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APPLICATION OF ENVISION® IN EUROPE THE NAPLES – BARI HIGH-SPEED RAILWAY LINE

by Rete Ferroviaria Italiana S.p.A. (RFI)

Envision® Platinum Award



ZOFNASS PROGRAM
FOR SUSTAINABLE INFRASTRUCTURE

 Graduate School of Design
Harvard University

TABLE OF CONTENTS

INTRODUCTION	3
PART A – THE OVERALL PROJECT	
1. BACKGROUND	5
1.1 PROJECT OBJECTIVES	7
1.2 OVERALL BENEFITS	7
1.3 MAIN CHALLENGES	8
1.4 PROJECT TEAM.....	8
1.5 FUNDING.....	8
2. PROJECT DESIGN.....	8
2.1 PROJECT STANDARDS	Error! Bookmark not defined.
2.2 Project COMPONENTs	10
2.3 DESIGN PROCESS	13
3. PROJECT BENEFITS.....	14
PART B – THE ENVISION CERTIFICATION	
4. THE FRASSO TELESINO - VITULANO SECTION	16
4.1 Overview.....	16
4.2 Companies involved in design and construction	18
5. THE ENVISION PROCESS	19
5.1 CHOOSING ENVISION.....	19
5.2 THE AWARD	19
5.3 SCORING SUMMARY	20
5.4 PROJECT STRENGTHS	22

Eleonora Marinou prepared this case study under the supervision of Prof. Spiro N. Pollalis as the basis for class discussion rather than to illustrate either effective or ineffective handling of an administrative situation or a project. It is part of a series of case studies on projects having received Envision® certifications. The authors would like to thank the Institute for Sustainable Infrastructure (ISI), Giulia Costagli, Head of the Centre for Studies and Innovative Projects department of Rete Ferroviaria Italiana (RFI) Spa, Giuseppe Carcasi, PhD, Team Leader of Studies and System Innovation business unit of RFI, Alessandra Ragugini from RFI, Lorenzo Orsenigo and Silvia Ciraci from ICMQ, and David Smith and Giovanni Ranza from Stantec.

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INTRODUCTION



The 150km high-speed rail Naples – Bari project, part of the existing 311 km Napoli-Bari railway line, upgrades the current Napoli-Bari railway line to higher technical standards. It increases the maximum design speed, transforming the Naples-Bari route into a high-speed/high-capacity (HS/HC) railway. The line is used for passenger and freight and is expected to increase the quality of rail services in Campania and Puglia and enhance national connectivity. Consistent with EU objectives, it will reduce

greenhouse gas (GHG) emissions and mitigate climate with a modal shift from road and air to rail

In 2019, the project received Envision^{®1} awards for two segments of the line, representatives of the entire route, the “functional lots”² of the Frasso Telesino–Vitulano section (Frasso Telesino–Telese and Telese–San Lorenzo Maggiore) using Envision version 2 and the Apice–Orsara section using Envision version 3. Both were awarded Envision Platinum. Rete Ferroviaria Italiana S.p.A. (RFI), the national railway infrastructure manager, submitted the documentation for the first award. Italferr, a consulting and engineering company, submitted the documentation for the second award. RFI and Italferr are part of the Ferrovie dello Stato Italiane Group (FSI Group).

This case study focuses on the first award of the Frasso Telesino–Vitulano segment. The final design was completed when Envision was considered, and construction proceeded in parallel with the Envision certification process. The segments' design, construction, and management (O&M) standards are the same as those adopted by RFI for the entire modernization project of the Naples-Bari route.

The case study is structured in two parts. The first presents the overall project. The second part focuses on the Envision certification for the specific segment. It is the first project in Europe to earn an Envision award. The case study analyzes the benefits of using Envision in a context different from the US and Canada, addressing the tool's international application.

¹ <http://www.sustainableinfrastructure.org/>. See Appendix for a short description of Envision.

² Lotto funzionale (functional lot) is defined in Italian as a specific object of a contract, which can also be awarded in a separate and autonomous procedure i.e., parts of a general work or service, whose design and construction is such as to ensure its functionality, usability, and feasibility independently of the realization of the other parts. Specifically, the functional lot is a part of a section of the entire route, which once built can be activated along with the new services, having an immediate return in benefits.

PART A – THE PROJECT



1. BACKGROUND



Project Type:	High-speed rail line (construction of new & upgrades to the existing railway lines)
Total estimated cost:	approx. €6.2 billion
Project Owner:	Rete Ferroviaria Italiana (RFI), Italy's railway infrastructure manager – FSI Group
Engineering design:	ITALFERR S.p.A - FSI Group
Total Length:	approx. 150 km (approx. 50% tunnels), part of the existing 311 km Napoli - Bari railway line
Construction started:	October 2015
Estimated Completion:	2027



The expansion consists of doubling and speeding up some sections of the current line to a maximum of 250km/h to increase the capacity, frequency, and regularity of transport services, improve the accessibility of the surrounding areas and facilitate travel from Bari to Naples and Rome. The work aims to fully integrate the railway system with the regional context of urban, port, airport, and logistics transportation nodes.

At a regional and national level, the Napoli-Bari high-speed railway project increases the competitiveness of rail transport. It contributes to the socio-economic development of southern Italy and its territorial cohesion. The project is part of several strategic infrastructure investments under the 'Unlock Italy' initiative launched by the Italian Government to reduce the disparity in infrastructure development between northern and southern Italy. The Naples-Bari transversal link plays a fundamental role in developing the south connecting two areas that account for more than 40% of the regional market activities. The upgraded railway is part of the Scandinavia-Mediterranean Trans-European Network (TEN) core corridor and the European TEN-T program for sustainable transport.



