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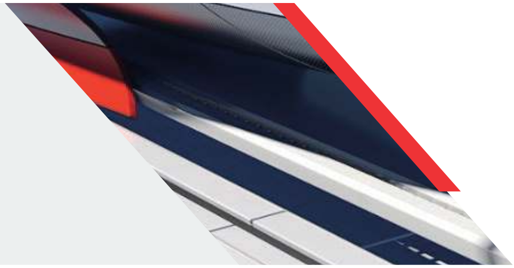
LEONARDO

HYPER TRANSFER

Feasibility Assessment
Key Topics

THE PROJECT
HYPER TRANSFER



OBJECTIVES:

Design, develop, build, and test a
high-speed transportation system utilizing magnetic levitation with low energy consumption, laying the foundation for an innovative, sustainable, and commercially competitive mode of transport.

TOOLS:

The Innovation Partnership
as a mechanism to unite the **public sector** (Ministry of Infrastructure and Transport, Veneto Region, CAV) with industry leaders (Webuild – Leonardo) through a collaborative model.

EXPECTED OUTCOMES:

Feasibility Assessment completed.
The evaluation outcome **is positive**.

Future Phases:
Design and construction of a Test Track (Pilot Section)
capable of **transporting passengers and goods**, demonstrating the scalability of the technology to national and international routes.

ORGANIZATION OF THE FEASIBILITY ASSESSMENT

COLLABORATIVE AND CROSS-DISCIPLINARY APPROACH BETWEEN

Project Governance:

- PPMO Group Program and Project Management Office of CAV and the University of Padua
- System Integrator: Italferr and Italcertifer

Technical Committee

Hyperbuilders Consortium

- Consortium Members: **Webuild, Leonardo**
- Appointed Designers: Rina, HyperloopTT
- Key Companies Specialized in Technologies: Thyssenkrupp, Prose, WayAssauto
- Universities: **Politecnico of Milano, Politecnico of Torino, Politecnico of Bari**

THE DEVELOPMENT ACTIVITIES HAVE BEEN ORGANIZED INTO

- 8 **Technical Groups** focused on vehicles, infrastructure, system integration, certification and approval, and stations
- **4 Management Group**s engaged in economic analysis, multidisciplinary coordination, and intellectual property
- **Weekly meetings** with progressively shared results during project meetings and workshops with the CAV PPMO Group

- **50,000** engineering hours
- **60 FTEs** (Full-Time Equivalents) employed
- **Over 5,000** pages of documentation produced
- **More than 1,000** hours of conference calls
- Work conducted across **8 different countries** involving **20 nationalities**

