
Europe's Rail
Co-funded by
the European Union
EUROPE'S RAIL
GENERAL ASSEMBLY
ONLINE
Day 2
25 November
2026
@EURail_JU
Europe's Rail Joint Undertaking

# Agenda – Day 2 – Operational Reports

| | |
|---|---|
| 9.00 – 9.15 | **Opening Words by the Director for Land Transport – DG MOVE** |
| 9.15 – 11.00 | **Implementation of the EU-Rail Programme**<br>• Innovation Pillar – State of Play and Year 4 Results<br>• Q&A<br>• System Pillar – State of Play and Year 4 Results<br>• Q&A |
| 11.00 – 11.10 | *Coffee Break* |
| *11.10 – 12.00* | **Implementation of the EU-Rail Programme**<br>• High-Level Deployment Group - State of play and Year 2 Results<br>❖ DAC Deployment Group<br>❖ FRMCS Deployment Group<br>• Q&A |
| 12.00 – 12.20 | **Getting Involved in EU-Rail Activities and how to find the information you are looking for** |
| 12.20 – 12.30 | **Closing Words by the JU Executive Director** |

Europe's Rail

# Opening Words by the Director for Land Transport General of DG MOVE

European Commission

*Implementation of the EU-Rail Programme*

# Innovation Pillar: State of Play and Year 4 Results

**Nicolas Furio, Léa Paties, Sébastien Denis, Judit Sándor**

# Innovation Pillar – 2026 General Overview

## By the end of 2026:

The innovation programme delivered approximately **800 deliverables**, of which **two-thirds** have been published or are expected to be published shortly on the EU-Rail website.

**12 projects**
have been launched or are about to be launched including
**6 Flagship Projects** (Wave 2)
***~75 partners*** *in each FP*

**11 projects ended or will finish by end of 2026**:
FP1-MOTIONAL, FP2-R2DATO, FP3-IAM4RAIL, FP5-DACTIVATE, FP6-FUTURE, PODS4RAIL
**Expl. Pr**: DACCORD, DACFIT NEXUS, InBridge4EU, Leader 2030

**Innovation Pillar at the end of 2026**

***MultiYear Programme***

***~ 1320 participants*** *of which* ***~ 440 unique entities*** *from* ***28 Countries***

***~ 440 M€*** *of EU funds and* ***~ 520 M€ in kind contribution*** *from private members*



# EU-Rail Flagship Projects
## Demonstration activities at a glance

### FP1 MOTIONAL
European Rail Network and Mobility Management

| DEMONSTRATORS | COUNTRIES |
|---|---|
| 80 | 11 |

### FP2 R2DATO

| DEMONSTRATORS | COUNTRIES |
|---|---|
| 7 | 7 |

### FP3 iam4Rail

| DEMONSTRATORS | COUNTRIES |
|---|---|
| 100 | 10 |

### Rail FP4 EARTH

| DEMONSTRATORS | COUNTRIES |
|---|---|
| 38 | 8 |

### FP5 TRANS4M-R
Transforming Europe's Rail Freight

| DEMONSTRATORS | COUNTRIES |
|---|---|
| 15 | 8 |

### FP6-FutuRe
Cost effective regional lines

| DEMONSTRATORS | COUNTRIES |
|---|---|
| 35 | 7 |

FP1-MOTIONAL | FP1-Travel Wise

# Flagship Area 1: Two projects

# FP1- MOTIONAL: Mobility management multimodal environment and digital enablers

- **Main objective:** Improve **flexibility, efficiency, resilience, and capacity adaptation of European rail network** to support development of a Single European Rail Area. Develop functional **requirements, specifications, and solutions for future European Traffic Management**, including common train planning, operations, automation, ticketing, network management and control.
- **Target solution:** **Dynamic network and traffic management at European scale** built upon a harmonized functional system architecture for agile, borderless, and mixed-traffic operations and offering.
- **Benefit:** Enables automatic management of cross-border rail traffic, improves service offers, operations, and capacity utilization, and enhances the competitiveness of rail-based mobility chains.
- **Four focus areas:**
  - **SG1**: Railway planning (Capacity Management systems)
  - **SG2**: Railway operations (Traffic Management systems)
  - **SG3**: Integration of Railway services with other modes (B2B)
  - **SG4**: Digital enablers transversal to railway sector

FP1 MOTIONAL
European Rail Network and Mobility Management

- **Total project cost:** 92.600.000,00 €
- **Project duration:** 46 months (completed)
- **Number of partners:** 93 (including AE and AP)

COORDINATOR

HACON

OTHER PARTNERS

adif, ALSTOM, mermec, CAF, ceit, DB, enyse, etra, Faiveley, Ferrovie Italiane, HITACHI, indra, Jernbane-direktoratet, KNORR-BREMSE, ÖBB, PKP, ProRail, SNCF, THALES, TRAFIKVERKET, voestalpine, SJ, FGC

Completed in 2026

Europe's Rail

FP1 MOTIONAL
European Rail Network and Mobility Management

## FP1 in numbers

**4** Years
**95** Partners
**32** Work Packages
**81** Demonstrations
**162** Use Cases
**64** Deliverables
**TRL 8**

## Scientific

Developed and validated **10** demos for decision-support algorithms and **3** simulation frameworks, creating a strong basis for future research and deployment activities.

## Societal

Over **75%** customer satisfaction on the ad-hoc demonstrations across Europe covering seamless multimodal services, integrated ticketing, disruption management, accessibility solutions and support for passengers with reduced mobility.

## Economic

ATO showed in the demos the potential to increase capacity by 7–10%, while C-DAS improved headway by 12% and energy efficiency by 18%. These results support reduction of operational costs, better use of capacity and future uptake by operators, infrastructure managers and suppliers.

## Technological

Validated **31** technical enablers in areas such as traffic management, capacity planning, automated conflict resolution, TMS-ATO integration, digital twins, federated data spaces, multimodal services and semantic interoperability.

## Environmental

Supported sustainability by increasing rail efficiency and attractiveness. **4** solutions for energy-efficient train operations, **4** for improved capacity management and **3** for multimodal integration, contributing to lower energy consumption and supporting modal shift towards rail.

## Political

Supported the objectives of the Single European Railway Area by promoting cross-border cooperation, interoperability and digitalization with **5** demos. Its results provide evidence to support future European transport policies and investment decisions.

## Regulation and Standardization

Contributed towards the adoption and validation of key European standards and interoperability frameworks, including Federated Data Space technologies and Common Data Models.

**Completed in 2026**

Europe's Rail

FP1 MOTIONAL
European Rail Network and Mobility Management

# SG1 – Railway planning (Capacity Management Systems - CMS)

## Capacity management:

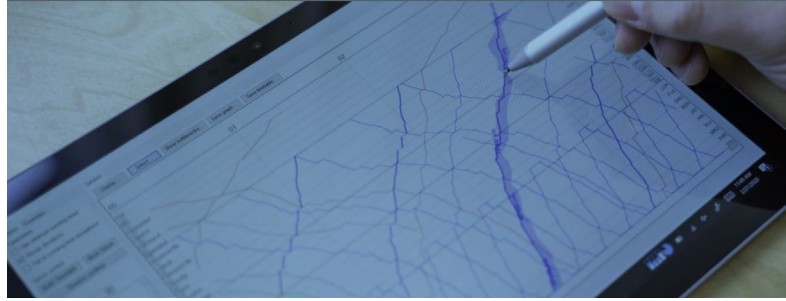
- **Cross-border path requests:** Automated link between local CMS and RNE's Path Coordination System. A new cross-border path is inserted in 1-10 seconds, replacing slow, error-prone manual work. Standards-based (TAF TSI) and scalable.
- **Residual capacity planning:** Solutions found in 10-30 minutes instead of a day's work. Good visualisation, scenario analysis and positive user feedback.
- **Collaborative yard capacity planning:** Shared status and digital communication for freight yard actors.
- **Integrated CMS/TMS:** Better planning consistency, improved handling of temporary capacity restrictions (TCRs), and synchronisation between local and national levels.

## Timetable optimisation and algorithms:

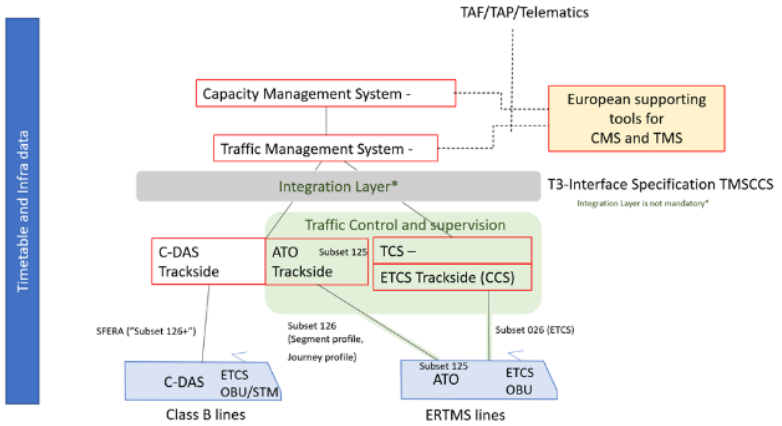
- **Long-term timetabling:** An algorithm pipeline supports strategic planning for medium-sized networks. Further work is needed to make optimisation tools usable for planners.
- **Short-term timetabling:** Mixed-integer programming outperforms metaheuristics → Algorithms can support every step and integrate with legacy systems.
- **Rolling stock:** Rotation plans produced quickly for Norway. Stabling algorithms for NS give sizeable improvements.

## Simulation: *Biggest capacity gains → Combining signalling, automation and traffic management*

- **Feedback loops:** Feedback between historical data, simulation and planning is easy to run once set up and adds to current practice.
- **Hybrid Train Detection:** Reduces headways, e.g. +4% capacity on the Dutch SAAL corridor and about -4 points utilisation on France's Atlantic line. Gains are largest on regional and single-track lines, smaller in dense or already optimised ETCS L2 areas.
- **C-DAS/ATO:** Gains come from stability and predictability. C-DAS is modest, ATO is high because it removes driver variation and shrinks timetable allowances.



**Digital tool developed by SINTEF to support short term and long term planning**




**The main intelligence is in national systems**

**→Connecting them to European tools is ongoing, with focus on evolution of Telematics TSI.**

**Completed in 2026**

Europe's Rail

FP1 MOTIONAL
European Rail Network and Mobility Management

## SG2 – Railway operations (Traffic Management systems)

**TMS-ATO interaction:** Train Path Envelope (TPE) generators were integrated with trackside and onboard ATO in simulation, aligning real-time network planning with automated operations.

**Cross-border TMS interfaces:** Distinct TMS instances (Civitanova-Albacina and Fabriano-Albacina corridors) shared real-time forecasts and delays.

**Energy efficiency and C-DAS:** ECO-DRIVE (Ceit) and Hitachi coupled timetable analysis with speed profile optimisation, linked to ATO-TrackSide through standard interfaces. Energy use falls without hurting punctuality. The Real Time Traffic Plan updater and enhanced simulation platforms keep data synchronised between automated systems and dispatchers.

**Disruption management:** AI and Large Language Model-based tools identify and resolve sequencing conflicts, deadlocks and cascading delays. This reduces dispatcher workload and moves operations from reactive, manual work towards proactive, supervised automation.

**Quantitative gains in energy consumption, schedule adherence and headway delays.**

**Dispatchers, RUs and IMs confirmed lower cognitive workload and better situational awareness.**

Completed in 2026

Europe's Rail

FP1 MOTIONAL
European Rail Network and Mobility Management

# SG3: Integration of Railway services with other modes (B2B)



## Multimodal integration and standardised interfaces

- **Financial platform:** A cloud-based platform (Application Service Provider MaaS platform, retail web portal, travel simulator, distributed ledger) was delivered and validated. It automates revenue apportionment and settlement for pre-paid and Pay-As-You-Go models.
- **Standardised interfaces:** Journey planning, ticketing and financial services exchange data through standard APIs, so the platform works as an integration layer.
- **Interoperability proof:** CEN NeTEx sales transactions from an external distributor were interpreted, processed and settled automatically.

## Passenger-centric and inclusive mobility services

- **Madrid:** Frictionless validation, indoor guidance and Account-Based Ticketing at Metro de Madrid.
- **Málaga and Asturias/Villalegre:** Accessibility solutions (assistive robot, accessible software and totem, Gobos, Gap-Filler). In Málaga, 67 of 72 accessibility challenges were completed independently.
- **Amsterdam:** Ultra-Wideband based hands-free travel integrated with GVB ticketing and access control, with automated in-station assistance triggering.
- **Berlin and Leipzig:** Illuminated platform-edge guidance validated in real operations, including with S-Bahn Berlin and train drivers.

## Demand forecasting, analytics and resource utilisation

- **Lodz:** Data Lake combined with demand forecasting and disturbance analysis for operational planning.
- **Multimodal station:** Short- and long-term demand forecasting and passenger-flow management to support resource allocation and coordination between modes.
- **MaaS-based forecasting:** Short-term prediction and proactive multimodal management, improving passenger information and occupancy awareness.

**Better demand anticipation, resource allocation and coordinated disruption response.**

Completed in 2026

Europe's Rail

FP1 MOTIONAL
European Rail Network and Mobility Management




# SG4: Digital enablers transversal to railway sector

**Federated Rail Data Space**

- A trusted, cybersecure sandbox for secure, interoperable data sharing between operators, infrastructure managers and suppliers. It is meant to become part of the future Common European Mobility Data Space.
- Validated: Data exchange methods, connectors, metadata brokering and the first App Store (confirmed against user requirements). The sandbox demo covered connectors, marketplace and services.

**Common Domain Ontology**

- A shared, machine-readable semantic foundation for rail. It is modular and federated, so no single data structure is imposed.
- **Toolbox consolidated:** Infrastructure/topology (RSM), rolling stock (RST) and operations (OPE), plus reusable components such as mappings and application profiles.
- **Use cases:** Lindometer sensor maintenance data, track inspection, collaboration with FP5-TRANS4M-R, and the cross-border Alnabru-Malmö dataset (lessons on topology, positioning and data quality). Reuse existing standards first, with mappings or adapters where models overlap. Tools for transformation, validation and quality assurance were developed, along with governance and versioning principles.

**Digital Assets Engineering**

- Harmonise digital engineering of railway assets (CCS, stations) through data models, validation tools and guidelines.

**Digital Twin support and run-time environment**

- A common design and simulation environment for virtual representation of rail systems, based on Flagship use cases. Four use cases presented:
    - Virtual certification of braking and traction equipment.
    - Point machine monitoring.
    - Eurobalise commissioning from the vehicle side.
    - Ballast degradation monitoring using the Rail Data Space.
- Tools: Simulations ran on Matlab, OpenModelica, Modelica/Dymola and Python, with a successful trial of web-service co-simulation. Use cases are stored in GitLab.

**Completed in 2026**

# FA1 Wave 2 | MOTIONAL2 FP1

- **Main objective:** **Higher maturity (TRL) of Technology Enablers started in FP1-MOTIONAL**

- **Main focus areas:**

**Workstream 1:**

- Cluster 1: Cross Border
- Cluster 2: Railway Planning
- Cluster 3: New Technologies, ATO, C-DAS
- Cluster 4: Resilient and reliable rail response
- Cluster 5: Journey support services
- Cluster 6: Operational Support

**Workstream 2:**

- Cluster 7: Transversal topics (Digital Enablers)

# FP1- TRAVEL WISE: First rail-aviation synergy project

- **Main objective:** Provide a **solution** to **support the shift from rail and air traffic orchestration in silos to an intermodal approach**
- **Target solution:** **Create a Travel Wise solution and an Intermodal Collaborative Decision Making to support Air-Rail operations management for nominal situations and disruptions**
- **Benefit:** **Optimises rail and air traffic management and improves passenger experience, especially during disruptions**
- **Four phases:**
  - **Benchmarking, &Technical enablers**
  - **Development of demonstrations**
  - **Validation**
  - **Replication and scalability**

Travel Wise FA1

- **Total project cost: 6,000,000 €**
- **Project duration: 36 months**
- **Number of partners:** 37 (including AE and AP)

**Consortium**

**Affiliated entities**

**Associated partner**

FLATLAND

# FP1- TRAVEL WISE

TRL1 | TRL2 | TRL4 | TRL6 | TRL7/8

Maturity check 08/04/2025 — Maturity check 30/04/2026 — Maturity gate 31/07/2027

| 2024 | | | 2025 | | | | | | | | | | | | 2026 | | | | | | | | | | | | 2027 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
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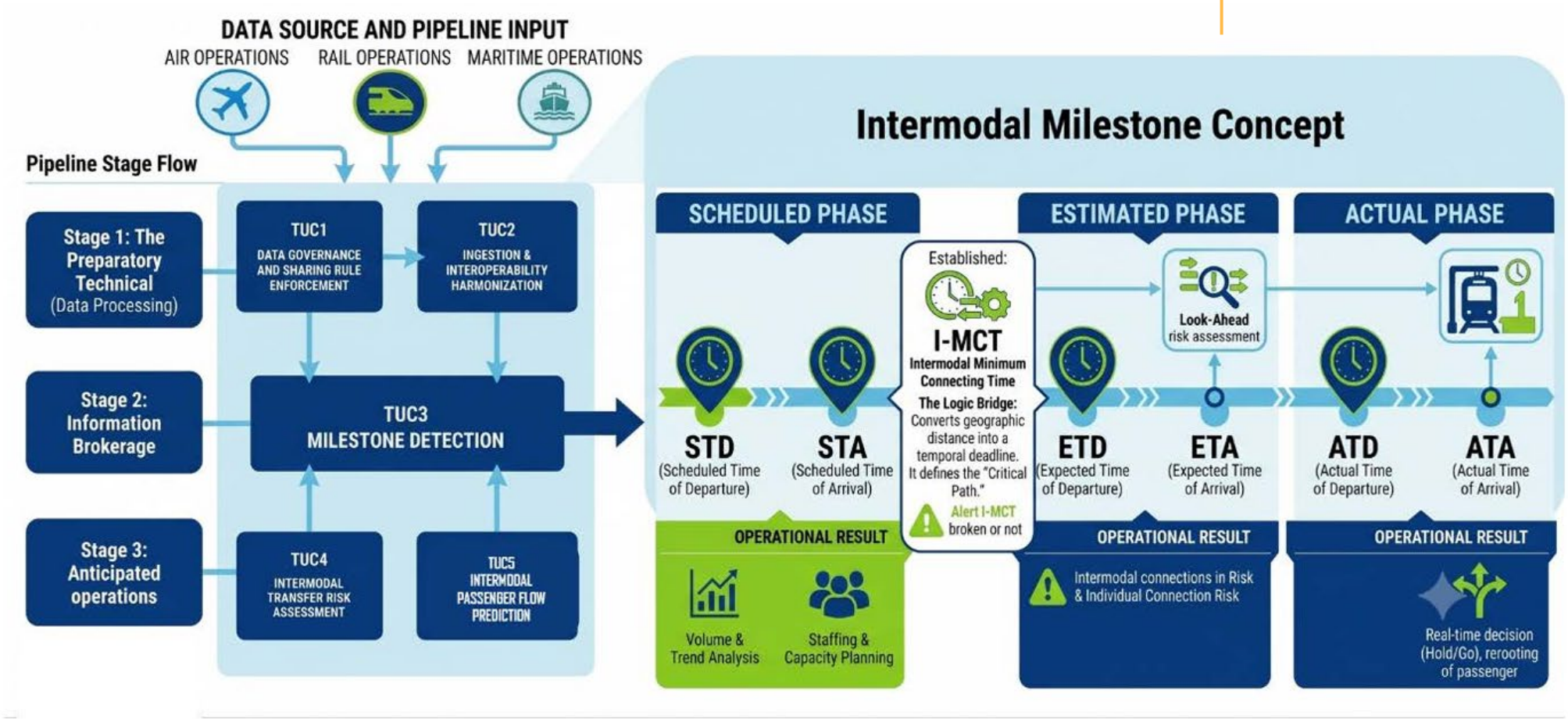


# FP1- TRAVEL WISE

## Benchmarking & Technical Enablers

- Completion of benchmarking activities.
- Completion of user requirements.
- In 2026, refinement of Technical Specifications addressing the complexity of the different operational environment and existing systems deployed.

## Development of demonstrations

Finalisation of validation plan & demonstrations preparations ongoing




### City Pair

**Paris-Amsterdam:** Improving air-rail data sharing, disruption management, and passenger assistance.

Multimodal cross-border data sharing in nominal and non nominal situations and interconnected air-rail operations plan




### International Hub

**Athens:** Enhancing real-time coordination across air, rail, and maritime transport to optimize passenger flow.

Large Seasonal Airport Hub combining Air, Rail, and Maritime




### Regional Airport

**Bologna:** Streamlining airport-rail connections, improving crowd management, and adjusting schedules dynamically.

Regional airport as future multimodal integrator hub

# FP1- TRAVEL WISE

## Validation

- Validation phase is delayed but is starting at the end of 2026



## Replication & Scalability

- Initiation of the standardization, replication and exploitation activities



FP2-R2DATO | FP2-MORANE-2

# Flagship Area 2: Two projects

# FP2 R2DATO: Rail to Digital Automated up to Autonomous Train Operations

- **Main objective:** Take the major opportunity offered by digitalisation and automation of rail operation and to develop the Next Generation ATC and deliver scalable automation in train operations, up to GoA4 for 2030, to enhance infrastructure capacity on the existing rail networks.
- **Target solution:** European solutions fitting requirements from many different use cases across the European network.
- **Benefit:** enables increasing traffic without need for additional investment in physical infrastructure (new railway lines) – enhancing the capacity, maintaining safety levels and operational flexibility.
- **Six focus areas:**
  - **C1**: Automation processes
  - **C2**: Optimised headway
  - **C3**: Enabling digital technologies
  - **C4**: Fast and effective deployment
  - **C5:** Innovative operational s
  - **C6:** Demonstrators

- **Total project cost:** 160.800.000,00 €
- **Project duration:** 42 months
- **Number of partners:** 78 (including AE and AP)

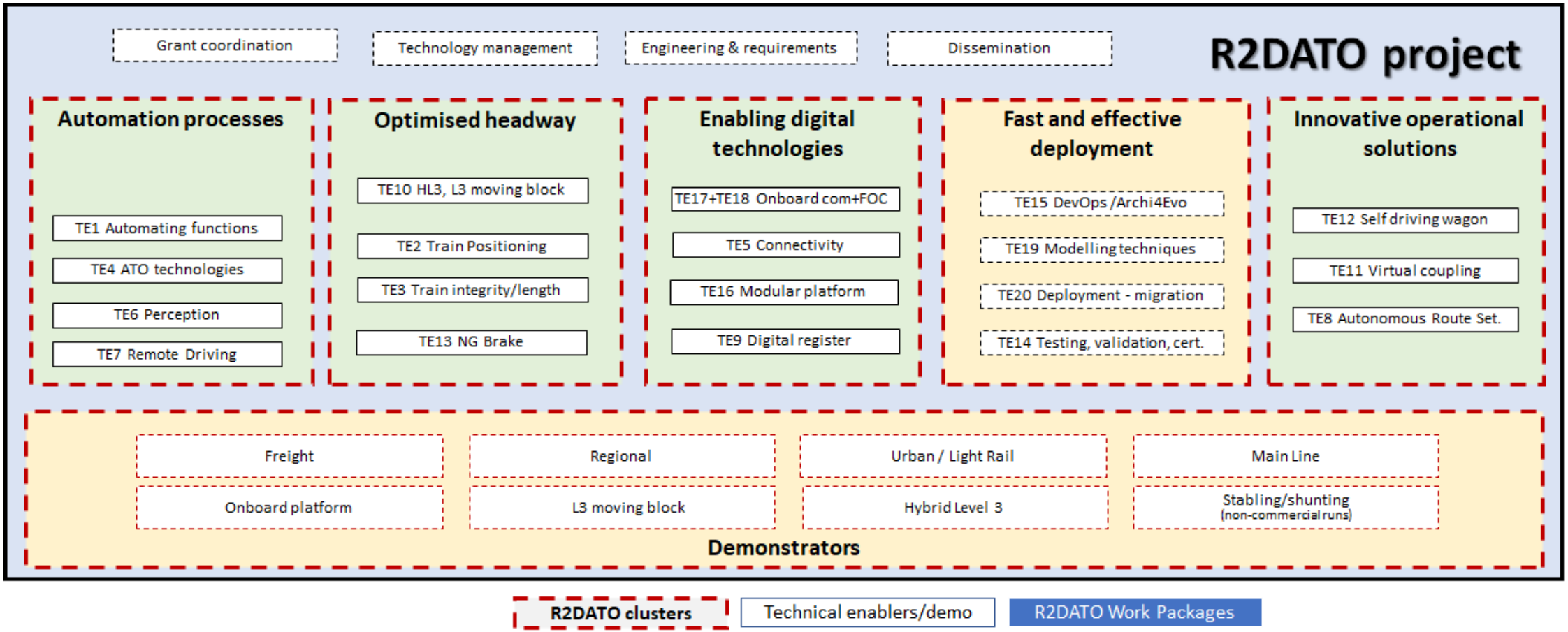
**Coordinator**

**Partners**

ASSOCIATED PARTNERS

**Completed in 2026**

# FP2 R2DATO: Project Overview




Completed in 2026

# FP2-R2DATO

## Cluster 1: Automation processes

**New specification baseline:** Delivered for ATO GoA3/4, remote driving, perception and automating functions.

**Safety analyses:** Confirmed the concepts are feasible within the current European railway safety framework. No fundamental safety barriers were found. Further standardisation is needed, especially on the split of responsibilities between onboard automation, remote operators and traffic management.