Fig.1: Trans-European Transport Network (TEN-T)

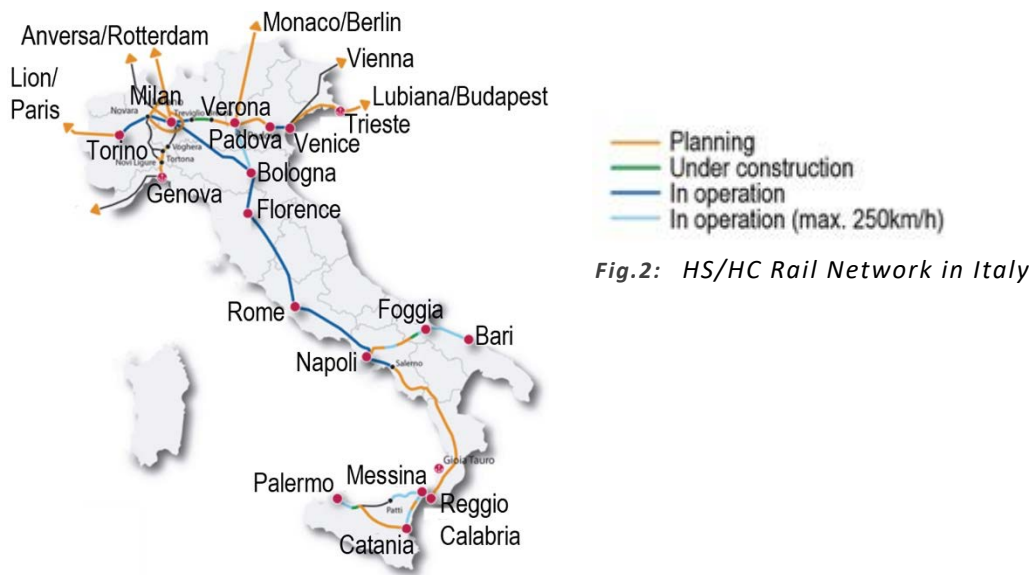


Fig.2: HS/HC Rail Network in Italy

1.1 PROJECT OBJECTIVES

- Accelerate the current link and improve accessibility for regional and freight services, both for national and long-distance services, with a maximum speed of 250 km/h. The corporate mission of RFI and the FSI Group addresses the need for railway mobility.³
- The project is expected to reduce the Naples-Bari journey times to about 2 hours (non-stop), saving 1h 40min compared to today. Rome-Bari will also be reduced to about 3h of travel (non-stop) – saving 1h compared to today. More than 2,000 jobs will be generated during its construction and 200 when the lines begin operation in 2027.⁴
- The complete integration of the upgraded railway system with the regional network, with the urban and logistical nodes, to maximize sustainability in the region and the mobility and accessibility for the territories crossed,
- The establishment of a “Multifunctional” Corridor through the support of other linear infrastructure networks.

1.2 OVERALL BENEFITS

- Interconnection and interoperability within the Trans-European-Network (TEN) Corridors.
- Enhanced integration of the railway infrastructure of the south-east of Italy with the connecting routes to the north of Italy and Europe.
- Promotion of the socio-economic development of the south.
- Contribute to transferring 50% of the current road freight traffic to rail by 2050,⁵ following EU targets.
- Contribute to triple the European high-speed rail network of the TEN-T⁶ and to doubling the Italian HS network.
- Contribute to connecting the main seaports to the railways.⁶
- Contribute to reducing emissions from transport by 60%, following EU targets.

³ The Ferrovie dello Stato Italiane Group (FS Group) is divided into four operating sectors: **transport**, which includes the companies performing passenger and/or cargo transport activities by rail, road; **infrastructure**, which includes the companies responsible for engineering, maintaining, operating and developing the rail infrastructure and the sea link services to the major islands; **real estate services**, which includes the companies that manage the main rail stations and take care of managing and valorizing the Group's property portfolio; **other services**, which include FS SpA and the companies that manage activities not directly related to the rail services. For more information please visit: <https://www.fsitaliane.it/content/fsitaliane/en/fs-group.html>

⁴ www.railjournal.com

⁵ “For goods, accessibility to the freight facilities present in the Caserta area will be improved, which can contribute to the achievement of the objectives set by the EU Transport White Paper: transfer by 2030 30% of freight traffic over 300 km from road to rail and 50% by 2050.” (Source: <https://www.napolibari.it/content/fsinapolibari/it/il-progetto.html>)

⁶ <https://infopoint.webuildgroup.com/en/sustainable-mobility-en/naples-bari-high-speed-railway-line-apice-hirpinia-section.html>

1.3 MAIN CHALLENGES

The railway's service continued during construction, and effective planning minimized disruption. Moreover, the Naples-Bari alignment is highly restricted, passing through SCI (Site of Community Importance) protected natural and valuable agricultural areas such as vineyards. The changes in the alignment are designed to minimize the impact on these areas. The current line also interfered with the wetland and surface water system. The project assessed the appropriateness of restoring wetlands and aquatic environments and maintaining a borderline between the project and the areas to be restored.

1.4 PROJECT TEAM

The project's primary stakeholders include RFI, Italferr, and contractors. RFI is the project developer and the owner of the assets. RFI is also the owner of the Envision certification process for the two segments, Frasso Telesino-Telese and Telese-San Lorenzo Maggiore. Italferr is the engineering company of the Ferrovie dello Stato Italiane Group. The firm is the technical entity for strategic investments and carries out project management and construction management activities in larger railway investments of the FS Italiane Group. Acting on behalf of RFI based on a framework agreement, Italferr is the designer and construction manager. Contractors have been selected via public tender for each segment.

1.5 FUNDING

RFI has an internal Investment Evaluation Committee that estimates the budget of infrastructure projects and coordinates with the Ministry of Sustainable Infrastructures and Mobility. At the time of certification, the total estimated project cost was **approximately €6.2 billion**. For the most part, the project is financed by the Italian State with the participation of the European Union (EU). A marginal residual contribution has been made available by local entities (i.e., regions, provinces). In 2021, the project was also included for financing in the Italian "National Recovery and Resilience Plan," following the Next Generation EU stimulus after the Covid-19 pandemic.

2. DESIGN

The design, construction, and commissioning of new facilities and the management and maintenance of the railway infrastructure are assigned by the Italian State through the Concession Act to RFI.

The design requirement was for high speed/high capacity with a maximum speed of 250 km/h and a maximum gradient of 13 per thousand. This choice resulted in 15 new tunnels with a total length of about 68 km and 25 new viaducts with a total length of 11.7 km. The new HS/HC line between Naples and Foggia – completing the HS/HC corridor to Bari – is 150km long, with about

50% in tunnels. The overall route will be completed in phases. According to an update of May 2021, the last section (Hirpina – Orsara) will be completed in 2027. The project will increase the speed of the trains,⁷ double the track and increase the capacity of the line and the speed of connections. The double-track railway sections will be built on new alignments, and the existing tracks will be dismantled. Almost 29 km have been completed and put into operation before 2017.