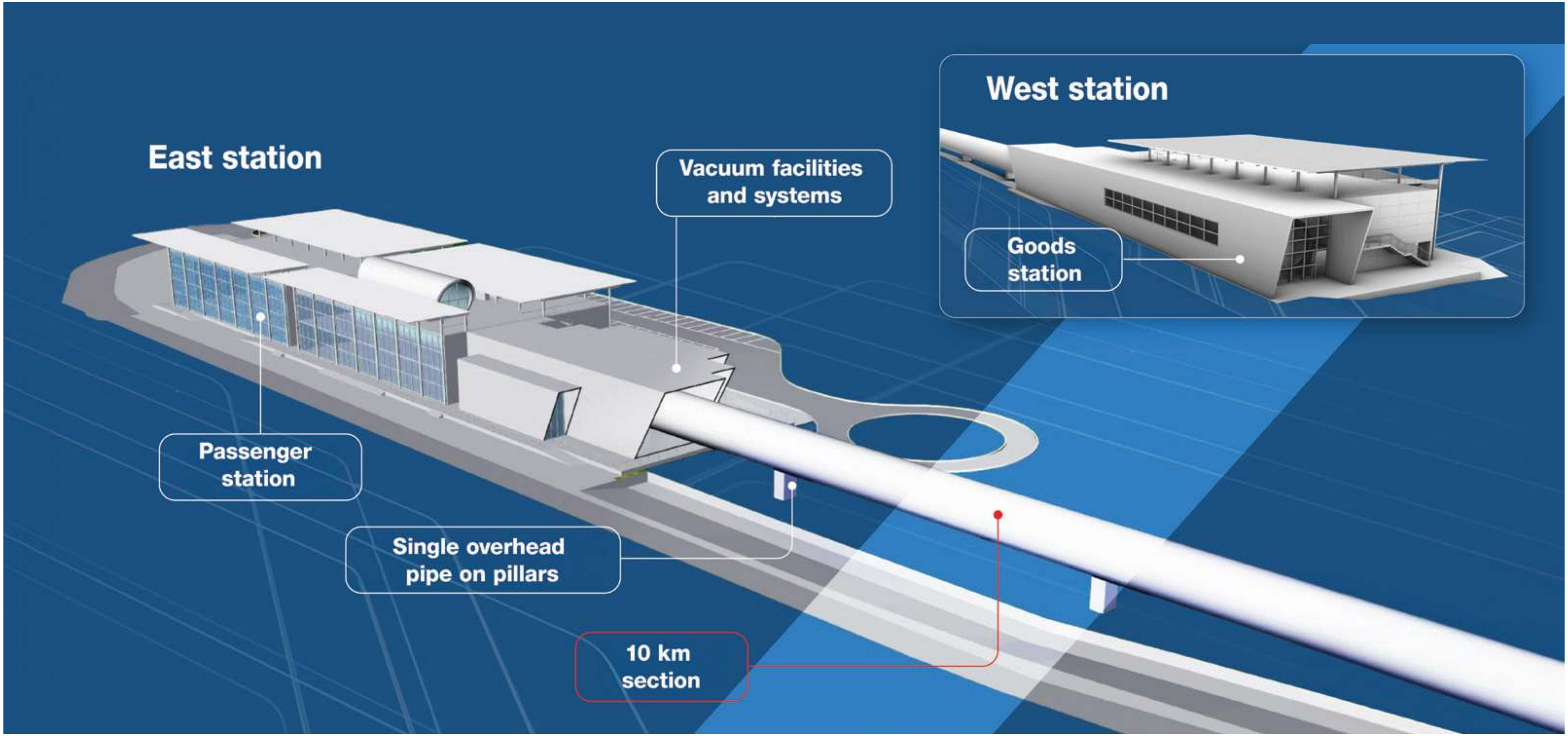
GUIDING CRITERIA FOR THE FEASIBILITY ASSESSMENT

The approach used in **selecting and integrating** the Test Track **systems** and capsule has been to choose, as much as possible, existing commercial **technologies or those already tested or designed**, and in any case available on the market without proprietary permits or licenses.

FUNDAMENTAL REQUIREMENTS:

1. A list of the **system's fundamental requirements** has been defined, serving as input for the entire study by establishing the design foundations and basic parameters.
2. **Focus** has been placed **on the main technical components and functional elements**.
3. An initial **scalability of the system** has been assessed based on the characteristics of the Test Track.
4. The internal systems of the capsules and their integration methods have been defined.
5. The maturity levels of the current technical-functional components have been analyzed.

SYSTEM
OVERVIEW



GENERAL CHARACTERISTICS AND MAIN KEY PARAMETERS

General Characteristics

- **Maximum speed > 600 km/h** (target of 630 km/h)
- **Single system** for both passenger and express express transport
- Sustainable, **zero-emission** transport with **high energy efficiency**, utilizing renewable energy and integration into the local environment
- **Fully autonomous driving**
- Test track designed to define the necessary technologies to achieve target speeds
- To become a center of excellence for developing, functionally verifying, and testing technologies
- In the medium term, to organize the center of excellence to test all improvements on traditional high-speed lines.

Main Key Parameters

Approximately **10 km route elevated on pillars**

- **Single tube with bidirectional circulation**, fully equipped and fitted with special instrumentation for system validation
- Initial tube pressure at 50 Pascals, to be confirmed based on energy trade-offs related to cooling and aerodynamics during design
- **Capsules carrying 38 passengers or 12 tons of freight, with speeds up to 630 km/h**
- Emergency evacuation openings
- **Gate valves for isolating tube sections in stations and in case of emergency.**