**Prototypes:** Development, integration and full laboratory validation completed for Automating Functions, ATO, Perception and Remote Driving, including modules from several suppliers. Technical feasibility and interoperability between the main components were confirmed.

## Cluster 2 – Optimised headway

**Moving Block:** Train-centric signalling concepts validated. Support dynamic train separation, increasing capacity and operational flexibility. Lessons learned fed back into the functional architecture and specification baseline, supporting future standardisation.

**Hybrid Train Detection (HTD):** Deployment studies, capacity assessments and specifications completed. Prototypes confirmed the feasibility of combining train-borne and infrastructure-based detection, supporting HTD with more flexibility and less infrastructure dependency.

**Next Generation Brake:** Validated evidence of better braking and adhesion management, enabling safer and more efficient automated operations.

**Train Integrity and Train Length:** Specifications, safety analyses and validation results finalised, forming a base for ETCS-based train-centric operations.

**ASTP (safe train positioning):** 8 demonstrators as first step to convergence towards a common generic architecture.

**EGNOS (augmented GNSS):** Three prototypes using EGNOS DFMC corrections showed measurable gains in positioning accuracy, robustness and availability.

Completed in 2026

# FP2-R2DATO

## Cluster 3 – Enabling digital technologies

**Onboard Communication:** Network management specification completed, building on user stories, functional and non-functional requirements and a list of network management functionalities.

**FRMCS: Isolation requirements** for simultaneous operation in the RMR and MNO bands finalised and validated in laboratory measurements (delivery to ERA).

**Modular platform:** Consolidated architecture aligned with System Pillar. It is a foundation for modular, software-driven railway systems.

**Digital Register:** Airgap Demonstrator with Alstom successfully showed data exchange between DR-Trackside and DR-Onboard, following the Track Train Communication Principles of the EDT task force.

**ACS/Gigabit Train:** Completed in 2025, aligned with FP6 and supporting further use of platform and connectivity prototypes across EU-Rail.

## Cluster 4 – Fast and effective deployment

Formal data modelling and workflow automation advanced , covering automatic transformation, V&V, traceability and hybrid testbed validation.

**DATO Business Case**: Operational benefits of ATO focus on operational DATO transfer, public acceptance, human factors, capacity and impact simulation.

Completed in 2026

# FP2 R2DATO

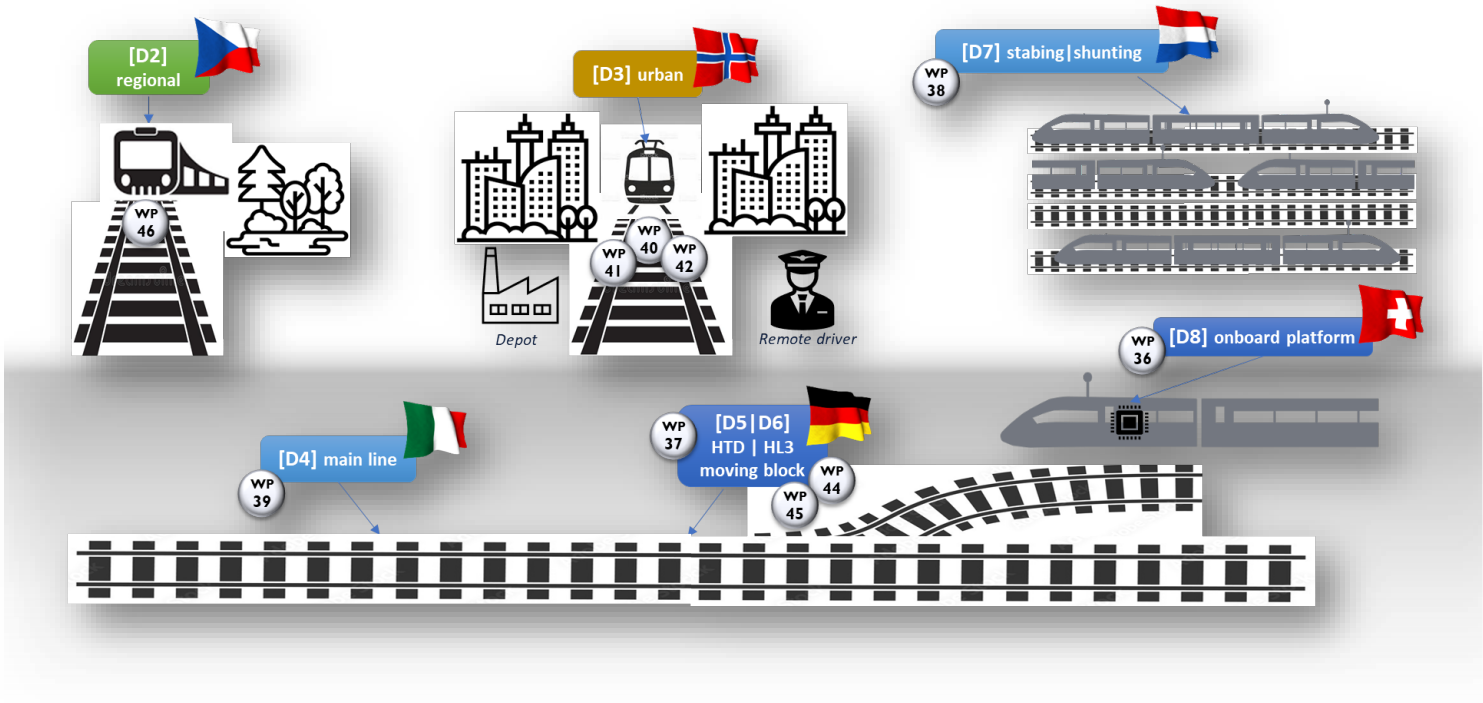
## Cluster 5 – Innovative operational solution

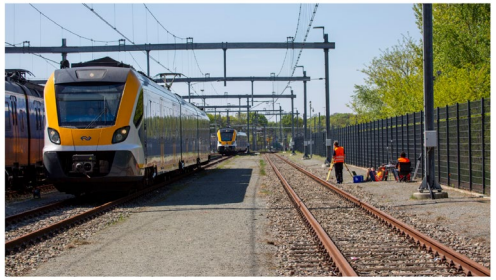
**Self-Driving Freight Wagon:** The refined concept confirmed its potential to improve flexibility and efficiency in freight logistics, especially in marshalling yards, terminals and first/last-mile operations.

**SRC and Relative Localisation test campaign:** Low-latency train-to-train communication and relative positioning reached the performance needed for advanced automation such as Virtually Coupled Train Sets. The results confirmed technical feasibility and gave insights into communication performance, positioning accuracy and operational constraints.

**Virtually Coupled Train Sets (VCTS):** VCTS remains a promising long-term concept for more capacity and flexibility. Technology maturity and certification are the key areas for future research.

## Cluster 6 – Demonstrators



**Testing in Amersfoort**
**August 2025**

Completed in 2026

# FA2 in Wave 2 | FP2-R2DATO-2

## Programme alignment:

- ✓ **On the basis of results stemming from Wave 1 (FP2-R2DATO)**
- ✓ **Close coordination with the EU-RAIL System Pillar**
- ✓ **Demonstrate TEs at higher Technology Readiness Levels (TRLs)**
- ✓ **Integrated demonstration of different Technical Enablers**
- ✓ **Common demonstrations with other Flagship Areas**

## Technical Enablers list for Wave 2:

| Enabler | Topic |
|---|---|
| 1 | Automated functions / train preparation |
| 2 | Safe train positioning |
| 3 | Train integrity |
| 4 | ATO technologies |
| 5 | Connectivity solutions |
| 6 | Safe environment perception |
| 7 | Remote driving and command |
| 8 | Autonomous route setting |
| 9 | Digital Register |
| 10 | Hybrid Train Detection / Moving Block / ETCS capacity solutions |
| 11 | Virtual Coupling |
| 12 | Self-driving freight wagon |
| 13 | Next-generation braking systems |
| 14 | Testing, validation and virtual certification |
| 16 | Modular ATC platform architecture |
| 17 | Evolved onboard communication networks |
| 18 | Stable ETCS onboard architecture and interface consolidation. |

**Wave 2** focuses on integrating and demonstrating Technical Enablers at **high TRLs** under more **realistic operational conditions** in order to prepare for **Wave 3**.

# FP2- MORANE-2: MObile radio for RAilway Networks in Europe 2

- **Main objective:** The main purpose of this project is to validate the FRMCS V2 Specifications & V3 target requirements with precommercial FRMCS system components in realistic operational conditions and to feed-back the result to the railway eco-system in order to timely start the migration to FRMCS across the European railway system.
- **Target solution:** Testing and validation of a European specifications for FRMCS.
- **Benefit:** Accelerate the upcoming deployment of FRMCS as a replacement of GSM-R

FP2-MORANE 2

- **EU contribution:** 13, 4 Million €
- **Project duration:** 34 months
- **Number of partners:** 43 (including AE and AP)

**Coordinator**

**Partners**

# FP2- MORANE-2

| 2024 | 2025 | | | | | | | | | | | | 2026 | | | | | | | | | | | | 2027 | | | | | | | | |
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**Test design and planning**

*Test specifications, lab and field test plan and test methodology*

**System component preparation and architectures**

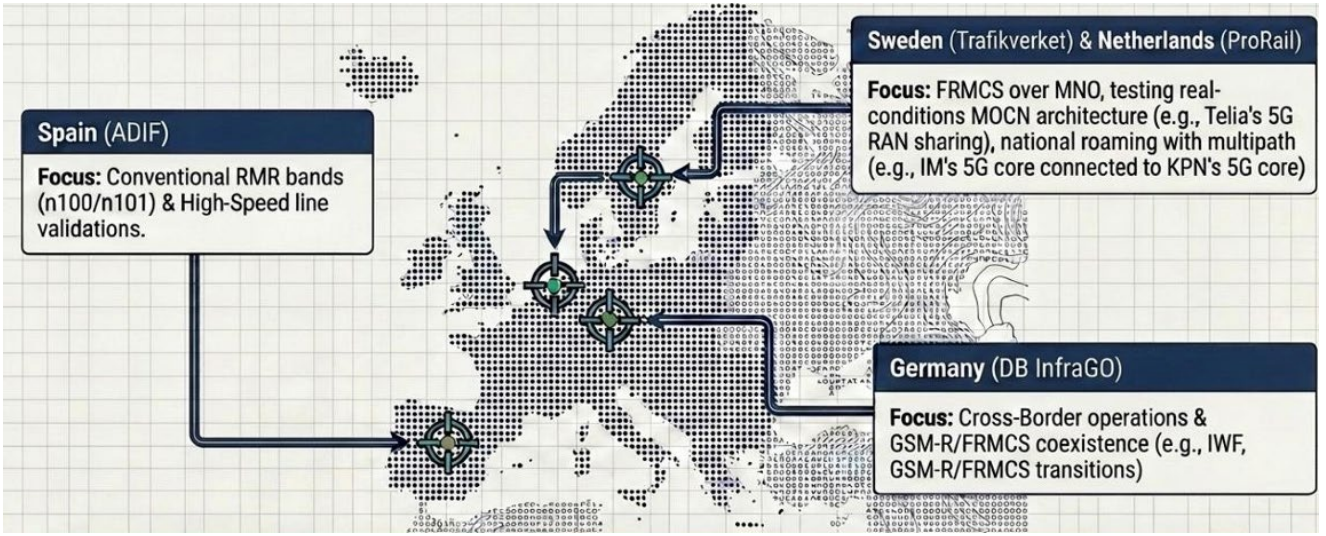
*Test architectures, development of system components*

**Lab test preparations and execution**

*Three lab tests execution (2026)*

**Field test execution**

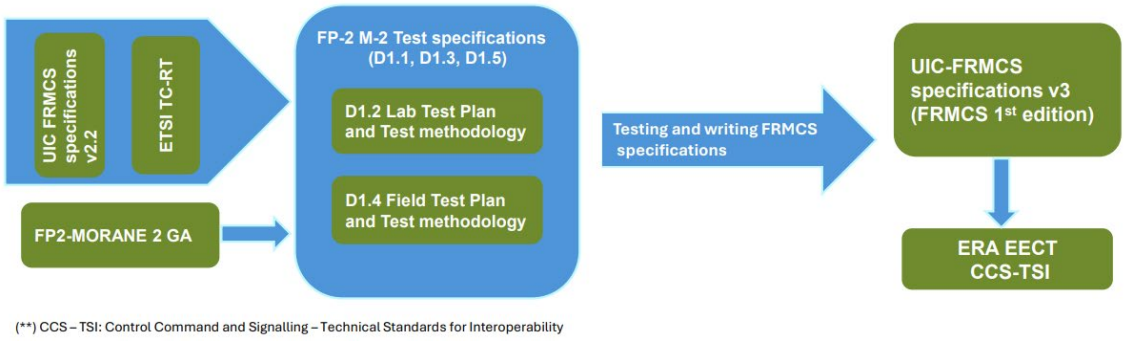
*Five field tests (2026-27)*



# FP2-MORANE-2

## Test design and planning

- Test scope for lab and field testbeds have been dispatched to Lab and Field test beds owners.
- Refining of test cases scope with groups dedicated to each field testbed involving supporting labs, before starting writing test cases.
- Test cases delivered.




(**) CCS – TSI: Control Command and Signalling – Technical Standards for Interoperability

## System component preparation and architectures

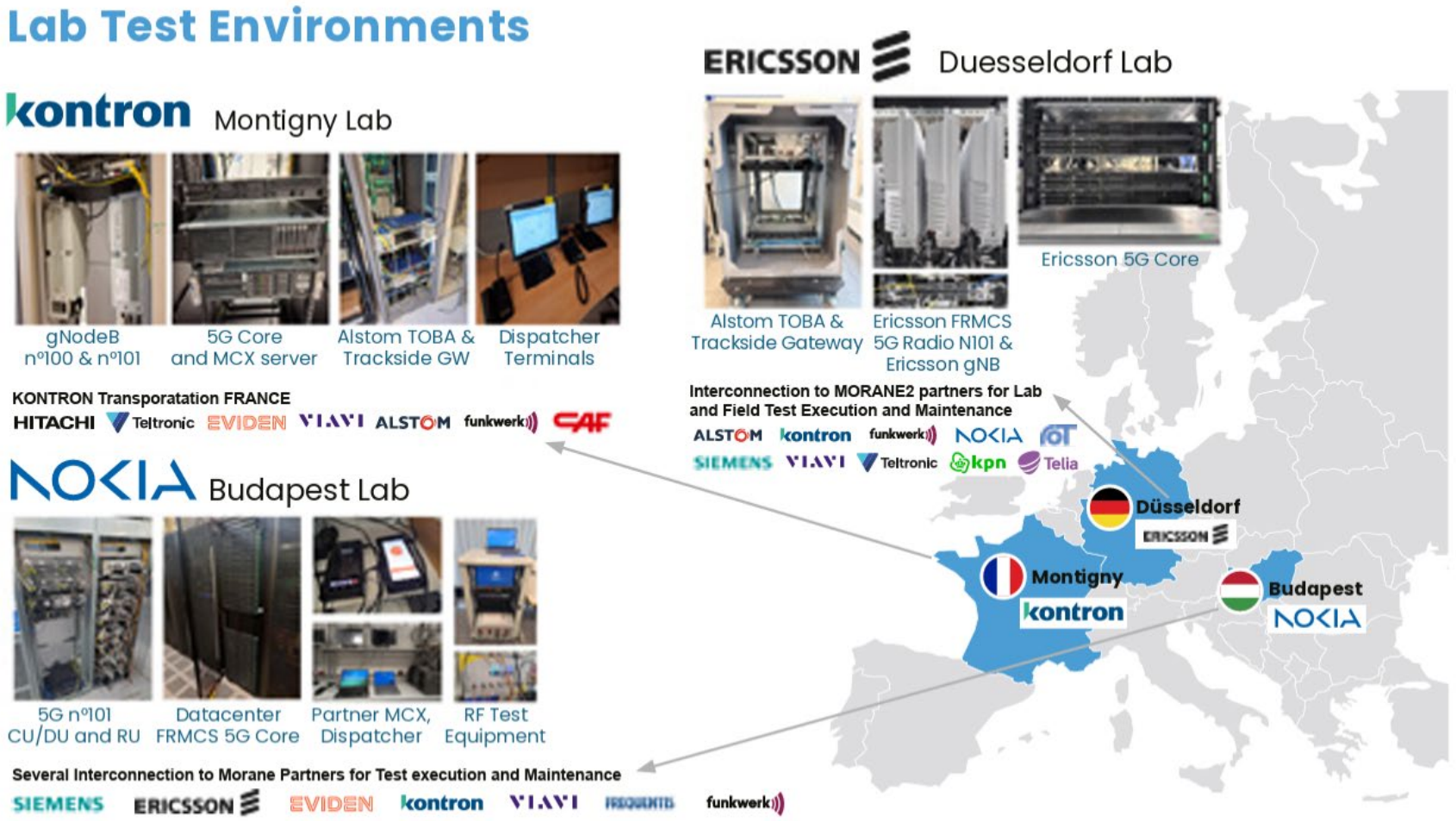
- Test architecture- E2E Generic Architecture delivered.
- Prototypes delivered/under finalisation.



# FP2-MORANE-2

## Lab test preparations and execution (ongoing)

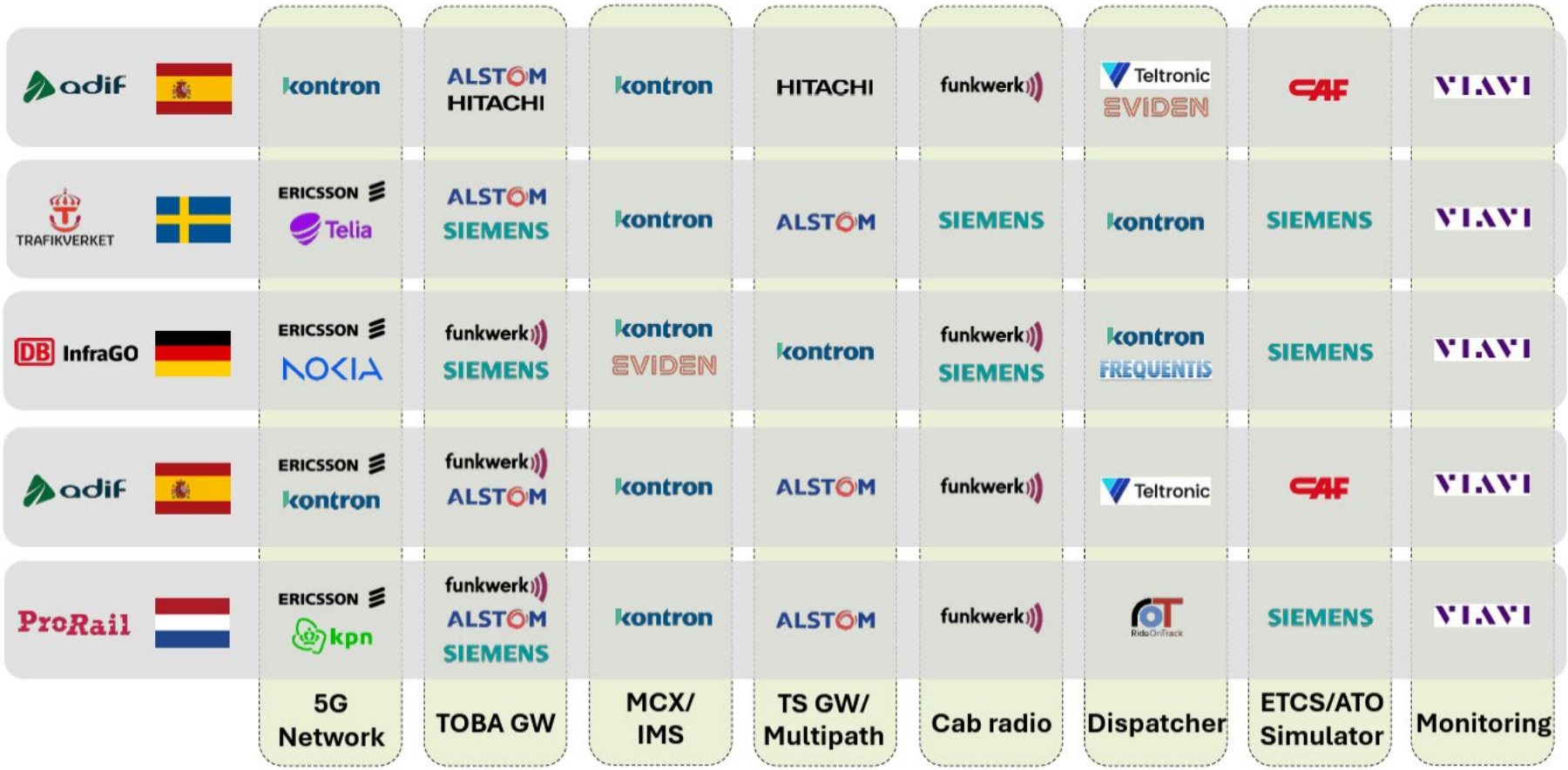
August 2026: lab tests have started! Expected to complete by **end of 2026**



# FP2-MORANE-2

## Field test execution (2027)

### Field Test Suppliers




**Spain (ADIF):**

- Conventional line (max 80km/h)
- High-speed line (max 300km/h)

**Sweden (Trafikverket):**

- Conventional line (max 200km/h) including MNO

**Germany (DB):**

- Conventional line (max 80km/h) including cross-border

**The Netherlands (PRORAIL):**

- Conventional line (max 140km/h) including MNO

FP3-IAM4RAIL

# Flagship Project 3

# FP3 IAM4RAIL: Holistic and Integrated Asset Management for Europe‘s Rail System

- **Main objective:** Provide innovative technical requirements, methods, solutions, and services based on the latest cutting-edge technologies to **minimise asset lifecycle costs** and **extend service life** while meeting safety requirements and **improving the reliability, availability, and capacity of the railroad system.**
- **Target solution:** **Intelligent Asset Management System** for both **Rolling Stock** and **Infrastructure;** Increased level and technology for **automation and robots** in construction and maintenance.
- **Benefit:** **Cost-effective** asset management, increased **RAMS** and **capacity** of the overall railway system. **Sustainable** production of **resilient** assets.
- **Five focus areas:**
  - **SP1**: Wayside Monitoring and TMS link
  - **SP2**: Rolling Stock Asset Management
  - **SP3**: Infrastructure Asset Management
  - **SP4**: Railway Digital Twins
  - **SP5**: Environment, User and Worker Friendly Railway Assets

- **Total project cost:** 106.900.000 €
- **Project duration:** 48 months
- **Number of partners:** 29 > 93

COORDINATOR

OTHER PARTNERS

**Completed in 2026**

# FP3 IAM4RAIL

| 2023 | | | | 2024 | | | | | | | | | | | | 2025 | | | | | | | | | | | | 2026 | | | | | | | | | | | |
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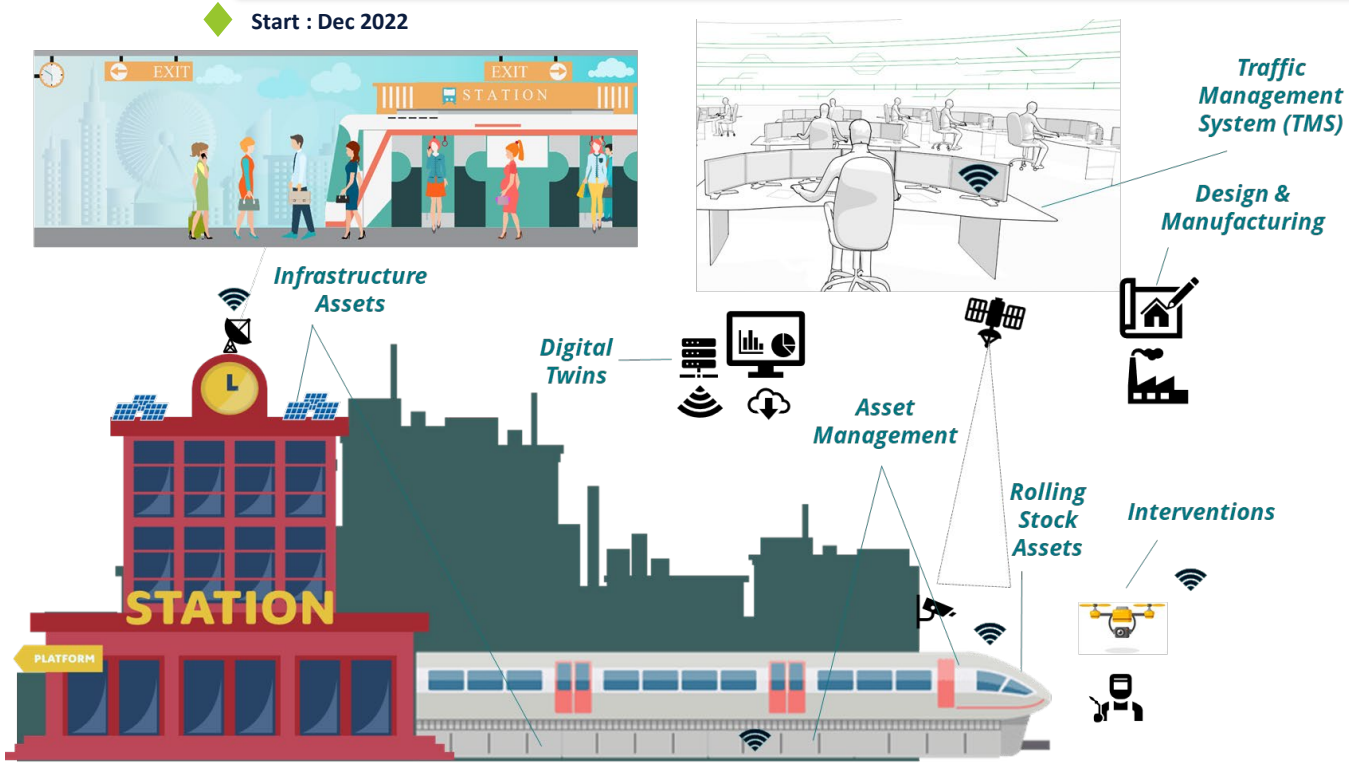
Start : Dec 2022

End




## Holistic and Integrated Asset Management

Implementing a comprehensive approach that considers maintenance, operations, financial aspects, and overall system performance

## Cost-Effective Solutions

Developing a common European asset management framework using digital technologies and data analytics to minimize lifecycle costs and extend the service life of rail assets

## Safety and Reliability

Enhancing the safety, reliability, availability, and capacity of the rail system through innovative technical solutions and services

## Advanced Decision-Making

Utilizing AI and digital twins to improve decision-making accuracy, predict anomalies, and optimize maintenance strategies

Completed in 2026

# FP3 IAM4RAIL

| 2023 | | | | 2024 | | | | | | | | | | | | 2025 | | | | | | | | | | | | 2026 | | | | | | | | | | | |
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Start : Dec 2022

End

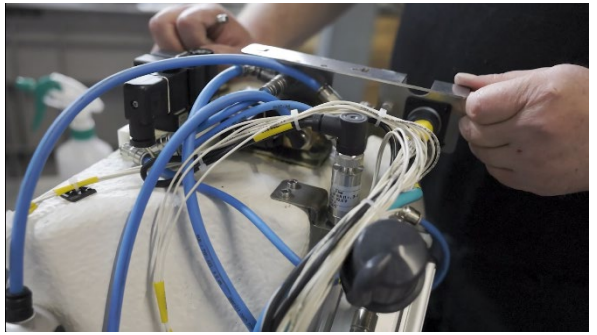
## SP1 – Wayside Monitoring and TMS link

- Integrated IAMS and TMS, enabling predictive maintenance, anomaly detection and decision support.
- Reductions of up to 10% in service failures and 25% in maintenance-related operational impacts.

