC	-20%	-29%	-16%	-41%
Reliability and punctuality	+ 39%	+ 55%	N/A[6]	+ 57%
Capacity	+58%	+90%	+21%	+96%

On the vehicle side, the main drivers for those improvements are:

- functional open coupling of different train classes, developed by S2R and aimed at reducing the number of required spare trains;
- development of traction system with reduced energy losses;
- several innovations reducing the train weight that allow an increase in standing passengers in peak hours; and
- increased reliability of the new traction system and new Train Control Management System solutions.

An example of implementation is the Electro Mechanic Brake (together with optimised adhesion through sanding system and software to adapt the wheel-slide protection and the optimised use of adhesion in traction and braking) and Silicon Carbide (dual system tramway AC traction system, metro/suburban rail AC traction system, regional train full traction subsystem, high-speed train (HST) traction system integrated in train or independent rotating wheels) solutions. This has been developed to TRL 7 and shown very promising results, with significant energy consumption reduction.

The main drivers for those improvements on the signalling side are the improved architectural elements, the new technology onto train (e.g. localisation and train integrity), and the newly moving block operation instead of fixed blocks, which increases capacity by more than 30%.

Also on the signalling side, a major achievement was the development of the technology and specifications for Automated Train Operations (ATO). Based on several rounds of testing and validation, the specifications are now included in the Control Command and Signalling Technical Specification for Interoperability (CCS TSI)[7] as part of an additional function to ETCS. The new CCS TSI entered into force in 2023, concluding years of work and allowing Railway Undertakings and Infrastructure Managers to start deploying ATO based on a commonly agreed, tested, and interoperable set of specifications. ATO is deployed in Luxembourg and in S-Bahn Hamburg, delivering significant increases of capacity. Several EU Member States have already indicated their plans of ATO deployment in the medium term[8].

On the infrastructure side, the main drivers for those improvements are:

- reduced maintenance costs due to new S2R solutions for improved inspection methods, proactive maintenance and better planning of maintenance activities;

S2R on new IT solutions for passengers are included in a separate attractiveness model. Therefore, the increase of demand is not considered in the results for the passenger scenarios. For the freight scenario, a demand increase could already be considered and therefore also its positive effect on the contribution margin.

[6] In the Metro rail passenger scenario, it was detected that providing a value for Reliability & Punctuality is not suitable. As the frequency of the trains is as high as every three to five minutes, the punctuality of any individual train is not the decisive factor but the time interval between two consecutive trains. As there is no data available of any metro system with a considerable frequency issue, the Reliability & Punctuality key performance indicator is not applicable.

[7] Commission Implementing Regulation (EU) 2023/1695 on the technical specification for interoperability relating to the control-command and signalling, OJ L 222, 8.9.2023, p. 380-560 ELI: http://data.europa.eu/eli/reg_impl/2023/1695/OJ.

[8] On the basis of the analysis of 12 available ERTMS national implementation plans, the Commission is aware of two Member States intending to install ATO country-wide and three intending to install ATO on certain lines.

- reduced capital costs by lowering production costs via automated manufacturing techniques and virtual testing; and

- reduced operational disturbances by using less invasive inspection methods, shorter times for fault clearing, and initial integration with Traffic Management Systems (continued in EU-Rail).

An example is the asset management solution developed in IN2SMART2[9] for Italian Urban Metro operator in Milan for track circuit monitoring and Wheels' status monitoring for preventive maintenance with Decision Support System. In term of Impact, comparing the new plan with the fixed preventive one, it was possible to compute that on average 40% of corrective activities could be performed in advance, with a direct benefit in terms of costs, and this is now being implemented in situ.

S2R projects have also made substantial scientific impact that can be illustrated by the following examples:

- 259 SMEs have introduced innovations[10];
- 664 (by the end of 2023)[11] publications in peer-reviewed high-impact journals in JU based on the funded projects under the S2R programme.

The Bibliometric research output of S2R from 2014 to 2021 revealed several strengths.

- 36% of S2R publications were international co-publications, and according to the Partnership Evaluation study[12] the share of S2R publications mentioned by policy-related documents is 5 times higher than the expected level, compared to 2 times for the Societal Challenge 4 baseline[13].
- Higher average authorship from Regional Innovation Scheme (RIS) country researchers (43%) compared to the Societal Challenge 4 (35%) and the EU-27 average (35%).
- A stronger emphasis on interdisciplinary publications (1.4) than Societal Challenge 4 (1.1), with the EU-27 average standing at 1.3.
- The S2R share of publications that are academic-private co-publications is 21%, which is above the Societal Challenge 4 level of 17%.

The following weaknesses regarding research outputs were identified in the Partnership Evaluation study.

- Citation impact indicators (CDI) for S2R publications (16) were below the figures found in the Societal Challenge 4 baseline (21). This means that S2R publications were cited less than their Societal Challenge 4 equivalents. However, S2R CDI remained above the EU-27 average of 10.
- S2R publications were available under an Open Access (OA) modality in 53% of cases, against 62% in other Societal Challenge 4 publications or the EU-27 average of 44%.

Effectiveness of Europe's Rail (from 2021 onwards)

For EU-Rail, the currently running JU, the general objectives are linked to the building of the Single European Railway Area, the transition to integrate European rail system into the wider mobility system and the creation of a strong European rail industry.

The specific objectives of EU-Rail are to provide solutions for:

- an integrated European railway network,
- a sustainable and resilient rail system,
- a unified operational concept and a functional, safe, and secure system architecture,

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[9] IN2SMART2
[10] See EU-Rail Annual Activity report 2023, scoreboard of Horizon 2020 KPIs.
[11] See EU-Rail Annual Activity Report 2023.
[12] Partnership Evaluation Report: Europe's Rail Joint Undertaking https://op.europa.eu/en/publication-detail/-/publication/e6cc1f91-6421-11ef-a8ba-01aa75ed71a1/language-en.
[13] Baseline provided by the overall level within Societal challenge 4 (see Partnership Evaluation Report p. 23).

- a competitive green rail freight,
- demonstration projects across EU,
- innovation for contribute to a strong and globally competitive European rail industry, building synergies with other EU policies, programmes, initiatives, instruments, or funds.

EU-Rail has built on the success of, and lessons learned from S2R.

EU-Rail's Innovation Pillar is tasked to deliver operational and technological solutions that contribute to a more efficient, flexible, and demand-led, yet safe and environmentally sustainable European railway system. In order to achieve more impactful results, flagship areas are organised within the Innovation Pillar that provides the demonstration ground for long-term scientific, societal, economic, and technological impacts of the partnerships. For each of these areas the following Flagship Projects have been successfully established since the end of 2022 and are now well into implementation.

