ISTITUTO ITALIANO DI NAVIGAZIONE
ITALIAN INSTITUTE OF NAVIGATION
EUGIN

THE STATE OF RAIL TRANSPORT IN EUROPE AND ITALY: SOME RECOMMENDATIONS

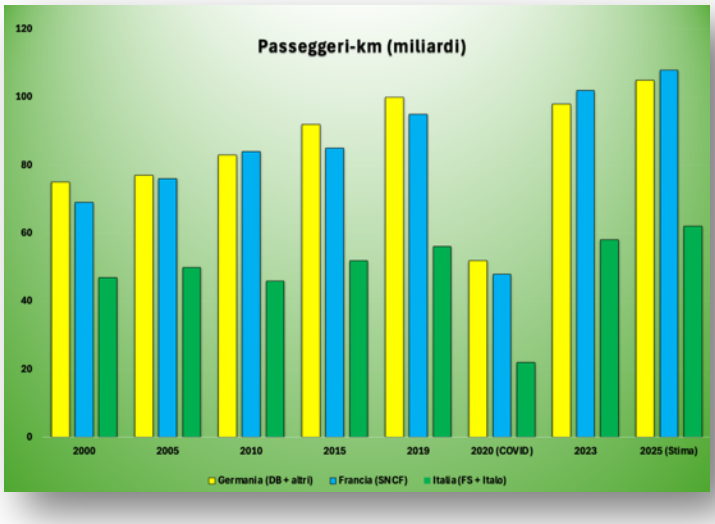
While Europe consolidates its position as a leader in safety and passenger transport, comparison with global giants highlights the need to continue investing in freight infrastructure and digital innovation. Trains are confirmed not only as the transport mode of the future for the ecological transition, but also as a strategic pillar for global connectivity, with increasingly high safety margins thanks to automation and the rigorous standards of the European Union. — Gustavo Scotti di Uccio[1]

Rail transport is undergoing a phase of profound transformation at a global level. While Europe is focusing on sustainability and network integration, other global powers such as China, India, and the United States are following different development models, sometimes prioritizing high-speed rail and at other times large-scale freight transport. Based on recent Eurostat data, we have conducted an analysis of the current scenario.

Rail Transport in Europe: Towards New Records

According to the latest Eurostat data, passenger rail transport in the European Union reached a new all-time high in 2024, with approximately 443 billion passenger-kilometers, marking a 5.8% increase compared to the previous year. Countries such as Germany and France continue to be the main drivers of this traffic volume.

However, the freight sector shows mixed signals: while intermodality (road-rail) has steadily increased over the past twenty years (rising from 45.8% in 2004 to nearly 60% in 2024), the total volume of goods transported by rail has experienced a slight decline due to the slowdown in industrial economic activity. Nevertheless, the EU's objective remains ambitious: to double rail freight traffic by 2050 in order to reduce CO_2 emissions.



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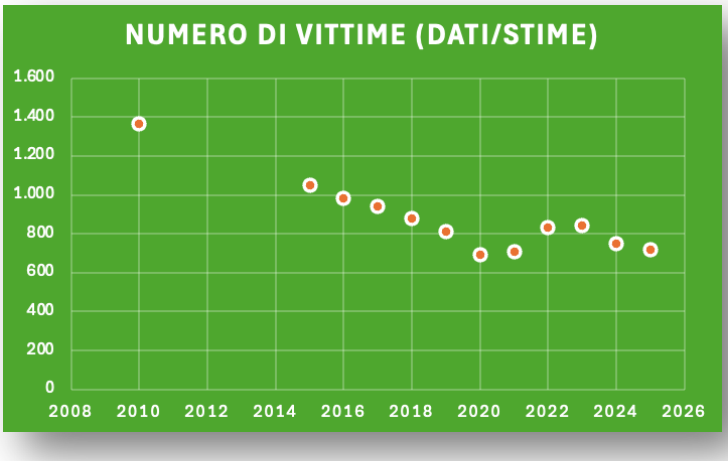
Models Compared