2.1 SPECIFICATIONS

RFI design & construction standards adopted for the HS/HC Naples – Bari line:

- Maximum speed: 250 km/h
- Maximum vertical gradient: 13 ‰
- Distance between tracks on a double track section: 4m
- Rail profile: 60E1 (Rail weight = 60 kg/m with R260 quality steel in 108m seamless bars)
- Crossbars: One-piece crossbars made of pre-stressed reinforced concrete with post-tensioned reinforcement, positioned at 60 cm spacing. Each element weighs 369 kg and has a length of 2.60 m and a width of 300 mm.
- Switches:
 - S60U/400/0.074, with a transit speed of 60 km/h, a radius of curvature of the branch in deviation of 400 m, and a tangent angle of 0.074
 - S60U/1200/0.040, with a transit speed of 100 km/h, the radius of curvature of the branch deviating 1200 m, and a tangent of the angle of 0.040
 - S60U/3000 /0.022, with a transit speed of 120 km/h, the radius of curvature of the branch deviating 3000 m, and a tangent of the angle of 0.022
- TE: The electrical traction is 3 kV direct current, with a 540 sq. mm contact line
- Signaling, command, and control system: the signaling and train protection system is based on a radio transmission of digital data, specifically for HS/HC lines, and ERTMS/ETCS level 2 technology is foreseen.

O&M standards

- RFI carries out preventive maintenance. The analysis of collected data makes it possible to maintain the infrastructure in three ways:
 - Ordinary: maintenance characterized by interventions aimed at keeping the infrastructure intact and efficient, limiting expected degradation of use, guaranteeing the useful life of the infrastructure, and coping with accidental events. Ordinary maintenance operations do not change the original characteristics of the asset itself, its essential structure, or its intended use.

⁷ The overall maximum speed of the future Naples-Bari HS railway line is 250km/h; however, some sections have lower top speeds, for example those that have been subject to the Envision certification reach 180 – 200 km/h depending on the section.

- Extraordinary: maintenance characterized by non-recurring, non-repeatable interventions of a high cost compared to the replacement value of the infrastructure and its annual ordinary maintenance costs. The interventions extend the asset's useful life and improve efficiency, reliability, productivity, maintainability, and serviceability.
- Predictive: seeking to predict how soon a given failure may occur to prevent it and intervene before it happens.

An annual infrastructure monitoring plan is prepared with punctual maintenance, programming resources, both materials and personnel. The maintenance is based on a multi-annual rolling period.

- For operations, project standards are related to the line's capacity and remote traffic management.
 - The National Railway Infrastructure Manager (NIM), RFI makes its railway infrastructure available to all Railway Undertakings (RUs) per principles of equality, non-discrimination, and transparency, to serve the safe movement of passengers and goods. RFI publishes annually an updated edition of the Network Statement to inform its customers – the Railway Undertakings (RUs) and the other entitled parties – of the criteria, procedures, terms, conditions, and tariffs for the allocation of infrastructure capacity and the provision of related services, together with all the information on the network characteristics and access conditions.
 - The stations and yards of the line will be equipped with modern ACC (Computerized-Centralized Interlockings)⁸ with remote centralized traffic management, command, and control to guarantee the safe movement of trains and shuntings. The ACC verifies the interlocking of all the yard units involved in the movement (level crossings, switches, signals) with the programmed logic guaranteeing the safety of the routes. The software logic improves the availability requirements of the entities, speeding up train movements and increasing the traffic potential and flexibility of the system. Additionally, this equipment also introduces automated diagnostic tools that allow maintenance personnel to carry out corrective operations in the event of failures in considerably less time than an electromechanical solution.

2.2 PROJECT COMPONENTS

Each segment of the Naples-Bari HS route is organized into functional and construction lots, designed and constructed in separate phases according to the overall design. According to a

⁸ A Multi-station Computerized-centralized Interlockings (Italian acronym ACC-M) is a system designed to control several stations, normally of small to medium size, by centralizing the so-called "Vital Nucleus" and the management logics of all or part of the systems involved, for which there is a single centralized Operator Interface. This system has the advantage of safely concentrating the management of entire nodes or lines in a single location, both in terms of traffic and maintenance.

May 2021 update, at the time of certification (2018-2019), the primary interventions were in the following segments:

- A. Rerouting the **Napoli – Cancello – Frasso Telesino** line, which passes through the existing HS Napoli Afragola station (expected to be operational by 2024).
- B. Track doubling and increasing the speed of the **Frasso Telesino – Vitulano** section (expected to be operational by 2026) and the **Apice – Bovino** section (expected to be operational by 2027).
- C. Track doubling of the **Bovino – Cervaro** section (already in operation) and developing the **Foggia link** to directly connect the Foggia-Bari and Foggia-Naples lines (already in operation).
- D. Upgrading of the **Bari node** (expected to be operational by 2021).

Railway lines

“The project has been divided into eight sections. The first is 15.5km long and runs from Naples to Cancello, covering the Casoria, Casalnuovo, Afragola, Caivano, and Acerra areas. The section will further connect to the new Napoli Afragola Station, which will provide regional and high-speed train services. The 16km Cancello to Frasso Telesino section is the second section of the railway line, while the third section stretches from Frasso Telesino to Vitulano over 30km. The fourth and fifth sections of the railway line are from Apice to Orsara (47.4km) and from Orsara to Bovino, and the sixth line connects Caserta to Foggia.”^{9,10}

“The [remaining] six project sections fall under Annex I of Directive 2011/92/EU, the Environment Impact Assessment (EIA) Directive, therefore requiring an EIA.”¹¹

Stations and Stops

New stations are constructed and activated, such as upgrading the Bari node (expected to be operational by 2022) and the operational station, since June 2017, of Napoli Afragola. After the activation of the Naples-Cancello bypass, planned to be operational by 2024, the Napoli Afragola station will serve as the hub for HS trains to and from Rome and Bari and regional services to the provinces of Campania.

⁹ <https://www.railway-technology.com/projects/naples-bari-high-speed-railway-project/>

¹⁰ *“The Apice-Hirpinia section will run from 18.7km between the towns of Avellino and Benevento and includes the construction of a station at Hirpinia and a stop at Apice, three tunnels and four viaducts. The section from Naples to Cancello will bring rail service to the new Napoli Afragola station. The project also includes the construction of the Acerra station and two urban stations, namely Casalnuovo and Centro Commerciale.”... “The construction of this section of €608.1m, was awarded by RFI in 2019 to the consortium comprising Salini Impregilo and Astaldi. The same consortium is responsible for the construction of Naples – Cancello section under a €397 million contract awarded in 2017. Within the consortium Salini Impregilo owns 60% and Astaldi 40%.” Source: <https://www.railwaypro.com/wp/eur-2-billion-eib-funding-for-naples-bari-hsr/>*

¹¹ European Investment Bank, Environmental and Social Data Sheet, Luxembourg, 17, September 2020.