## SP2 – Rolling Stock Asset Management

- Validated onboard and wayside monitoring solutions for HVAC, sanitary systems, brakes, traction equipment and bogies.
- Demonstrated up to 30% faster fault detection, 25% improvement in maintenance-planning efficiency.





Completed in 2026

# FP3 IAM4RAIL

| 2023 | | | | 2024 | | | | | | | | | | | | 2025 | | | | | | | | | | | | 2026 | | | | | | | | | | | |
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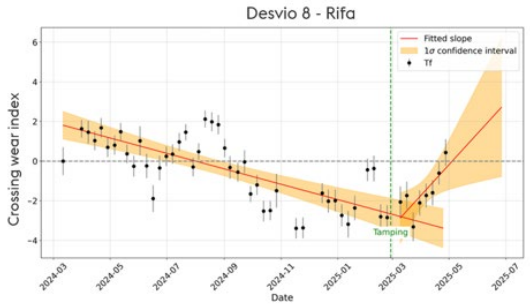
Start : Dec 2022

End

## SP3 – Infrastructure Asset Management

- Validated decision-support tools for lifecycle cost optimisation, Remaining Useful Life estimation and maintenance planning.
- Validated advanced monitoring technologies for track, switches & crossings, bridges, tunnels and earthworks.
- Demonstrated up to 25% reduction in maintenance-related operational impacts.

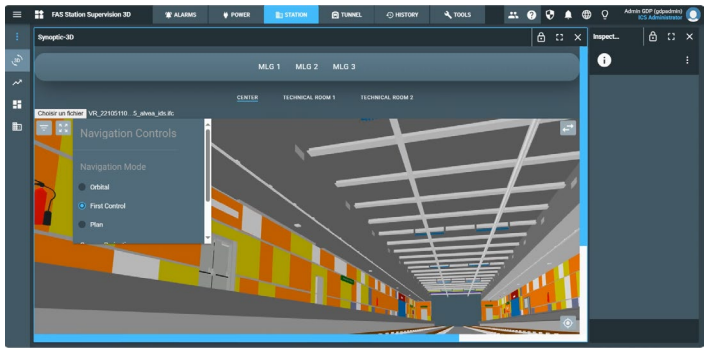







## SP4 – Railway Digital Twins

- Integrated BIM, DT, monitoring systems and maintenance-management platforms.
- Demonstrated 15% reduction in manual inspections and up to 25% operational cost reduction in selected applications.




Completed in 2026

# FP3 IAM4RAIL

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Start : Dec 2022

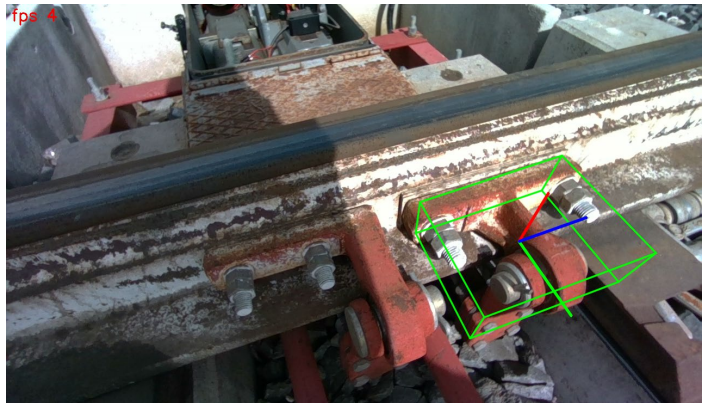
End

## SP5 – Environment, User and Worker Friendly Railway Assets

- Demonstrated sustainable infrastructure solutions, additive manufacturing and Digital Warehouse concepts. Achieved more than 80% reduction in production lead times, up to 50% cost savings in selected UCs.
- Validated robotic inspection and maintenance platforms, automated installation systems, exoskeletons and AR-based maintenance support tools. Demonstrated technologies up to TRL 6–7.







Completed in 2026

# FP3-IAM4RAIL-2 – FA3 Wave 2

- **Main objective: Progressing on the TRLs and/or expanding the scope of the FP3-IAM4RAIL Use Cases**

- **Five focus areas (approximately 80 use cases):**

  - **Cluster ALFA** - Non-Invasive / Automated Rolling Stock Asset Inspections and Overall Maintenance.
  - **Cluster BETA** - Non-Invasive / Automated Infrastructure Asset Inspections and Overall Maintenance.
  - **Cluster CHARLIE** - Central Information Sharing and Holistic Central Asset Management Units.
  - **Cluster DELTA** - Pre-deployment of Automation / Robotics and cutting-edge techniques in maintenance operations.
  - **Cluster ECHO** - Certification and Standardisation of new concepts.

FP4-RAIL4EARTH

# Flagship Project 4

# FP4 Rail4EARTH: Sustainable and green rail systems

- **Main objective:** Improve the existing **sustainability** performance of railways, build a **more attractive and resilient transport mode** and contribute towards the objectives of a climate neutral Europe for 2050. The activities are covering topics of **rolling stock, infrastructure, stations, and all their related sub-systems** (traction, bogies, brakes, energy storage systems, HVAC, etc.).
- **Target solution:** Decarbonization of diesel trains, noise and vibrations reduction, energy savings, circular economy, resource consumption savings, resilience to climate change and pandemic attack, and attractiveness of passenger trains.
- **Benefits:** Significantly progress on several families of Key Performance Indicators on different fields - technical, environmental, economical, standardization.
- **Six focus areas:**
  - **SP1**: Alternative energy solutions for the rolling stock
  - **SP2**: Energy in rail infrastructure and stations
  - **SP3**: Sustainability and resilience of the rail system
  - **SP4**: Electro-mechanical components and sub-systems for the rolling stock
  - **SP5**: Healthier and safer rail system
  - **SP6**: Train attractiveness (Interiors)

- **Total project cost:** 95.100.000 €
- **Project duration:** 48 months
- **Number of partners:** 71

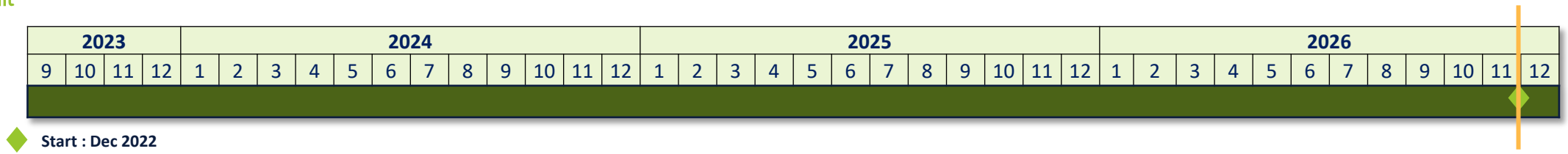
COORDINATOR

ALSTOM

OTHER PARTNERS

Extended to 2027

# FP4 Rail4EARTH




## Alternative energy solutions for the rolling stock

Low carbon trains: Electro-technical Systems, Alternative Propulsion – Battery and Hydrogen

## Electro-mechanical components and sub-systems for the rolling stock

Airless train - Electro-Mechanical Braking (EMB) system, pantograph and suspensions; Optimized motors, gearboxes, bogies, suspensions and new materials; Eco-friendly HVAC; Aerodynamic certification with experimental and numerical methods

## Energy in rail infrastructure and stations

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

## Healthier and safer rail system

Air quality on board and in railway stations

## Sustainability and resilience of the rail system

Solutions and models to reduce noise and vibrations from infrastructure and rolling stock and to predict the effect of degradation, maintenance and noise perception as well as ensuring resilience to external risks, such as climate change

## Train Attractiveness (Interiors)

Modular rolling stock interiors providing new design and new architectures

Extended to 2027

# FP4 Rail4EARTH

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Start : Dec 2022

## SP1 – Alternative energy solutions for the rolling stock

- 3 High-Performance BEMU demonstrators are at different stages of development: lab testing, performances simulation and validation, sub-components modelling.
  - ❖ North Europe BEMU demonstrator: complete traction chain and ESU have been/are being tested in lab; components' integration in the demo train defined.
  - ❖ South Europe BEMU demonstrator: Simulations on selected battery cell technologies and related batteries confirm feasibility of 200 km range. Test procedure under definition.
- 2 scenarios simulated for the Sub-urban demonstrator with Onboard Energy Storage System.
- In the H2 traction domain, pre-standardization activities progressed & the mechanical design & integration of the Metal Hydride reactor in the current hybrid locomotive is ongoing, along with simulations of energy efficiency and optimization.

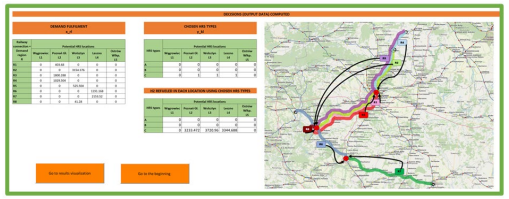




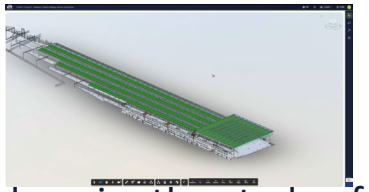


## SP2 – Energy in rail infrastructure and stations

- Tools supporting decision-making for the H2 station localisation / configuration and for modelling the H2 refuelling process developed.



- Málaga María Zambrano station Energy Digital Twin was rolled out on the real environment, allowing to link the station sensors to the DT for energy consumption optimisation.



- In the smart infrastructure power supply domain, the study of double side feeding of 50 Hz AC traction substations using FACTS was carried out by co-simulating two new technologies (SFC and RIPF).
- Technologies for new smart green modular station validated and corresponding tool developed.

Extended to 2027

# FP4 Rail4EARTH

| 2023 | | | | 2024 | | | | | | | | | | | | 2025 | | | | | | | | | | | | 2026 | | | | | | | | | | | |
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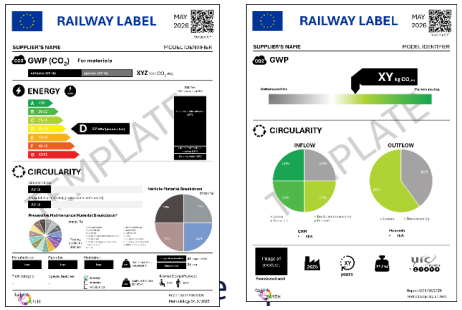
Start : Dec 2022

## SP3 – Sustainability and resilience of the rail system

- «Railways adaptation to climate change» European Workshop
- Development of a climate data base tool demonstrator and completion of 7 impact chains; 47 ideas of possible existing solutions documented by benchmark.
- Noise perception indicator 2nd experiment finished. Neoballast to limit noise and vibrations over the infrastructure lifespan tested. Ground-borne vibration mitigation measures catalogue updated.
- Improvement of visuals for GWP and Circularity indicator, along with the methodology for labelling definition.

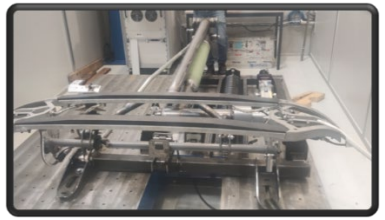



- Circular economy solutions studies finalized for 2 use cases. On-going development of e-commerce platform defined with members of the project.

## SP4 – Electro-mechanical components and sub-systems for the rolling stock

- Air-less train: EMB lab-tests ongoing.
- Two e-Panto 1:1 scale demos in lab tests.
- Several IRW in laboratory testing phase or installed and tested.
- Eco-friendly HVACs tested in climatic chambers.
- Numerical simulations and validation using experimental test results completed for virtual aerodynamic certification.







Extended to 2027

# FP4 Rail4EARTH

| 2023 | | | | 2024 | | | | | | | | | | | | 2025 | | | | | | | | | | | | 2026 | | | | | | | | | | | |
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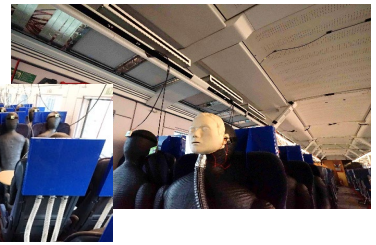
Start : Dec 2022

## SP5 – Healthier and safer rail system

- Demonstration of the efficiency of a PEPA-F™ filter by testing on a real suburban train, completed by a PEPA-F™ and MLLF filters tests on decommissioned DB's DIRK train.



- Test of a sanitization lighting and sanitization coating on a high-speed train in real operation conditions.
- PureVector™ ionizer and various new solutions for the reduction of particles in the passengers' compartment tested.
- New localized ventilation and air purification concepts tested, reducing the particle concentration directly in the vicinity of an aerosol-exhalating thermal passenger mannequin.





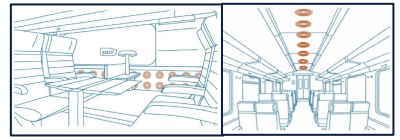
- Low-Cost Sensors measurements in Paris finished and evaluated. Air quality measurements results in Stockholm and Paris used to validate predictions and their transferability.

## SP6 – Train Attractiveness (Interiors)

- **Ultra-modularity mock-ups:** quick fixing system for strong part of interiors; a beam usable for 2 classes of seats; a modular beam for 2 / 3 seats - possibly made of recycled composite material; a toilet for day/night train.



- **Circular design:** 1) New sustainable materials for interior panels with recycled fibre tested and characterized and 1:1 prototype produced; 2) Mock-up of "Woodflow" roof produced and tested. 3) Samples of new finishing materials based on industrial RS waste developed.
- **Modularity on board:** work on mechanical quick fixation systems. Electrical wireless induction components substituting electric cables optimized and validated; adaptive height of vanity unit and touchless toilet control with 1:1 functional mock-up. First layout configurators VR to explore new onboard experience by immersive 3D completed.



- Two types of **touchless controls** prototyped: interface for drivers, for which gestural control was defined and functional mock-up of touchless controls integrating AI technology for passengers' toilets.



Extended to 2027

# FP4 Rail4EARTH2 – FA4 Wave 2

- **Main objective:** Continue to improve the **sustainability** performance of railways, build a **more attractive and resilient transport mode** and contribute towards the objectives of a climate neutral Europe for 2050.
- **Six focus areas and relevant solutions:**
  - **SP1**: Sustainability and resilience of the rail system
    - ↳ Adaptation to climate change and climatic resilience of critical railway assets, noise and vibrations reduction, standardized reporting of the environmental impacts of the rail sector
  - **SP2**: Alternative energy solutions for the rolling stock
    - ↳ High-performance BEMUs, Hydrogen hybrid locomotive, Auto adaptive train energy consumption, Hydrogen refueling connector solutions, hydrogen quality for rail transport.
  - **SP3**: Energy in rail infrastructure
    - ↳ Rail power smart grids and integration of energy storage solutions.
  - **SP4**: Electro-mechanical components and sub-systems for the rolling stock
    - ↳ Electro-mechanical braking systems and pantograph, Optimised motors and gearboxes, High-performance bogies, suspensions and new materials, Eco-friendly HVACs, Aerodynamic certification.
  - **SP5**: Healthier and safer rail system
    - ↳ Air quality in trains, stations and tunnels.
  - **SP6**: Train attractiveness (Interiors)
    - ↳ Sustainable and modular rolling stock interiors

**Wave 2** mainly focuses on progressing on the TRLs and/or expanding the scope of the FP4-Rail4EARTH demonstrators.

FP5-TRANS4M-R / FP5-DACtiVate

# Flagship Area 5: Two projects

# FP5-TRANS4M-R: Transforming Europe's Rail Freight

- **Main objective:** European **harmonised, scalable, upgradable DAC systems** to support digital-enabled **operational procedures** and digital **yard automation** and management solutions. **Maximise flexibility and reliability of rail freight service**s by providing **effective intermodal prediction algorithms** and **seamless planning** covering the complete end-to-end rail service

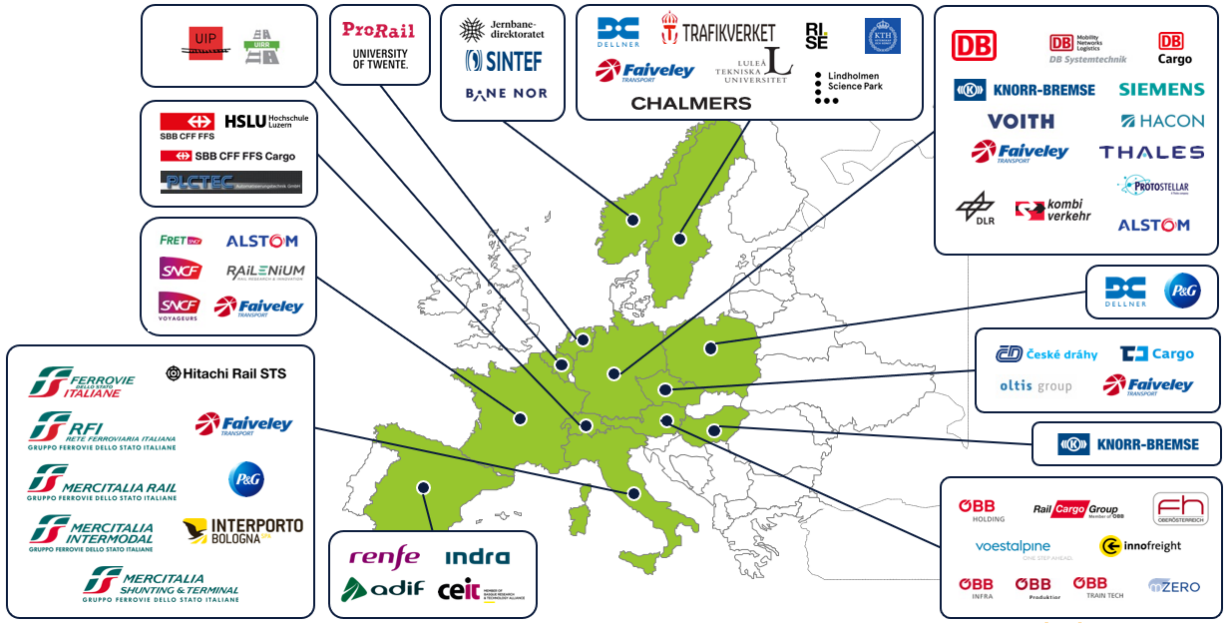
- **Target solution:** Increase in capacity, productivity, efficiency and flexibility of rail freight operations, responding to **customer demands** in a timely and flexible manner.

- **Benefit:** Enable management of cross-border rail traffic, improve rail freight services and operations.

- **Focus areas:**
  - **WS1: Full Digital Freight Train Operations (FDFTO)**
  - **WS2: Seamless rail freight (Seamless)**

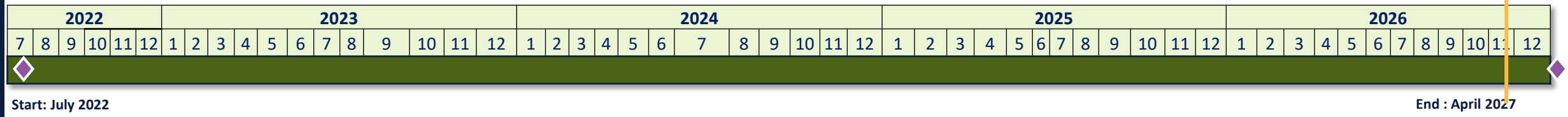
FP5TRANS4M-R
Transforming Europe's Rail Freight

- **Total project cost:** 97.500.000,00 €
- **Project duration:** 58 months
- **Number of partners:** 76 (AEs included)




Extended to 2027

# FP5-TRANS4M-R




Start: July 2022

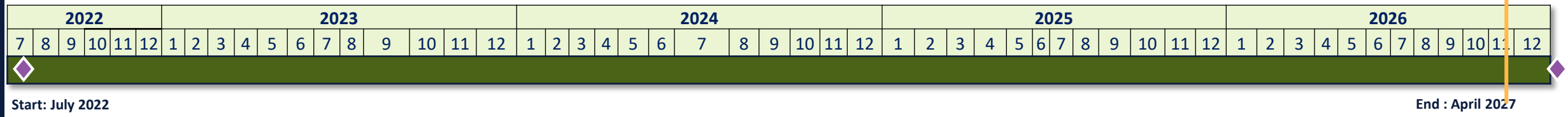
End : April 2027

## WS1: Full Digital Freight Train Operations (FDFTO)

- **Operational Procedures, Functional Requirements and Freight System Architecture**
  - A common European technical baseline for the **DAC Basic Package** was established, covering specifications, standardisation, interoperability testing and authorisation requirements (https://rail-research.europa.eu/wp-content/uploads/2026/10/DAC-Basic-Package-Article_V2_final.pdf) .
  - **The validation and deployment framework was implemented**, including **the Train Test Laboratory**, demonstrator programme and methodology supporting future roll-out. Functional and interoperability testing covered coupling and uncoupling, automated brake testing, train composition detection, train integrity and train-length function
  - **Power and communication validation progressed**: Functional and interoperability tests of the communication system were completed across joint laboratories with predominantly successful results and continued together with CCU testing where required
  - EMC tests for Italian and Austrian wagons successfully passed, complying with EN 50121 and relevant national requirements.