- **Flagship Project 1** (FP1) is working to improve the network management planning and control in a multimodal environment. The project facilitates the implementation of a railway digital twin environment. Increased resilience of a connected 'real time' rail network is at the core of the project, looking at the integration of Traffic Management Systems (TMS) and processes, including cross-border traffic management, as well as improving resilience and efficiency of disruption management at European level. Linking TMS to ATO/C-DAS for optimised operations is researched with a focus on automated decisions and decision support for traffic management optimisation. Initial demonstrations were made available for a Decision Support System in 2024. The project outputs include the integration of rail traffic within multimodal door-to-door mobility and services for inclusive rail-based mobility and anticipating demand, leading to improved resource utilisation.

à FP1 delivers a flexible, efficient, resilient, and high-capacity European rail network, contributing to the Single European Rail Area (SERA).

- **Flagship Project 2** is working to achieve digital and automated rail operations up to fully autonomous train operations. It works to improve and reduce the cost of localisation of the train. Eight demonstrators are being prepared to be delivered by 2025. Cooperation is ongoing with EUSPA and ESA to provide the necessary augmentation system according to jointly agreed railway requirements. Specifications of fully automated trains ATO GoA 3-4 will be delivered in 2032. In 2024, first demonstrators have proven the concept of remote-controlled trams and locomotive, for most efficient shunting operations. Railways need to improve their communication system. Alongside the support for the testing and validation of FRMCS[14], EU-Rail delivers key building blocks for the Gigabit train[15]. Additionally, it develops a proof-of-concepts for virtual coupling, self-driving wagons, autonomous path allocation, and validation and certification. Lastly, it focuses on ensuring the cybersecurity system viability of the use of those innovative digital solutions.

à FP2 delivers a competitive rail system, with cost-effective, safe and breakthrough digital solutions that enhance operational efficiency and capacity.

- **Flagship Project 3** is working to ensure holistic and integrated asset management for rail infrastructure and rolling stock. It minimises asset life-cycle costs and extend life cycles while meeting safety targets and improving reliability, availability and capacity of the railway system. It is achieved by developing multi-purpose, full life cycle, Intelligent Asset Management Systems (IAMS), based on Shift2Rail Technical Demonstrators. A major focus points is the integration of asset condition information into the traffic management system, enabling optimisation of train routing decisions and improving the overall life cycle of monitored assets, in full coordination with FP1. FP3 develops also improved design and manufacturing, and automation of maintenance. There are about 80 use case demonstrators expected to reach TRL 6 and above by 2026.

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[14] Future Railway Mobile Communication System, based on 5G technology it replaces the current system - GSM-R.
[15] 'The Gigabit Train' is the concept of a train achieving wireless connectivity of 1Gbps of capacity to passengers.

à FP3 contribute to reducing infrastructure and rolling stock life-cycle costs and improving the reliability and efficiency of rail assets management.

- **Flagship Project 4** is working to develop sustainable and resilient rail systems. Its R&I outputs are further minimising the overall energy and resource consumption and low environmental impact. The project investigates the alternatives to diesel engines for rolling stock, focusing on high performance battery powered regional trains (reaching autonomy of 200km) and hydrogen hybrid locomotive. The project also looks at passenger comfort and wellbeing solutions, on optimisation of brakes, motors and gearboxes, Heating Ventilation and Air Conditioning (HVAC) systems using green refrigerants, including contaminant removal, as well as aerodynamic optimisation. It also works to improve the attractiveness of train interiors: improvement of access, lighting, thermal and acoustic comfort and adapting rolling stock interiors to increase the capacity of the rolling stock. There are 38 demonstrators expected to reach TRL 6 and above by 2026.

à FP4 supports the European Green Deal by promoting environmentally-friendly rail solutions, reducing greenhouse gas emissions, and enhancing the sustainability of rail applying circular economy principles in the rail sector.

- **Flagship Project 5** is working to establish rail freight as the backbone of a low-emission, resilient European logistics chain. Strong emphasis is placed on rail freight and intermodal transport services to deliver green freight, with the Digital Automated Coupler (DAC) as a key technical enabler, fully integrated in the logistics value chain and utilising the potential of automation and digitalisation. A fully digital freight train with DAC, including energy and data supply, hybrid couplers and automated brake tests has been developed. The first commercial demo train with DAC is operational in Sweden.

à FP5 enhances rail freight attractiveness and competitiveness, increasing the greening of European logistic, with seamless and integrated freight operations.

- **Flagship Project 6** is working to revitalise capillary lines and regional rail services. The project ensures long term viability of regional railways by decreasing the total cost of ownership, such as the cost per kilometre, both in terms of Operational Expenditure (OPEX) and Capital Expenditure (CAPEX), while offering a high quality of service and operational safety to staff and end users. It includes R&I activities on booking and ticketing solutions, passenger information system for regional services in an integrated mobility service, to become an attractive and preferred choice of transport mode. The project also covers operations for regional lines that are not functionally or operationally connected with mainlines. Application for cost efficient traffic management systems and Control Command and Signalling for regional lines are part of the project activities[16].

à FP6 lays the groundwork for next-generation rail regional systems, ensuring the rail sector remains competitive and capable of addressing evolving transportation demands

In addition, EU-Rail has promoted exploratory R&I with running projects such as Pods4Rail[17] for the development of an autonomously driving vehicle (Pod) which comprises an electric only drive unit (Carrier) and a transport containers (Transport Unit) to be used as seamlessly and cost-effective as possible on different infrastructures such as rail and road, improving multimodal transport solutions, or RAIL4CITIES[18] focusing on creating green and socially inclusive railway stations, contributing to urban sustainability. EU-Rail also supports with other projects a network of PhDs and the development of hyperloop technologies, among others disruptive research.

These projects are collectively driving economic growth and sustainability across Europe by promoting innovative technologies, optimising energy use, reducing infrastructure costs, and boosting performance through digitalisation and automation.

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[16] See EU value added section for information on FP6 harmonisation impact.
[17] Homepage 01 - Pods4Rail
[18] Home - RAIL4CITIES

The Partnership Evaluation study[19] indicated that a lesson learned from S2R is that the implementation of new approaches and solutions within the rail system is not only about technology, but also about the introduction in diverse operational environments and rail systems to realise SERA. One of the challenges remains providing cost-effective methods for infrastructure development, understanding that high costs can hinder such investments in different EU Member States and associated countries.

This lesson has been addressed in EU-Rail by developing an overall system approach i.e. coordinating the improvements to maximise system benefit rather than focusing on single solutions. This changed approach is delivered through the System Pillar, which develops future concepts of operations and the underpinning system architecture. A particular focus is on reducing lifecycle cost and adopting modular and flexible design to allow easier and more efficient evolution, providing confidence in investments.

The System Pillar works on a Railway System architecture and Operational Design (task 1), and on developing operational concept(s) and system architecture for Control-Command and Signalling (CCS) (task 2), for Capacity Management System (CMS) and Traffic Management System (TMS) (task 3), and for automation and digitalisation of freight (task 4).

