European rail "nextgen" backbone of sustainable and smart mobility and transport

21 April 2022

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Executive Director

Europe's Rail: Vision

European Green Deal

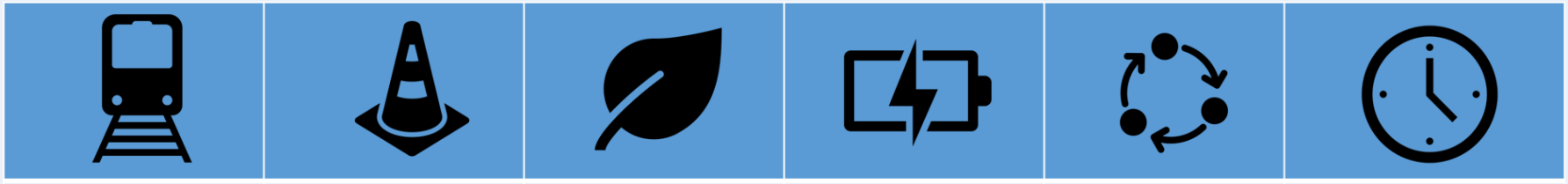
EU policy priorities

- An economy that works for people: New Industrial Strategy
- A Europe fit for the digital age: Shaping Europe's Digital Future
- Europe in the world

Sustainable and Smart Mobility Strategy

EU-RAIL VISION

To deliver, via an integrated system approach, a high capacity, flexible, multi-modal, sustainable and reliable integrated European railway network by eliminating barriers to interoperability and providing solutions for full integration, for European citizens and cargo.



DELIVER AN **INTEGRATED EUROPEAN RAILWAY NETWORK** BY DESIGN

DEVELOP A **UNIFIED OPERATIONAL CONCEPT AND A FUNCTIONAL SYSTEM ARCHITECTURE** FOR INTEGRATED EUROPEAN RAIL TRAFFIC AND CCS/AUTOMATION

DELIVER A **SUSTAINABLE AND RESILIENT RAIL SYSTEM**

DELIVER A **COMPETITIVE, GREEN RAIL FREIGHT** FULLY INTEGRATED INTO THE LOGISTICS VALUE CHAIN

DEVELOP A **STRONG AND GLOBALLY COMPETITIVE EUROPEAN RAIL INDUSTRY**

EUROPE'S RAIL:

ONE INTEGRATED R&I PROGRAMME

SYSTEM PILLAR

OPERATIONAL CONCEPTS

FUNCTIONAL SYSTEM ARCHITECTURE

A SINGLE COORDINATING BODY FOR THE WHOLE SECTOR EVOLUTION

OPEN INTERFACES TO OTHER TRANSPORT MODES AND BUSINESSES

SYSTEM REQUIREMENT SPECIFICATIONS

INNOVATION PILLAR

TECHNOLOGICAL AND OPERATIONAL SOLUTIONS FOR SERVICES OF FUTURE

FLAGSHIP PROJECTS

LARGE-SCALE DEMONSTRATIONS

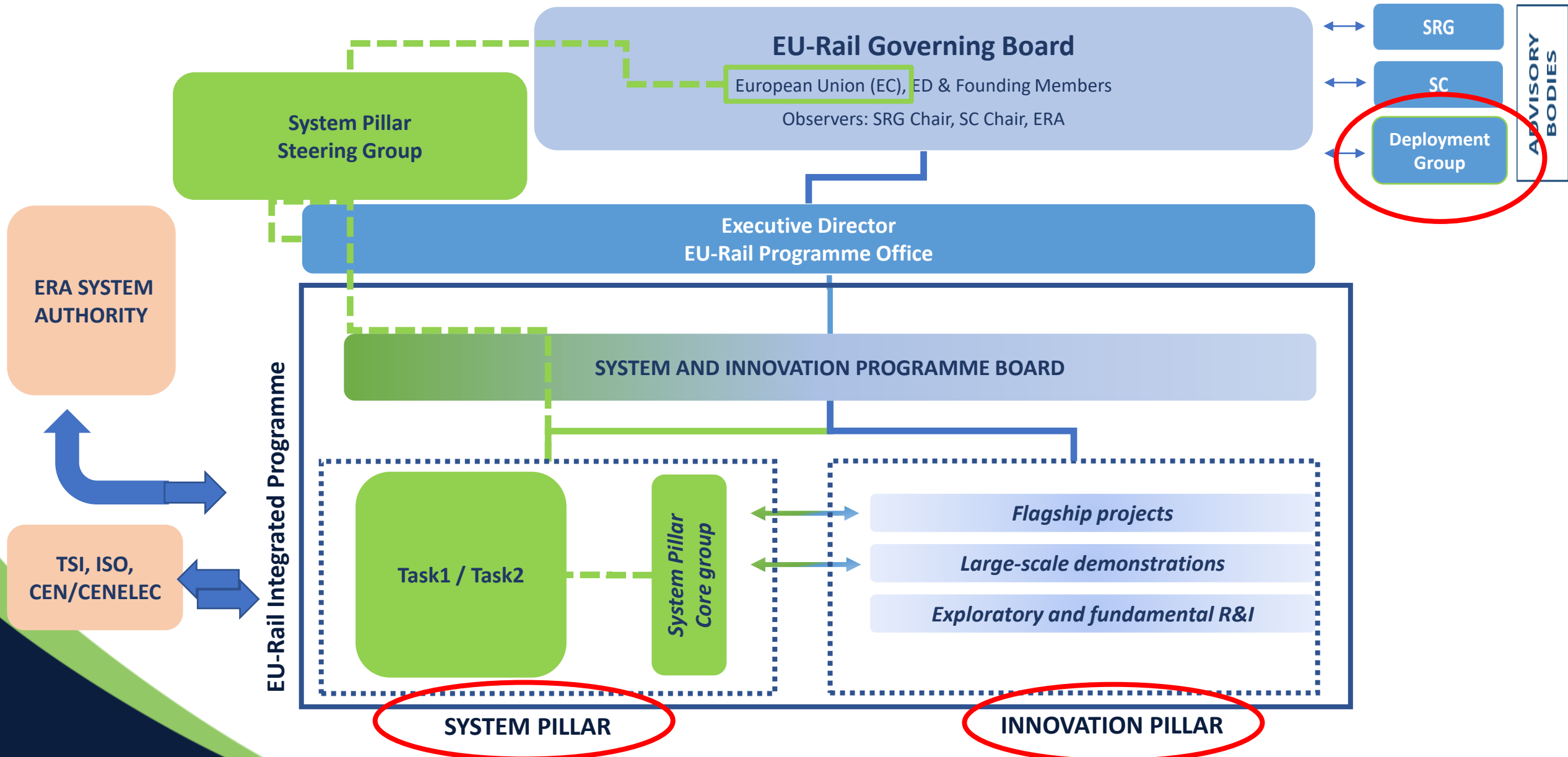
EXPLORATORY AND FUNDAMENTAL R&I

1	**EUROPEAN RAIL TRAFFIC AND MOBILITY MANAGEMENT**	Manage and improve rail traffic at EU level Adjust rail traffic management in function of the mobility demand
2	**DIGITALISATION & AUTOMATION IN TRAIN OPERATIONS**	ATO implementation Digital train operations
3	**SUSTAINABLE AND DIGITAL ASSETS**	Integrated assets testing & life-cycle framework Zero-emmission, silent rail system
4	**COMPETITIVE, DIGITAL, GREEN RAIL FREIGHT**	New digital customer interaction & innovative rail freight services Multimodal and rail freight innovation integration
5	**REGIONAL RAIL SERVICES IN LOW DENSITY AREAS**	New system approach to regional rail services in low density areas