Extended to 2027

# FP5-TRANS4M-R




Start: July 2022

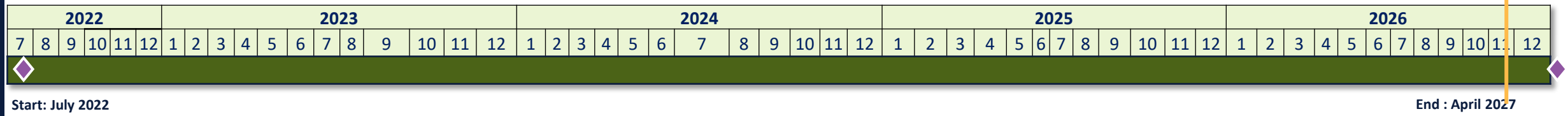
End : April 2027

## WS1: Full Digital Freight Train Operations (FDFTO)

- **Demonstration trains**
  - Austrian demonstrator: Two Vectron locomotives equipped with hybrid couplers; more than 500 coupling operations and winter testing completed without operational restrictions.
  - Full-consist validation completed: 400 V power supply and SPE data communication successfully tested across 17 fully equipped FDFT wagons.
  - Commercial-service experience gained: DAC-equipped steel and intermodal trains operated in Sweden, including testing under harsh winter conditions.
  - Yard demonstrators prepared: DAC and FDFTO functions integrated into flat- and hump-yard scenarios, including automated coupling, train composition detection and brake testing. It demonstrated basic communication between ASO onboard equipment and a yard control centre and identified the remaining need for standardised interfaces to yard and traffic-management systems.
  - Demonstrators provided the operational evidence base for interoperability, authorisation and future European DAC deployment.

Extended to 2027

# FP5-TRANS4M-R




Start: July 2022

End : April 2027

## WS2: Seamless rail freight (Seamless)

- **Planning and dynamic dispatching tools delivered decision-support capabilities**: Advanced macrosimulation, capacity and optimisation tools, including Proton-based approaches and connected planning modules, supported long-term and short-term freight planning, first- and last-mile coordination and ad-hoc replanning. Demonstrated how network, yard and terminal information can be combined to improve planning quality and operational responsiveness.
- **ETA prediction and data-driven monitoring advanced** despite limited live-data availability: The work delivered ETA prototypes using mainline, yard, terminal and environmental data and a multi-algorithm approach with iterative learning.
- **Multimodal service integration improved customer-facing rail access**: Planning, monitoring and prediction functions were integrated into multimodal service concepts to provide more transparent routing, booking support and milestone-based ETA information
- **European Railway Checkpoints** were established and demonstrated in operational environments. The solutions combine intelligent video gates, wayside sensors, RFID where available and AI-based image analysis to digitalise inspections and information exchange at borders, yards, terminals and other operational stopping points
- **Seamless demonstrations successfully conducted**: initial data exchange between development modules and real-world checkpoint applications presented in Germany, Sweden, Spain and the Netherland

Extended to 2027

# FP5-DACtiVate: Activating DAC Development Through Testing and Engineering

**Main objective:** Advance the full digitalisation of freight train operations in Europe, aiming to **enable the pre-deployment of pilot trains with Digital Automatic Coupling (DAC) by executing required additional tests to the complementary project FP5-TRANS4M-R.** Establishing confidence before full implementation, while enabling DAC authorisation processes.

**Target solution:** Test the interchangeability of DAC components, expand the number of Wagon Onboard Units in line with FP5-TRANS4M-R's system architecture and enable thorough validation of the pre-deployment trains by additional locomotives able to integrate hybrid couplers.

**Benefit:** Collaboration with FP5-TRANS4M-R is vital to align with its functional specifications and technical architecture, ensuring the project's contributes to the related DAC authorisation process

**Focus areas:**

**WS1: Derailment and propelling safety tests, crash tests, climate chamber to prove interchangeability of DAC coupler head/shank and draft gear across DAC solutions**

**WS2: Mix and match tests – test specification, execution and validation preparation for DAC subsystem interchangeability**

**WS3: Technical analysis and fitting solutions for hybrid coupler for mainline and shunting locomotives**

**WS4: Provision of wagon on-board unit prototypes for FP5-TRANS4M-R**

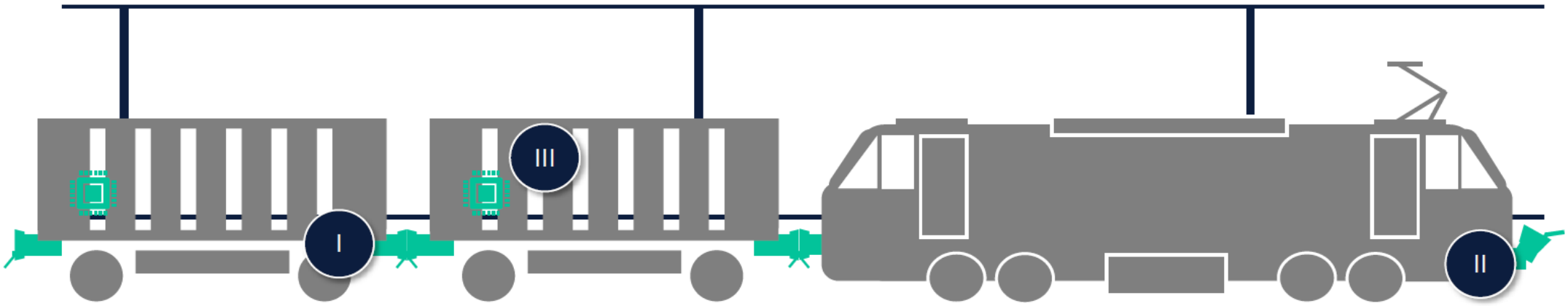
**Total project cost:** 10,726,665.84 €
**Project duration:** 25 months
**Number of partners:** 21 (AEs included)

FP5DACtiVate

**21 Partners from all over Europe**

**Completed in 2026**

# FP5-DACtiVate




**I** **DAC Testing**

Validation Tests
Mix&Match Interface A

**II** **Hybrid Coupler for Locomotives**

DAC integration

**III** **Wagon Onboard Units**

WOBU provision for
Train Test Lab

**Enabling DAC Pre-Deployment**
in **close collaboration** with **FA5 projects**

Completed in 2026

# FP5-DACtiVate: Activating DAC Development Through Testing and Engineering

**WS1: Derailment and propelling safety tests, crash tests, climate chamber to prove interchangeability of DAC coupler head/shank and draft gear across DAC solutions**

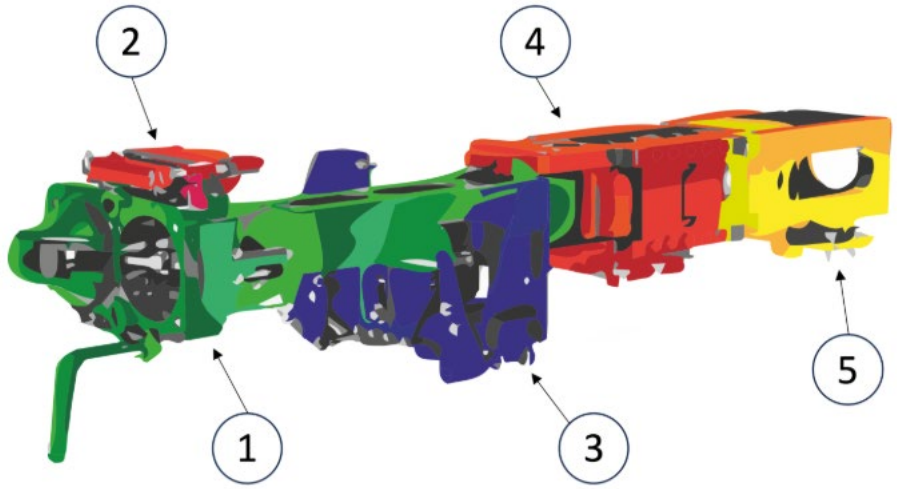
- **Climate chamber and derailment test** reports have been shared with the industry partners. Findings from the climate chamber tests have informed **improvements to the electrical coupler design.**

- **Crash tests** were successfully completed at TÜV in Görlitz on 19–23 October 2026, providing important insights into coupler performance under crash conditions.

**WS2: Mix and match tests – test specification, execution and validation preparation for DAC subsystem interchangeability**

- The test specification has been approved, and initial tests combining coupler heads and draft gears from different suppliers have been performed.

- **Further testing is planned in Poland** in November and in Germany in December, with results feeding into the validation documentation.




*The different parts in the Digital Automatic Coupler: coupler head (1), electrical coupler, (2), vertical support (3), draft gear (4) and support plates (5)*

Completed in 2026

# FP5-DACtiVate: Activating DAC Development Through Testing and Engineering

**WS3**: **Technical analysis and fitting solutions for hybrid coupler for mainline and shunting locomotives**

- The hybrid DAC and CCU have been integrated into the Stadler EuroDual locomotive.

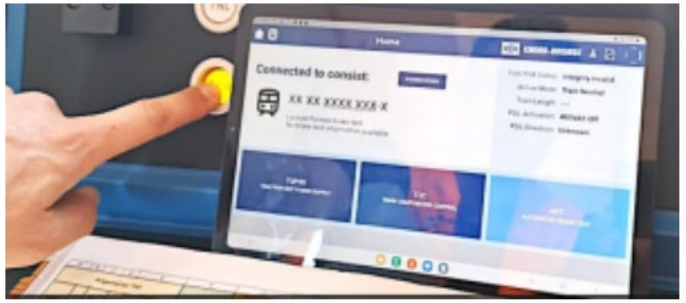
- Re-commissioning is complete, train functions have been tested repeatedly, and D3.2 was submitted on time.




Front view of locomotive with installed system interfaces for DAC preparation.

**WS4**: **Provision of wagon on-board unit prototypes for FP5-TRANS4M-R**

- Knorr-Bremse and Wabtec have completed production of the wagon on-board unit prototypes.




CCU user interface showcasing digital train functions such as automated brake testing.

Completed in 2026

# FA5 in Wave 2 | FP5-FUTURE4FREIGHT

- **Main objective:** **Higher maturity (TRL) of Technology Enablers started in FP5-TRANS4M-R and FP5-DACtivate**

- **Main focus areas:**

**Workstream 1: Full digital freight train operations using Digital Automatic Coupling (DAC)**

- Finalisation and qualification of the interoperable DAC basic package.
- Finalisation of authorization and standardization of the interoperable DAC basic package.
- Input from DAC European Pioneer trains.
- Development of additional FDFT train functions.
- Work on migration aspect.

**Workstream 2: Seamless freight services with easy access and reliable, multimodal and digitally supported transport solutions**

- Improved freight operations through cross-border planning and dispatching.
- Multimodal freight service integration.

FP6-Future

# Flagship Project 6

# FP6 – FutuRe: Delivering Innovative rail services to revitalise capillary lines and Regional rail services

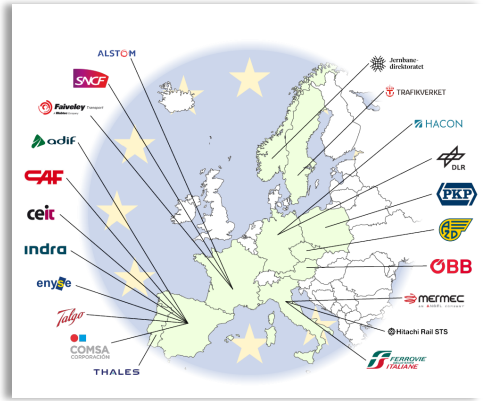
**Project motivation:** Regional railway lines need to be revitalized or even rebuilt to make them economically, socially, and environmentally sustainable and meet the current customer needs but also reduce CO2 emissions of the European transport sector.

**Target Solution:** A concept tailored to regional railways that includes digitalization, automation and utilization of mainstream and emerging technologies for signalling and trackside components, rolling stock and customer information.

**Benefit:** Long term viability of regional railways, lower CAPEX and OPEX, increasing quality and reliability of the service, improving customer satisfaction

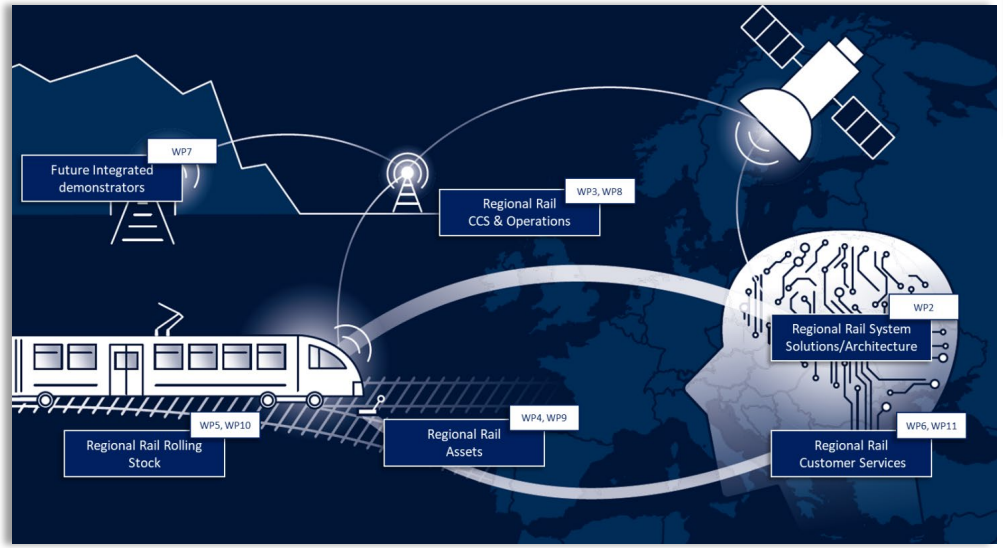
FP6-FutuRe
Cost effective regional lines

- **Total Project Costs:** 32.9M EUR
- **Project duration:** 48 months
- **Partners:** 51




**Focus Areas:**

- **SA1**: Suitable Regional System Solution
- **SA2**: Cost efficient performing CCS system
- **SA3**: Optimised Railway Asset
- **SA4**: Sustainable Rolling Stock
- **SA5**: Suitable Customer Service




Completed in 2026

# Flagship Project 6 – *FUTURE*

| 2022 | | | | 2023 | | | | | | | | | | | | 2024 | | | | | | | | | | | | 2025 | | | | | | | | | | | | 2026 | | | | | | | | | | |
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| Start | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | End |

## Area 1 - Suitable Regional System Solution

- High-level regional railway architecture finalised and aligned with the System Pillar and other Flagship Areas; potential TSI inputs identified.
- Regional-line requirements finalised, supported by a traceability matrix covering all developed demonstrators.
- KPI achievement is positive, with almost all KPI targets considered achievable by at least one demonstrator or task. The final report is in preparation.
- G1 safety analysis and the regional migration strategy finalised, including mitigations and laboratory-to-field pathways.

## Area 2 – Cost efficient performing CCS system

- ATO GoA2 delivered theoretical evidence of energy savings above 10%; GoA4 perception and stop-on-demand use cases and Remote Driving were demonstrated.
- Moving Block, Hybrid Train Detection and TMS test campaigns were completed, confirming operational viability with fewer trackside assets and scalable traffic management.
- ASTP demonstrator focused on entering and leaving a radio-hole section: continue operation with expected confidence-interval behavior during degraded data availability.
- ***WAVE 2: focus on the increase of TRL and integration of the technical enablers***




Completed in 2026

# Flagship Project 6 – FUTURE

## Area 3 – Optimised Railway Asset

- **10 demonstrators** and **one simulation** advanced into implementation, testing and final deliverables.
- **Test environments** were completed for wireless/self-sufficient level crossings, switches and obstacle detection.
- The **first solar-powered wireless gate signal** was installed.
- High performant train to track communication with TRL5.
- 1 Gbps train-to-track radio network tests in laboratory environment were carried out for ATP and ATO communications over a given network.
- ***Wave 2: Next planned steps address integration in large scale demonstrator and the increase of TRL.***



## Area 4 – Sustainable Rolling Stock and non interoperable CCS (G2)

- Topology-optimised steel cut car body mass by 68% for G1 and 57% for G2; composite and hybrid concepts achieved more, at higher cost.
- Battery-electric and hydrogen-hybrid powertrains were assessed, including multimodal charging infrastructure.
- The Swedish G2 field campaign on the Nässjö–Gothenburg route validated cloud-connected CCS building blocks in real operations.
- ***Wave 2: Next planned steps for G2 address integration in large scale demonstrator and the increase of TRL.***



Completed in 2026

# Flagship Project 6 – FUTURE

## Area 5 – Suitable Customer Service

- **Four demonstrators** were completed and validated in Saarland and Rome; all achieved TRL 6.
- The passenger information system integrated **Demand Response Transportation service**, **real time information update**, **occupancy forecasts** and **accessibility profiles**. It also included walking-distance optimization for trip searches.
- A bidirectional TMS–PIS interface proved feasible, exchanging operational changes and passenger-demand forecasts.
- Congestion decision support and passenger-oriented platform allocation were demonstrated with realistic data and expert users.
- ***Wave 2: Next planned steps is to increase the TRL.***




Completed in 2026

# FA6 in Wave 2 | FP6-FUTURE2

- **Main objective:** **integrating and demonstrating Technical Enablers at high TRLs under more realistic operational conditions in order to prepare for Wave 3**

- **Main focus areas:**
  - Cost efficient performing CCS system for interoperable railway networks
  - Cost efficient performing CCS system for non-interoperable railway networks
  - Optimised Railway Asset
  - Suitable Customer Service
  - Collaboration with the relevant Flagship Projects (FP1 and FP2), with System Pillar
  - Establish links with PREFER *(under Grant Agreement Preparation phase)*

5 projects

# Flagship Area 7

# EU Rail: Flagship Area 7 of the Innovation Pillar

## VISION of FA7

Develop **the next generation of railway transport systems** based on **fully automated multimodal mobility systems** for passengers and goods, which are **sustainable and interconnected**, **more flexible**, **natively digital, standardized and scalable**, enabling **new business models** towards on-demand mobility

## OBJECTIVE of FA7

Explore non-traditional and emerging flexible and/or high-speed guided transport systems, as well as to create opportunities for innovators to bring forward ideas for shaping those future systems via a scientific approach into an existing rail system.

Destination

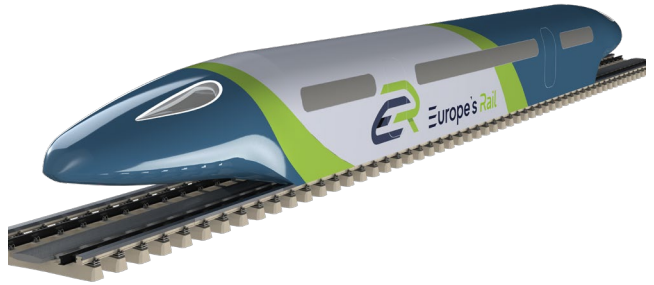
### AUTOMATED MULTI-MODAL MOBILITY-SYSTEM



TARGET @2031 – TRL 5

Destination

### MAGLEV-DERIVED TRANSPORT SYSTEMS




TARGET @2031 – TRL 6-7*

Destination

### UNCONVENTIONAL FAST TRACK-BOUND TRANSPORT SYSTEMS



TARGET @2031 - TRL 5-6*

*with the assumption that other complementary initiatives and programs

# Flagship Area 7: Progress in 2026

FA7 pods 4 RAIL

- **Total Project Costs:** 3M EUR
- **Project duration:** 34 months
- **Partners:** 15

Rail-based, fully autonomous, "supermodal" mobility system for both passengers and freight, a system designed to be standardised, scalable, and adaptable to various modes of transport




**Key achievements:**

- Concept study for pod carrier and Transport Unit has been developed (TRL3).
- Creation of 3D-printed models for both a rail-vehicle carrier and a road-vehicle carrier.
- Concept Development for Traffic Coordination of Pods System together with the handling system.
- Proposal for concept of architecture of a ropeway carrier.

# Flagship Area 7: Progress in 2026

**Objective:** To explore non-traditional and emerging maglev-derived systems, assess the technical feasibility and effectiveness in Europe as well as demonstrate in relevant env. (**TRL6**)

**Key activities:**

- Assessment of the most promising Maglev-Derived System (MDS) configurations for integration into the European railway network.
- Assessment of compatibility with existing infrastructure and railway systems, including levitation and guidance subsystems.
- Definition of the technical baseline and target architecture for design, simulation, safety and validation.
- Preparation of testing activities, considering EM interaction with CSS

*Starting date: December 2025*

*Duration: October 2028 | Funding: 3M€*

**Objective:** To facilitate the harmonization and interoperability of hyperloop technologies and analyse the technical and economical feasibility.

**Activities:**

- Completion of the cost-benefit analysis for freight and passenger services of a hyperloop network across the EU
- Finalisation of the passenger-oriented concept of operation considering the different technical approaches of the key promoters.

*Starting date: December 2024*

*Duration: November 2026 | Funding: 2.3M€ -* Extended to 2027

# Flagship Area 7: 2026 New projects

## PREFER*

**Objective:** To deliver sustainable, passenger-centric solutions for regional and suburban rail networks across Europe based on FP6-Future and Pods4Rail results .

**Planned activities:**

- Virtual concept design for lightweight modular regional vehicles based on FP6-Future requirements.
- Develop, test and validate the specific RS components (**TRL4-6**) e.g. carbody, running grear, battery electric powertrains.
- Further develop the pod system (**TRL4/5**) considering the carrier, transport unit, handling and mobility mgt system.

*Starting date: December 2026*

*Duration: May 2030 | Funding: 3.77M €*

** Grant Agreement preparation phase*

## HyperSafe*

**Objective:** To develop the safety requirements, method and guidelines as well as identify certification processes which can be applied overall in Europe.

**Planned activities:**

- Definition of proposals for technical safety requirements.
- Development of a technical safety guideline proposal and input to standards.
- Develop a Certification Roadmap proposal.
- Validate key safety components of the hyperloop system based on the defined safety guidelines.

*Starting date: December 2026*

*Duration: November 2028 | Funding: 3M€*

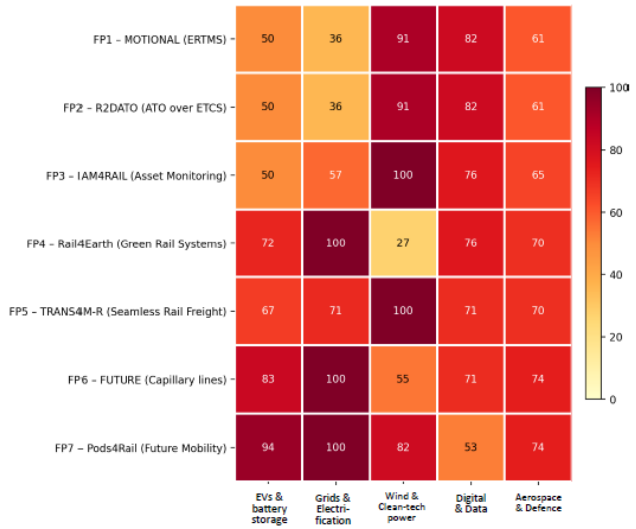
** Grant Agreement preparation phase*

6 projects

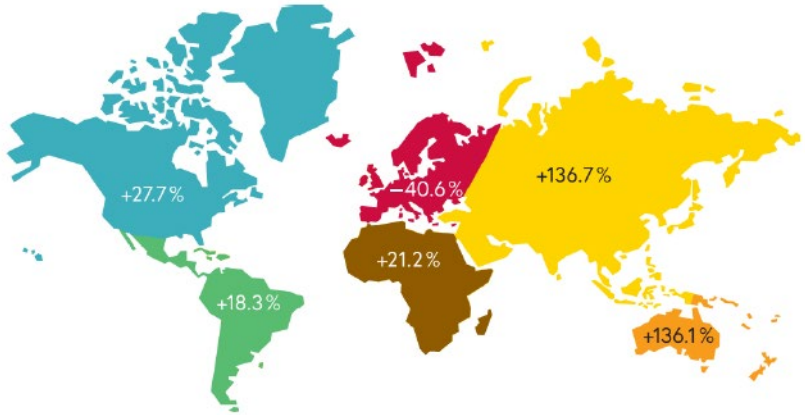
# Exploratory Projects

# 2026 Achievements: Focus on LEADER 2030

- LEADER 2030 assessed whether sufficient raw materials and components will be available to deploy Rail innovations by 2030. It consolidated analysis of supply disruptions, Critical Raw Materials, semiconductors and logistics vulnerabilities, translating the findings into **industrial and policy recommendations to safeguard the delivery of Europe's Rail Flagship Projects**.
- The competitiveness of the European rail sector in 2030 will depend not only on its capacity to innovate, but also on its ability **to secure resources, strengthen supply-chain resilience and deploy innovations** in an increasingly uncertain global environment.