New technologies

The strengthening and upgrading of the line also include network equipment upgrades with the latest generation instruments and systems, including the activation of ACC station equipment and ERTMS.¹² All the above contribute to interoperability with the Scandinavian-Mediterranean Corridor. As a result, the line will serve as a “multifunctional” corridor. Additional linear infrastructures will be constructed along the alignment: (a) in the medium term, an electrical backbone, which will increase the balancing and real-time loading of renewable energy sources, part of the "European Supergrid 2050," and (b) in the long term, the installation of fiber optic in the "white spots" to connect the new train stations digitally.

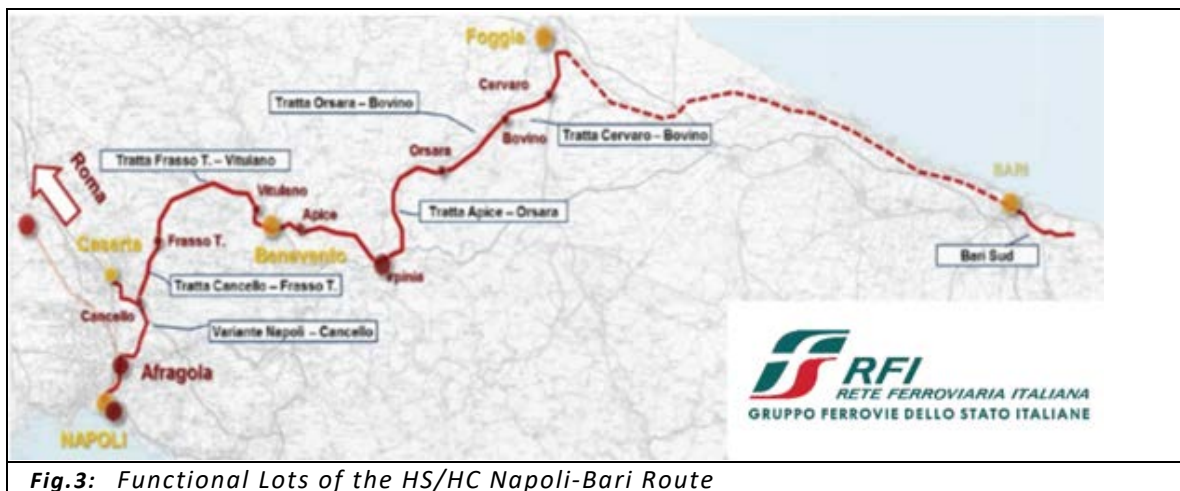


Fig. 3: Functional Lots of the HS/HC Napoli-Bari Route

Land Acquisition

“The implementation of the project includes about 412 hectares of land acquisition for the new railway alignment, the construction of road underpasses and overpasses, stations, and other buildings. The land acquisition process includes the demolition of 115 buildings with the consequent need to resettle about 100 households and ten businesses. The procedures for resettlement and compensation of people and businesses are ongoing and are carried out in compliance with the national legislation.”¹³

Status as of December 2021

The sections wherein the doubling and upgrading works are completed and are fully operational are the Vitulano – Apice, opened in 2008; the Bovino – Cervaro section, opened in June 2017; and the Bretella di Foggia, opened in July 2015. In December 2021, the sections of Naples-Cancelli, Cancelli-Frasso Telesino, Frasso Telesino-Telese, Telese-Vitulano, and Apice-Hirpinia were under construction. The section Bari C.le-Bari Torre a mare was in the design phase, and

¹² This technology ensures the interoperability of national railway systems while reducing the investment and maintenance costs of signaling systems and increasing the train speed, the infrastructure capacity, and the level of safety in rail transport.

¹³ European Investment Bank, Environmental and Social Data Sheet, Luxembourg, 17, September 2020.

the sections Hirpinia-Orsara, and Orsara-Bovino were in the design and construction tendering phase.