DEPLOYMENT GROUP

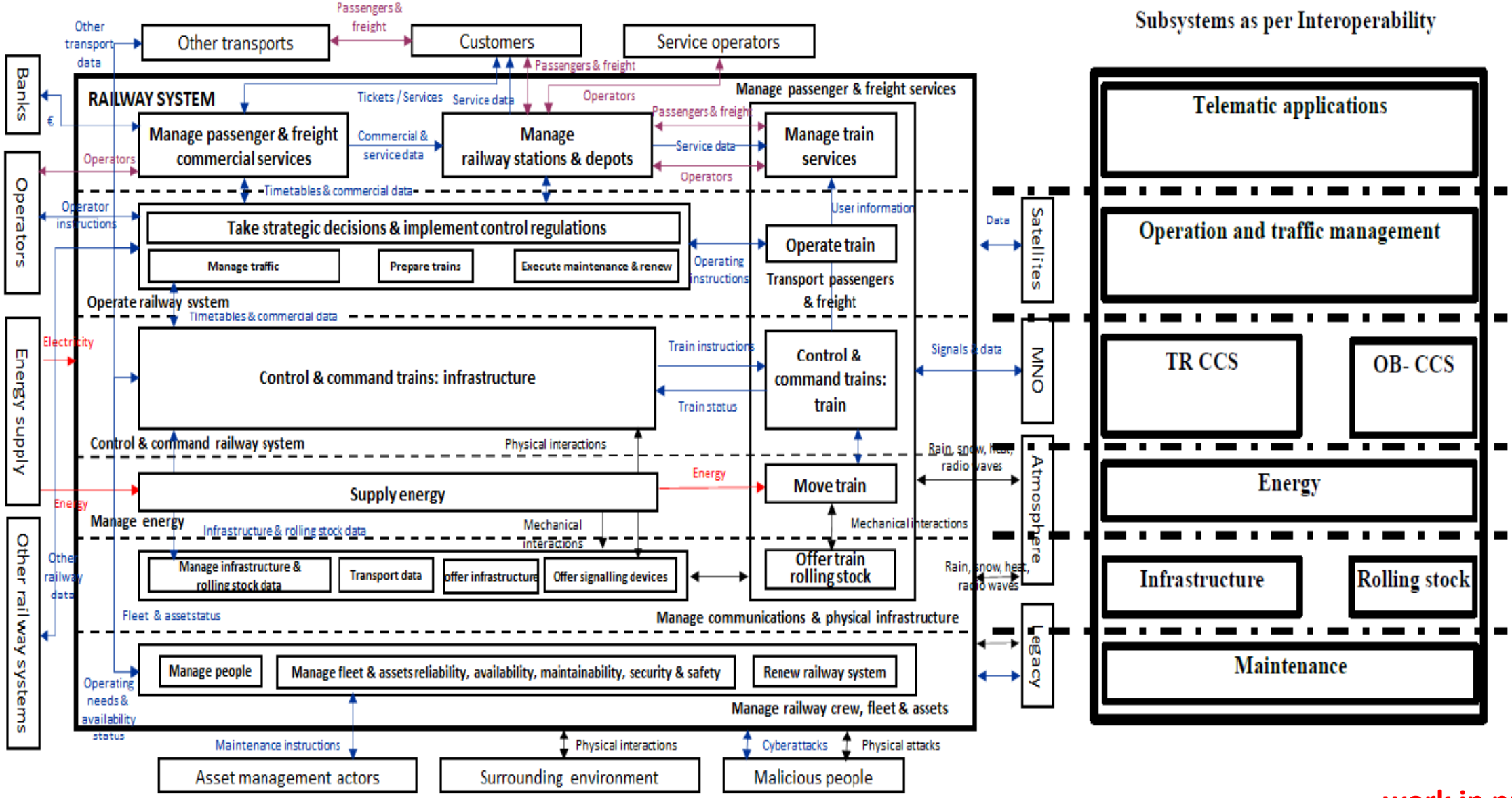
FUTURE SOLUTIONS DEPLOYED IN A COORDINATED AND CONSISTENT WAY AT EUROPEAN LEVEL, TAKING INTO ACCOUNT ALTERNATIVE ROLLOUT SCENARIOS, BEHAVIOURAL AND ORGANISATIONAL CHANGES, SYNERGIES WITH OTHER MODES OF TRANSPORT

Governance


EU-Rail Governing Board
European Union (EC), ED & Founding Members
Observers: SRG Chair, SC Chair, ERA
SRG
SC
Deployment Group
ADVISORY BODIES
System Pillar Steering Group
Executive Director
EU-Rail Programme Office
ERA SYSTEM AUTHORITY
TSI, ISO, CEN/CENELEC
EU-Rail Integrated Programme
SYSTEM AND INNOVATION PROGRAMME BOARD
Task1 / Task2
System Pillar Core group
Flagship projects
Large-scale demonstrations
Exploratory and fundamental R&I
SYSTEM PILLAR
INNOVATION PILLAR