Semi-quantitative measure of material over-lap with the other most demanding sectors based on the 10 key raw materials required by each FP




Mining production rates 2000-2023: declining only in Europe (World Mining Data)

**Cross-cutting priority areas:**

- Strengthening Value Chain Coordination, Governance and Institutional Capacity
- Unlocking Investment, Financing and De-risking Mechanisms
- Simplifying Regulation and Ensuring a Competitive Framework
- Scaling Circularity, Innovation and Industrial Capacity
- Enhancing Supply Chain Resilience and Strategic Logistics
- Aligning Market Design, Procurement and Industrial Incentives
- Strengthening the Broader Macroeconomic and Strategic Conditions for European Autonomy

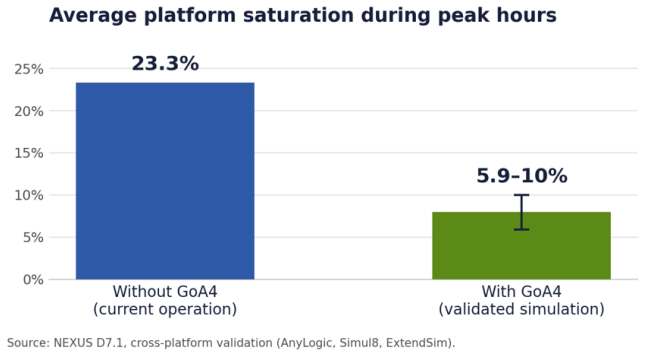
LEADER 2030 final intelligence analysis and recommendations to deliver Europe's Rail 2030

# 2026 Achievements: **Focus on NEXUS**

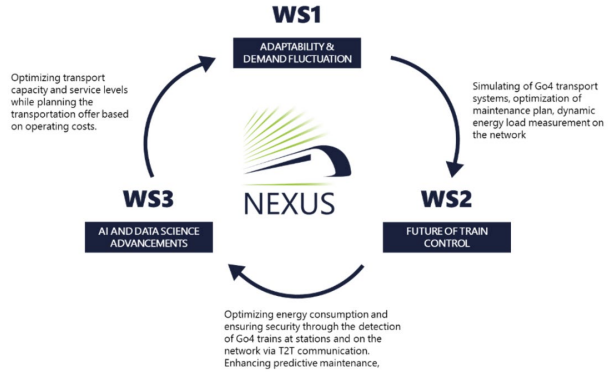
**NEXUS** aimed to establish an innovation benchmark and provide guidance for the transformation of European metros, focusing on optimisation and adaptability to passenger demand.

## Main outputs and results

- **23 operational scenarios validated** across AMT Genoa and MetroS Sofia, alongside three AI use cases: crowding prediction, timetable creation and CCTV-based anomaly detection.
- **Driverless-metro (GoA4) vehicle interior concepts developed** for AMT Genoa, MetroS Sofia and a generic European metro, complemented by three service optimisation methodologies.
- Developed **a structured business case** for the transition to unattended, driverless operation at both demonstration metros.
- Consolidated its finding into **37 practical guidelines** to help other European metro operators assess their own readiness for similar innovations and adapt NEXUS approach to their own networks.
- Produced two validated, operator specific **“acceleration pathways”** for moving from research results towards deployment.




Source: NEXUS D7.1, cross-platform validation (AnyLogic, Simul8, ExtendSim).



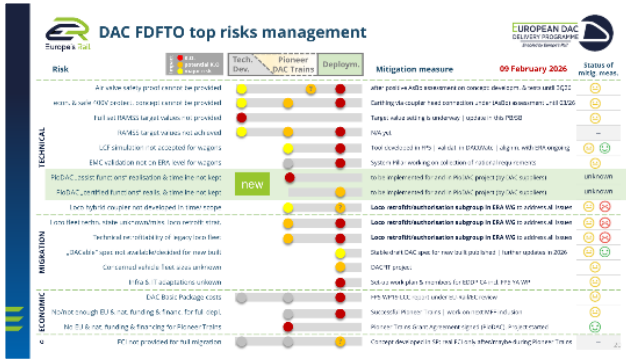

**More information available here:**

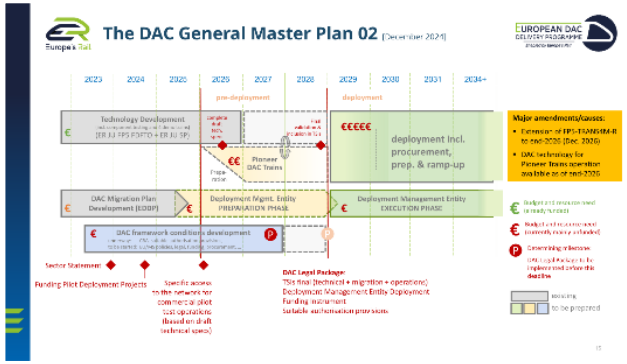
https://nexus-heproject.eu/about/

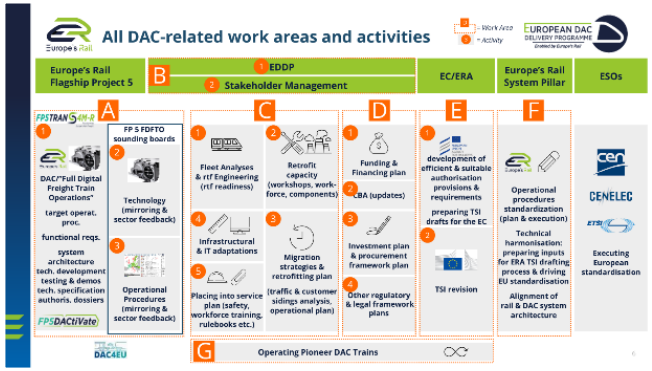
# 2026 Achievements: **Focus on DACcord**

**DACcord** aimed to enable an effective and coordinated European-wide DAC roll-out and setting up an actionable migration and implementation plan.

- **Managed European DAC Delivery Programme (EDDP),** prepared, moderated and followed up **30 Programme Board and 21 Supervisory Board meetings.**
- **Conducted Europe's Rail DAC-related projects (FDFTO) risk management, identifying, assessing and actively managing 70 programme risks.**
- Generated **high-impact visibility for DAC** through stakeholder management.
- Created the **DAC General Master Plan 01 and 02.**
- Conducted **multi-annual planning for EDDP areas.**
- Followed up the **EU-Rail Sounding Boards** for and with the railway sector community on operational procedures and DAC technology.




**More information available here:**

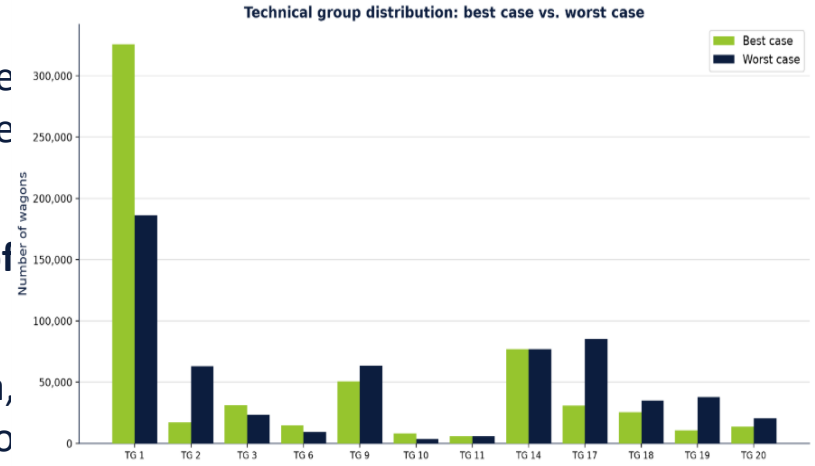
https://rail-research.europa.eu/european-dac-delivery-programme/projects/daccord/

# 2026 Achievements: **Focus on DACFIT**

**DACFIT** consolidated the technical and operational basis for retrofitting the European freight fleet with Digital Automatic Coupling (DAC). It developed practical retrofit processes, assessed workshop capabilities and delivered a Decision Support System (DSS) to support capacity planning and informed decision-making for the DAC transition.

**Main outputs and results**

- Conducted **a comprehensive fleet analysis (analysed 42 locomotive types 120 subtypes) and 261 freight wagon types**, exceeding the original targets of 35 locomotive and 50 wagon types.
- **Classified wagon types into technical groups** linking vehicle characteristics to retrofit requirements, processes and capacity planning.
- **Conducted 11 retrofit trials** involving seven wagons and four locomotives in three countries, and identified standard work steps, effort estimates and workforce competencies.
- **More than 1,000 workshops surveyed and assessed, providing an overview of available retrofit capabilities.**
- **A Decision Support System and visualisation tool developed**, integrating fleet data, regional retrofit demand, workshop capabilities and retrofit effort to support scenario analysis and identify capacity gaps.
- Developed **a framework for comparing different DAC migration approaches** and supporting **a more coordinated view of the transition to DAC**.




**More information available here:**

https://dacfit.vpi-vers.eu/en/home

# 2026 Achievements: **Focus on InBridge4EU**

**InBridge4EU** aimed to improve the assessment of railway bridge dynamic performance by providing technical evidence and recommendations for the revision of European standards and interoperability requirements.

**Main outputs and results**

- **Built comprehensive European databases** covering more than 500 representative railway bridges and a wide range of train types.

- **Developed new Dynamic Train Categories (DTCs) and improved assessment methods** to better represent dynamic effects and evaluate bridge performance.

- **Proposed improvements to key European technical criteria**, covering:
  - Static compatibility checks (EN 15528).
  - Dynamic amplification factors and damping provisions (EN 1991-2).
  - Deck acceleration limits for ballasted and ballastless bridges.

- **Evaluated bridges potentially requiring intervention** using the new DTCs and technical-economic studies.

- **Delivered recommendations for future revisions of European standards and the INF TSI**, supporting more consistent, interoperable and cost-effective bridge assessments.

**More information available:**
https://inbridge4eu.eu/

# Exploratory Research: Progress in 2026

## Academics4Rail

**Objective:** To create tools for mapping research theme, establish a scientific observatory to identify gaps and future needs, deliver a KPI framework for assessing the performance of Europe Rail's programme and enabling 6 PhDs in Railway Engineering.

**Key achievements:**

- Completion of the position paper on research gaps and the catalogue of PhD topics, establishing the project's scientific observatory;
- Completion of the final assessment framework for KPIs, establishing a collaboration pathway with EU-Rail and JRC.
- Progress across all six PhD programmes that passed mid-term milestones with each candidate publishing at least one peer-reviewed paper, advancing work in aerodynamics, EMC, wireless communications, predictive maintenance, and AI-driven driving assistance.

*Starting date: September 2023*

*End date: February 2027 | Funding: 2 M€*

## PhDs EU-Rail

**Objective**: Realization of 10 PhD positions, teaming up with the industry; and continuous process for the extension of a rail excellence scientific community.

**Key achievements:**

- Ten PhDs lines aligned with EU-Rail's priorities and the Master Plan, positioning each PhD within a credible pathway towards scientific excellence and industrial relevance;
- Scientific community expanded beyond traditional rail engineering, integrating social sciences, gender studies, education and accessibility;
- Strong progress across all ten PhDs, dealing with decarbonization, gender, education, urban logistics, night trains, bridge dynamics, safety communication, socio-economic, accessibility and ERTMS. 10 papers produced and 10 more in progress.

*Starting date: October 2024*

*End date: September 2027 | Funding: 2 M€*

# Exploratory Research: Progress in 2026

## SYMBIOSIS

**Objective:** To integrate biodiversity throughout the lifecycle of railway and linear infrastructure projects, aligning with UN Sustainable Development Goals and the European Green Deal.

**Key achievements:**

- Based on a review of over 100 case studies and a Delphi consultation with railway experts across seven European countries, a comprehensive assessment of existing impact assessment approaches has been completed.
- A Knowledge Transfer and Capacity Building Strategy was delivered.
- Transformative Insights and Strategies for Biodiversity Monitoring in European Railway based on a Europe-wide survey conducted across 26 transport organisations were delivered.

*Starting date: September 2024*

*End date: August 2027 | Funding: 2,8 M€*

## XCROSS

**Objective:** To develop a suite of integrated disruptive technologies which combine to provide a technological process for the monitoring, inspection, and maintenance intervention of crossing surface profiles, demonstrated in urban environment;

**Key achievements :**

- Laboratory testing, field measurements and initial validation of the individual technologies (handheld 3D laser scanning and geometry analysis methods, DT models for predicting wheel-rail interaction and optimising crossing repair profiles, an AR application for visualising maintenance guidance, 3D printed tools for supporting welding and grinding operations) with involvement of welders and maintenance contractors during development and assessment phases.
- Preliminary results: this could increase from 2-4 years the extension of crossing nose service life, and reduce maintenance frequency and costs, as well as track availability.

*Starting date: October 2024*

*End date: March 2027 | Funding: 2,7 M€*

## QuieterRail

**Objective:** To introduce a step change in predicting and mapping of railway noise and vibration, acceptance testing of new rolling stock, and promoting of cost-effective noise mitigation.

**Key achievements:**

- Mainline noise and vibration tests successfully carried out in May 2026; ground vibration measurements performed at two locations characterized by significantly different soil conditions.
- Acoustic measurements performed on two track sections exhibiting substantial differences in rail pad stiffness and track decay rates. Results will be used to validate N&V transposition procedures.
- For on-board rail roughness, a beta version of the open-source toolbox was developed.
- The SILVARSTAR hybrid vibration prediction tool has been successfully transferred from a locally executed desktop application to a cloud-based solution.

*Starting date: October 2024*

*End date: September 2027 | Funding: 4,1 M€*

# Exploratory Research: Progress in 2026

## CLIFRAILEU
CLIMATE FINANCE FOR EUROPEAN RAIL

**Objective**: To unlock climate finance opportunities for the European rail sector by enabling rail to play a transformative role in the EU's net zero transition.

**Key achievements:**

- Assessment of climate finance options for rail projects
- Assessment of methods to measure and report greenhouse gases emissions and emission reductions
- Assessment of reporting needs and Corporate Sustainability Reporting Directives (CSRD) requirements for rail organizations
- Assessment of financing potential, policy gaps and suitable use cases for rail investment

*Starting date: August 2026*

*End date: January 2029 | Funding: 0.6 M€*

## VALORail

**Objective:** To address a critical barrier to the decarbonization of Europe's transport sector - the underutilization of climate finance in the rail sector - and develop the knowledge, tools, and strategies needed to unlock new sources of climate-aligned capital for rail.

**Key achievements expected:**

- Identify barriers and enablers to rail's access to climate and sustainable finance instruments;
- Develop methodologies for measuring and verifying GHG reductions, including avoided emissions from modal shift;
- Explore how Corporate Sustainability Reporting Directive (CSRD) reporting can facilitate access to climate finance;
- Develop recommendations for standardized methodologies to enable rail to access carbon markets and results-based climate finance.

*Starting date: September 2026*

*End date: February 2029 | Funding: 0.6 M€*

## tRail5.0

**Objective:** To support the transition of the European rail freight sector towards Industry 5.0.

**Key achievements expected:**

- The Atlantic Corridor will be tRail5.0 main use case, enabling validation under real operational, governance and cross-border conditions, while ensuring transferability to other TEN-T contexts.
- Expected delivery of a validated set of challenges, critical success factors, drivers and risks for the implementation of Industry 5.0 in rail freight, a structured framework for measuring progress in SRE, and concrete recommendations for pilot projects and public policy pathways.

*Starting date: September 2026*

*End date: February 2029 | Funding: 0.6 M€*

# Exploratory Research: Progress in 2026

## FRMCS IN-SIGHT *

**Objective**: To provide support for the activities of the European FRMCS Deployment Group, ensuring well-organised planning, effective execution, and continuous monitoring of all actions related to deployment.

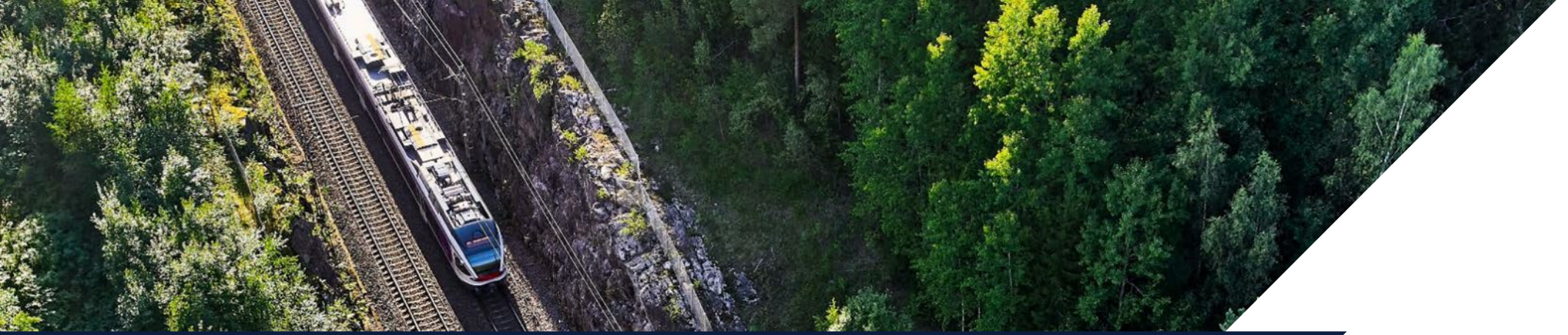
**Key achievements expected:**

- Capacity mapping and planning analysis
- Independent cost and time driver study
- Deployment guidelines toolbox
- European deployment dashboard
- Knowledge sharing and acceleration
- Market readiness development
- Risk and deviation management
- Expertise and technical support on key areas, i.e., system authorisation, cybersecurity, and RAMS.

*Starting date: June 2026*

*End date: May 2028 | Funding: 0.7 M€*

** Grant Agreement preparation phase*



# Q & A



*Implementation of the EU-Rail Programme*

# System Pillar: State of Play and Year 4 Results

**EU-RAIL System Pillar team, System Pillar Core Group, and System Pillar Task and Domain leads**

# System Pillar

## *General Overview*

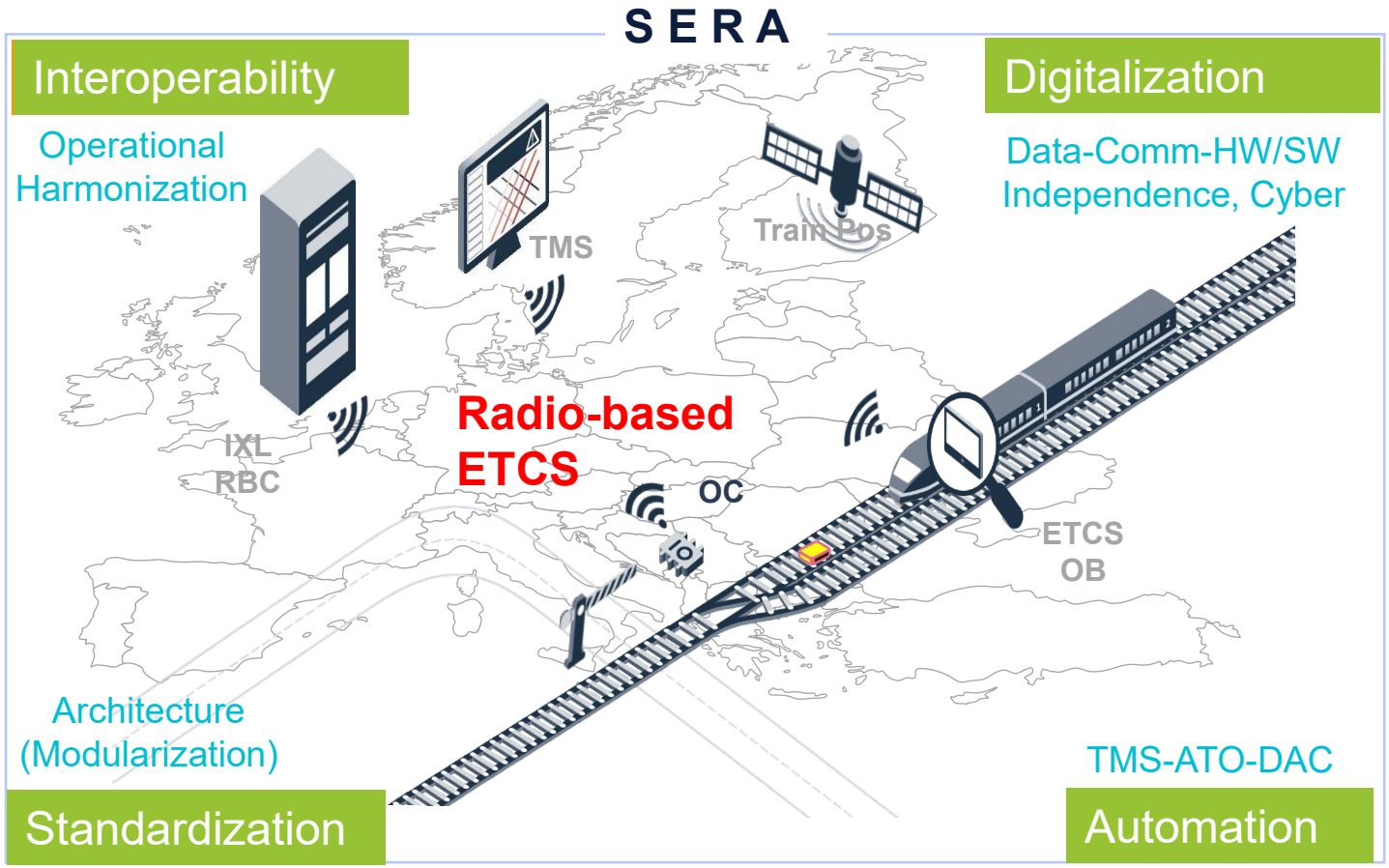
EC, ERA, Member States, and Sector agreed on a dedicated structure - System Pillar - to provide a unique opportunity to allow the Rail sector to converge on a strategic vision for the evolution of the **Single European Rail Area (SERA)**.

**System Pillar**

***MultiYear Program***

***~ 400*** *experts from Sector*

***55 m*** *EU funded*



# System Pillar

***Why – The motivation for the System Pillar***

Harmonize operations and products with a powerful and modular architecture.

| | |
|---|---|
| Reduce process effort on all sides (products, assets, production) | Reduced cost |
| Accelerate product evolution by creating higher market potential per product | Performance, Capacity, Automation, Digitalisation. |
| Migrate-able and affordable product and asset lifecycles.<br>Manage complexity and knowledge availability risks. | Healthy Business. |
| Improve interoperability | SERA. |

# System Pillar

***How – organisation and process***

Europe's Rail

System Pillar Steering Group

15 specialized "domains"

EC
ERA
Sector bodies

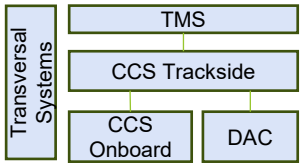
Railways
Suppliers
Mirror Groups

Harmonized Operational Processes



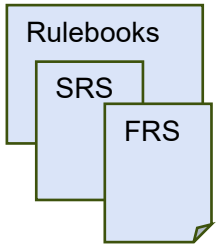
Derived harmonized requirements

Precise Architecture Specification (MBSE)




Operational Rulebooks.

Precise System and Interface Specification




Harmonisation

TSI CR proposal

Standardisation proposal

System Pillar Publication

**Draft proposal**
Propose specifications as draft input for harmonisation processes (TSI, ESOs)

# System Pillar

## *Outputs (so far) in 2026*

### SYSTEM PILLAR STEERING GROUP APPROVED DECISIONS

**Cybersecurity**
- V1.1 of System Pillar Cybersecurity specifications

**Task 2, Train Control System**
- Train CS Architecture as a direction for future specification work, including update for cybersecurity
- Onboard modularity – mature solution proposals to Technical Specifications for Interoperability

**Task 2, Traffic Control System and Operational Harmonisation**
- Traffic CS Technical Design Decisions as an input for specifications

**Task 2, Concept of Employment**
- Overall Concept of Employment for CCS, Hardware Compatibility Interface and Virualisation Interface specifications, and Safety Risk Analysis System Level 4

**Task 2, Trackside Assets**
- Conformance test cases

**Task 4, Digital Automated Coupler, Future Freight**
- Concept for Safe Train Length and Train Integrity
- Concept for central Instance organisation for DAC/FDFTO as a basis for future implementation work

**https://rail-research.europa.eu/system-pillar-steering-group**

### EXTERNAL RELEASE V1

***SPECIFICATIONS INTENDED FOR USE IN PROCUREMENT***

**Cybersecurity**
- V1.1 of System Pillar Cybersecurity specifications

**Task 2, Trackside Assets**
- EU-RAIL Trackside asset specifications, a subset of EULYNX Baseline Set 4 Release 4

**https://rail-research.europa.eu/first-external-release/**

### SYSTEM PILLAR STATE OF PLAY V1

***FULL SNAPSHOT OF CURRENT OUPUTS ACROSS ALL DOMAINS FOR INFORMATION TO THE SECTOR***

# Focus on Cybersecurity

***Regulatory and implementation environment***

- EU recognition of cybersecurity importance
  - NIS-2 & CER Directives
  - Cyber Resilience Act

**Regulation evolution**



- Heterogeneity of Railway System
- Legacy and modern technologies coexistence

**Implementation Challenges**



# Focus on Cybersecurity

***Resilience in an age of uncertainty***




Traditional security **looks backward**: risk-based controls are built on experience, not future uncertainty.