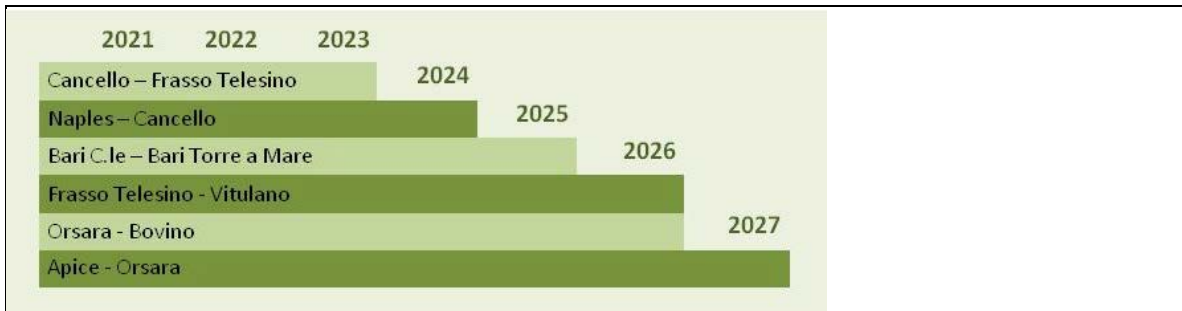


Fig.4: Sections estimated completion dates

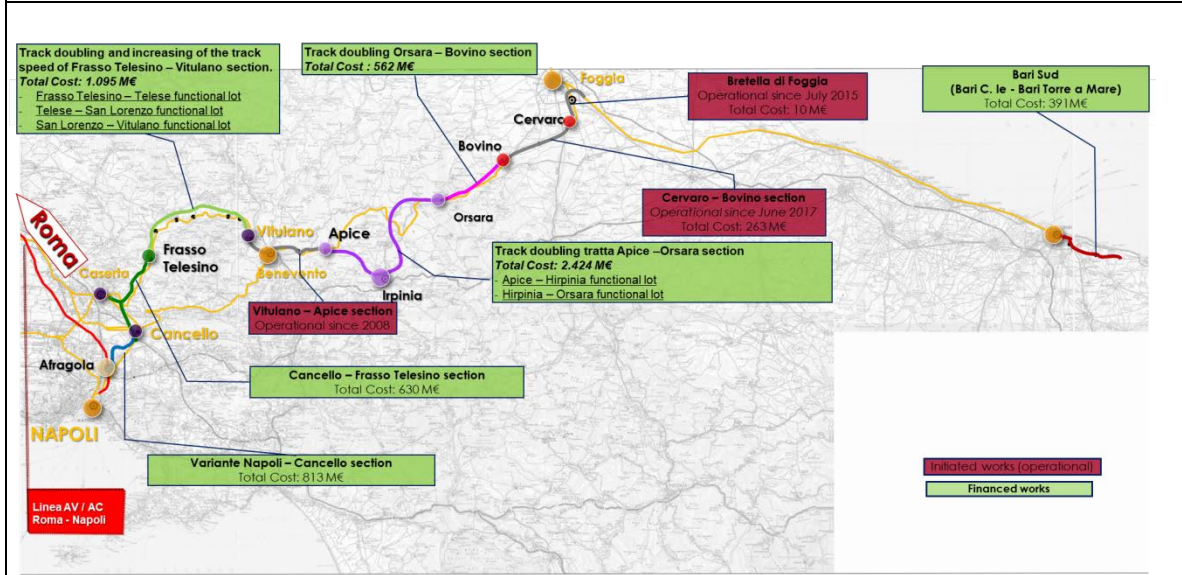


Fig.5: Status as of May 2021 of the HS/HC Napoli-Bari Route

2.3 DESIGN PROCESS

In the preliminary project phase, Italferr proposed several routes per section to the Commissioning Body (RFI), carrying out an analysis of the proposed alternatives through a matrix of indicators regarding the sustainability of the proposed alternatives, included in the “Environmental Impact Assessment.” Together with the documentation produced by RFI – i.e., transport studies, cost-benefit, and multi-criteria analysis for the various alternatives – were delivered to the Ministry of Sustainable Infrastructures and Mobility. The Ministry, together with RFI, assessed and selected the most sustainable alternatives for a better triple bottom line. Communities were also engaged in evaluating the route alternatives.

The alternatives were assessed based on environmental, transport, social, economic, and technical factors, including:

- the interception of water slopes, slope stability, disturbance of wildlife, reduction of greenhouse gases, air pollution, noise pollution, etc.,

- the population served, the potential capacity of the line, expected rail mobility demand (freight/pax), modal split and modal shift, time travel savings, barrier effect on the territory, reduction of road accidents, alleviation of road congestion, etc., and
- the complexity of the implementation, the areas available for construction sites, investment costs, operations, and maintenance costs, expected profits from track access charges, financial return on investment, etc.

3. PROJECT OUTCOMES

The positive effects of the new Naples-Bari line include:

1. Significant reduction in travel time.

The new line will provide direct high-speed rail service between Naples and Bari and will increase the capacity of Bari-Rome-Bologna-Milan-Turin and Bari-Pescara-Bologna. The transport capacity between Naples and Bari will increase with the possibility of up to ten trains/hour on the network compared with the current capacity of four trains/hour. Travel times will also be reduced:

- Napoli-Bari: approximately 2h (no stop), reducing 1h40 m compared to the current journey time.
- Roma-Bari: approximately 3h (no stop), reducing 1h40 m compared to the current journey time.

2. Improvement of the competitiveness of rail transport.

The new line is aimed to increase the share of traffic on the railways, providing a response to the mobility needs of passengers and goods in a sustainable and intermodal manner and contributing to the greater economic and social integration of entire southern Italy.

3. Integration of network services and intermodality.

The line is a key part of the European TEN-T Scandinavian-Mediterranean Core Corridor.¹⁴ It will connect the new Napoli Afragola station, serving regional and long-distance trains, to the HS/HC lines along the Turin-Milan/Brescia-Naples axis. It will place the entire Puglia region into the Italian HS/HC system and increase the connection with regional rail services, particularly in the Naples and Bari metropolitan areas. Furthermore, the upgrading of the Bari node will consent to the integration with the local, regional network of *Ferrovie del Sud-Est*. In contrast, the interventions in the Naples node are designed to favor interchange and intermodality with *the Circumvesuviana line*. The new line will allow the integration of structures dedicated to intermodality and logistics regarding freight traffic.

¹⁴ It links Helsinki, Finland to Valletta, Malta via Central Europe; it crosses the Alps through the new Brenner Base Tunnel (under construction) and runs longitudinally through the whole territory of Italy, including the main cities of Sicily in the south.

4. Spatial integration and environmental sustainability.

The passenger rail modal share will increase. The new line and its new stations will strengthen the transport capacity and develop the rail/rail and rail/road interchange in the cities served by the new line, particularly in the province of Naples and Bari and the areas of Caserta, Benevento, and Foggia. It will also reduce CO₂ emissions.¹⁵

For the freight transport, the accessibility to the terminal facilities in the Caserta area will be improved. These facilities can contribute to achieving the objectives set by the EU Transport White Paper: to transfer 30% of goods traffic over 300 km from road to rail by 2030 and 50% by 2050. It is also planned to reduce interferences in the territory by eliminating existing level crossings, bringing large metropolitan areas closer together, and retrieval, redevelopment, and valorization of railway areas to be decommissioned. The construction of the new line is followed by an ante-operam, on-site, and post-operam environmental monitoring, the results of which are constantly transmitted to the Ministry for Environment, Land and Sea Protection. For the sections being designed, environmental monitoring of the leading environmental components is foreseen, in line with the indications of the competent bodies.

5. Impact on employment.

The social impact of the implementation of the first interventions in the initial phase, in terms of the effects on employment, is estimated at an average of 2,200 man-months, of which:

- 2,000 people employed in direct construction work and related indirect activities,
- two hundred employees in related industries.

According to WeBuildGroup, “the expected benefits for the areas crossed by the project are significant. Include the demographic growth of around 90.000 people, 1.6% GDP growth, and 3.6% increase in residents’ income.”¹⁶

¹⁵ According to the EIB’s estimations: “Based on RFI’s forecast of passenger and freight volumes, the project will produce about 149 ktonnes CO₂e/year. Project emissions savings are estimated to be about 158 ktonnes CO₂e/year. The estimated values refer to an average year of the 30-year appraisal period.”...” The baseline (without project scenario) considers emissions from existing rail and the road network of both passenger and freight traffic. *Relative emissions are calculated considering modal shift from the road network to the new railway and the overall savings at network level.*” (Source: European Investment Bank, Environmental and Social Data Sheet, Luxembourg, 17, September 2020).

¹⁶ <https://www.webuildgroup.com/en/projects/railways-underground/naples-bari-high-speedrailway-line-apice-hirpinia-section>

PART B – THE ENVISION CERTIFICATION



The final design of the segment Frasso Telesino - Vitulano (Frasso Telesino – Telese and Telese – San Lorenzo Maggiore), which received the Envision V.2 platinum award in 2019, was already completed when the certification process started. The design, construction, and management (O&M) standards of these segments are the same as those adopted by RFI for the entire modernization project of the Naples-Bari route.