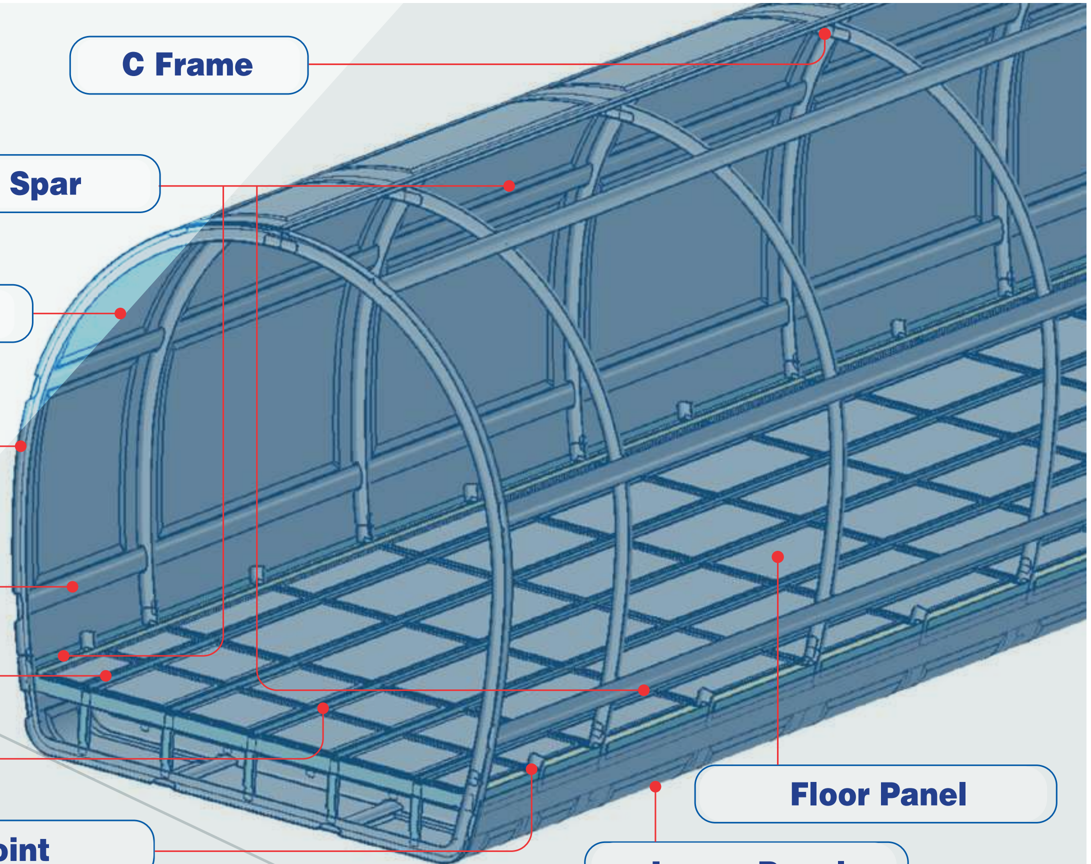
SPEED

To be validated on the Test Track for future commercial use for both **passengers and freight.**