Statistical risk models can manage only threats that are **already known and measurable.**

Rail systems **last for decades**. They must withstand uncertainties that **cannot yet be predicted.**

As uncertainty grows, **risk controls alone are not enough**. We need **resilience by design.**

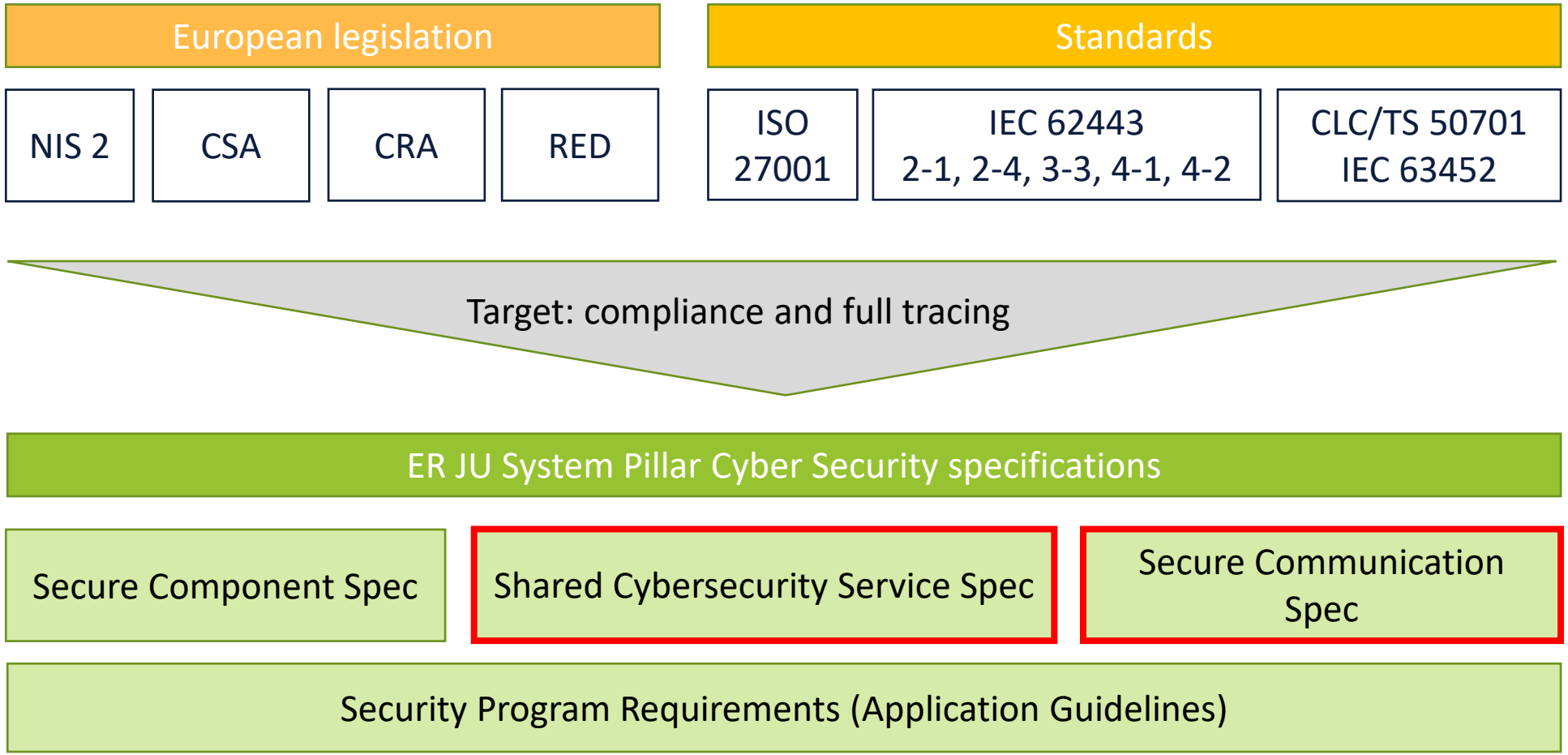
**EU-Rail**'s harmonized security architecture makes resilience **practical, affordable and effective:**

**Resilience by Design**

Picture by aranha. CC0. Source: https://pixabay.com/photos/rack-railway-railway-tracks-rails-73023/

# Focus on Cybersecurity

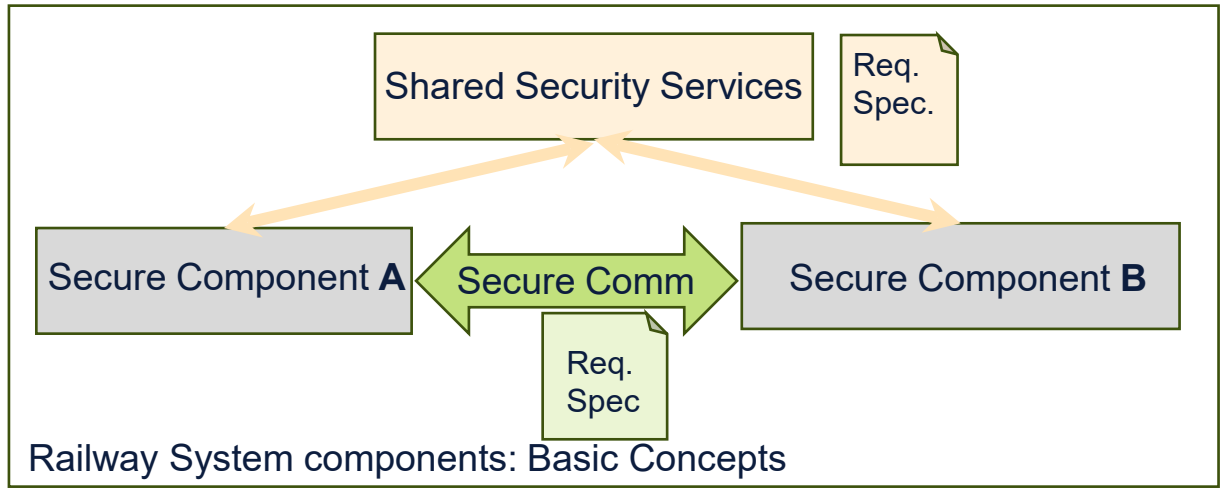
## *EU-RAIL System Pillar outputs*




**Red circled box are Interoperability (TSIs) relevant.**

# Focus on Cybersecurity

## *EU-RAIL and ERA cooperation*




EU-Rail input

**ERA Technical Document - Secure Communication**
Interface specification for the End-to-End security communication layer

**ERA Technical Document - Shared Cybersecurity Services**
Interface specification to Shared Cybersecurity Services

### Scope of application

New Cybersecurity requirements only
for pertinent TSIs and ready for evolutions needed for future treats

### Proportion principles

Focus on interoperability related aspects, e.g. interfaces between Interoperability Constituents

### Consistency check

Thorough review with support from rail stakeholders and ENISA

Reference for

- Energy TSI
- Control Command and Signalling TSI
- Rolling Stock - Locomotives and Passengers TSI
- Operation and Traffic Management TSI
- Rolling Stock - Freight Wagons TSI
- Infrastructure TSI

# Focus on ERTMS Blueprint

***System Pillar CG railway representatives view on the need to consider the full Control Command and Signaling system in ERTMS implementation***

## Challenges today

- Digitalization completely changed the CCS asset business.
- System dependencies grow and time to deploy also.
- Increasing costs and asset management risks.
- Not making full use of the CCS potential aiming for better performance, automation, modularity.
- CCS technology changes rapidly, how to manage change?

## SERA impact

- 2027 ERTMS blueprint is a first step towards SERA.
- **The prerequisite:** The SERA system will need to provide feasible migration roadmap from current implementations.
- The switch to off-the-shelf modular products and harmonized processes is the chance for a digital transformation and generic EU CCS product.

## Conclusion

The ERTMS Deal and Blueprint are the way forward to achieve affordable and efficient CCS deployment.

It is crucial to harmonise operational rules, system architecture and safety approvals at EU level.

**To become successful, it requires** High commitment, collaboration and priority from suppliers and railways.

As prerequisite it is necessary to have stepwise timeline and piloting that allows realistic deployment of mature outcomes

# Focus on ERTMS Blueprint

***System Pillar Core Group supplier representatives view on the need to consider the full Control Command and Signalling system in ERTMS implementation***

**Challenges today**

Europe suffers from fragmented, non standardised CCS solutions in two key areas

- **Operational rules and interlockings:** National railway safety philosophies, as well as operational and technical regulations are 'programmed' into interlocking systems.
- **ETCS trackside solutions:** Engineering of ETCS trackside lacks harmonisation and there is a desire to 'emulate' the national ATP (Class B) with ETCS.

**ERTMS Deal impact**

The ERTMS blueprint

- Is a tool to **overcome bespoke national solutions**
- Enables the supply industry to **achieve economies of scale**
- Must include as **pre-requisite harmonized operational rules**, accepted by Railways for their national deployment
- Shall establish a **phased roadmap** to achieve the complete Blueprint and to define its scope to primarily **support ERTMS deployment**

**Conclusion**

The ERTMS Deal and the concept of the ERTMS Blueprint and the SERA label are endorsed as it targets the right objective, namely standardisation and economies of scale for an affordable and efficient SERA.

**To become successful it requires the support of all sector stakeholders and a clear governance structure.**

Interne SNCF Réseau

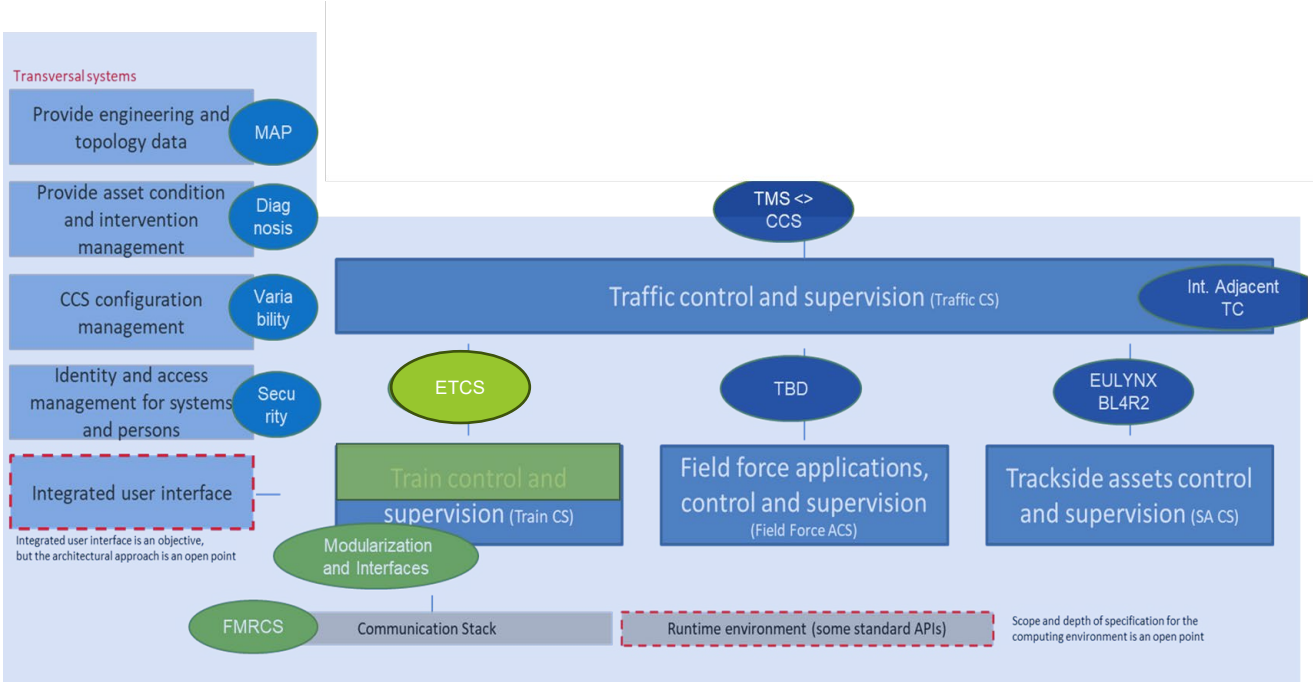
# Focus on ERTMS Blueprint

***The opportunity and current reality***

Where ERTMS is introduced as a standalone system – **ETCS only without lineside signalling - there is significant opportunity to simplify:**

- Removing interactions with existing national systems
- Reducing specific project requirements
- Streamlining requirements based on national signalling rules
- Harmonising operational implementation options

At the moment this opportunity cannot be not taken – **there is no European reference for the whole CCS system**.



# Focus on ERTMS Blueprint

## *The EU-RAIL System Pillar approach*

### ETCS only implementation

ETCS alone considered as the signalling system – this is the basis for a more complete harmonisation process.

### Whole CCS System

Address the complete CCS system, not just ETCS.

Target harmonised architecture and technical requirements based on Common Business Objectives.

### Operational Harmonisation

Link **operational harmonisation** to **system design** and **engineering rules**.

**Focus** on a restricted implementation set to **simplify the technical solution**.

### Safety Harmonisation

Link to **harmonised European Risk and Safety Rules** for national safety approval according to aligned safety acceptance criteria by NSA (and aligned with ERA).

Internal

# Focus on ERTMS Blueprint

***Full breadth and depth: the System Pillar approach***

**Full breadth**

Analysis of all CCS-related processes. Leveraging L2 experience.

- **National L2 Rulebooks**
- **Sector goals**
- **TSI**
- **Operator experience**

**Full depth**

Detailed descriptions of driver and signaller actions.

Specification of human and system interactions and behaviour.

**Harmonized Operational Processes**

Operational core derived through structured systems engineering.

**European Rulebook & Rules**

Unified European operational and engineering ules and engineering derived from

**Trackside System Architecture**

Standardized logical and physical architectures defining the entire system.

Internal

# Focus on ERTMS Blueprint

***A real business case for all actors and a route to industrialisation and reuse***

**1**

## Reduce Complexity

Support a structured process to systematically reduce the complexity of CCS deployments across Europe.

**2**

## Harmonised Products

Enable a market for more standardised products that can be deployed across multiple countries.

**3**

## Reduce Cost

Drive down deployment and lifecycle costs through shared engineering, common approvals, and economies of scale.

**Direct effects**

### Railways

- More efficient procurement
- More efficient training and recruiting
- Life cycle optimisation
- Lower depreciation

### Supplier

- Fewer products to maintain
- Larger market per product
- Fewer resource bottlenecks

Higher development capacity

Specialisation & competition

**Indirect effects**

**Automation of human effort, faster functional improvements**

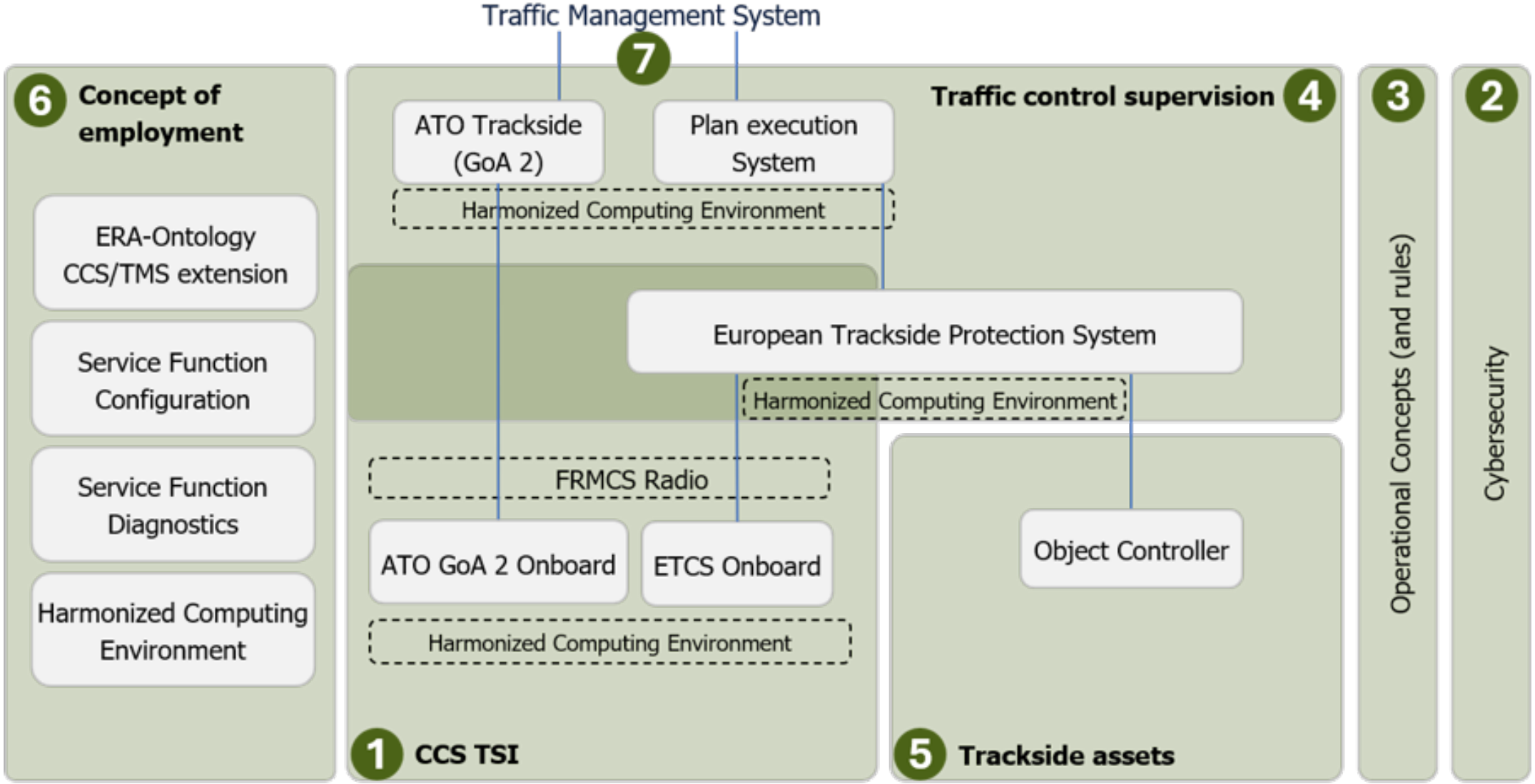
**<u>Automation of…</u>**

- Operational processes
- Installation/replacements
- Software updates
- Engineering
- Integration
- Safety & security work
- Config & infra data mgt.
- Testing / Trouble shooting

→ **Less trackside assets**
→ **Better use of capacity**

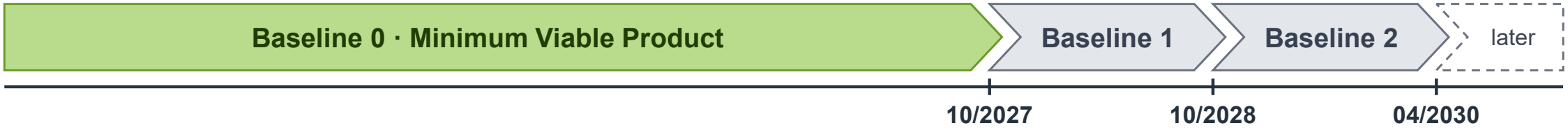
# Focus on ERTMS Blueprint

## *The elements of the ERTMS Blueprint*



# Focus on ERTMS Blueprint

## *Operational harmonization and Traffic Control System – a deeper dive*




**SC2.7 OBJECTIVE**

### Baseline 0 — the MVP

**due 31 October 2027**

**TARGET APPLICATION** Simple lines, e.g. regional branch lines

**FUNCTIONAL SCOPE**

- normal and degraded situations for usual operation on simpler lines
- trackside / on-board train detection
- centralised configuration
- working area handling (simple)
- splitting and joining of train sets

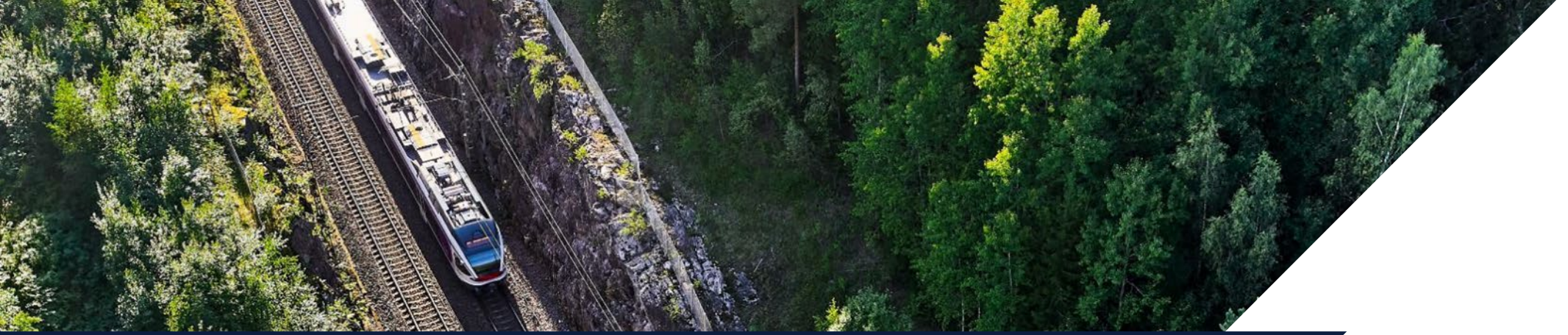
**Purpose: a pilot line with harmonised SERA application**
· key new features · return of experience
Topics not yet harmonised stay project-specific.

**Baseline 1 · due 31 October 2028**
Complete network, except complex locations
+ level crossings
+ handover inside SERA
+ transition in and out of SERA
+ entering occupied tracks with system support

**Baseline 2 · due 30 April 2030**
Complete network, incl. complex operations
+ shunting including pushed movements
+ train composition changes
+ supervised working areas
+ enhancements requiring TSI changes

**After Baseline 2, e.g.**
GoA 3/4 · driving in relative distance

Interne



# Q & A



Europe's Rail



# Coffee Break

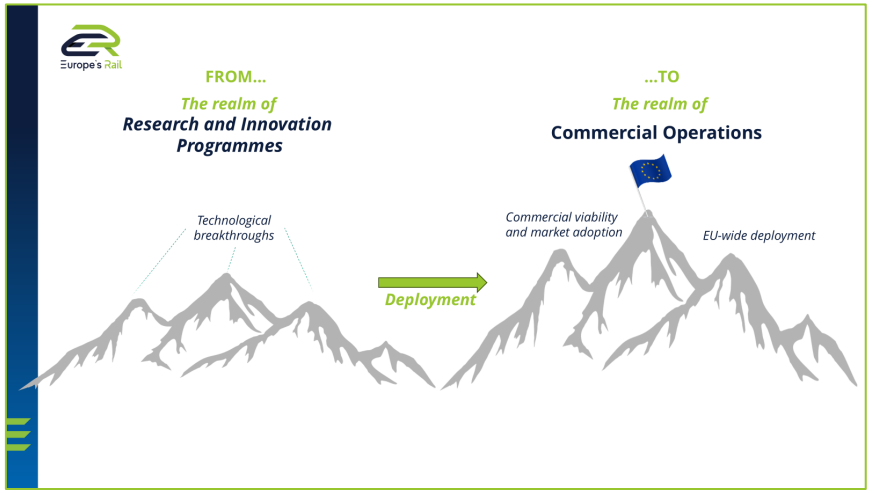
See you back at 11.10 am

*Implementation of the EU-Rail Programme*

# High-Level Deployment Group: State of Play and Year 2 Results

**Merve Demirkan Aydogan, Karel van Gils**

# Deployment Group




**Provide advice and recommendations to the sector on the best way to deploy new innovations**

**Business focus: cost efficient, simple, fast**

**From Talking to Testing to Implementing**

- Objective is to close gap between R&I/Test activities and Deployment and Migration
- Support smooth, fast and cost-effective introduction of Innovations and new architecture
- Open group, contributing to whole railway sector and industry

**Examines and provides recommendations on:**

- Scenarios and analyses for the fast rollout of innovative solutions
- Authorisation, cost-drivers, capacity and migration risks

**Today's focus on FRMCS and DAC deployment**

- ➢ Implementation programmes are and stay responsibility of RUs/IMs/lessors and Member States (inclusive financing).
- ➢ Based on broad input from development and innovation programmes, system/architecture developments, standardisation bodies, and test and demonstrator projects

Members

# High-Level Deployment Group




adif

AERRL

NEXRAIL .LEASE

ALE EUROPE

ALSTOM

axians

CAF

CER The Voice of European Railways

DB

EIM ** European Rail Infrastructure Managers

SNCF

FERROVIE DELLO STATO ITALIANE

Hitachi Rail STS

KNORR-BREMSE

Jernbane-direktoratet

ÖBB

ProRail

SIEMENS

PPP PORTUGUESE RAILWAY PLATFORM

TRAFIKVERKET

uic INTERNATIONAL UNION OF RAILWAYS

unife THE EUROPEAN RAIL INDUSTRY

voestalpine

EUROPEAN UNION AGENCY FOR RAILWAYS

Europe's Rail

BANEDANMARK *

MÁV *

ITALFERR GRUPPO FERROVIE DELLO STATO ITALIANE *

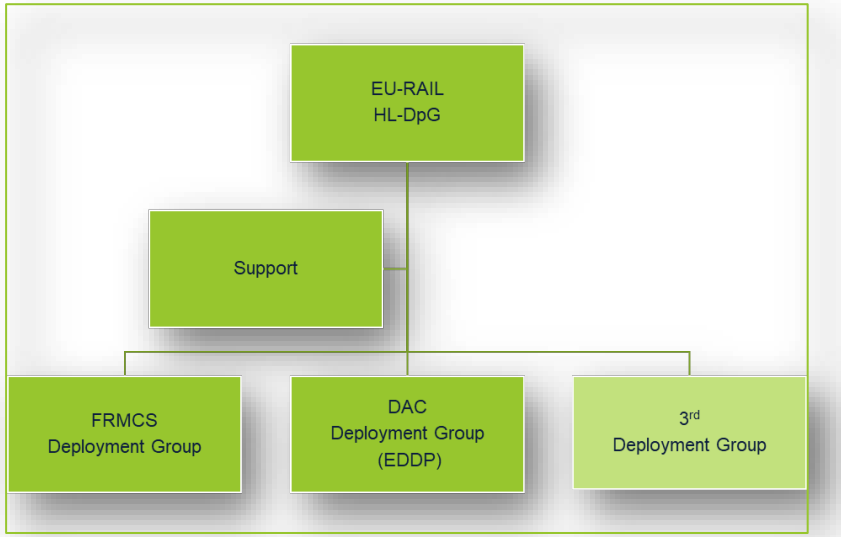
STADLER *

UIP *

* Candidate members
** Current Chair

# High-Level Deployment Group
# 2026 Developments

- ✓ Installation of new DAC Deployment Group (DpG) under the umbrella of EU-Rail's High-Level Deployment Group
- ✓ Adoption of Governing Board rule to invite non-High-Level Deployment Group members to the different working Groups
- ✓ Finalisation support DACcord for European DAC Delivery Programme per 1 April, intermediate management by EU-Rail, new DAC Deployment Programme management appointed per 1 September 2026. Remits for DAC DpG endorsed.
- ✓ Support FRMCS Deployment Group still under assessment (EU-Rail call 2025-II)
- ✓ Best practice exchange started between DAC and FRMCS Deployment activities
- ✓ 3 HL-Deployment Group meetings in 2026




Governance as from July 2026

# FRMCS DEPLOYMENT GROUP

Karel van Gils

# FRMCS Deployment Group

# Making Deployment Recommendations in a complex environment under high pressure

- GSM-R getting obsolete in the early 30's, with only best-practice support.
- New telecommunication system necessary in all digitalisation developments.