The System Pillar provides an integrated plan (standardisation and TSI input plan - STIP)[20] for and delivers the specification and standards to the European Commission and the rail sector. This is critical for the implementation of European solutions - bridging the gap between research and innovation and the translation into specifications and standards – as industry relies on these documents to develop solutions.

Specifications will be published throughout the life of Europe's Rail. A first example is the EULYNX Baseline 4 specifications which are related to trackside assets and transversal functions. They increase market access to non-traditional suppliers, and the draft cybersecurity specifications are essential for the future security of the European rail system.

A further element to improve the effectiveness of the JU is the creation of the Deployment Group that targets strengthening the sector's capability to contribute to sustainability and accelerating the market introduction of rail innovations, especially the key innovations developed by EU-Rail. The Deployment Group provides a platform for the sector to coordinate on all essential deployment activities beyond research and innovation and specification or standard development (for example political commitment, funding support, and migration planning). Its first activities are focused on FRMCS, the next generation communication system that uses 5G technology to replace the GSM-R technology which will reach its end of life (telecom suppliers' support) in 2030.

Based on the above, we conclude that the objectives of both S2R and EU-Rail have been or are being met.

The positive results at microeconomic levels (Key Performance Indicators mentioned above) and the positive impact in terms of common deployment of technologies, are expected to translate into positive economic and societal impacts of the overall improved approach to rail R&I[21]. The impact assessment study for Institutionalised European Partnerships[22] under Horizon Europe indicates that the application of the R&I output from EU-Rail would be able to significantly divert more traffic to rail from other, less environmentally friendly, modes. The expected reduction is between 2.5 and 4 million tonnes in 2031. This impact could be expected to increase if the competitiveness of rail

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[19] https://op.europa.eu/en/publication-detail/-/publication/e6cc1f91-6421-11ef-a8ba-01aa75ed71a1/language-en
[20] See also below section EU Value Added.
[21] Due to the long-life cycle of railway assets (i.e. 30-100 years), the timeline for the introduction of innovations is beyond the timeline of this evaluation. Hence, the best possible approximation of the effect of the partnerships are the most recent estimates.
[22] https://op.europa.eu/en/publication-detail/-/publication/8e98b39a-8154-11eb-9ac9-01aa75ed71a1

services continued to improve beyond the period of Horizon Europe, therefore, making a substantial contribution to reaching the Green Deal objectives[23].

The Foresight report conducted by Ernst on Young on the output of the transformative projects of the JU[24] estimated the following impacts by 2050.

► Our estimates show that, compared to 2017, by 2050 rail transport can achieve the following impacts:

Impact area	Measure	Moderate scenario	Maximum scenario
Climate change	Avoided CO2 emissions	> 6.300 MtCO2	> 8.400 MtCO2
Jobs	Direct & indirect jobs	4,8 million	6,4 million
Economic growth	Gross value added	> €350 billion	> €470 billion
Passengers' evolution	Traffic (% modal share)	> 1.800 billion pkm (20%)	> 2.200 billion pkm (25%)
Rail freight	Traffic (% modal share)	> 1.500 billion ton-km (45%)	> 2.600 billion ton-km (76%)
Industrial competitiveness / Export	Export levels of turnkey solutions		

- Additional details related to the evolution of impacts in 2030, 2040 and 2050 together with scenarios applied are provided in section 4.

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A noteworthy example of the translation of scientific and technical impacts of S2R and EU-Rail into long-term strategic investments for Europe is the Digital Automated Coupler (DAC), a technology that will transform and revitalise rail freight. The JU created the European DAC Delivery programme (EDDP) that builds on outcomes of S2R's freight related R&I activities. It brings together the rail sector beyond the JU membership to bridge the research work with innovation, including migration planning, towards the deployment of a European DAC solution, built on open and transparent specifications. This enables new operations and services that will contribute meeting the expectations of the Commission's Sustainable and Smart Mobility strategy. To date more than 300 experts and more than 80 companies and organisation across Europe and beyond are involved in the EDDP. The following has so far been achieved:

- DAC target operational procedures for the first DAC use cases
- EU-Rail Flagship Project 5[25] (FP5-TRANS4 m-R, 2022-2026) is ongoing and aims at:
  - developing the DAC specification for 'mechanical/pneumatical', 'energy' and 'communication';
  - demonstrating Digital Freight Trains in 2025 with DAC Type 4 & 5 incl. Energy and Data Supply, Hybrid Coupler, and automated brake test (at TRL 7/8);
  - developing robust and feasible migration scenarios, a premiere in Europe.

Further, a call for expression of interest was launched in January 2024 for rail stakeholders to be part of the implementation of 100 pioneering trains running DAC in commercial operation across Europe. The call was already answered by about 50 companies reflecting a wide part of the rail sector.

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[23] Impact assessment report - SWD(2021)37, report 10/19: https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/11910-European-Partnership-for-transforming-Europes-rail-system-Horizon-Europe-programme-_en.
[24] https://rail-research.europa.eu/wp-content/uploads/2020/07/S2R_FOD_Final-Report.pdf
[25] https://projects.rail-research.europa.eu/eurail-fp5/

The System Pillar addresses the common integration of the DAC into the broader EU-Rail system, the principles of data exchange for DAC, and the coordination of the specifications, standards, and operational rules.

2. Additionality

Financial and in-kind contributions from members in line with the Funding Regulation

	EU cash	Private members' cash	Private members' IKOP	Private members' IKAA	Total
H2020 (S2R) Target	450 000 000	13 500 000	336 500 000	120 000 000	920 000 000
H2020 (S2R) Execution	450 000 000	13 500 000	582 200 000		1045 700 000
HE (EU-Rail)	600 000 000	24 000 000	576 000 000		1 200 000 000

2023 was a closing year for the activities under the **S2R programme**. By now, 99% of it has been completed from an operational perspective and 100% in the financial project execution. Within this, finances are in line with the expectations. The exceeding achievement rate of 118% at S2R programme level is due to contributions from private members – representing the total contribution of the private members: cash, IKOP and IKAA, which exceeded the target of EUR 470 million by 27%.

The implementation of the **EU-Rail programme** on R&I is essentially carried out through calls for proposals – four calls launched until now, which will be supplemented by further calls for proposals and calls for tenders until 2031.

Currently, the cumulative EU's contribution is 31% of the maximum 600 million target projected in the SBA and the private contributions 24% of the minimum 600 million target from the SBA. This is in line with expectations. Differences in contributions are expected, particularly at the beginning, as the EU takes on the pre-financing activities. The remaining contributions from the EU and the private members should be provided until the end of the programme.

From the launch of EU-Rail and until the end of 2023, contributions of 70 million EUR in IKAA have been made, which represents a solid basis to meet the SBA target.