TEST TRACK	COMMERCIAL ROUTE
630 Km/h	1000 Km/h

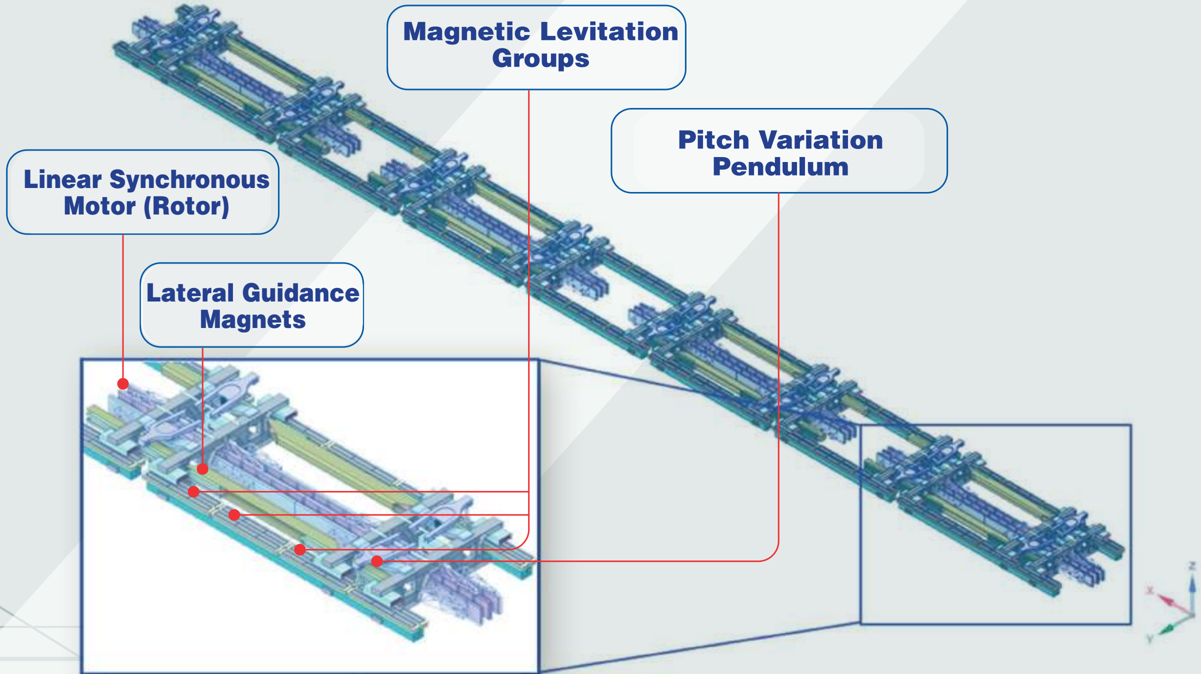
HIGHLIGHTS OF KEY COMPONENTS

Capsule Structure
Preliminary Model

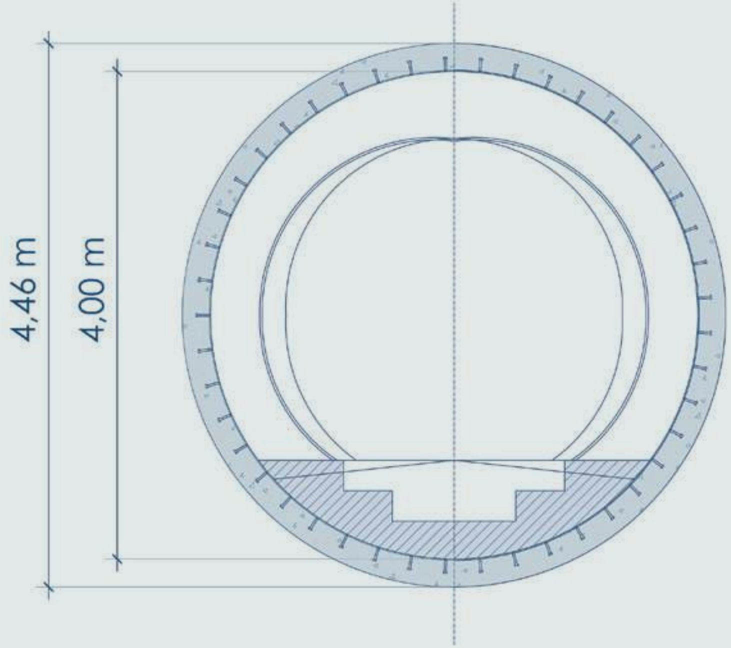


HIGHLIGHTS OF
KEY COMPONENTS

Carriage
Preliminary Model

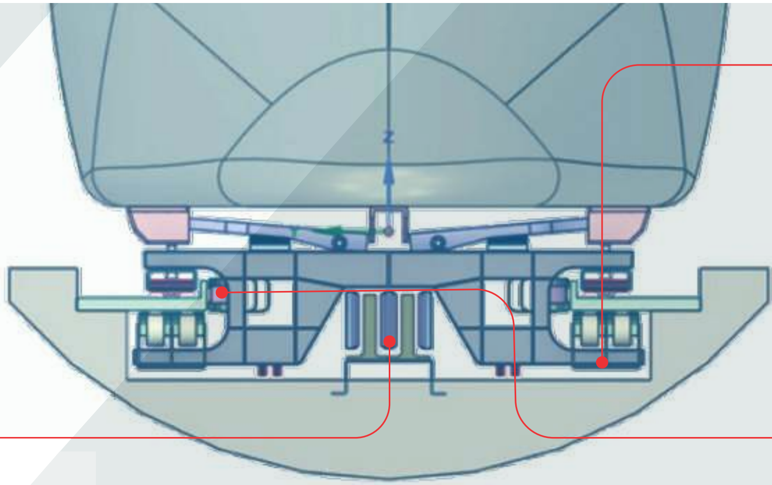


Tube
Preliminary Model



PROPULSION, LEVITATION, AND GUIDANCE SYSTEMS

These three systems are integral to both the capsule and the infrastructure and are connected via the Bogie/Track interface.



LEVITATION

A MagLev system uses magnetic fields to levitate the vehicle via forces generated by passive magnets and active electronic control.

PROPULSION

The propulsion system of Hyper Transfer is electrically powered and designed to accelerate and decelerate each capsule to its design speed along a specific route and it must generate sufficient force to overcome aerodynamic or magnetic resistance during acceleration.

The chosen technology is the Aircore Linear Synchronous Motor, which employs a row of Linear Synchronous Motors and two rows of permanent magnets on the bogies, providing cost and track control advantages. This solution is also recommended by ThyssenKrupp (designer of the MagLev Transrapid, operational in China).

LATERAL GUIDANCE

Lateral guidance has been achieved through electromagnetic repulsion relative to the guide rail.

PROPULSION, LEVITATION, AND GUIDANCE SYSTEMS

The pumping system is a modular system integrating proven technologies and solutions into a containerized unit, ensuring high maintainability and reliability.

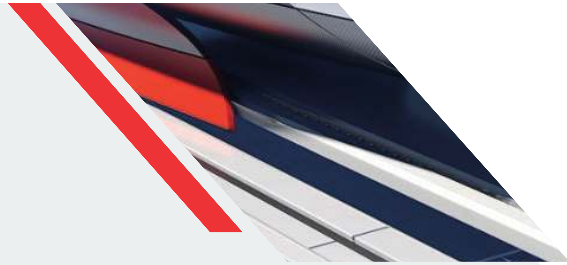
Its functionality and performance have been demonstrated through full-scale single-system tests.

The functionality of the pumping sequences remains to be validated on a long-range Test Track in the presence of capsules traveling inside the tube.