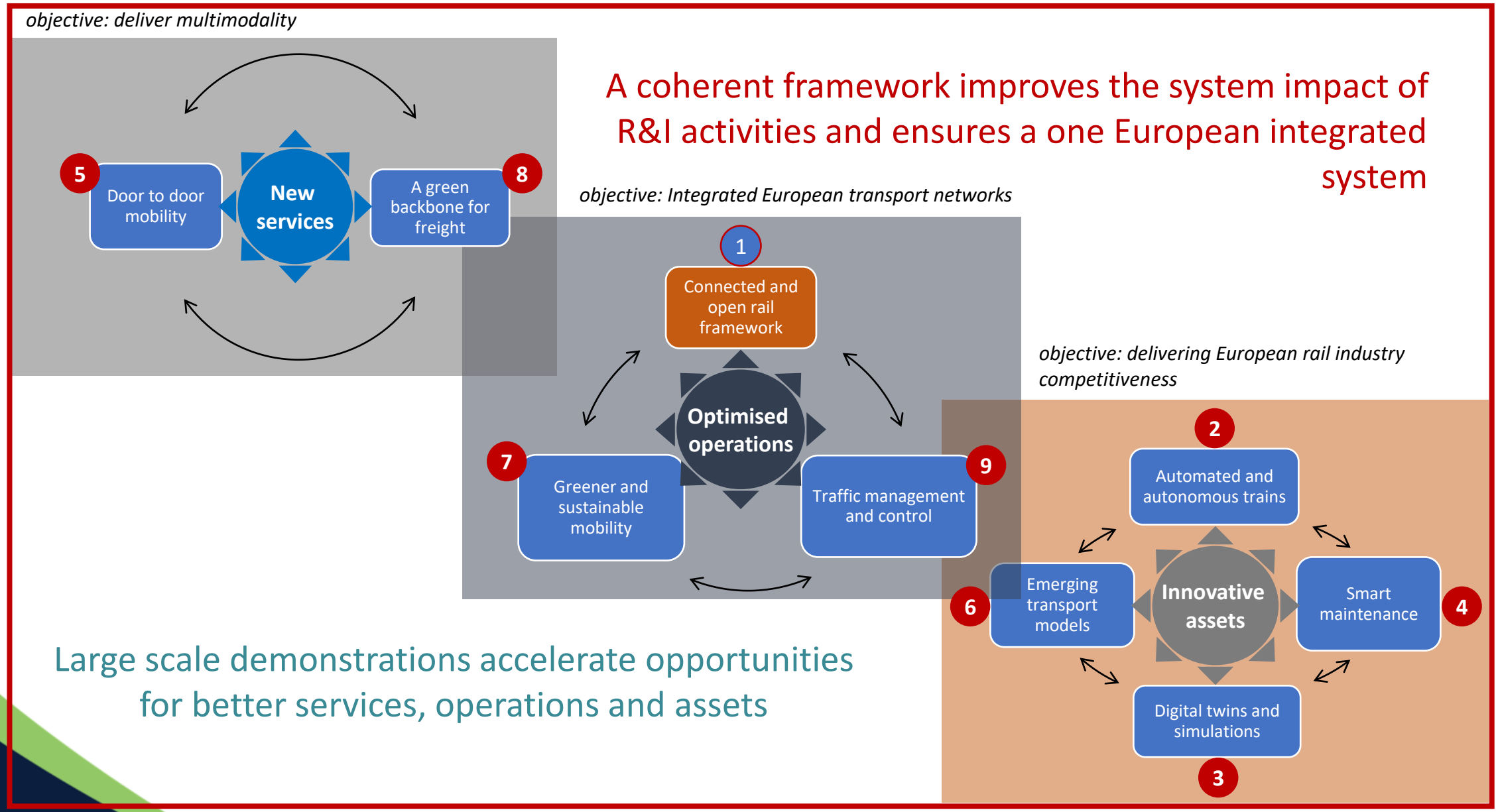
System Pillar

domains of the railway system and their alignment with sub systems

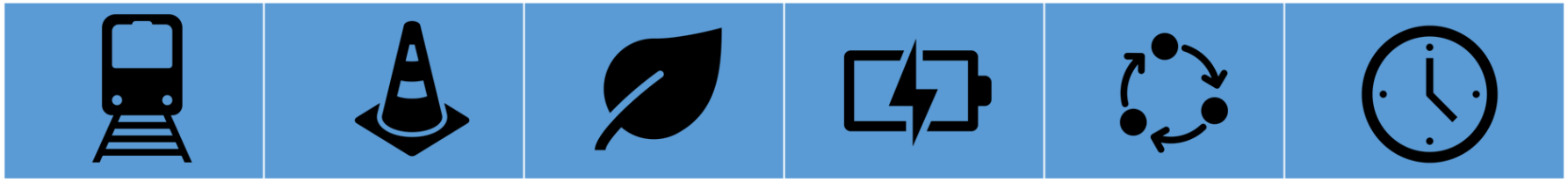


work in progress

Innovation Pillar



Key Performance Indicators of the Shift2Rail Programme



CAPACITY INCREASE	OPERATION RELIABILITY	REDUCE EMISSIONS	ENERGY EFFICIENCY	LCC REDUCTION	INCREASE PUNCTUALITY

SPD	LCC	Capacity	Punctuality
Target	-50%	+100%	+50%
High Speed	-19% (-20% / -15% / -18%)	62% (62% / 69% / 74%)	35% (35% / 29% / 19%)
Regional	-36% (-37% / -21% / -24%)	74% (74% / 57% / 49%)	53% (53% / 51% / 15%)
Metro	-18% (-18% / -16% / -18%)	25% (25% / 23% / 28%)	n/a (n/a / n/a / 19%)
Freight	-39% (-39% / -39% / -40%)	94% (94% / 42-114% / 91%)	57% (57% / 78% / 71%)

release 3.2 | release 2.0 | release 1.0

EU-Rail Work Programme 2022 2024 Budget

Year 2022	Type of call	Value of the actions	Maximum EU-Rail co-funding	Non-funded activities	Target contributions from Members in case of award	Indicative publication date
Multi-annual Call for Proposals	**Open**	390.0	234.0	156.0	302.0	Q1
Call for Proposals– Exploratory Research	**Open**	14.5	12.5	2.0	4.3	Q3
Call for Tenders	**Open**	15.5	13.7	1.8	0.0	Q1–Q4 & implementation of new and ongoing contracts/framework contracts

EU-Rail Call 2022-1

DESTINATION Topics	Type of Action	Expected TRL	Expected EU contribution per project (EUR million)	Number of projects expected to be funded
	Opening: 10 March 2022 - Deadline: 23 June 2022			
HORIZON-ER-JU-2022-FA1-TT-01	IA	5 to 7	38.0	1
HORIZON-ER-JU-2022-FA2-01	IA	5 to 7	54.3	1
HORIZON-ER-JU-2022-FA3-01	IA	5 to 8	46.3	1
HORIZON-ER-JU-2022-FA4-01	IA	5 to 7	38.3	1
HORIZON-ER-JU-2022-FA5-01	IA	5 to 8/9	40.6	1
HORIZON-ER-JU-2022-FA6-01	IA	5 to 7	16.5	1