- **China**: The undisputed leader in high-speed rail (HSR). With a network exceeding 45,000 km, China has built the largest HSR infrastructure in the world in just over a decade, far surpassing the entire European network combined. Here, trains have replaced airplanes on many domestic routes, becoming the backbone of mass mobility.
- **USA**: The scenario is the opposite of China. The United States has one of the most efficient and profitable freight rail networks in the world, but passenger transport remains limited to a few corridors (such as the Northeast Corridor). Railways are primarily seen as a means of transporting containers and raw materials over vast distances.
- **India**: With one of the densest rail networks on the planet, India is investing heavily in modernization. The focus is on full electrification of the network (nearly completed) and the introduction of semi-high-speed trains (Vande Bharat) to improve safety and travel times for millions of daily commuters.
- **Australia**: Here, rail transport is dominated by the mining sector. Heavy, kilometer-long trains (often automated) carry iron ore and coal to ports, representing an example of extreme logistical efficiency in desert and sparsely populated environments.

The Growth of Railway Safety

Safety remains a hallmark of the European rail system, confirming it as one of the safest modes of transport overall.

- **Decline in accidents**: After a two-year period of slight increase following the pandemic, Eurostat data for 2024 show a significant drop: fatalities from railway accidents in the EU fell to 750, a decrease of about 11% compared to 2023.



- **Main causes**: Despite technological progress, most accidents are not due to structural issues or train collisions (which are extremely rare), but to external factors. **About 65% of fatalities** involve unauthorized persons on the tracks, while 25% occur at level crossings.
- **Technology and prevention**: Europe is investing in the implementation of **ETCS (European Train Control System)**, an advanced signaling system that reduces human error. Although adoption is still uneven (Italy is among the leading countries in safety despite technological challenges), the long-term trend shows a 45% reduction in fatal accidents compared to 2010.

The Situation in Italy

Italy confirms itself as a European "laboratory" for technological innovation applied to safety (ERTMS). The challenge for the next decade will be to extend the high standards of high-speed rail to southern networks and secondary lines, reducing internal disparities and strengthening the country's role as a natural logistics hub between the Mediterranean and the rest of Europe.

Focus on Infrastructure, NRRP, and Safety

Italy currently holds a prominent position in the European rail landscape, characterized by a dualism between established excellence in high-speed rail and the need to modernize regional networks and freight transport.

Improvement Projects and Investments

Thanks to **NRRP (National Recovery and Resilience Plan)** funds, Italy is implementing the largest railway investment plan in recent decades. Key measures include:

- **HS/HC High-Speed / High-Capacity Network** Completion of strategic corridors such as Milan–Venice, the Third Giovi Pass (linking Genoa to Milan and Northern Europe), and Naples–Bari, aimed at drastically reducing travel times between the Tyrrhenian and Adriatic coasts.
- **Strengthening Urban Nodes**: Major interventions in Rome, Milan, Florence, and Palermo to separate long-distance and regional traffic, reducing commuter delays.
- **ERTMS (European Rail Traffic Management System)**: Italy is at the forefront in deploying this digital signaling technology, which will replace old national systems. The goal is to cover the entire network by 2036, increasing track capacity and, above all, eliminating human error.
- **Elimination of Level Crossings**: A systematic plan to remove road-rail intersections, which, as noted, are responsible for a significant share of accidents.

Comparison with Major European Countries

Compared to France, Germany, and Spain, Italy shows both strengths and areas for improvement:

- **Safety**: Italy boasts one of the highest safety rates in Europe. While Germany handles much higher traffic volumes but with a more fragmented network prone to structural delays, Italy has implemented train control systems (SCMT) across almost the entire network, surpassing many EU partners in coverage.
- **High-Speed Rail**: While France (TGV) and Spain (AVE) have more extensive HSR networks in absolute kilometers, Italy stands out for its competitive model between operators (Trenitalia and Italo), which has led to improved services and reduced prices—unique in Europe.
- **Electrification**: Italy has one of the highest shares of electrified lines in Europe (around 70%), above the EU average and significantly higher than France (around 55–60%), directly contributing to reduced greenhouse gas emissions.
- **Freight Transport**: This remains a weaker area. Compared to Germany, where rail freight is an economic pillar, Italy still suffers from infrastructure limitations in ports and Alpine tunnels—obstacles that NRRP projects aim to overcome in order to align with Central and Northern European standards.

Can Recommendations Be Made?