3. Transparency and openness

Compared to S2R, membership in EU-Rail has increased substantially. The S2R Founding Regulation had listed only 8 founding members other than the EU, of which only 2 infrastructure managers, and the rest from the supply industry. Thanks also to the successful results and positive perception by the sector, the SBA lists for EU-Rail an increased membership by more than 3 times compared with S2R, with 25 founding members other than the EU, while the EU contribution only increased 1.3 times compared to S2R, largely equivalent to the inflation rate applied over the last 10 years. Ten of the EU-Rail founding members are operators and infrastructure managers, 2 are research centres and the rest come from the supply industry. This membership widened the stakeholders' base of EU-Rail, both geographically and concerning their role in the implementation of the Single European Rail Area. In S2R, this widening was only possible to obtain with lower committed members in terms of contribution, which participated as associated members. EU-Rail launched the call for associated

members[26] targeted at EU stakeholders having key capabilities/capacities and competencies in the new/enlarged R&I areas described in the update of the multiannual work programme.

Further, the calls for proposals launched by EU-Rail were open, while under S2R there were some calls that were only open to members and some that were open to non-Members. To be noted that both for S2R and EU-Rail many more stakeholders beyond the membership are involved in projects and in implementing the programmes.

The EU-Rail project portfolio comprises today 6 Flagship Projects with 452 participants in the first call for proposals launched March 2022. Against HE's Cluster 5, the portfolio has a much higher participation of private companies (67% in the partnership vs 44% in Cluster 5), indicating a particularly high involvement of the rail industry i.e. train operators, infrastructure managers or technology providers. In the JU's second call for proposal for exploratory research launched in 2022, 7 new projects were selected for funding, with 53% of the beneficiaries being universities or research centres, indicating the higher involvement of rail academic researchers in exploratory calls.

EU-Rail launched another call for proposals in 2023 that included a joint topic with SESAR JU and it was the first time that a joint call across JUs was launched. Further, the call included exploratory research topics. Overall, it resulted in 7 new projects currently in the Grant Agreement preparation phase with an estimated 27% of the EU funding for SMEs.

Overall, in the four calls for proposals launched by EU-Rail since 2022, 746 beneficiaries from 28 different countries are involved in the EU-Rail projects, benefit from Horizon Europe funding and work towards delivering on the EU-Rail programme and achieving the EU's transport policy goals. Ninety-three beneficiaries are SMEs and their average success rate based on total SMEs participation across those four calls is significant, i.e. 76%, indicating the programme high accessibility to SMEs. However, the commitment of EU-Rail members to reduce the funding rate to 60% can be a challenge to some SMEs and should be addressed within each consortium.

Concerning S2R, the operational activities ended in 2023 and 477 beneficiaries from 29 different countries across Europe participated.

S2R had 8 private founding members and 19 associated members, while EU-Rail comprises 25 private founding members listed in Annex II to the SBA. In 2024. the JU launched an open call for expression of interest in view of selecting associated members, with deadline on 4 November 2024. As mentioned above, the call is targeted at EU stakeholders having key capabilities/capacities and competencies in the new/enlarged R&I areas described in the update of the multiannual work programme.

At project level, EU-Rail and S2R have established an innovation ecosystem for the European rail sector in which interactions are simplified, and collaboration is efficient. EU-Rail emphasises transparency and makes essential efforts to disseminate and communicate activities throughout the sector. For example, documents are made publicly available, which increases transparency and the JU's visibility. In addition to the regular Information Days on the calls for proposals, stakeholder engagement is actively promoted and links with other sectors are established by organising events, such as the 'Rail Transport Day' organised in 2023 together with the European Commission. These efforts produce results. In 2022, EU-Rail welcomed 99 newcomers in its activities, including nine from outside the EU. In 2023, 51 newcomers were integrated.

Moreover, the EU-Rail Governing Board of EU-Rail meets once a year in a general assembly and all participants to the research and innovation activities of EU-Rail are invited to attend. T The operational part of the General Assembly is open. Therefore, that part of the meetings is also open the entities not yet involved in the implementation of the programme.

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[26] call-for-expression-of-interest-with-a-view-to-selecting-eu-rail-associated-members

The System Pillar Steering Group of EU-Rail includes representatives of the rail and mobility sector and of relevant organisations: the European Union Agency for Railways and of the European Rail Research Advisory Council (ERRAC). This ensures the sectorial input beyond the current EU-Rail membership.

In addition, EU-Rail has two stakeholders' groups open beyond the EU-Rail membership but also beyond the entities interested in performing R&I: the Deployment Group and the European DAC delivery programme[27]. Both groups are open to enlarge membership based on defined criteria and mechanisms to ensure appropriate thematic focus and representativeness.

The EU-Rail multiannual work programme (MAWP) has been developed involving all partners and is adapted according to the technological developments, user needs and EU policies. One example is the adoption by the Governing Board on 21 June 2024 of the revised MAWP, to include the gaps identified during the implementation of the EU-RAIL Flagship Projects. Moreover, this revision addresses additional R&I elements of relevance to the JU objectives as well as aspects where new EU-RAIL members could bring additional value, in particular as regards artificial intelligence, cybersecurity, the next EU-RAIL communication system, climate adaptation and regional solutions. In its activities, EU-Rail actively seeks input from advisory bodies and stakeholders to ensure effectiveness in the pursuit of its objectives.

The principal mechanism to achieve an effective consultation of all relevant stakeholders are through the States' Representatives Group (SRG), System Pillar Steering Group, Deployment Group, and Scientific Steering Group (SSG).

The SSG provides the Governing Board and the Executive Director with advice and recommendations on the implementation of the EU-Rail programmes and on scientific issues. It is composed of twelve members working within different types of research organisations from eight different EU countries.

The SRG reviews information and provides its opinion on the programme progress, the strategic research and innovation agenda and links with other initiatives. Its main tasks include engaging with SMEs, start-ups, higher education institutions, research organisations and coordinating measures to promote newcomers. It is composed of 58 members from all EU Member States and 14 participants from five associated countries.

The System Pillar Steering Group (SP STG) supports the identification of priorities around the overall vision of the SERA System Architecture and operational concepts for the future of the rail system.

The Deployment Group gives advice to the Governing Board on the market uptake of rail innovations developed by EU-Rail. It supports a coordinated and consistent deployment of innovative solutions and therefore completes EU-Rail's contribution to the entire innovation cycle in rail via integrated R&I programmes. In addition, for the identification of its exploratory research topics, EU-Rail regularly consults the SRG, SSG but also the European Technological Platform for Rail Research (ERRAC) and takes into account any input provided by the sector stakeholders to the JU.

The General Assembly also stimulates the reflection on the overall direction of the activities of EU-Rail while conducting an open and transparent discussion on the progress in implementing the Master plan.