Call structure (see also annex VII of the EU-Rail Work Programme 2022 2024):

- **Destination:** indicates the objectives as well as clear and quantified targets in term of KPIs to be reach with the R&I activities.
- **Expected outcome**: describes the expected demonstrations, the expected preparatory works to be launched for the future set of demonstration foreseen in the MAWP and the input/output expected with the linked actions from other Destinations.
- **Scope:** identifies the expected capabilities/enablers that should be developed through R&I activities for achieving the expected demonstrators. It also highlight other requirements, as the need to measure and monitor KPI, contribute to standards and interact with the System Pillar activities.

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EU-Rail call topic 2022 "Destinations":

The 1st call destination 2022 covers FAs 1 to 6 + the TT activities at about 50% of their planned activities.

They have clear demonstration targets by 2025 and all proposals shall also cover in 2026 important preparatory works needed to be launched for the future set of demonstration foreseen in the Multi-annual Work programme in view of the evolutions of the solutions

The following is an overview of the expected outcome in term of demonstration in 2025 for each of the 1st topic call "Destinations", including their TRL

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DESTINATION 1 – Network management planning and control & Mobility Management in a multimodal environment and Digital Enablers

WS1: Network management planning and control & Mobility Management in a multimodal environment
deliver **by 2025** innovative solutions to be demonstrated with:

- Tactical and short-term timetable planning including cross-borders with improved models and functions; use of decision support to support integrated capacity planning of the rail network and operations for yards, stations, terminals **[TRL6/7];**
- HMI for TMS with decision support modules, based on User Experience (UX) Design and human-in-the-loop awareness **[TRL6-8]**
- Demand-driven predictions to improve operations and service offers, considering information about events across modes. Effect of cross-regional, multimodal travels in combination with demand forecast and disruption handling on improvement of daily operations, benefit on customers (accessibility and attractiveness). **[TRL 7-8]**

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DESTINATION 1 – Network management planning and control & Mobility Management in a multimodal environment and Digital Enablers

WS2: Digital Enablers

deliver **by 2025** the following outcome:

- Develop data federation, access and processing services through standardized interfaces
- Based on the outputs and toolset developed within LinX4Rail, a common machine-readable domain ontology must be developed to structure the data unambiguously across all systems participating in data sharing
- Ensure a powerful, secure and reliable data and communication infrastructure.

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DESTINATION 2 – Digital & Automated up to Autonomous Train Operations

deliver **by 2025** at least the following:

- Demonstrate technical and functional enablers such as ATO GoA3/4 over mixed radio based ETCS levels (**TRL7 or higher**), Hybrid Level 3, moving block and TIMS (**TRL6)**, connectivity (**TRL7**), perception (**TRL6**), train positioning (**TRL6**), automated functions and digital register (**TRL6**).
- Demonstration of the remote driving and command in depots and yards, including perception systems (**TRL6**).
- A first demonstrator on next generation ATC, with modular onboard and trackside ATC architectures, at proof-of-concept stage, in close collaboration with the EU Rail System Pillar.
- A proof-of-concepts and/or validation in laboratory and field (i.e., up to **TRL5 in Lab and TRL6 on site**) for the following new functions and technical enablers:
  - Virtual Coupling Train Set
  - Self-driving wagon
  - autonomous path allocation (linked to input from Destination1)
  - validation and certification
  - Demonstrate a Functional Open Coupling System prototype covering all required subsystems in an operational environment (TRL7)
  - Demonstrate a modular hardware platform using architectural software design patterns and methods (TRL7) allowing SIL2 respective SIL4 (depending on the application)

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DESTINATION 3 – Intelligent & Integrated asset management

deliver **by 2025** solutions that can be demonstrated by system approaches of the various developments targeting up to TRL 6 as European common integrated solutions, on :

1. **Asset Management & TMS.** The main aim of the demonstrator shall be to show the integration between the Intelligent Asset Management System (IAMS) and the Traffic Management System (TMS) enabling the share of data and optimising decisions using common metrics **– TRL6**.
2. **Asset Management & Rolling Stock.** The main objective of this demonstrator shall be to present the monitoring of rolling stock (including on board and wayside technologies) leading to decisions and planning of interventions, and redirecting rolling stock to workshops to execute the (re)scheduled work both manually as well as by new technologies and solutions to conduct inspection tasks automatically **– TRL6**.
3. **Long Term Asset Management.** Development of Life Cycle Cost (LCC) models for infrastructure and rolling stock. This demonstrator shall include cross-border infrastructure remaining useful-life analysis and space-time cross-analysis and visualisation – **TRL6**.

