



# Introduction to Rail4EARTH

The scope of work of the four-year FP4-Rail4EARTH project, under the HORIZON-ER-JU-2022-FA4-01 call topic, is to **improve the existing sustainability performances of railways**, to build a **more attractive and resilient** mode of transport and to contribute towards the objectives of a **Climate Neutral Europe for 2050**.

The activities are covering **the Europe's Rail Flagship Project 4 "Sustainable and Green Rail Systems"** including rolling stock, infrastructure, stations and all of their related sub-systems (traction, bogies, brakes, energy storage systems, HVAC, etc.).



Funded by  
the European Union

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## **The FP4-Rail4EARTH consortium is working on solutions addressing:**

- ▶ **Energy and equivalent CO2 savings in the rail system;**
- ▶ **Circular, sustainable and resilient solutions;**
- ▶ **A healthier, safer and more attractive railway system;**
- ▶ **Alternative energy solutions for the rolling stock (transitioning from diesel trains);**
- ▶ **A holistic, flexible and controllable energy approach in rail infrastructure, stations and railways buildings, considering the whole life cycle;**
- ▶ **Improvements to the electro-mechanical components and sub-systems for the rolling stock, including airless components to move towards airless trains;**
- ▶ **The attractiveness of trains to stimulate modal shift and therefore indirectly reducing the CO2 of road transports;**
- ▶ **Digital Twin developments;**
- ▶ **Standards & Norms (EN / IEC) of railway hardware or software assets (Rolling Stock, Infrastructure, Stations and their components).**

# Project in a nutshell

The project is structured into 28 WPs under 6 different blocks, as shown in the diagram below.

- ▶ **Vertical blocks** are mainly new technical solutions developments/validations/demonstrations.
- ▶ **Horizontal blocks** are more transverse, focusing on work that needs a deeper consortium cooperation. These WPs are applicable to all “vertical” blocks. WP27 will allow WP leaders to exchange all relevant information.

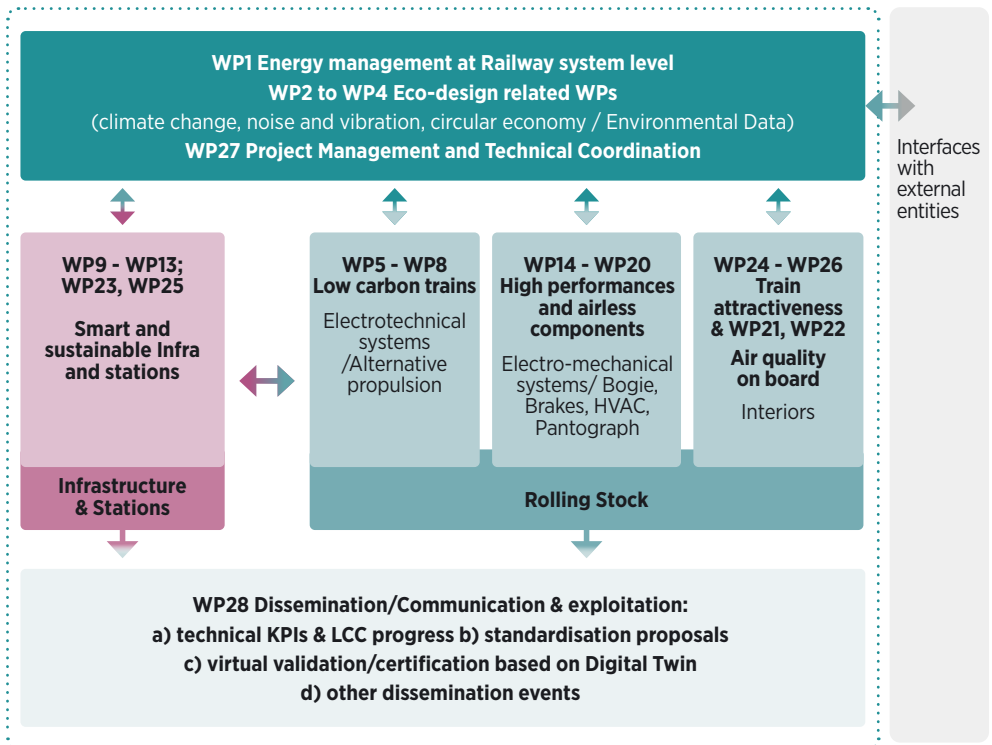


Figure 1. Schematic diagram of FP4-Rail4EARTH

**Building upon the work achieved in the Shift2Rail (S2R) Programme and other research and innovation actions, FP4-Rail4EARTH will demonstrate all the expected results through its six Sub-Projects described below, offering the necessary holistic approach:**