Prototype
Gate Valves


Prototype
Vacuum System

SAFETY AND CERTIFICATION ASSESSMENTS

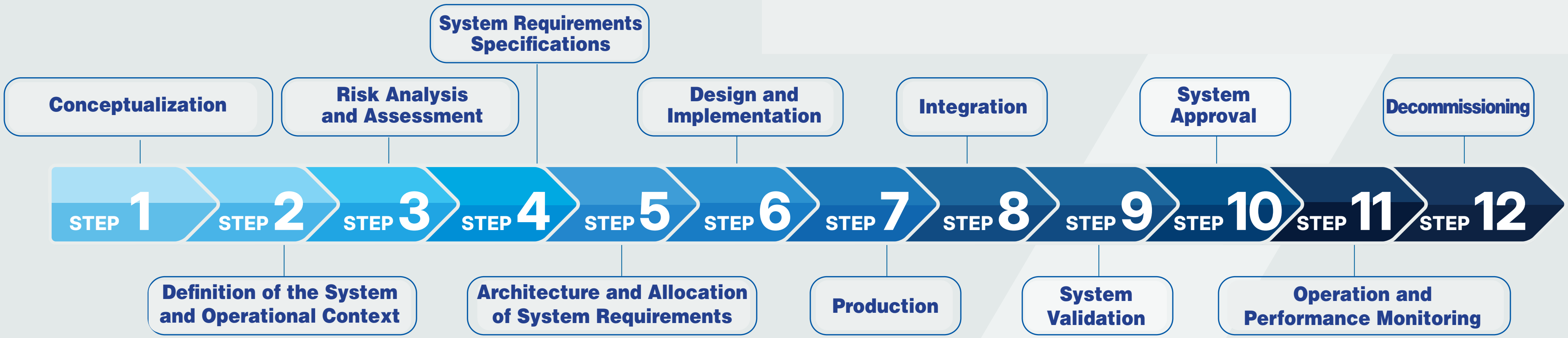


During the feasibility assessment, a System Safety Management Plan has been prepared, and a hazard register was defined, along with safety analyses and dedicated workshops focused on:

- propulsion, levitation, and guidance systems
- collapse mechanisms
- vacuum section closure mechanisms

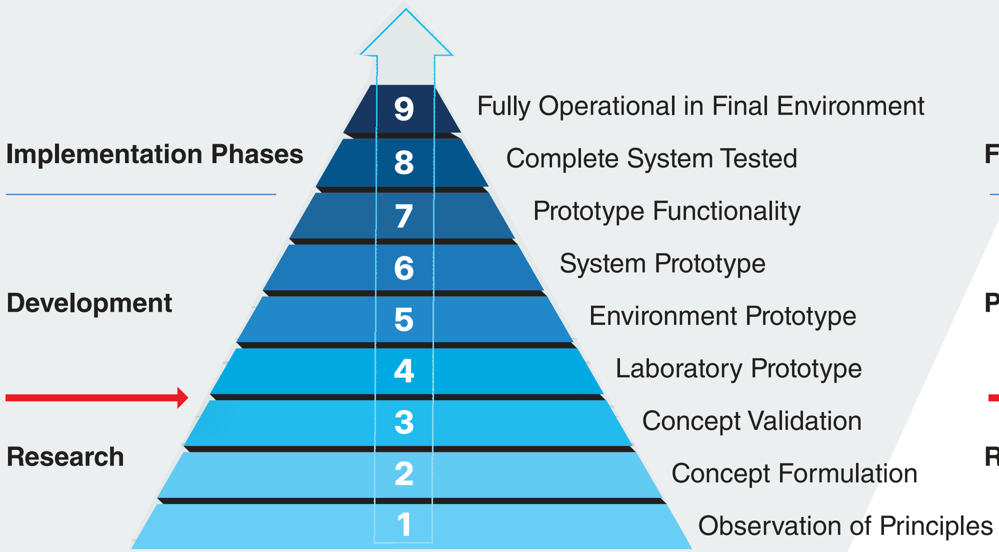
A preliminary list of risks applicable to the Hyper Transfer Project was defined, identifying potential threats to the **safety of passengers, personnel, and third parties** (e.g., capsule derailment, detachment from the carriage, main brake malfunction, etc.).

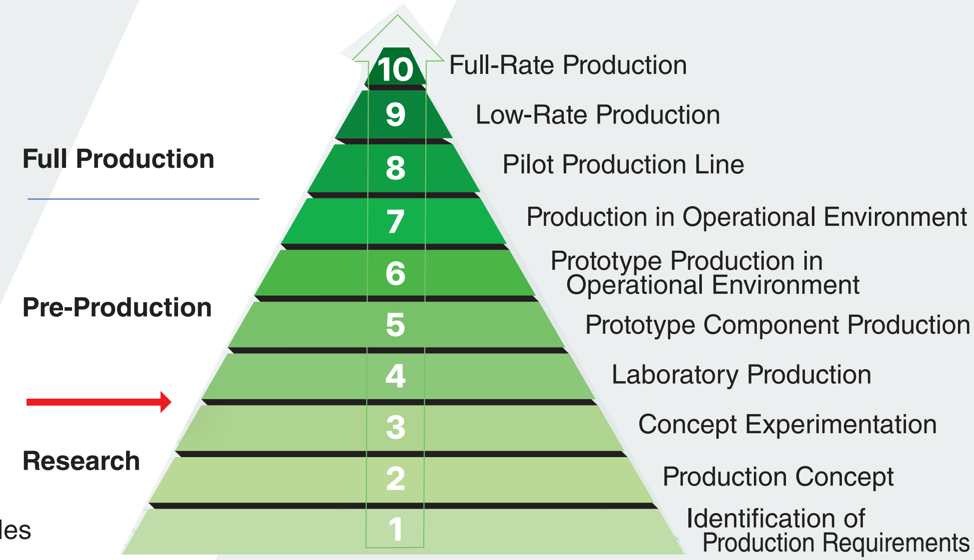
Regarding system certification, a list of **systems requiring certification and approval** was established along with a technical requirements matrix. An initial set of **relevant regulatory standards** for the systems was identified, and a preliminary proposal for the certification/approval process was presented.