4. THE FRASSO TELESINO - VITULANO SEGMENT

4.1 OVERVIEW

<p>Province: Benevento</p> <p>Total cost: €1.1 billion</p> <p>Development: 30 km</p> <p>Maximum speed: 200 km/h</p> <p>Track width: 4m</p> <p>MAX Inclination: 12%</p> <p>No of tunnels: 5 (Frasso – S.Lorenzo) & 3 (S.Lorenzo – Vitulano)</p> <p>Tracks in tunnels: 10.6km</p>	<p>No of bridges: 11 (Frasso – S.Lorenzo) & 1 (S.Lorenzo – Vitulano)</p> <p>No of overpasses & underpasses: 3 & 4</p> <p>No of viaducts: 7 (Frasso – S.Lorenzo) & 2 (S.Lorenzo – Vitulano)</p> <p>Tracks in viaducts: 1.8km</p> <p>No of stations: 1 (Telese Terme)</p> <p>No of stops: 4 (Amorosi, Solopaca, S. Lorenzo Maggiore, Ponte Casalduni)</p>
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The segment has a total length of approximately 30km and a total cost of €1.1 billion. The Italian State provided the funds for this section. Interventions were limited to 11.20km for the Frasso Telesino – Telese and 11.35 km for the Telese – San Lorenzo Maggiore parts. The upgraded speed is 180 km/h and 200 km/h, respectively, and 140 km/h for freight trains. 7.6 km are in tunnels. The tracks were doubled on one part with a displacement/rerouting of the current track and in the other part parallel to the existing single-track. The line was decreased by 1.21 km, mainly due to tunnels. Four new stops and one station were constructed, and 20 existing level

crossings were eliminated.¹⁷ The project is in the province of Benevento passing through Dugenta, Castel Campagnano, Melizzano, Amorosi, Telese Terme, Solopaca, Castelvenere, Guardia Sanframondi, Vitulano, and San Lorenzo Maggiore. The Frasso Telesino – Telese will be operational by May 2025, the Telese – S. Lorenzo) by April 2026.



Fig.6: Functional Lots of the Frasso Telesino – Vitulano

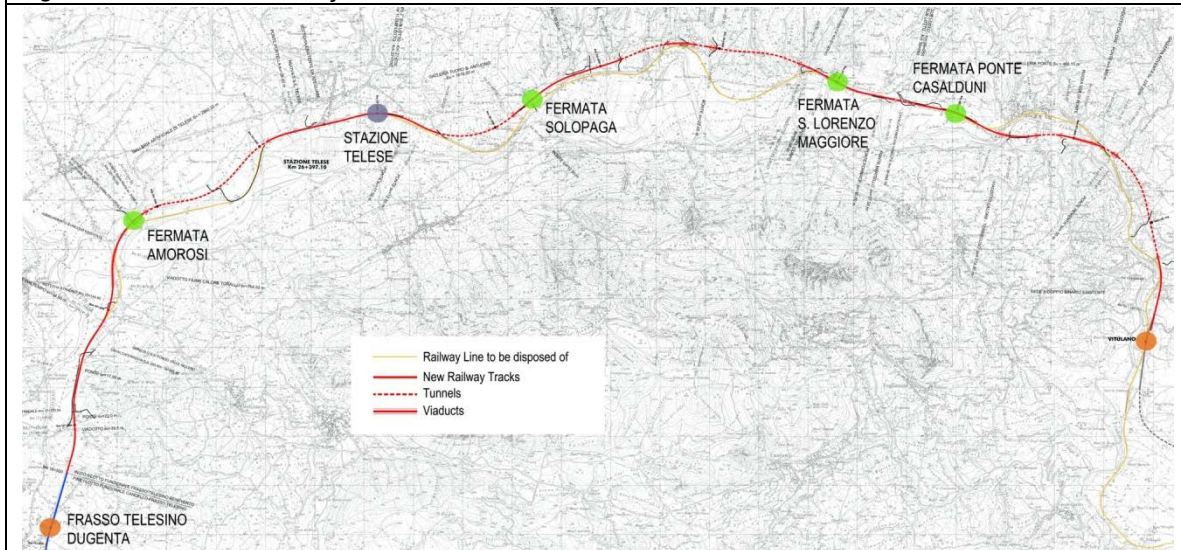


Fig.7: Map of the Frasso Telesino – Vitulano section (edited by the Zofnass Program) (Source: <https://www.napolibari.it/content/fsinapolibari/it/il-progetto/tratte-interessate/frasso-tesino---vitulano.html>)

The design and construction contribute towards sustainability by:

- mitigating the impacts on the communities and the environment affected by the project,
- reducing the lifetime costs (construction, management, and maintenance costs), and

¹⁷ Envision Conference, Milan, 7, May 2019. “Scenari e percorsi di sostenibilità infrastrutturale” (Infrastructural sustainability scenarios and paths). ICMQ, STANTEC, ENVISION.

- increasing the efficiency of the project through critical savings.

4.2 DESIGN AND CONSTRUCTION



Fig.8: Teleso station (Source: Google)

Commissioning body, Developer, Owner: RFI

Preliminary & final design: Italferr

Contractor for the Frasso Telesino-Teleso functional lot:

IMPRESA PIZZAROTTI & C. S.P.A (agent group leader) - Itinera S.p.A. (Agent) - Salcef S.p.A. (principal) - EDS Infrastrutture S.p.A. (principal) - Design Consultant ATI Geodata Engineering S.p.A. - Integra S.r.l. - Rina Consulting S.p.A.

Contractor for the Teleso - S. Lorenzo functional lot:

CONSORZIO TELESO SOCIETA' CONSORTILE A RESPONSABILITA' LIMITATA¹⁸ made up of Ghella S.p.A. - ITINERA S.p.A. - SALCEF S.p.A. - COGET IMPIANTI S.p.A.