4. Efficiency

The table below reports, for the period 2014-2023, Shift2Rail and Europe's Rail's **total operational costs** (EU contributions; Validated IKOP; Financial contributions to operational activities by JU partners; Eligible project costs funded by non-JU members to project activities; Contribution from Member States and international organizations to project activities),the **certified IKAA** (In-Kind

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[27] EDDP – see Section on effectiveness.

Contributions to Additional Activities) and **running costs** (commitment appropriations EU voted budget and contributions from sources other than the EU). See also Annex 4.4.1 for a comparison of operational expenditure and administrative expenditure of Joint Undertakings and EIT KICs of the period 2014 -2023.

Operational and administrative expenditures Shift2Rail and Europe's Rail (2014-2023) (source: CORDA)

The table includes data for Europe's Rail and Shift2Rail Joint Undertakings. **OC** *: Operational Costs;* **IKAA** *: Certified IKAA;* **RC** *: Running Costs*

	2014 [EUR]	2015 [EUR]	2016 [EUR]	2017 [EUR]	2018 [EUR]	2019 [EUR]	2020 [EUR]	2021 [EUR]	2022 [EUR]	2023 [EUR]	Total
OC	-	-	88,120,148	61,747,093	73,675,414	117,084,681	81,819,445	13,841,961	354,304,534	13,058,734	803,652,010
IKAA	-	-	48,422,572	65,997,423	39,960,347	34,819,699	20,766,217	16,442,300	31,658,025	112,643,410	370,709,992
RC	267,595	2,239,601	3,300,000	1,775,296	3,223,678	2,803,733	3,022,479	1,232,595	4,977,000	3,206,920	26,048,897

EU-Rail and S2R have been cost effective and operationally efficient regarding the timely implementation of the budget designated, as expressed by the partnership evaluation report[28]. S2R proved to be successful in setting annual budget proposals and monitoring their execution, regarding implementing the commitments and payments against the total budget.

During the S2R programme the grant agreements for all 101 projects were signed by 2021, all major technical activities ended in 2023. The programme is still undergoing its phase-out and is expected to be closed in 2025, with the execution of all remaining payments and in full compliance with the Founding Regulation.

The implementation rate of the EU-Rail operational budget in 2023 was 100% for commitment appropriations (99.9% in 2022) and 85% for payment appropriations (79% in 2022).

According to the SBA, the JUs are expected to operate back-office arrangements by concluding service level agreements, subject to the need to guarantee an equivalent level of protection of the EU's financial interest when entrusting budgetary implementation tasks to joint undertakings. The SBA also underlines that these synergies among JUs should be implemented where screening of resources has proved to be efficient and cost-effective, while respecting the autonomy and the responsibility of each Authorising Officer. In this respect, EU-Rail took the lead on the back-office arrangements on accounting services, concluding service level agreements with the other JUs on 16 December 2022 and taking over the accounting services previously provided by DG BUDG. Those back office arrangements are fully operational and are delivering the intended services, including the preparation of the annual accounts for 10 JUs. The feedback from the other JUs confirms the ability of EU-Rail to run an effective and efficient service.

EU-Rail continues the S2R efforts to minimise the duration of the granting process to ensure rapid implementation of R&I activities and the transparency and simplicity of the grant preparation process. For calls under S2R, the average time between contacting the successful applicants and signing the grant agreement (TTS) was 94 days. The average time between the call deadline and the signing of the grants for all calls was 191 days. The operational efficiency of EU-Rail was also assessed positively in the Partnership evaluation report[29]. Accordingly, the process from proposal submission to project initiation could be rated as highly efficient, which was particularly noticeable in the outstanding speed of the overall process. A tight schedule was maintained to finalise quickly the grant agreements from the 2022 calls, so that the projects could start by the end of 2022. Based on the data extracted from HE Dashboard (stand 1 July 2024), for all signed grants the Time-to-Grant (TTG) was 194 days, which is well below the TTG target of 245 days.

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[28] Partnership Evaluation report: Europe's Rail Joint Undertaking, pp. 18 and 20.
[29] Partnership Evaluation Report: Europe's Rail Joint Undertaking, page 20.

EU-Rail addresses the administrative burden on applicants and beneficiaries arising from the complex process of funding allocation and specifically from the interaction within the JU. It strives for a far-reaching reduction while at the same time considering formal requirements. As a pioneer, S2R also introduced the lump sum approach in 2018 under the pilot scheme, before its large-scale implementation under HE, simplifying expenditure control and the administrative approach, to the benefit of a more stringent and effective control on the operational side.

This considerably simplified the funding process at an early stage in terms of administrative steps to be taken and improved transparency in expenditure control. Therefore, EU-Rail significantly reduced the administrative burden for beneficiaries in terms of project reporting.

It can already be concluded that the shift from the cost control to the results control brings positive outputs. The JU can focus oversight on content of the R&I project, hence more able to provide input for policy purposes in full collaboration with the Commission. However, this approach does not save resources on the JU side, as the decreased financial administrative burden is fully compensated by an increased workload on monitoring the projects progress and results, to ensure that the conformity assessment for payment is based on a successful conclusion of the work package tasks, milestones and deliverables, and not anymore on a control of declared costs (i.e. assessment based on spending) and general validation of outputs. At the same time, no more *ex post* financial audits are possible, which could lead to resource problems for the JU in case lump sum projects are selected for post-review by audit services, given that the JU has no resources allocated to such activities.

5. Coherence and synergies

EU-Rail is focusing its activities on ensuring coherence and complementarity with relevant national and European investment programmes, such as Connecting Europe Facility (CEF), European structural and investment funds (ESIF), and the Recovery and Resilience Facility (RRF), 15% of the latter will be invested in national railway systems. To this end, the JU seeks dialogue with local, regional and national stakeholders in order to coordinate and complement the research and innovation activities carried out, with the SRG once again playing a key role.

S2R and EU-RAIL activities are at lower TRLs than deployment. Therefore, deployment of solutions and technologies developed in the partnership can then, once at a given level of maturity, and if eligible, be supported by other EU policies and programmes. This is the case for example for DAC deployment, where there is a consideration to support an initial deployment based on the work developed in S2R and EU-Rail.

For regional and national programmes on rail research, the coherence at EU level of the overall partnership programme is managed in several ways:

- Through the State Representative Group, Member States gain full visibility of the EU-Rail programme and also feedback on any related activities at Member States to support coherence in the programme.
- Through participation in cooperative activities as done in 2023 with Spanish Presidency of the Council by organising a joint 'Satellite for Rail' conference in collaboration with the European Union Agency for Railways and the European Union Agency for the Space programme, supported by the Spanish Transport Ministry, or with the Swedish Presidency of the Council where EU-Rail organised a joint event with the Commission, with the title 'Rail Transport Day'.
- Memoranda of understanding have been signed with European regions and Member States, JUs, European and international organisations, such as with RNE, UIC, CEN/CENELEC, ETSI.
- Coordinated activities at EU level with national / sectorial R&I actions on the Digital Automated Couplers with the European DAC Delivery programme, enabled by EU-Rail.