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4. **Asset Management & Infrastructure.** The objective shall be to integrate on field and on board systems with central platforms capable of managing Big Data to enable prescriptive interventions, minimising dangerous situations and service disruptions during operation – **TRL6**.
5. **Asset Management & Digital Twins.** The focus shall be on design, maintenance, upgrade and renewal interventions driven by Digital Twins for the optimisation of processes, maintenance planning and involved logistics. This shall enforce the use of BIM to standardise system configuration and AI tools to execute simulations and predictions. The Digital Twin demonstrator shall include visualisation, prediction and simulation – **TRL7**.
6. **Design & Manufacturing.** This demonstrator shall be the showcase of eco-friendly production of resilient assets supported by new fabrication techniques such as additive manufacturing (focussed on infrastructure assets) – **TRL5**
7. **Robotics & Interventions.** The focus of this demonstrator shall be the showcase of high-tech automated execution solutions for construction and interventions supported by robotics and wearables, among other devices, building a safer and more automated railway environment.- **TRL5/6**

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DESTINATION 4 – A sustainable and green rail system

deliver by 2025 innovative solutions to be demonstrated by:

1. **Alternative energy solutions for the rolling stock at TRL6**, covering:
   - High performances Batteries Electric Multi-Unit (BEMU) train (reaching TRL6/7);
   - Hydrogen hybrid trains with test of heavy-duty inspection vehicle and loco for freight-passengers ;
   - Sub-urban catenary trains with on board Energy Storage Systems (ESS);
   - Auto adaptive train energy consumption to various services situations;

2. A **holistic approach to energy in rail infrastructure (design, production, use and intelligent management) at TRL6**, covering:
   - Rail Power Smart Grid in different systems as well as the integration of energy storage solutions;
   - Application of solutions for the production, storage and refuelling of hydrogen for railway vehicles on the example of a prototype refuelling station;

3. **Sustainability and resilience of the rail system** in a holistic approach to asset management, delivering more value:
   - Development of solutions and models for the reduction of noise and vibrations from railway infrastructure and rolling stock and to predict the effect of degradation, of maintenance and of noise perception **(TRL6);**

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5. **Improvement of electro-mechanical components and sub-systems for the rolling stock, at TRL6**, covering:
   - Technological solutions for the migration to the airless train: Electro-mechanical braking system and novel electro-mechanical pantograph and suspensions;
   - Optimised motors and gearboxes, high performance bogies, suspensions and new materials;
   - Eco-friendly HVAC system technologies;
   - Aerodynamic certification with experimental and numerical methods;

6. **Healthier and safer rail system**, covering:
   - Simulation tools for improving the air quality in trains, stations and tunnels **(reaching TRL7);**

7. **Attractiveness, at TRL6**, covering:
   - Modular rolling stock interiors providing easy access (incl. PRM) and new architectures for drivers’ cabin.

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DESTINATION 5 – Sustainable Competitive Digital Green Rail Freight Services

WS1 Full digital Freight Train Operations with DAC as enabler for full digital freight train operation
deliver by 2025 the following demonstrators:

- **European full digital freight train operations: (TRL 8-9)** Large-scale demonstrator showing full digital freight train operations based on DAC Type 4 (incl. energy supply & data/communication solution and Type 5 upgradability, DAC wagon retrofitting and DAC – Hybrid for locomotives) in different regions with several train sets under real operational conditions including technical enablers described in scope section.
- **European full digital freight train operations: (TRL 7)** Proposals are expected to deliver a second demonstrator with a lower TRL level for technical solutions for parking brake system, digital wagon inspection (including rolling stock and infrastructure assets), DAC based telematic applications for customer requirements (goods monitoring) / for asset performance management /CBM / for safety related applications, distributed power system and electro-pneumatic brake.
- **European full digital freight train operations: (TRL 8 – some functionalities at lower TRL, see enabler section)** Demonstration of Yard automation equipment, wagon identity system allowing automated shunting, video gates and way side check points with visual recognition and AI tools for yard automation.

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DESTINATION 5 – Sustainable Competitive Digital Green Rail Freight Services

WS2 Seamless Freight: with easy access and reliable (intermodal) transport service offering digital solutions.
deliver by 2025 at least the following:

- **Seamless freight corridor (TRL 5-8)** The comprehensive innovations for planning and operation of cross-border freight trains should be demonstrated on (parts of) two European corridors. Freight specific pilot implementations of key enablers for improved cross-border timetable planning, management and path ordering systems taking into account also last mile service, as well as for real-time interaction between various TMS (including yards/terminals). Digital technologies for standardized European Railway checkpoints at borders or other operational stop points. Integrating and connecting the last mile (accession lines/shunting/yards/ terminals) slot planning directly or via interfaces.