¹⁸ The Design Joint Venture method was chosen before the tender phase by the Construction Joint Venture led by Ghella and composed of Itinera, Salcef, and Coget, all main players on the Italian infrastructure market. The Design Joint Venture is led by the engineering company of Systra SWS (58%) & Systra-Sotecni. It is responsible for the alignment, bridges, viaducts, stops, MEP, excluding tunnels, tracks, including the demolition of the existing line and construction of the new one, catenary system, electrical substations, signaling, the telecommunication systems, and low voltage. SWS, which holds 42% in the joint venture, is responsible for tunnels, including MEP, geology, geotechnics, environmental studies, hydrology, and hydraulics. Source: <https://www.railwaypro.com/wp/systra-wins-contract-for-a-section-on-naples-bari-high-speed-line/>

5. THE ENVISION CERTIFICATION PROCESS

5.1 CHOOSING ENVISION

Sustainability is at the core of RFI and FS Group activities. The railway is a sustainable mode of transportation that contributes significantly to SDGs and decarbonization targets. RFI continuously aims to improve the engagement of stakeholders, searching for new metrics and methodologies – in addition to cost-benefit analyses, multi-criteria analysis, and transport studies – to support the dialog with decision-makers, stakeholders, and central and local government agencies to facilitate the discussion within the territory. Since the certification is provided by an independent third-party assessor based on a globally adopted and structured protocol, RFI can provide the stakeholders quantitative and objective evaluations about the triple bottom line of sustainability, moving forward from purely qualitative and often polarized discussions.

Hence, after an initial screening, RFI experimented with using the Envision methodology on a section of a very strategic railway route that complied with its standards. This first test case showed that the Envision protocol successfully met the needs of RFI and that the design and construction process of new infrastructures adopted by RFI reaches outstanding levels of sustainability with global standards.

5.2 THE AWARD



In 2017, RFI had an internal preliminary assessment of the project for certification, and in August 2018, the project was registered with ICMQ for official certification. ICMQ is accredited by the Institute for Sustainable Infrastructure (ISI) to conduct Envision certifications. The certification process was carried out in collaboration with Stantec.

The Envision verification was carried out before the design development and construction tender. It concluded in February 2019 with the platinum award. The following process was followed:

- ✓ **Preliminary assessment of the Naples-Bari itinerary** on the preliminary design phase of the entire project, which did not have the necessary evidence to acquire points on some Envision criteria.
- ✓ **Selection and evaluation of the section submitted to certification.** The segments were selected in the final design to have the information needed for properly completing the evaluation. The Frasso Telesino – Vitulano segment had more interesting elements on the protection/enhancement of its territory.
- ✓ **Evaluation and verification.**
- ✓ **Certification**

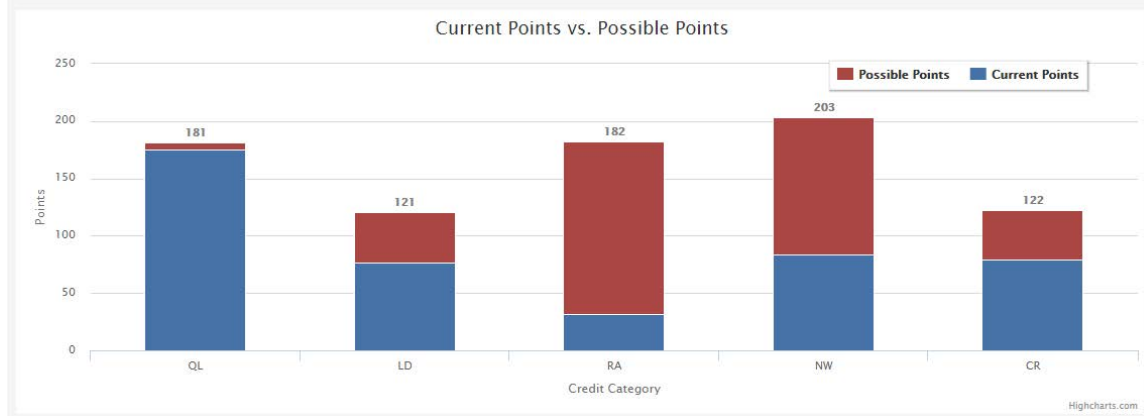
The evaluation of the project with Envision counted on RFI's collaboration with important administrative and technical stakeholders.¹⁹ They enriched the information level of the project and made it possible to obtain many Envision credits. For example, the Campania Region helped develop an online open-data platform for information management called i.TER Campania. It increased the information sharing and the transparency of the project data. i.TER Campania was very useful for QL and NW credits.

5.3 ENVISION SCORE SUMMARY

The project is the first Envision® certified project in Europe and the first for a railway line worldwide. Its assessment was extremely positive in Quality of Life, Climate & Risk, and Leadership, whereas it could be improved in the Resource Allocation category.

PROJECT NAME	SECTOR	LEVEL	YEAR	ENVISION SCORE %				
				QL	LD	RA	NW	CR
Itinerario Ferroviario Napoli-Bari. Tratta Frasso Telesino – Vitulano, 1° e 2° lotto funzionale Frasso Telesino – Telese e Telese – S. Lorenzo Maggiore.	Transportation TYPE: Rail	Platinum	2019	95,0%	55,0%	16,0%	41,0%	65,0%

Credit Category	Submitted Score Information			Verified Score Information		
	Applicable	Submitted	Percentage	Applicable	Verified	Percentage
QUALITY OF LIFE	181	175	97%	181	172	95%
LEADERSHIP	121	77	64%	121	66	55%
RESOURCE ALLOCATION	182	32	18%	182	29	16%
NATURAL WORLD	203	84	41%	203	84	41%
CLIMATE AND RISK	122	79	65%	122	79	65%
Total Points / %	809	447	55%	809	430	53%



¹⁹ Campania Region; University of Sannio, CRESME Research Center; University of Sannio; Campana Mobility Infrastructure and Networks Agency (ACaMIR); Energia e Sistemi Elettrici (Ensiel); GEK Terna Group; Almaviva (Italy's leading Information & Communications Technology Group); Autostrade per l'Italia SPA; Confindustria Association.

The project obtained close to the maximum score in the “Quality of Life” category since, by its very nature, a railway infrastructure project enhances the quality of life of the communities, improving the accessibility of the territories and bringing added value to the area. In addition, strengthening the public transport sector promotes a modal shift from road to rail transport, reducing CO₂ emissions. Strengths of the project include the active involvement of the stakeholders, the increase of the population, the improvement of local economies, the mobility and the accessibility of local stations/stops, the minimization of the project’s construction and operation impacts, the enhancement of the local public transport and the heritage of the territory.