- Rail system architecture coordinated in the System Pillar with national and sectorial input notably around signalling activities.
- Coordination with the Digital PRIME working group composed of rail infrastructure managers and also with Rail Net Europe on the implementation of digital solutions by infrastructure managers, especially infrastructure capacity planning and traffic management.
- The Deployment Group will serve to coordinate the JU and rail key innovations with the investment plans and funding at various level from EU to local level extending the European DAC Delivery programme benefits to other rail innovations.

Further, the R&I activities implemented within the EU Rail programme could be linked with those of the EU Agency for the Space programme (EUSPA), ensuring that the European GNSS is fully adopted within the European Rail Traffic Management System (ERTMS). Therefore, Europeans will benefit from reduced railway operational costs, improved safety on regional and low-density lines and accurate passenger information services. In 2024, EU-Rail implemented its cooperation with EUSPA and the European Space Agency (ESA) in a specific project implementing EGNOS for rail, under the strategic leadership of the Commission and in coordination with the European Union Agency for Railways (ERA).

Synergies and cooperation at programme level are key for the European rail sector to compete with other transport modes, while also keeping its global leading role and increasing its strategic sovereignty by integrating innovations from other industries. EU-Rail is therefore actively seeking synergies with other European partnerships and has already started coordination activities with several other JUs.

Following the definition of the first synergy topic calls- in 2023, 2024 is the year in which the first joint project between EU-Rail and SESAR 3 will be implemented in traffic management, improving door-to-door mobility, potentially involving other modes of transport. EU-Rail will administratively manage EUR 3 million from SESAR 3 JU based on the synergy call topic cooperation agreement.

A joint topic call for the testing and operational validation of the next EU rail communication system was also only agreed 2024 with the Smart Network Services JU (SNS JU). EU-Rail will administratively manage 1 million EUR from SNS JU based on the synergy call topic cooperation agreement. EU-Rail working on the next, 5G based, communication system is an addition to the programme, and this demonstrates the confidence provided in EU-Rail by the Commission and the sector in handling such strategic activity and key innovation, building on activities previously performed within different organisations, outside the EU governance.

In addition, the JU is also liaising with EU missions, such as the Mission for Climate-Neutral and Smart Cities, by the means of the Contribution Agreement with the Commission for a total of 0.7 million EUR, which was concluded in 2022 to finance the implementation of the 'Pilot project – IRS Smart Cities project: new railway station concept for green and socially inclusive smart cities'[30].

Collaboration also takes place with other mobility initiatives through various Horizon Europe clusters, focusing on topics such as multi-modal transportation, vehicle automation, decarbonisation, and alternative fuels. Synergies have been achieved with:

- **Cluster 4 'Digital, Industry and Space':** Considering the key challenges related to the digital transformation of rail, this cluster collaboration has also been critical. Artificial intelligence, cyber-security and high-performance computing are cross sectoral issues that require deep coordination especially for the development of use cases and the application of European standards. In addition, European space policy appears to be of key relevance, considering the ambition to introduce more and more satellite-based solutions for localisation or data

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[30] https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/opportunities/topic-details/horizon-er-ju-2022-explr-01

transmission. Here also synergies with EUSPA (and ESA) and SNS will be continued building upon the past experience;

- **Cluster 5 'Climate, Energy and Mobility':** EU-Rail has reached out to other mobility JUs with the aim to build, where possible, consistent projects and demonstrators for climate neutral mobility solutions. This may also address shared areas of intervention such as multi-modal transport, automation in vehicles and other assets, decarbonisation, use of alternative fuels, etc. In particular, specific coordination with the European Partnership SESAR 3, Clean Hydrogen, as well as with the Batteries co-programmed partnership (BATT4EU) is ongoing.

6. EU added value

EU-Rail and S2R are now essential elements of the European rail landscape. Previously, research and innovation activities were not coordinated, leading to lack of comprehensive market ready solutions and significant duplications and fragmentation of research funding as well as poor uptake of the R&I results and delivery on the EU policy goals. This, however, has changed, and the JU structure is accepted as the focal point for European R&I.

Because the rail sector is a complex network industry, deep coordination and alignment of public and private R&I funding, including the integration of different actors, are essential. To ensure that technological advances benefit the rail industry and its users (passenger and freight), a partnership scheme like EU-Rail addresses the problems of slow deployment and limited market uptake of innovative solutions.

The added value of the partnership is also driven by its ability to address:

- fragmentation of different regional and national systems, networks and technical operating standards;
- fragmentation among rail subsystems. Complex interactions between subsystems (infrastructure, rolling stock and signalling equipment) and actors (manufacturers, railway undertakings and infrastructure managers) limit the potential development of specific elements of the system and the implementation of breakthrough solutions impacting on the system as a whole;
- fragmentation along the innovation life cycle. Past uncoordinated EU research activities generated by European R&I projects have led to very poor market uptake of innovative rail solutions, resulting in limited direct leverage of EU funding;
- the 'bottom-up' approach of collaborative research projects on rail has resulted in an uncoordinated programming approach and poor alignment with EU policy goals.

The EU-Rail programme, as compared to interventions carried out at regional or national levels only, brings multiple advantages by providing:

- a long-term strategy for rail-related R&I, with research and development activity aligned with European policy objectives for the rail sector, see for example the Standardisation and TSI Input plan that is aligned and supports the delivery of the TSIs and standardisation requests[31];
- a higher level of overall R&I invested, not least because of a commitment of financial and in-kind resources from rail industry organisations who are better able to engage under a legally binding framework governing the allocation of resources. It accelerates innovation and attracts private investments;
- effective management of a pipeline of activities covering basic research, development and demonstration, with an appropriate allocation of resources to projects at different TRLs;

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[31] See also the Effectiveness section.

- an EU-wide scope is ensured, to address jointly market needs and ensure interoperability of the rail system and the needed operational harmonisation, which require coordination beyond the national and regional level;
- targeted support for research at TRLs 1 to 3 with possibility to translate the outputs from such research into intellectual property for exploitation both within Europe and in global markets;
- coordination of rail R&I to avoid parallel developments by individual stakeholders (the EU here acts as a catalyst to efficiently deliver rail research), to stimulate cooperation beyond national borders (linking university, research institutes, railway companies and suppliers) and to involve relevant partners from outside of the railway sector;
- standardised EU solutions, brought together by the actors in EU-Rail innovations, so that services for passengers and freight customers are improved and costs decrease for the entire EU network.
- higher Technology Readiness Levels (TRLs) compared to those achievable through solely national initiatives and with capacity to develop, and coordinate large-scale research and innovation activities at the European and national level with a high likelihood of successful implementation, leading to the implementation of the Single European Railway Area;
- synergies and cooperation with other relevant European, national, and regional programmes so that activities can be pursued efficiently.