- **Seamless customer freight (TRL5-8)** seamless planning, management and booking of multimodal rail-based transport integrating multi-actors, should be demonstrated integrating rail in modern supply chains. Improved routing engines more responsive to changing demand, disruptions and customer requirements. This demonstrator will ease end customers to interface with rail. Dynamic dispatching tools for the optimal automation of yards and last mile operations

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DESTINATION 6 – Regional rail services / Innovative rail services to revitalise capillary lines

deliver by 2025 demonstrations under the following scenarios:

1. **Regional Railway System (CCS & Operations) Demonstration**

- Demonstrate a single integrated Operations Control Center (OCC) covering interlocking, radio blocking and traffic management for regional lines that are not functionally/operationally connected with mainline **(TRL 4/5)**
- Demonstrate simple on-track radio network based on the findings in destination 2 related with cost effective communications, supporting all FRMCS applications, minimizing civil works and energy consumption, to the achievement of cost effective Gigabit Train, the use of public network coverage and compatibility with main lines **(TRL4/5)**
- Demonstrate a specific application for Traffic Management Systems for regional lines improving resilience of a connected rail network, optimizing train operations including disturbing events taking into account high/low-demand situations (disturbance and distraction) **(TRL 5)**

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DESTINATION 6 – Regional rail services / Innovative rail services to revitalise capillary lines

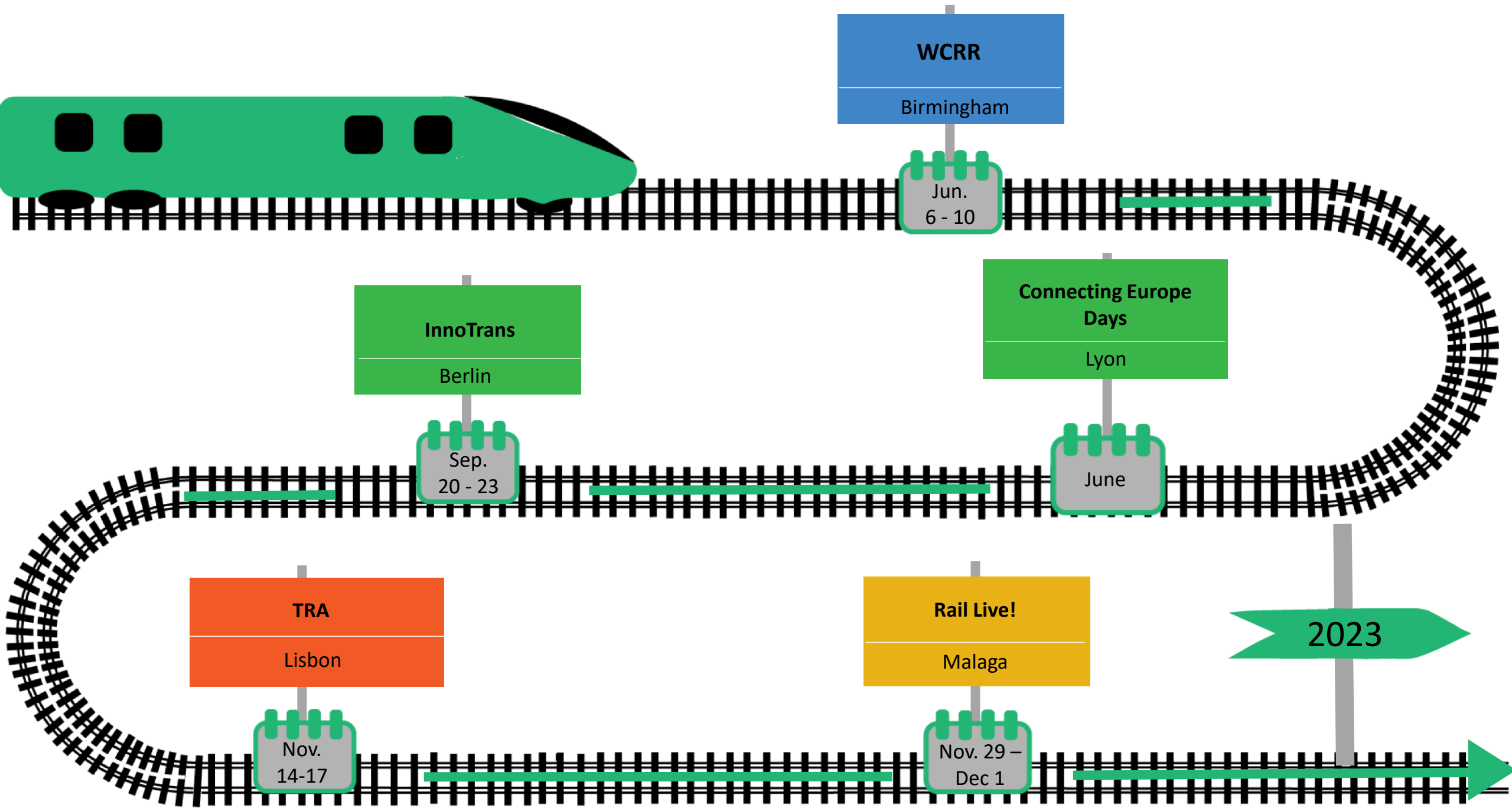
deliver by 2025 demonstrations under the following scenarios:

2. Assets Demonstration

- Demonstrate a systemic approach with the implementation of different railway assets in particular for cost-efficient wireless, energy self-sufficient wayside components in particular CCS track-side components (e.g. switches, level crossings) and if applicable for track vacancy detections and signalling shall be evaluated and demonstrated **(TRL4/5)**

3. Suitable customer services

- Demonstrate cost-efficient integration of on-board information of multimodal services integrating regional multimodal services such as carsharing **(TRL4/5)**
- Demonstrate passenger congestion rate monitoring, flow optimization application as well as a low-cost passenger information system for regional services developed within this action **(TRL4/5)**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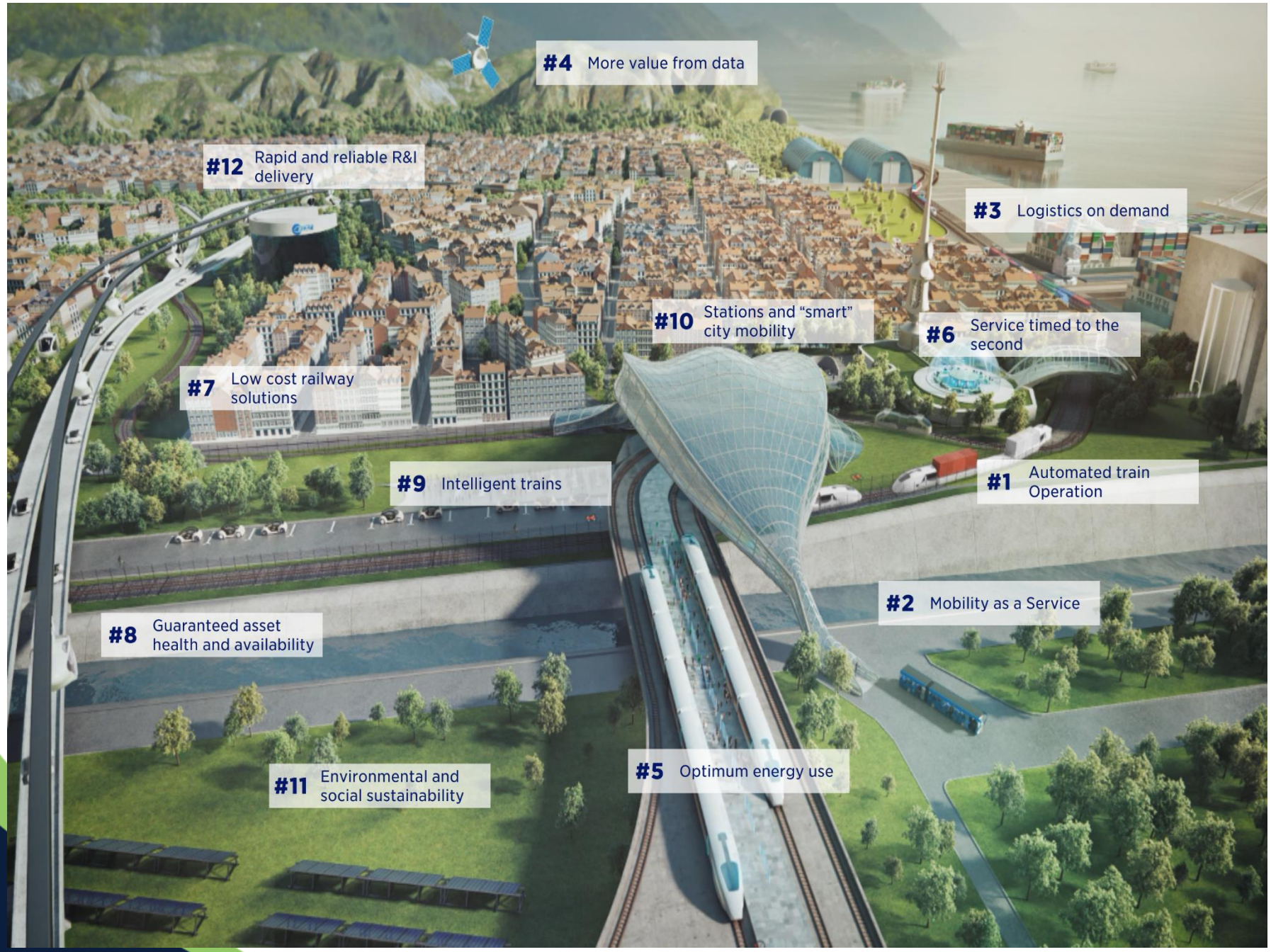

Europe's Rail

INNOVATION CAPABILITIES

USER FIRST

EUROPE'S RAIL JU:

RAIL RESEARCH AND INNOVATION TO MAKE RAIL THE EVERYDAY MOBILITY

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