TRL AND MRL
LEVELS

Both standards are derived from NASA's methodologies:





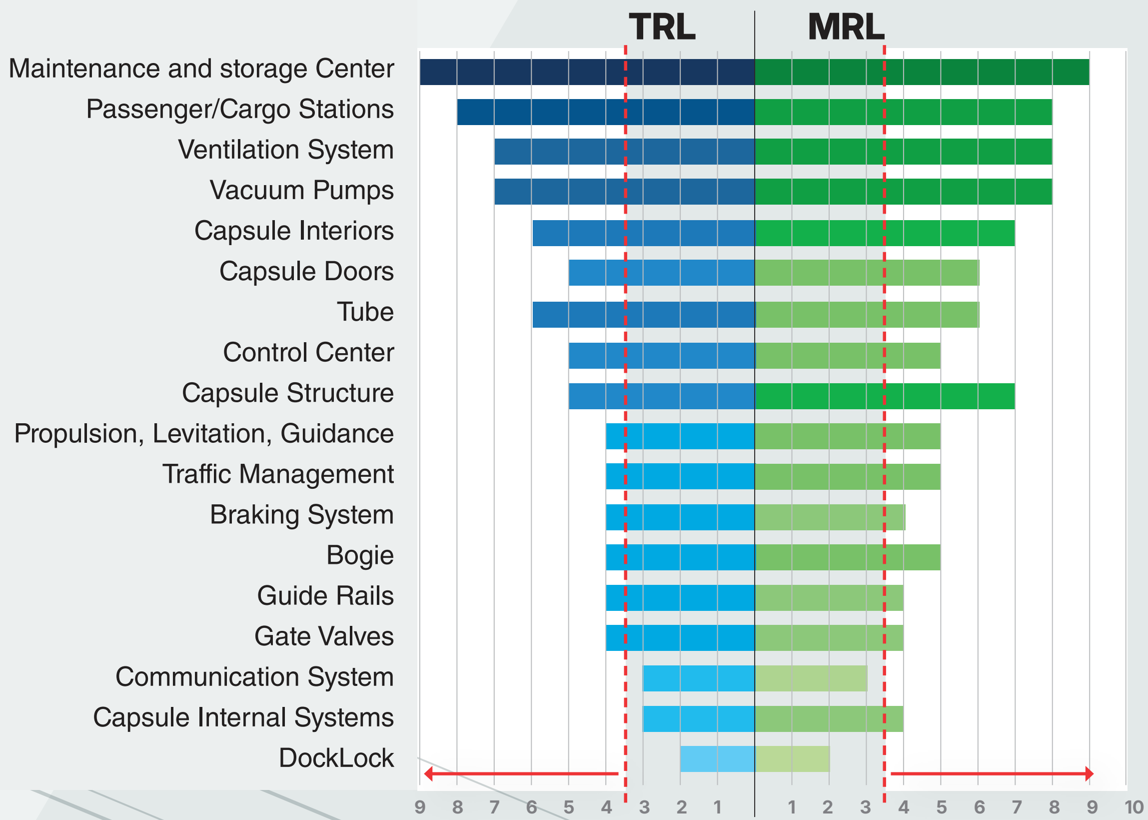
TRL Scale (Technology Readiness Level) is a scale ranges **from 1 to** 9, indicating a product's or process's **technological maturity**, from concept (1) to market readiness and initial production (9).

MRL Scale (Manufacturing Readiness Level) is a scale ranges **from 1 to 10,** assessing a **product/system's readiness for large-scale production.** MRLs are used in technology development, product design, and acquisition programs to determine manufacturing maturity and associated risks.