7. Relevance

The objectives of S2R and EU-Rail are still relevant as they address both the objectives of the respective Framework programmes and EU policies (see point 1 Effectiveness).

S2R aimed at stimulating and better coordinating EU research and innovation investments in the rail sector with a view to accelerating and facilitating the transition towards a more integrated, efficient, sustainable and attractive EU railway market, in line with the business needs of the rail sector and with the general objective of achieving a Single European Railway Area (SERA). In particular, S2R has contributed to specific objectives defined in the 2011 Transport White Paper and in the Fourth Railway package, including the improved efficiency of the rail sector for the benefit of the public purse. It also contributed with R&I to expand the capacity of the rail network, to enable rail competing effectively and taking a significantly greater share of passenger and freight transport. Part of the R&I also addressed the improvement in the quality of rail services by responding to the needs of rail passengers and freight forwarders, as well as contributed to the removal of technical obstacles holding back the sector in terms of interoperability. It also worked on the reduction of negative externalities linked to railway transport such as noise and vibrations.

Those objectives are still relevant and have been taken over by EU-Rail which have its global objectives aligned with:

- EU priorities (European Green Deal, Fit for 55, Sustainable and Smart Mobility strategy, Digital Decade, Industrial strategy);
- UN's Sustainable Development Goals;
- Cluster 5 (Climate, Energy, and Mobility) of Horizon Europe.

Specifically, EU-Rail is contributing to achieving the Single European Rail Area (SERA), ensuring a fast transition to more attractive, user-friendly, competitive, affordable, easy to maintain, efficient and sustainable European rail system, integrated into the wider mobility system, as well as supporting the development of a strong and globally competitive European rail industry.

The rail system is a key element of the sustainable option for European mobility. For this, EU-Rail is delivering a high-capacity integrated European railway network by eliminating barriers to interoperability and providing solutions for full integration, covering traffic management, vehicles, infrastructure and services, aiming to achieve faster uptake and deployment of projects and innovations. It exploits the huge potential for digitalisation and automation to reduce rail's costs,

increase its capacity and enhance its flexibility and reliability, based upon a functional system architecture shared by the sector, in coordination with the European Union Agency for Railways.

A transformation of the rail system is enabled by digitalisation. Coordination at EU level is needed (and happening in EU-Rail) to seize digital opportunities and achieve the ambitious EU policy and sector goals.

The partnership addresses political, demographic, technological and market challenges linked to the needs of passengers and freight customers. These shifts, along with disruptive events like the COVID-19 pandemic, require a flexible instrument for R&I like EU-Rail to adapt the course of the sector and EU research. One example of this is the new focus on standardisation of contaminant such as viruses, removal from the trains heating, ventilation, and air conditioning systems (HVAC).

Rail must also be able to accommodate increased demand and become more resilient against the impacts of climate change. New infrastructure will be necessary in certain areas, but the digitalisation and automation of operations, under the systemic approach that can only be provided today by the EU-Rail framework, will create the vast bulk of future increased traffic leveraging existing infrastructure and helping to address traffic disruptions caused by climate crisis related phenomena.

The European rail supply industry is world leading. However, today it is facing many challenges at global level. Innovative solutions, conceived, designed, and developed jointly in EU-Rail for creating new solutions to be deployed at European level (following also the recommendations of the EU-Rail Deployment Group) will strengthen the competitiveness of the European rail supply industry. Furthermore, to be more competitive and support future increased usage, rail must deliver services at reduced cost compared to today, including tackling all the elements of its life cycle, and improve its interaction with other transport modes. EU-Rail has proven to be key in creating synergies unexploited before.

Rail must also move to one European network more unified that delivers SERA – and be more flexible to introduce and scale up new technological and operational solutions to deliver new and improved client-oriented services. For this reason, part of the R&I of EU-Rail is dedicated towards enabling European traffic management (today it is managed at regional or at best at national level) and it is harmonising the technical interfaces among innovative systems and fostering rail operational rules harmonisation at EU level.

8. Directionality

EU-Rail aims to create a more competitive, sustainable, and integrated European rail system. It focuses on R&I to address global challenges, including climate change and economic competitiveness. Therefore, it is integral to the European Green Deal, targeting a reduction in greenhouse gas emissions, to promote rail as a sustainable transport mode, and enhancing its efficiency and attractiveness.

Fostering advanced technologies, including digitalisation, automation, and improvement in safety and efficiency, EU delivers better rail services to the citizens, ensuring rail transport contributes increasingly to achieve climate neutrality by 2050. The transport resilience needs to be hedged against disruptive events, like a pandemic or geopolitical tensions. Russia's war of aggression on Ukraine continues to have a huge impact on the transport infrastructure by affecting supply chains and limiting European citizens mobility. Considering that Europe seeks alternatives to Russian energy supply, the rail transport's role in the efficient movement of goods and people becomes even more critical to ensure connectivity and security, pushing for the need of a resilient and autonomous European rail system. For this reason, it appears fundamental to improve rail networks and the ability of rail to provide a quality standard service across Europe and beyond, something that EU-Rail has demonstrated to support in a coordinated way with its partnership framework of high TRL R&I. Investing in rail research and development, EU-Rail strengthens the EU's position in the global rail

market. It drives economic growth by creating jobs, stimulating investment in infrastructures and technologies, and boosting the industry's overall competitiveness and the EU economy.

In 2023, the overall investments mobilised by EU-Rail towards EU priorities accounted for 561 million EUR linked both to the Green Deal and the 'Europe fit for the digital age' strategy. For those investments EU-Rail contributed with 243.9 million EUR of EU funds (and additional 42 million EUR are in Grant Agreement Preparation phase in 2024), demonstrating the partnership ability to deliver under the provided directionality.

9. International positioning

EU-Rail has significantly boosted the international visibility of EU in the rail R&I domain.

A strategic focus on communication activities has been pursued, in line with Commission guidance, which has led to continuously promoting the programme, and yielding a significant increase in the recognition of R&I activities, mission, and vision. Project results and ongoing activities are widely disseminated through the website, online resources, presentations at internal and external stakeholder gatherings, and coverage in press and social media platforms.

The success of its efforts is illustrated by a substantial number of press articles referencing the JU's activities have been published in international journals and media outlets over the past years. As of 2023, the dissemination and outreach activities other than peer-reviewed publications (e.g. press releases, flyers, social media) reached 2 866 292 people. In 2023, EU-Rail published 10 newsletters, 6 press releases, 5 publications, organised 4 events, and participated in 62 industry events. The JU's website was visited by 144 645 unique visitors in 2023, which is a significant increase compared to 2022. Most visitors (84%) were based in Europe, followed by Asia (9%) and North America (5%). The readership of the JU newsletter has increased to 2 105 in 2023.