- EU-Rail System Pillar radio Report 2025 sets sector scope for 1st edition.
- UIC programme developing the specifications. Ongoing with open points to be solved in finalisation scope and towards final version V3.
- Sector stakeholder alignment meeting to follow progress and risks.
- Test programme MORANE2 to validate specifications. Other (national) tests started.

- European Telecommunication Standardisation Institute (ETSI) to deliver generic FRMCS standards.
- ERA started ERA's Extended Core Team to assess specifications before going into TSI.

- Industry UNITEL indicate risks in achieving full scope, but will deliver products after TSI. Note industry has not yet delivered aligned ETCS Baseline 4 products.
- EC is working on 'lean baseline' solution for ETCS/FRMCS interface for 'older' baselines.
- EC published ERTMS Deal towards further harmonisation, SERA label and Fastlane authorisation.

# Main focus: **Support to fulfilling preconditions for FRMCS Deployment**

Smooth, fast and affordable FRMCS Deployment is based on:

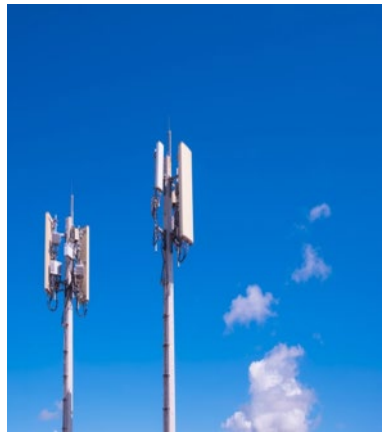
- Mature and tested stable specifications and requirements.
- Efficient fast-lane test, validate and authorisation processes.
- Early pre-deployment activities for knowledge building and preparational (FRMCS-ready) works.
- Clients (IM's, RU's, lessors) buying futureproof equipment 1st edition, full scope.
- Mature and tested products (interoperable, interchangeable and safe).
- Production facilities, workshops and staff to produce and install new equipment.
- Funding and financing.
- Sector collaboration and open transparent communication.



# EU-Rail contribution to FRMCS development and deployment

## FRMCS Deployment Group

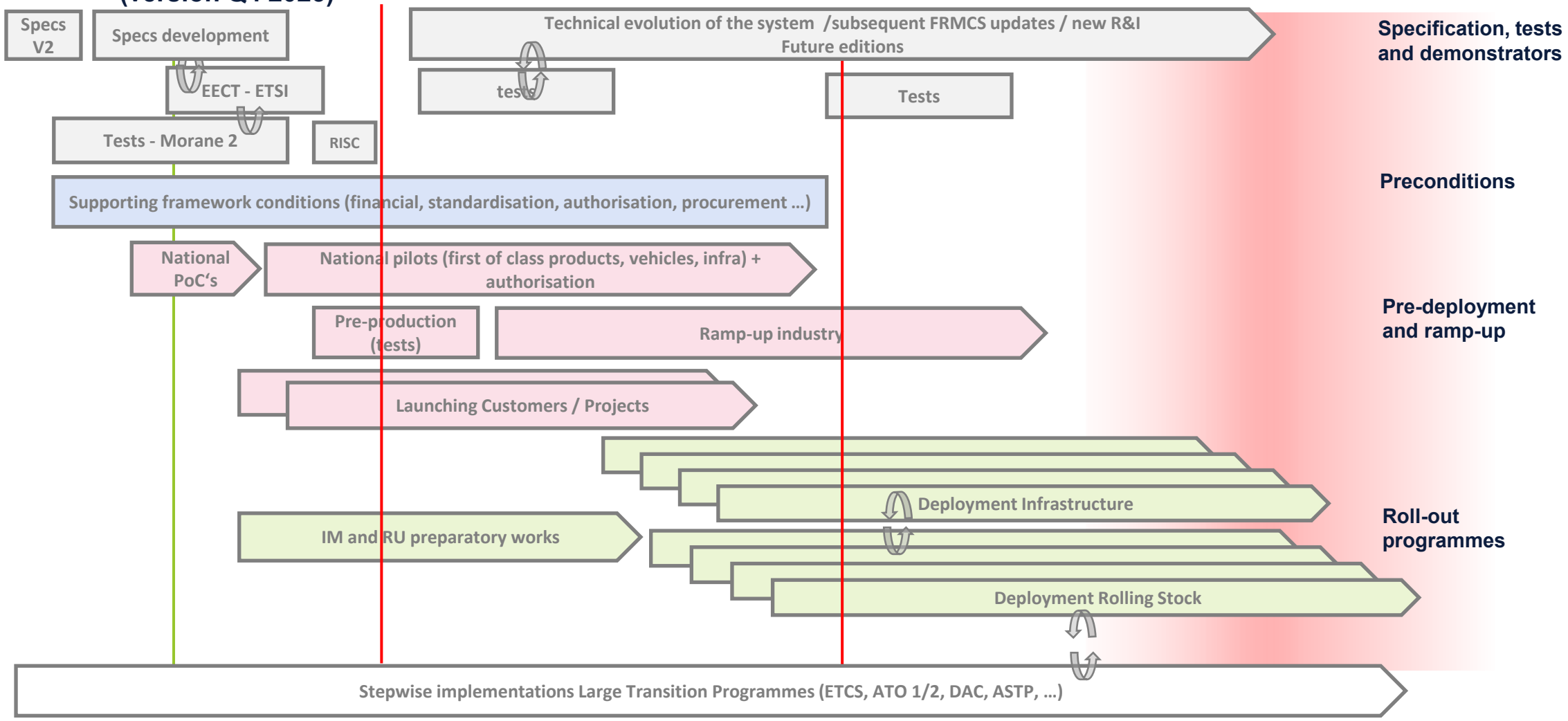
- System Pillar Steering Group adopted sector radio report on 23 October 2025
  - Report on FRMCS V2 and V3 Scope and Planning – Version 2.4
  - Support to ERA authorisation process
- MORANE2 Test Programme
  - Ongoing, based on V2.2. specs.
- Innovation Pillar R2-DATO + R2-DATO2 project
  - WP25 – connectivity analyses
- Future European R&I and Deployment initiative
  - Paper on future partnership and annexes on 4 flagship initiatives
  - More focus on pre-deployment activities and ECF funding
- Deployment Group work
  - Risk assessment (in cooperation with Stakeholder Alignment meeting)
  - Awareness and knowledge building and documents and outputs
  - See next slides



# FRMCS Deployment Group

# Master steps towards FRMCS implementation

(version Q4 2025)



# Progress in 2026
# Outputs and Documents

**Recommendation reports on:**

Deployment technology:

- Locomotive rooftop coexistence
- Draft SLA how to manage MNO's in railways
- Study on non-ETCS applications

Legal and finance:

- Recommendations for simplifying certification and authorisation
- Comparison study on Aviation and Rail processes
- Cost driver report
- Tool to calculate deployment costs

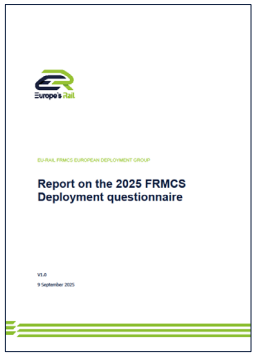



Scenarios:

- Updated migration scenario's report
- Estimation of capacities needed

Other:

- Advices to ERA regarding the  deployment of FRMCS
- FRMCS supplier perspectives, insights
- FRMCS Deployment surveys 2025 and 2026



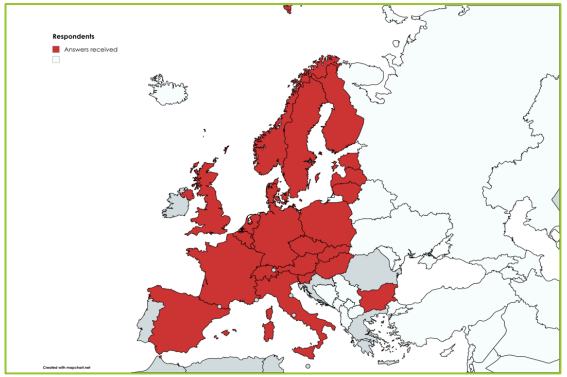
# Progress in 2026
# Status update sector knowledge (2026 survey)

Respondents from 23 countries.

Main findings :

- Very strong interest in MNO from Infrastructure Managers and industry.
- Half of the trainsets that will be equipped with FRMCS will not be equipped with ETCS during its lifetime.
- Funding is still not solved.
- Authorization is a burden. Fast authorization process is expected for Voice only trains and for error correction (including cybersecurity threats).
- Deployment industrial capacity needs to be investigated.

Full results presented in Webinar 7 October 2026 and available on website




20 Infrastructure Managers (covering 22 countries)
27 Railway Undertakings / lessors (13 countries)
8 NSA's
3 NoBo's
6 Onboard Providers
7 Trackside Providers
10 MNO's (5 countries)

# Progress in 2026
# Transversal activities

**Stakeholder management**

- Alignment with all associations, SRG, UIC, ERA and MORANE-2 programme. Increasing collaboration and transparancy
- Stakeholder Alignment Meetings

**Risk assessment**

- Overall Deployment risk matrix has been delivered, for monitoring, escalation and total overview for the sector
- The Risk matrix is now helping to build and follow-up dedicated action and mitigation plans.

**Communication and dissemination**

- 4 Webinars in 2026 (all >250 attendees),
- Dedicated webinar with ERTMS-Forum members / Member States
- Workshops on ERA-ERTMS Conference plus participating in events
- Presentations during InnoTrans 2026
- Publication of papers and newsletters on Website and Social Media



# DAC DEPLOYMENT GROUP

Mark Topal-Gökceli, Jens Engelmann

# From Vision to Reality

## Since 2022, FP5 TRANS4M-R has moved Digital Automatic Coupling from concept to operational reality



Swiss DAC testing



Austrian Demonstrator Train incl. Vectron loco equipped with Hybrid DAC

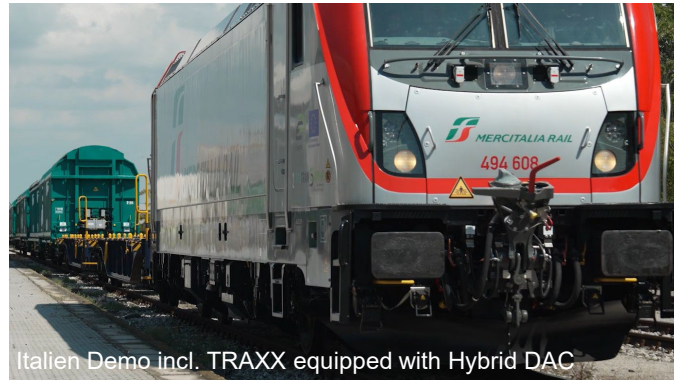


Test Train Lab DB TRAXX loco



Stadler Loco equipped with Hybrid DAC


Swedish Demonstrator Train



Italien Demo incl. TRAXX equipped with Hybrid DAC

### First real-world demo

DAC Basic Package proven under real operational conditions

### Demos in several countries

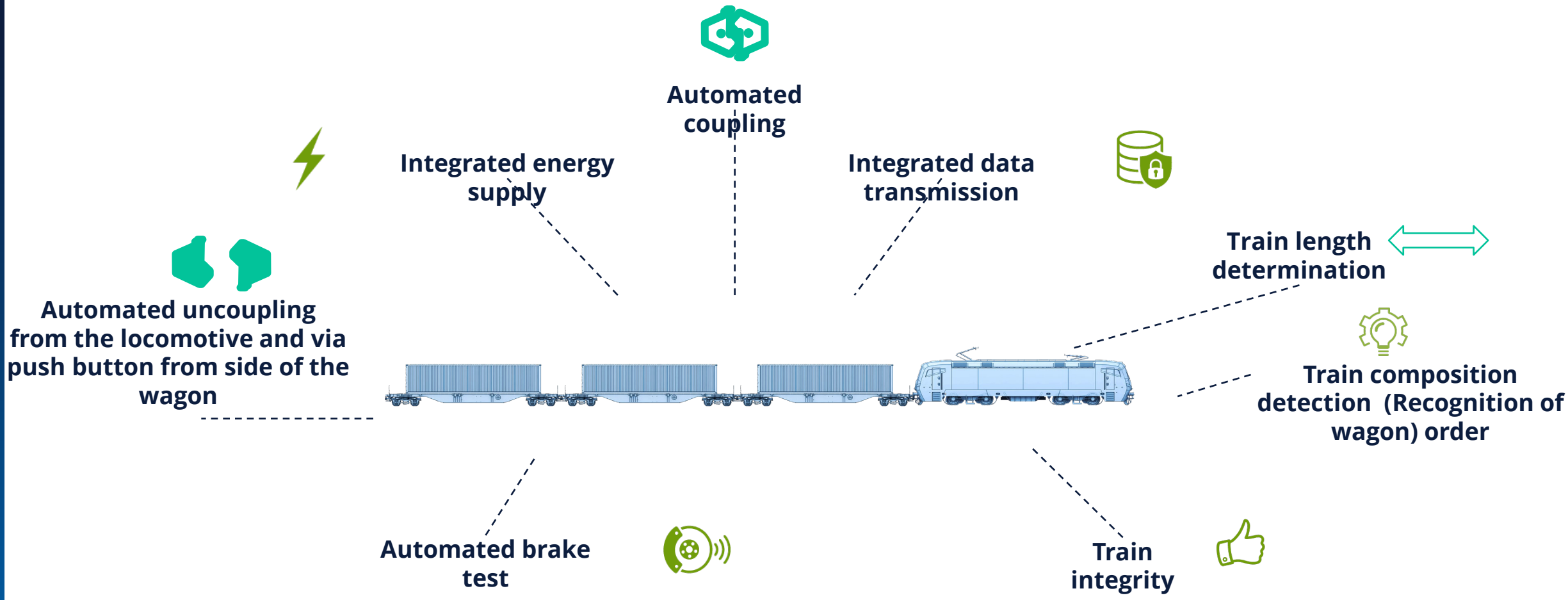
Austria · France · Germany · Italy
Norway · Sweden · Switzerland

### Next: pre-deployment

Pioneer DAC Trains · FUTURE4FREIGHT
Full Digital Freight Train

# From Vision to Reality

## DAC Basic Package – Sector agreed on a set of functions for demonstrators and pre-deployment as basis for development work



Main focus:

# Support to fulfilling preconditions for DAC deployment




Source: DACcord project

# Managing the way to deployment, driven by the DACcord project

## THE DACCORD PROJECT

- OPEN PLATFORM EDDP
- BRIDGING THE R&D DEPLOYMENT GAP
- SUPPORTIVE & COLLABO-RATIVE

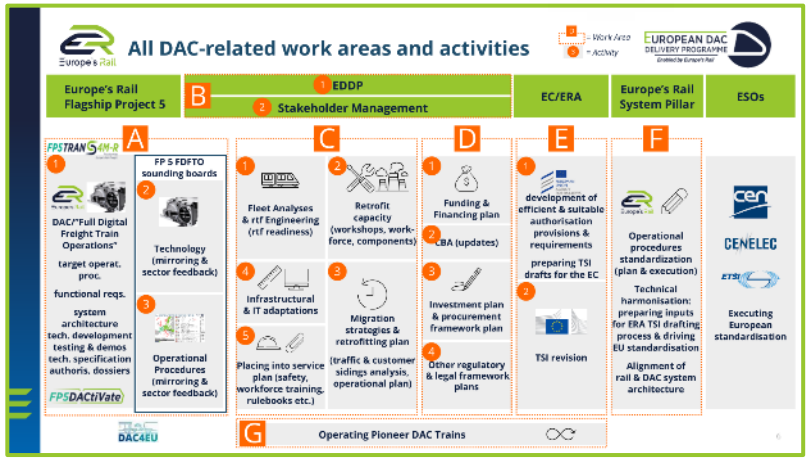
(2023-2026)

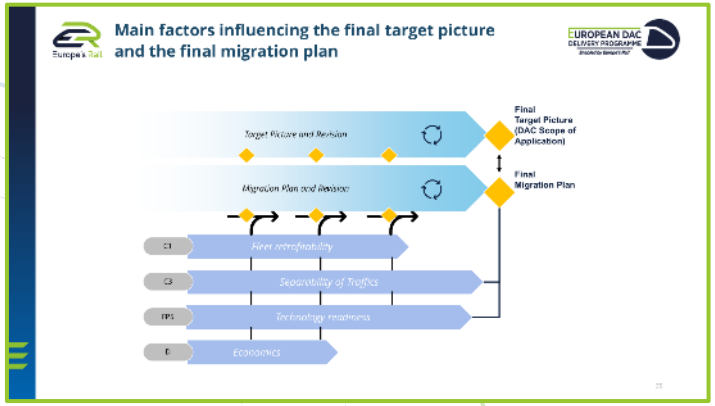
## MAIN ACHIEVEMENTS

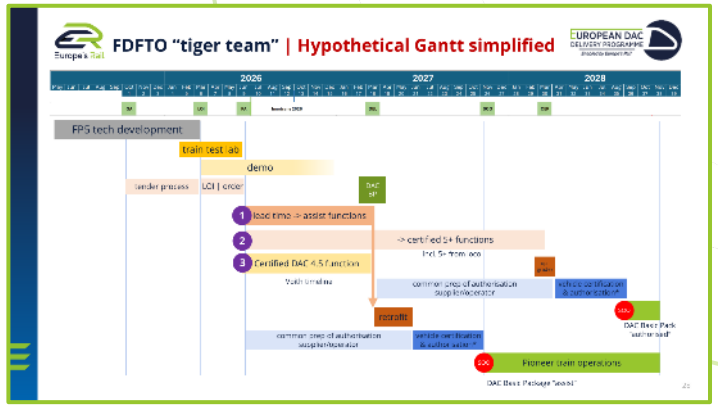
- DAC MASTER PLAN
- MULTI-ANNUAL EDDP PLANNING
- TANGIBLE INSIGHTS, E.G. COSTS, MIGRATION
- RISK MANAGEMENT
- HIGH-IMPACT VISIBILITY FOR DAC
- SUPPORTING BUDGET MOBILIZATION FOR PIONEER TRAINS

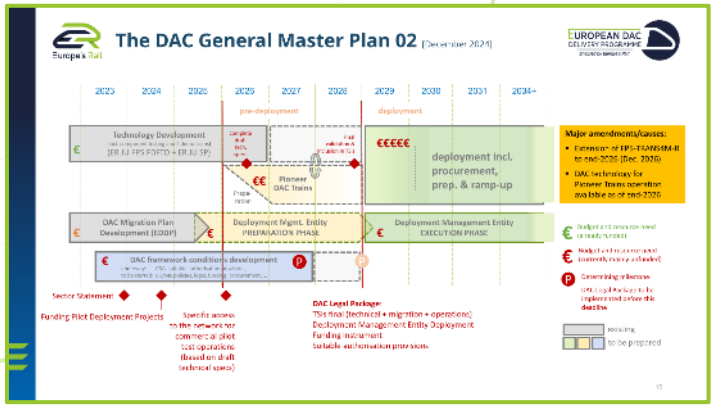
# Key DACcord artefacts



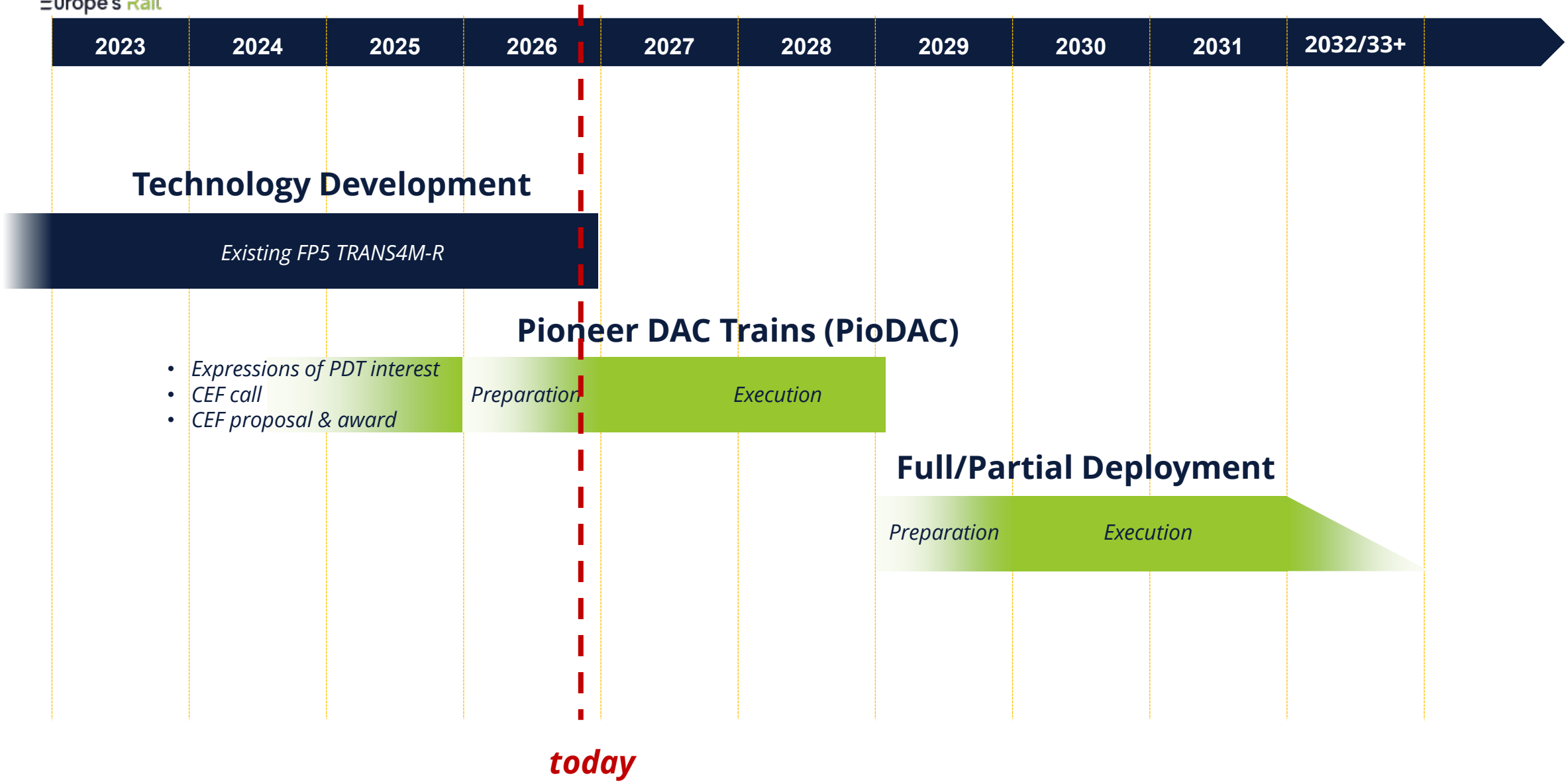



# DAC-programme in three major phases



# The DAC Deployment Group's absolute current priority is to enable the Pioneer Trains to successfully run by 2027/28

## MISSION

The PM(O) mandate until Q1/27 is to **enable a successful Pioneer Train delivery & focus on the essentials.**
The PM(O) will **identify, verify and actively address the top risks.**