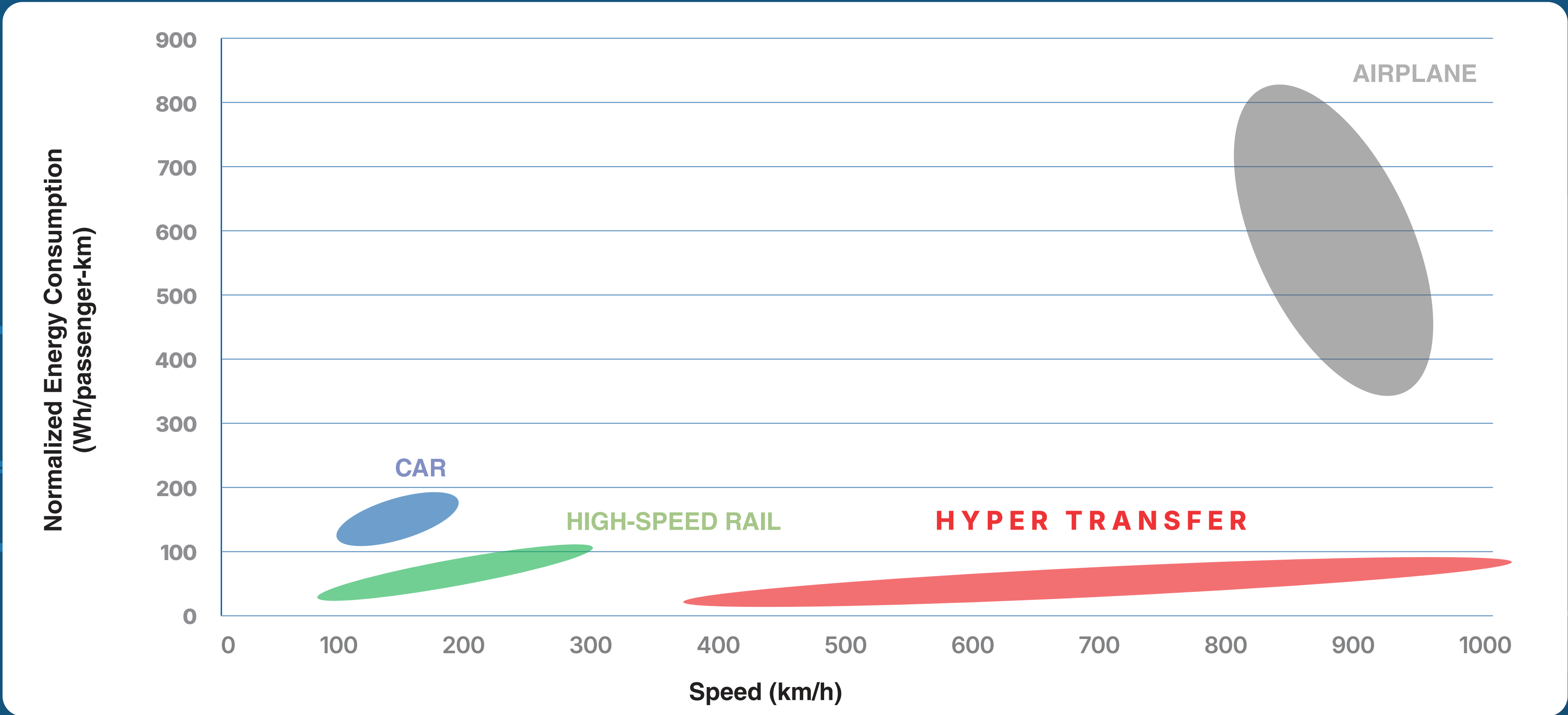
HYPER TRANSFER:
TRL AND MRL LEVELS

The key technological challenges for Hyper Transfer:

- Ultra-high speed in a vacuum
- Thermal management
- Closed capsule environment management
- Continuous data transmission requirements



ESTIMATION OF CONSUMPTION



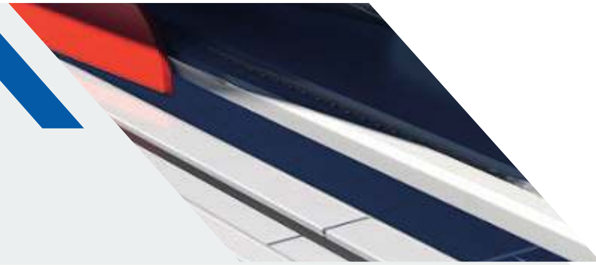
Preliminary energy model based on a hypothetical 250 km route, currently being validated during the design phase (70% confidence level).

TRANSPORT STUDY AND INITIAL ECONOMIC ASSESSMENTS

The study **compared a commercial Hyper Transfer system**, for long-distance routes with defined technical specifications derived from the Test Track, **with current transport systems** (high-speed/high-capacity trains, cars, planes).

Analyses were conducted on **four hypothetical commercial route lengths (150, 300, 500, and 700 km)**, considering Italian-specific factors (station/airport access times, waiting times, airport locations) **and calculating travel times for city center, suburban, or rural origin-destination.**

TRANSPORTATION EVALUATION RESULTS



150 km

Cars remain the most competitive mode of transport on 150 km distance. However, **Hyper Transfer demonstrates lower generalized costs** for solo travelers during peak traffic hours, when car travel times are affected by congestion.

300 km

High-Speed Rail (HSR) is the most competitive om 300 km distance. **Hyper Transfer's generalized cost is comparable to HSR** for origin-destination pairs with demand exceeding 4 million passengers per year and **lower than air travel**.

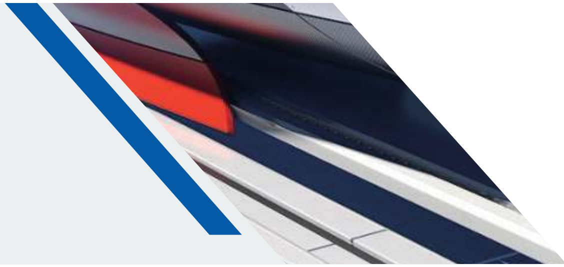
500 km

Hyper Transfer emerges as the most competitive mode of transport for origin-destination pairs with a demand exceeding 4–5 million passengers per year.