- ▶ **Sub-project 1: Alternative energy solutions for the rolling stock**, 6 demos
  - High performances Batteries Electric Multi-Unit (BEMU) train, TRL6/7 in 2025;
  - Hydrogen hybrid trains with test of heavy-duty inspection vehicle and loco for freight-passengers, TRL4/5 in 2025;
  - Sub-urban catenary trains with on board Energy Storage Systems (ESS) , TRL 3/5 in 2025;
  - Auto adaptive train energy consumption to various services situations.
- ▶ **Sub-project 2: Energy in rail infrastructure and stations**, 7 demos
  - H2 refueling station, TRL6 in 2025;
  - Smart low consumption electrical infrastructures (with local renewable energy sources, ground energy storages, etc.), TRL6 in 2025;
  - Smart green railway stations, TRL6 in 2025;
  - Energy hubs in railway infrastructures, TRL5 in 2025;
  - Methodologies/ guidelines for the optimal design/rehabilitation of stations including modularity and carbon footprint reduction, TRL5/6 in 2025.
- ▶ **Sub-project 3: Sustainability and resilience of the rail system**, 3 demos
  - Software tool specification on European climate variables usable for railway assets Reports, TRL5 in 2025;
  - Noise indicators, simulation tools and development of optimized components for noise and vibrations minimisation, TRL6 in 2025;
  - Software tools and indicators to promote eco-design, assess environmental performance /standardised reporting of the environmental impacts of the rail sector, TRL5 in 2025.
- ▶ **Sub-project 4: Electro-mechanical components and sub-systems for the rolling stock**, 18 demos
  - (Airless) electro-mechanical braking system, pantograph and suspensions, TRL7 in 2025;
  - Optimised (energy, weight) motors and gearboxes, TRL in 2025;
  - Replace hydrofluorocarbon refrigerants by HVAC system using green refrigerants or new cooling technologies, TRL6 in 2025;
  - Enhanced experimental and numerical methods on train aerodynamic optimization, TRL6 in 2025.
- ▶ **Sub-project 5: Healthier and safer rail system**, 2 Demos
  - Healthier HVAC – air quality improvement, contaminant (particle / aerosol) removal, reduced virus/bacteria lifetime, TRL7 in 2025.
- ▶ **Sub-project 6: Train Attractiveness (Interiors)**, 2 demos
  - Reinforce train attractiveness via on-demand comfort for users (access, lighting, thermal and acoustic comfort), TRL5/6 in 2025;
  - Reinforce the facility to adapt rolling stock interiors (like modular architecture) to support the increase of capacity of the rolling stock, targeting TRL5/6 in 2025.

# Positioning of Rail4EARTH

**The ambitions are numerous:** the decarbonisation of diesel trains (with battery trains targeting 200km of autonomy), noise (-3 to -8dB targets for specific use cases) and vibration reductions, energy & CO2 savings (up to -30% target in specific use cases), circular economy reinforcement, resource consumption reduction, resilience to climate change, pandemics and attractiveness of passenger trains. These technical & environmental ambitions are at the heart of the project and are developed whilst considering the reduction of the Life Cycle Cost (LCC) by-5-10% for specific use cases including externalities costs.

The project is identifying the precise needs of rail operators, including implicitly the European public policies of sustainable transport (Climate Neutral Europe for 2050, European Green Deal, Sustainable and Smart Mobility Strategy) and **is directly improving 3 of the environmental objectives of the Taxonomy: climate change mitigation, climate change adaptation and transition to a circular economy.**

It provides the needed scientific and technical solutions via the development and setting-up of demonstrators (**more than 30**, up to TRL7) of new solutions increasing drastically the environmental performances of the holistic railway system.

The Life Cycle Assessment (LCA) of the new solutions is done on environmental variables (including CO2).

These new solutions are proposed while verifying that they have viable economic models ensuring a rapid commercialisation for the benefit of European citizens. Beyond the fact that FP4-Rail4EARTH will provide even more sustainable solutions, the project will also strengthen the competitiveness of the European railway industry.

The consortium is also very open to related and complementary discussions and/or synergies via regular and official exchanges with other EU-RAIL Flagship Areas (FAs), the System Pillar (SP) and other European R&D initiative and projects (Clean H2 JU, Batt4EU, Build4People, New European Bauhaus, EuroSpecs, etc). More precisely, this project is directly exchanging with FA1 and FA2, mainly on energy management via traffic regulation interfaces with trains/ DAS/C-DAS and with FA3 mainly on Digital Twins used for predictive maintenance purposes. Other potential synergies are also discussed with FA5 which focuses on Green Rail Services and FA6 targeting regional innovative services to revitalise capillary lines.

Moreover, specific consortium Working Groups are envisaged, to extend the discussions to other suitable entities and stakeholders. For example, the power semi-conductors European WG on reliability and lifetime prediction -implemented under S2R with the European Centre for Power Electronic- will be continued in FP4-Rail4EARTH under WP5 and WP6 specific tasks.

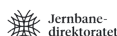
# Rail4EARTH consortium

The consortium is composed of the 23 beneficiaries listed below which, together with their affiliated entities, brings the total to 71 partners across Europe.

Coordinator

**ALSTOM**

Other partners



SIEMENS



## Facts and Figures

Starting Date: 01/12/2022

Grant Agreement n° 101101917

Coordinator: ALSTOM TRANSPORT S.A.

DURATION

48

Months

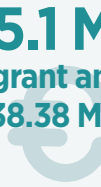


TOTAL PROJECT COST

95.1 M€

Max grant amount

38.38 M€



PARTNERS

71



## Contact

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