## WORK PROGRAMME

**CHALLENGER ROUNDS WITH PIODAC AND CONTRIBUTORS**

**DERIVE, MAP & ADDRESS THE TOP RISKS**

Topics: **locos & integration, DAC maturity, dependencies, authorisation dossiers, cyber, etc.**



# FP5/PioDAC top overarching risks currently managed

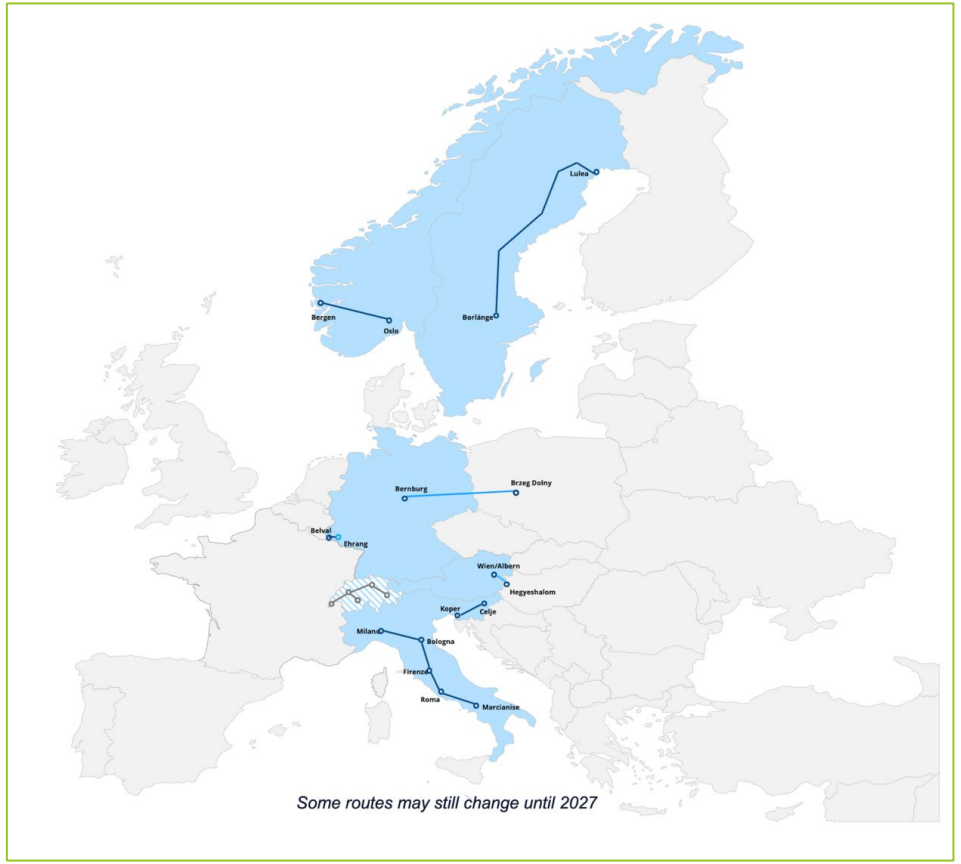
| ID | Risk | Who | Until |
|---|---|---|---|
| 1 | Air valve safety proof | PioDAC (suppliers) | 2027 |
| 2 | Safe 400V contact protection concept + earthing concept | FP5 | 08/12/2026 |
| 3 | Safety requirements (RAMSS) | FP5 | 08/12/2026 (report) |
| 4 | 1) Current Cybersecurity (RAMSS) requirements<br>2) EU CRA requirements to be complied with as from 12/2027 | PioDAC (suppliers) | "asap" |
| 5 | Interoperability between DACs of different suppliers, especially for train functions | FP5 | 03/27 |
| 6/7 | **Locomotives for PioDAC:** Transparency on technical feasibility, commercial impact on PioDAC, loco OEMs' ability for quotations, ERA guidance for authorization | PM/PMO with FP5, PioDAC, ERA, .. | 08/12/2026 |
| 8 | Adapter wagons design & authorisation | FP5 DACtiVate | (mitigated) |
| 9 | Wagons design & autorisation | FP5 ERA | (mitigated) |
| 10 | Supporting evidence for authorization (certification test results) | PioDAC suppliers FP5 | 2027 |

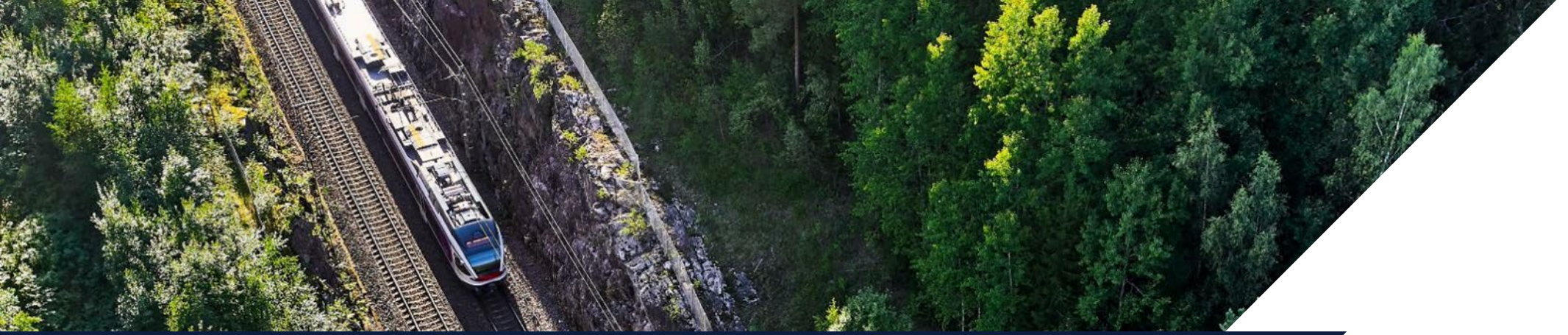
PioDAC consortium

# Basis facts and figures

- Project start: 01/11/2025
- Duration: 36 months
- 11 partners / 8 Affiliated Entities / 9 Associated Partners
- DAC in commercial operation
- 7 pioneer trains operating in 9 countries
- Cross-border traffic: LU–DE, DE–PL, AT–HU
- Various segments and characteristics
- ~250 wagons to be retrofitted plus locos

**Note:** final scope is subject to change





# Q & A



# Getting Involved in EU-Rail Activities and How to find the Information you are looking for

Europe's Rail

# Our Activities

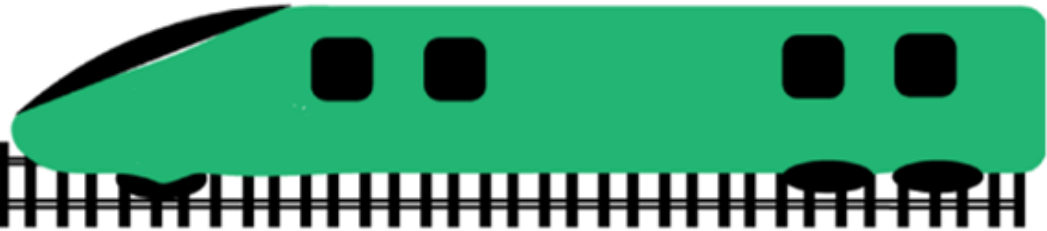


# EVENTS 2026

**Europe's Rail**

**Europe's Rail Info Day Call for Proposals 2026-01**
Online
February 9

**Rail Forum Europe: "How Can Rail Research Boost Industry Competitiveness?"**
Online
January 27



**RailTech Europe**
Utrecht, the Netherlands
March 5

**20th Rail Transport Forum**
Bratislava, Slovakia
March 17-18

**Status of FRMCS Migration Scenarios**
Online
March 18

**7th Edition of the European Startup Prize Opening Ceremony**
Lisbon, Portugal
April 14

**ERTMS Conference 2026**
Valenciennes, France
April 21-23

**ITF Summit 2026**
Leipzig, Germany
May 6-8

**Webinar "Where Are We With FRMCS In Europe?"**
Online
June 17

**Annual EPF Conference**
Maastricht, the Netherlands
June 5

**Portugal Railway Summit 2026**
Entroncamento, Portugal
May 20

**Nokia FRMCS Interest Group Conference**
Helsinki, Finland
May 18-19

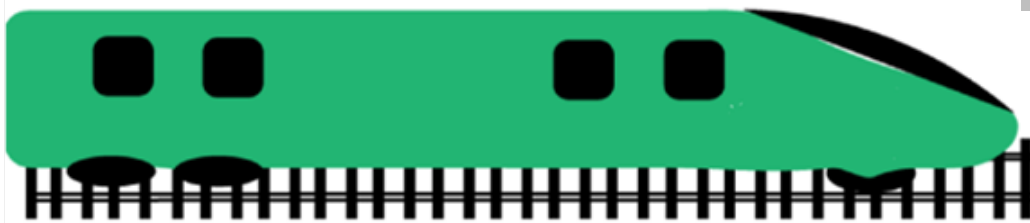
**TRA**
Budapest, Hungary
May 18-21

# EVENTS 2026

**1st EU Transport Competitiveness Summit**
Florence, Italy
July 15

**Battery and Energy Storage Tech Europe Event**
Barcelona, Spain
September 8

**35th Economic Forum**
Karpacz, Poland
September 8



**UNIFE High Level Lunch Debate**
European Parliament, Brussels
September 29

**Women in Rail Award 2026**
Berlin, Germany
September 22

**Innotrans**
Berlin, Germany
September 22-25

**IEEE Intelligent Transportation Systems Conference**
Naples, Italy
September 15

**DAC Live Demonstration**
Vienna, Austria
September 11

**CER Event – Forum Founding to Delivery**
European Parliament, Brussels
September 9

**Connecting Europe Days**
Brussels, Belgium
29 September-1 October

**Webinar "Presentation of the Results from the FRMCS Deployment Questionnaire"**
Online
October 7

**European Start-up Price**
Luxembourg
October 14

**Kontron User Group**
Strasbourg, France
July 15

**Visit to Graz University of Technology**
Graz, Austria
July 15

**R&I Days**
Brussels, Belgium
November 10-11

**EU-Rail General Assembly 2026**
Brussels & Online
November 24-25

# SPOTLIGHT: INNOTRANS 2026



## EUROPEAN TRAIN

- Around 300 passengers
- 175 arranged meetings
- 5 Sessions on board
- 2 interactive activities
- Quiz
- High-level driver cabin tours
- Arrival ceremony



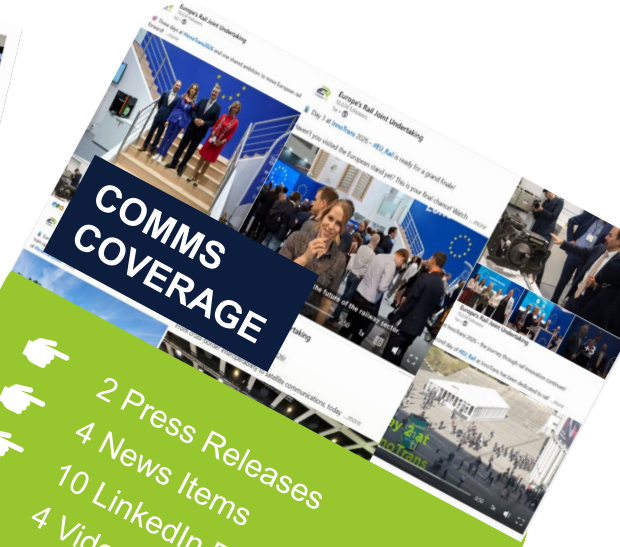
## ON STAGE

- 22 Sessions on Central Stage
- WIR Award Ceremony
- 100 Senior Executives and Experts taking part in the DAC High-level event



## DEMOS AND TOURS

- 13 Physical Demos
- 3 Info-points
- VIP Tour
- 9 Innovation Tours Reaching 60 Participants across the Booths of 18 Members



## COMMS COVERAGE

- 2 Press Releases
- 4 News Items
- 10 LinkedIn Posts
- 4 Videos

## The Example of…

https://rail-research.europa.eu/events/innotrans-2026-europes-rail-joint-undertaking-programme/



# SOCIAL MEDIA AND NEWSLETTERS

## LINKEDIN ACCOUNT

- ~250 Posts in 2026
- 19K Followers
- <4K Unique Visitors
- 898K Impressions
- Follow us!

## LINKEDIN NEWSLETTER

- NEW From March 2026
- <7,2K Subscribers
- 16,2K Article Views
- 276 Engagement
- Subscribe here!

## NEWSLETTER

- Monthly Delivery
- <4,3K Subscribers
- 60,7K Total Sends
- 38,5K Open rate
- Subscribe here!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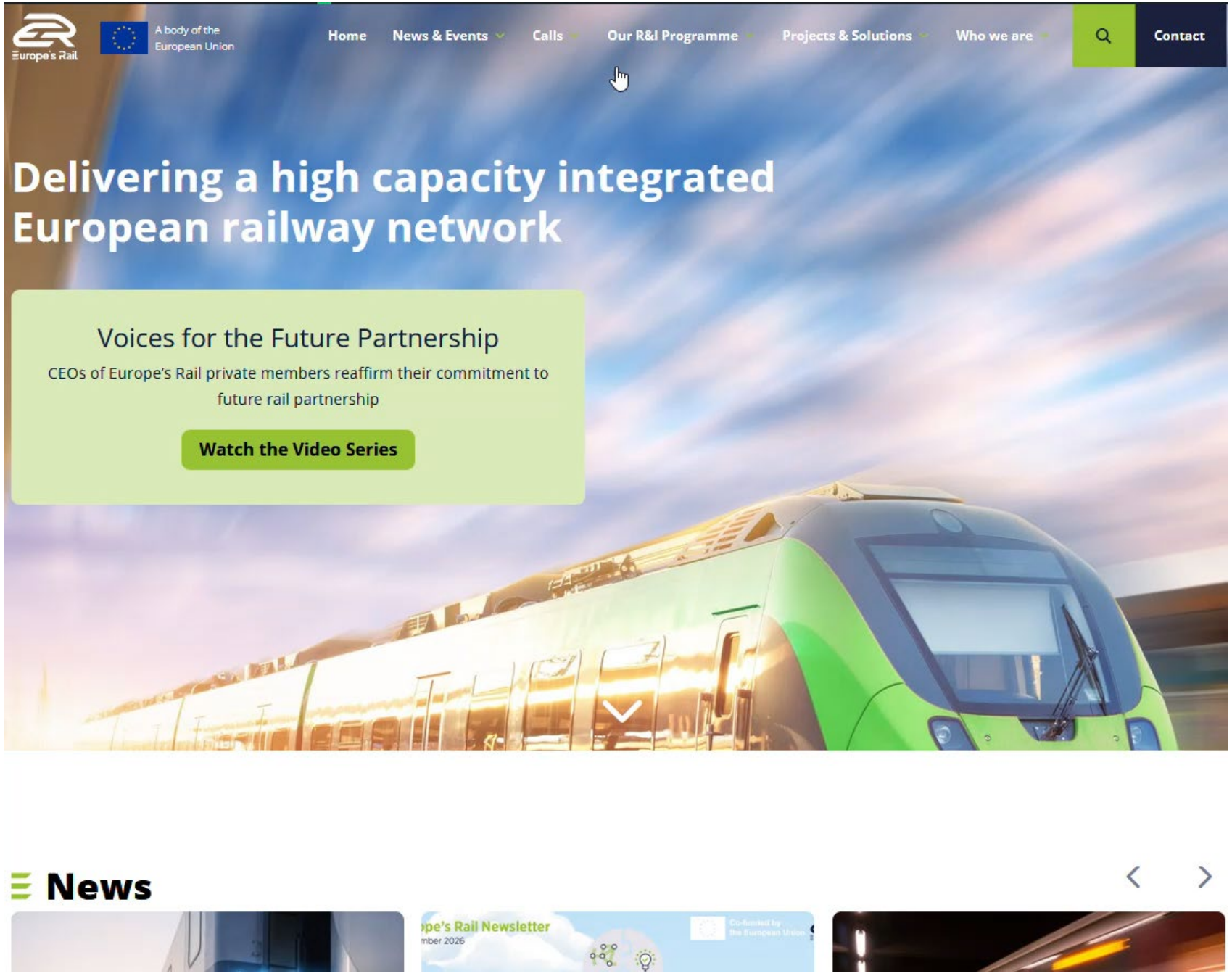
Calls for Associated Members
Calls for Tenders
Recipients of Funds
Innovation Pillar
System Pillar
Deployment Group
High-level Paper "Unlocking the Rail Success"
EU Rail Projects
Shift2Rail Projects
Interactive Catalogue of Solutions
All the Solutions
About Europe's Rail
Members
Structure and Governance
Reference Documents

Europe's Rail

NEW

# INTERACTIVE CATALOGUE OF SOLUTIONS



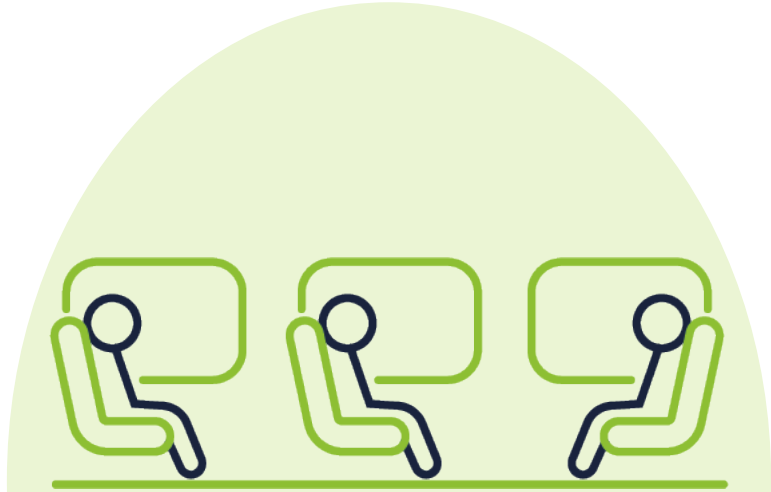
# INTERACTIVE OPPORTUNITIES



WORKSHOPS



WEBINARS



STAKEHOLDERS MEETINGS

Europe's Rail

# Calls for proposals



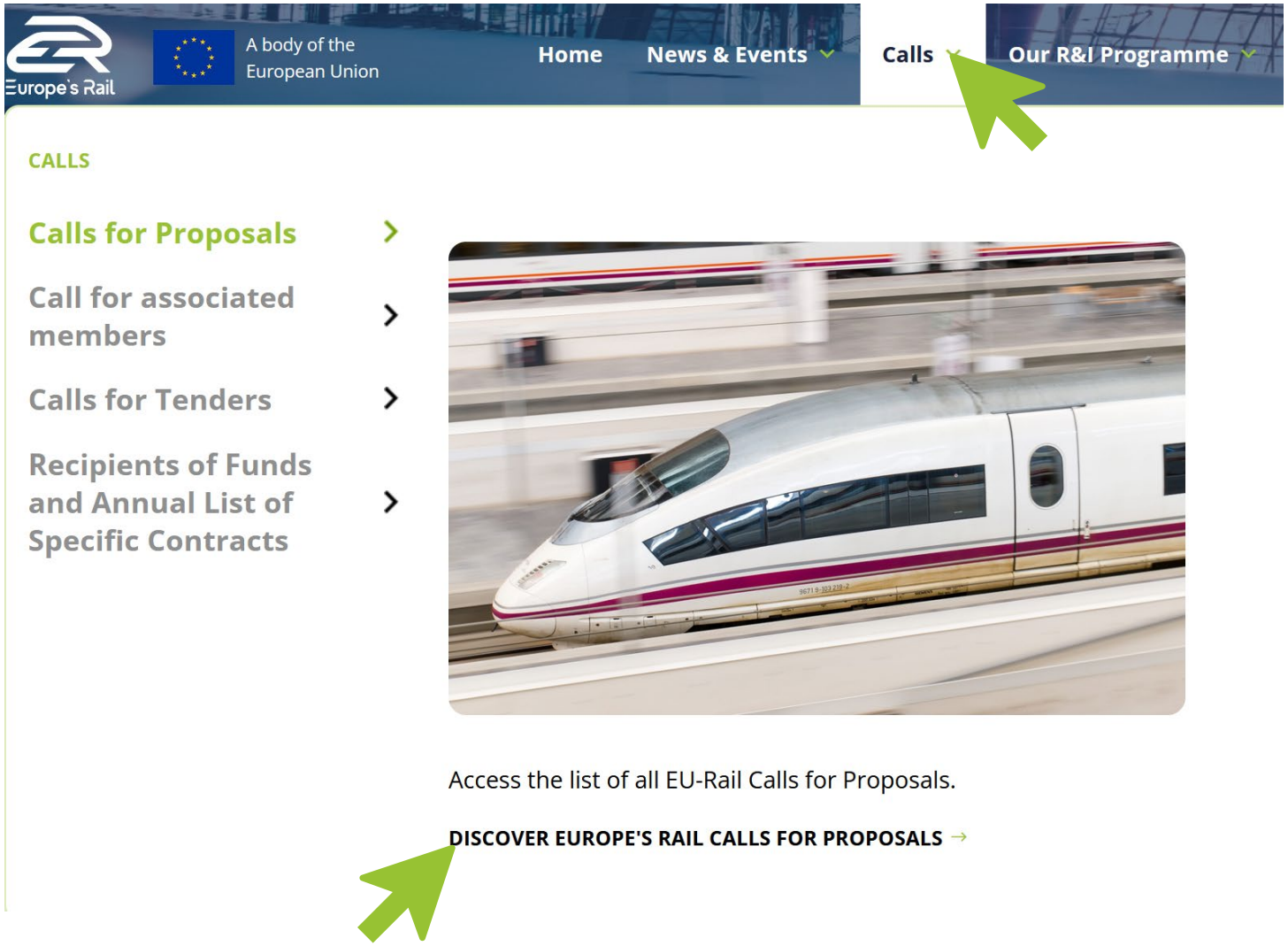
# TAKE PART IN OUR PUBLIC CALLS FOR PROPOSALS

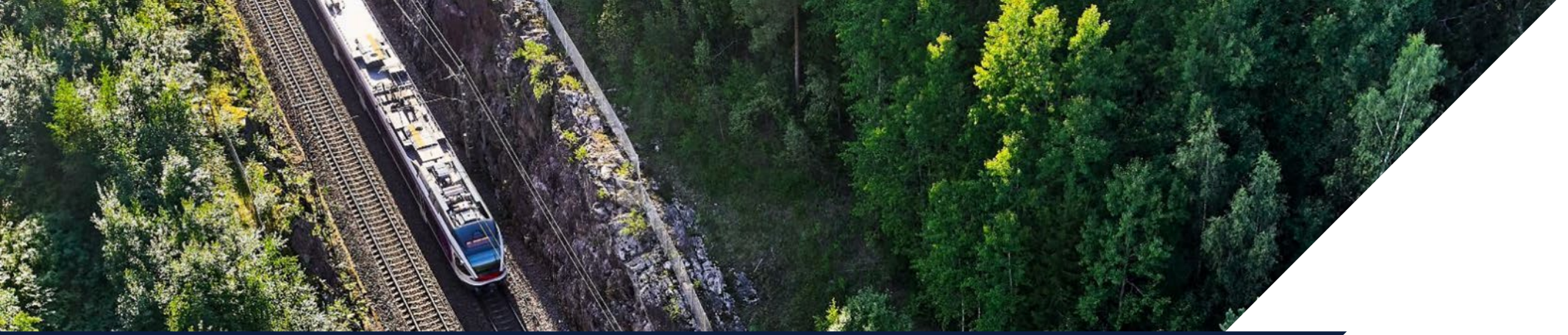
**PURPOSE:**

Encourage innovations in digitalisation and sustainability of the rail sector

**ANY QUESTION?**

info-call@rail-research.europa.eu





# Q & A



# Europe's Rail Members



acciona
adif
ALSTOM
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CAF
ceit
MEMBER OF BASQUE RESEARCH & TECHNOLOGY ALLIANCE
CD
DB
DLR
eSGR
European Smart Green Rail
Faiveley Transport
A Wabtec Company
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FREQUENTIS
FOR A SAFER WORLD
HITACHI
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Talgo
Infraestruturas de Portugal
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KNORR-BREMSE
kontron
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ÖBB
PKP
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SNCF
GROUPE
Strukton
Rail
TRAFIKVERKET
RAILWAY SYSTEMS
by voestalpine
XLAB
Slovenske železnice
VIAS

# Thank you

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