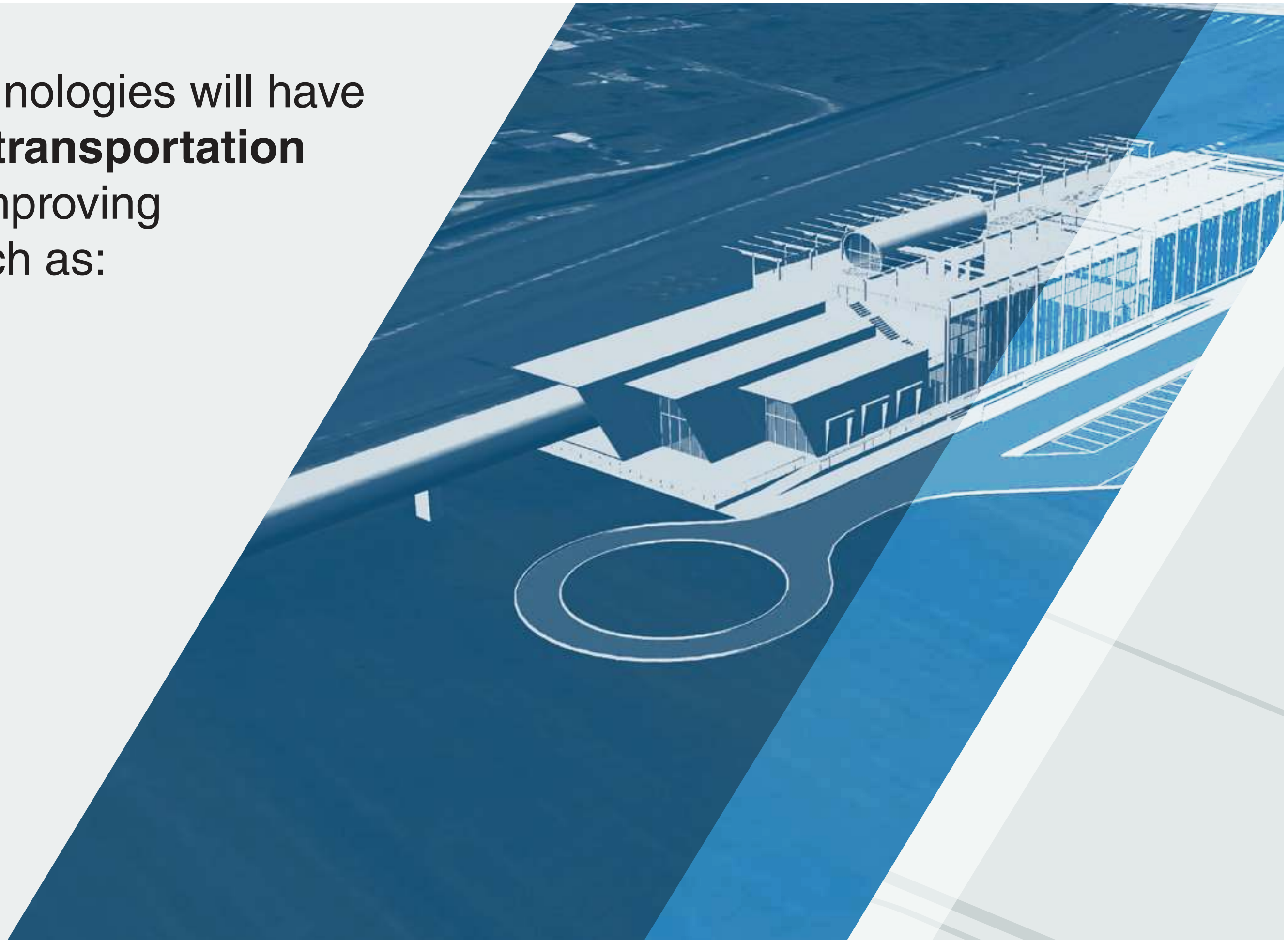
700 km

Air travel is generally the most competitive on 700 km distance. However, for demand exceeding 4–5 million passengers per year, **Hyper Transfer proves more advantageous for users**.

INDUSTRIAL IMPACTS
IN THE MEDIUM TERM

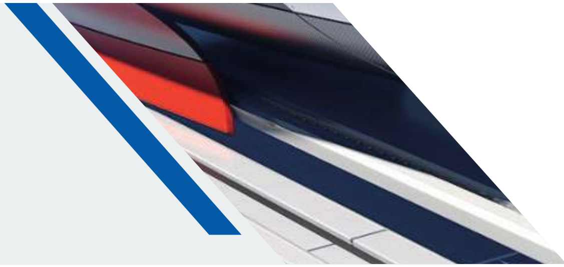


The development of certain technologies will have impacts on existing high-speed **transportation systems** in the medium term, improving components currently in use such as:



- **Inverters**
- **Braking systems**
- **Cooling systems**
- **Communication and signaling systems**
- **Aerodynamics**
- **Onboard energy sources**

PROJECT PHASES
HYPER TRANSFER



PHASE 1:

Feasibility Assessment

PHASE 2:

Design

PHASE 3:

Prototyping and Field Testing (Test Track - Pilot Route)

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