EU-Rail has improved its international positioning through event participation and organisation, summing up to nearly 80 events, solidifying its position as a key player within the global rail and transport community. The main international events where EU-Rail plays a key role are the Connecting Europe Days, the Transport Research Arena, InnoTrans, and the International Transport Forum summit. Furthermore, it actively contributed to the European Start-up Award for Mobility, held by the Chair of the European Parliament's Transport Committee.

At projects level, in 2023 international actors actively contributing to the EU-Rail R&I Programme included 28 entities from associated countries and non-EU countries participating in projects. More specifically, 8 from Norway, 9 from Switzerland, 8 from the UK, 1 from Ukraine, 1 from Serbia and 1 from Türkiye, representing 1 public organisation (4%), 12 higher or secondary education establishment (43%), 6 research organisations (21%), 7 private for profit organisations (25%) and 2 other organisations (7%).

In 2024, EU-Rail continues the collaboration with associations representing the sector's key stakeholders, and non-EU country programmes. For example, EU-Rail has cooperation with several key international partners, such as the Federal Railroad Administration (FRA), the American Public Transportation Association (APTA), the Federal Transit Administration (FTA) in the US, the Canadian Urban Transit Research and Innovation Consortium (CUTRIC), Gulf countries, India, and it will establish a collaboration with Australia in the near future.

The collaboration with the EU neighbouring countries, in particular Western Balkans and the Transport Community has been reactivated in 2023, the latter has now an observer role in the States Representatives Group (SRG).

10. Phasing-out preparedness

The general planning is summarised as follows:

Task	Lead	2026	2027	2028	2029	2030	2031	Beyond 2031
Commission proposal for a new Framework Programme for Research and Innovation	EC	X						
Decision on EU-RAIL phasing-out	EC		X					
Legacy decision	EC		X					
Human Resources planning/adjustment	EU-RAIL	X	X	X	X			
Budget planning/adjustment	EU-RAIL	X	X	X	X	X	X	
Annual accounts	EU-RAIL	X	X	X	X	X	X	
Logistics and IT	EU-RAIL	X	X	X	X	X	X	
Monitoring of contractual obligations, incl. project closure and follow-up	EU-RAIL	X	X	X	X	X	X	
Monitoring of financial contributions	EU-RAIL	X	X	X	X	X	X	
KPIs monitoring	EU-RAIL	X	X	X	X	X	X	
Transfer to legacy management entity							X	X

Source: Phasing-out plan[32]

According to the Single Basic Act[33], all Joint Undertakings have the legal obligation to adopt a plan for the phasing-out of the partnership from Horizon Europe funding by the end of 2023. The aim of the plan is to ensure a smooth continuation of the JUs' activities in the scenario of no funding available under the next Framework Programme. In this perspective, JUs are asked to perform an in-depth reflection on a phasing out strategy leading to a lesser dependence from the Union contribution.

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[32] https://rail-research.europa.eu/wp-content/uploads/2023/12/GB-Decision_14_2023_Annex_EU-Rail-phasing-out-plan.pdf
[33] Council Regulation (EU) 2021/2085 establishing the Joint Undertakings under Horizon Europe.

In December 2023, Europe's Rail's Governing Board adopted a preliminary phasing out plan.[34] It included administrative and operational adaptations, which should allow the JU to proceed its activities in case of no Union funding under the next Framework Programme. In detail, the adaptations concern several aspects, such as legal status, staffing, accounting and cashflow, procurement, logistic and IT, follow up of the grant agreement obligations after the end of projects.

In November 2024, the Governing Board adopted an updated version of the phasing out plan[35], which includes concrete reflections on short- and long-term targets, strategic alignment and financial sustainability. The aim is to develop a strategy enabling the JU to obtain the objectives beyond the duration of the Union's participation.

In detail, according to the latest version of the document, in the event of a phasing out of the funding from Horizon Europe, EU-Rail will continue to fulfil its financial and reporting obligations in line with the JU's financial rules. The Programme Office will therefore continue to prepare the JU's annual accounts, and monitor the financial contributions from partners and the assets of the organisation until 31/12/2031. The final accounts of EU-Rail – due by June 2032 together with the 2031 Annual Activity report -Report – will have to be prepared in the context of the legacy management.

Post-2031, in case of no renewal of the JU under the new programme, building up on its achievements and further innovating with new policy objectives, all the remaining obligations will be transferred to the relevant Commission departments. These years are planned to be executed with (EU budget) payment appropriations from the implementation and closure of existing administrative and operational expenditures of procurement contracts and grant agreements.

The phasing-out plan of the JU should be designed in a strategic manner and as a 'bridging strategy' to the next framework programme. In case of EU-Rail, this is relevant for the achievement of the Single European Railway Area (SERA), to a fast transition to a more attractive, user-friendly, competitive, affordable, efficient and sustainable European rail system, and to the development of a strong and globally competitive European rail industry, with an integrated system approach, research, development and demonstrations of innovative technologies and operational solutions (enabled by digitalisationdigitalization and automation) for future deployment, and to deliver on the EU's policy objectives.

Lastly, it is important to underline that the phasing out plan must be intended as a living document. In this perspective, Europe's Rail is committed to updating the plan, further complementing the information and the strategic reflection included in the document while taking into account any relevant future developments.

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[34] https://rail-research.europa.eu/wp-content/uploads/2023/12/GB-Decision_14_2023_Annex_EU-Rail-phasing-out-plan.pdf
[35] https://rail-research.europa.eu/wp-content/uploads/2024/12/Annex_GB-Decision-18-24_Rev_Phase_out_plan.pdf

Annex: Acronyms

ATO	Automatic Train Operation
C-DAS	Connected Driver Advisory System
DAC	Digital Automatic Coupler
DG	Directorate-General
ERA	European Union Agency for Railways
ERRAC	European Railway Research Advisory Council
ERTMS	European Rail Traffic Management System
ESA	European Space Agency
EU-Rail JU	Europe's Rail Joint Undertaking
EUSPA	European Union Agency for the Space Programme
FP	Flagship Project
GoA	Grade of Automation
HE	Horizon Europe
IKAA	In-kind contribution for additional activities
IKOP	In-kind contribution for operational activities
IP	Innovation pillar (EU-Rail)
IP	Innovation programme (S2R)
JU	Joint Undertaking
KPI	Key Performance Indicators
LCC	Life Cycle Costs
MAWP	Multiannual working plan
R&I	Research and innovation
S2R	Shift2Rail
SBA	Single Basic Act
SERA	Single European Railway Area
SME	Small and medium-sized enterprises
SRG	States Representatives' Group
SSG	Scientific Steering Group
TRL	Technology readiness levels