In light of Eurostat data and comparison with global powers, the Ministry of Infrastructure and Transport (MIT) faces a crossroads: consolidate technological leadership or resolve long-standing bottlenecks. Below are some strategic recommendations, divided by areas of intervention, to transform Italy's land transport system.

Priority on "Last-Mile" Intermodality

Italy's main limitation is not long-distance travel (high-speed rail works well), but the connection between stations/ports and final destinations.

Reduce dependence on private cars for commuters, which today represent the largest share of emissions and traffic

The efficiency of a journey is measured not by train speed, but by how easily the final destination (home or office) can be reached. Currently, the "last-mile gap" pushes millions of Italians to choose private cars.

- **Physical Integration**: Transform railway stations into mobility hubs—not just tracks, but interchange points with secure bike racks, EV charging stations, and automated park-and-ride facilities.
- **Schedule Synchronization**: Use optimization algorithms to ensure regional buses do not depart minutes before train arrivals—a chronic issue in many provinces.
- **Digitalization**: Implement tap-to-go technology (payment via bank card or smartphone) across all surface transport, eliminating paper ticket barriers.

A. Recommendation: Fund the creation of intermodal hubs in medium and small stations, promoting electric car-sharing, protected cycling infrastructure, and perfect scheduling coordination between regional buses and trains.

Acceleration of Freight Traffic (Rail Incentives and EU Standards)

While Germany dominates freight, Italy struggles with outdated infrastructure that limits train length.

Implement a single digital platform for logistics management that connects ports, inland terminals, and the railway network in real time.

To shift freight from road to rail, rail must become competitive in cost and time. Italy's network was largely designed for passengers and is often incompatible with modern heavy freight trains.

- **Performance Upgrades**: Adapt tracks to the European 750-meter standard. Longer trains carry more containers with the same staff and energy consumption, reducing cost per ton.
- **Loading Gauge (P400)**: Upgrade tunnels to allow road semi-trailers to be transported on rail wagons. Without this, trucks arriving from ports or Northern Europe must continue by highway.
- **Port Connectivity**: Remove bottlenecks in ports (such as Genoa, Trieste, and Gioia Tauro) by extending rail tracks directly to docks, avoiding multiple container transfers.

B. Recommendation: Upgrade tracks to European standards of 750-meter-long freight trains and increase tunnel clearance to allow the transport of road semi-trailers by rail ("rolling highway")

Predictive Maintenance and Active Safety

Italy excels in safety, but regional road and rail infrastructure is aging.

"Predictive" maintenance (repairing before failures occur thanks to sensor data) costs 30% less than emergency maintenance and ensures service continuity, which is currently lacking on many regional lines.

Traditional maintenance models are either reactive ("fix when broken") or time-based ("fix every set number of months"), both inefficient and costly.

- Widespread Sensors (IoT): Install vibration, temperature, and acoustic sensors on switches and viaducts. Real-time data allows anomalies to be detected weeks before failure.
- Diagnostic Trains: Expand fleets such as RFI's "Diamante," laboratory trains that scan tracks at 300 km/h, measuring wear with millimeter precision.
- Service Reliability: With predictive maintenance, work can be scheduled at night or during low-traffic windows, eliminating sudden disruptions that frustrate passengers.

: C. Recommendation: Invest heavily in IoT (Internet of Things) sensors on bridges, viaducts, and railway switches.

Digitalization of Local Public Transport

Citizens want simplicity

In many European countries (such as Austria and Switzerland), a single national ticket exists. Italy's transport system is fragmented among hundreds of local operators (ATAC, ATM, ANM, Trenitalia, Italo, private buses). For users, buying multiple tickets for a short journey is a major deterrent.

- **Unified Interoperability Platform**: The Ministry should enforce a common technological standard allowing different apps to communicate.
- **Dynamic Pricing and "Best Fare"**: An advanced MaaS system would automatically calculate the most convenient fare at the end of the day or month, regardless of the transport modes used.
- **Practical Example**: A resident in a Lombardy province should be able to use a single QR code on their phone to take a local bus, a train to Milan, the metro, and even a shared e-scooter, with one consolidated charge at the end of the journey.

D. Recommendation: Promote MaaS (Mobility as a Service) on a national scale—one single app to plan and pay, with a single click, for a journey that includes train, urban bus, and electric scooter in any Italian city