The scores obtained showed an intrinsic difficulty in achieving significant points in the "Resource Allocation" category, evidenced by the low percentage of scores achieved compared to the other categories, linked to:

- The Italian legislative system (acknowledged in FSI/RFI internal procedures) states that public tenders need to be non-discriminatory and consider maximum openness to the market in terms of contractual requirements, also not significantly restrict the access to the market that can result in negative influences over project times and costs. In addition, the specific nature of the materials and technologies should not limit the number of offerors.
- It is impossible to track the sustainability of the materials used before the tenders since the tender procedures of RFI did not specify the procurement of sustainable materials despite monitoring the sustainability of the supplier's business processes. FSI has committed to improving its environmental and social performance in the last few years. To this extent, RFI has launched a systematic activity to monitor the performance of the entire supply chain regarding compliance with the principles of Corporate Social Responsibility (CSR). The 2016 legislation of public tenders has also introduced a new logic to reward environmental protection and CSR in general; the performance of companies will be taken into consideration under these profiles, which will be considered in subsequent tenders issued by RFI. The companies that participate in the tenders may be subject to an assessment to compete for the award of the bonus score. This evaluation will be conducted through the monitoring platform developed by EcoVadis, a provider of supplier sustainability assessments for the global supply chain.
- Despite the region's water shortages, there are no estimates and monitoring of water consumption on the construction site. RFI, however, has improved its sustainability footprint by setting specific targets.
- The unavailability of a Life Cycle Assessment (LCA) as a standard evaluation process of railway projects in Italy does not require LCA.

Envision brought these critical issues to light, including lack of awareness, and, afterward, actions were taken to improve sustainability and the company culture in these areas.

5.4 PROJECT STRENGTHS

Some of the project's key factors that lead to the achievement of the award include:²⁰

The sustainability and resilience as a corporate mission for RFI

The project has addressed the resiliency of the railway towards possible threats and vulnerabilities linked to climatic variations, the geomorphological conditions of the regions, and the different socio-economic conditions. The project is designed to strengthen and promote electric rail transport and mass transit. Estimates showed that once the entire route has been activated, there will be a significant modal shift from road to rail – both for passengers and freight – with an associated drastic reduction in CO₂ emissions. The Cost-Benefit Analysis Report showed that the project has a satisfactory economic Net Present Value (NPV) and a cost-benefit ratio. The benefits associated with the modal shift towards rail are savings in travel time, O&M costs of road vehicles, and reduction in negative externalities (reduction of road accidents and congestions, lower noise and environmental pollution, reduction in GHG).

Project's Environmental value

The rail segment is situated in a vast and restricted area with protected natural areas, valuable agricultural areas, hydrothermal vents, and areas at hydrogeological risk.



Fig.9: KPIs for the sustainability of the project²¹

Protection of natural areas: The interventions associated with the re-alignment of the line in the two certified segments have the objective of optimizing the current route's geometry to increase the maximum permitted speed and minimizing the crossing of protected natural areas, in the original route. The final route of the line will only intersect the "Fiume Volturno e Calore

²⁰ <https://sustainableinfrastructure.org/project-awards/itinerario-ferroviario-napoli-bari-tratta-apice-orsara-1-lotto-funzionale-apice-hirpinia/>

²¹ <https://www.webuildgroup.com/en/projects/railways-underground/naples-bari-high-speed-railway-line-apice-hirpinia-section>

Beneventano” Site of Community Importance (SCI) areas at three specific sites. Specific mitigation measures have been adopted for crossing these sites to achieve a better visual impact, reconstruct natural landscapes, and ensure the habitat's ecological continuity.

A study was also carried out to minimize the interference of the new route with the hydrothermal vent to preserve the tourist destination of the town of Telesse Terme.

Urban and rural area redevelopment: In cooperation with local stakeholders, the project team planned the redevelopment of areas enclosed by the railway. For instance, in the vicinity of Telesse Terme station, there is a transition area between the city and the countryside, which has been revamped for the new route to reduce the visual and acoustic impact on the adjacent residential area. To preserve valuable agricultural areas with vineyards, partitioning properties or enclosing areas have been avoided, reducing the amount of reclaimed land and minimizing territorial fragmentation.

Areas subject to hydrogeological instability: There are landslides and flood zones along the route; hence, detailed studies and analyses were carried out, leading to protection measures for the areas adjacent to the railway route, in agreement with the local municipalities. To avoid hydrogeological instability, soil stabilization was planned upstream of the existing railway line. Moreover, the presence of the Calore River basin in the vicinity of the railway line paved the way to verifying the capacity of the minimum spans of the viaducts and to protecting the piles using boulders. A further measure was to reroute the track from its current location to the Amorosi station, which has been flooded in the past, even by low-intensity rainfalls.

“The project is part of the National Transport Plan (Allegato Infrastrutture – Connettere l'Italia) for which a Strategic Environmental Impact study was undertaken according to SEA Directive 2001/42/EC.”^{22,23}

Project's Social Value

There will be a significant improvement in the number and quality of the railway services in the future, especially in terms of shorter travel times – for regional, long-distance, and freight services. Greater traffic regularity, better adaptation to transport demand, increase in frequency, better accessibility to rail transport, enhancement of freight services, and

²² <https://www.eib.org/en/projects/pipelines/all/20190755#>

²³ *“The upgrading project is part of a strategic infrastructure programme, Infrastructures Annex to the Economy and Finance Document (Allegato Infrastrutture al Documento di Economia e Finanza, 2015), issued by the Italian Ministry of Infrastructures and Transport, which was subject to a Strategic Environmental Assessment (SEA) conducted in accordance with the provisions of Directive 2001/42/EC (the SEA Directive). The program and the SEA documentation were published for public consultation on the websites of the Ministry of Infrastructures and Transport and the Ministry of Environment. The announcement to the public was given in the Italian Official Journal (Gazzetta Ufficiale, Parte Seconda, no.150, 31-12-2015). The public was invited to send comments to the Ministry of Environment within 60 days from the publication. Following the public consultation, the program was adopted.”* (Source: European Investment Bank, Environmental and Social Data Sheet, Luxembourg, 17, September 2020). See Appendix for EIA information.

improvement of inter-modality are expected. The territorial socio-economic analysis and the impact assessment of the HS/HC Naples-Bari line allowed a link between the positive change in accessibility, demographic change, and economic trend. The most disadvantaged territories undergoing depopulation would see a demographic increase, higher than average for the municipalities directly serviced by the upgraded line. The project helps reverse the downward trend that characterizes the Campania-Puglia area. The 20-year scenario (2036) predicts a net gain in the Campania and Apulia population.

Infrastructure systems synergies

The Naples-Bari route was designed as an upgrade of the existing railway infrastructure. Given the strategic nature of the project, i.e., a cross-country link, it was conceived as a "multifunctional corridor" to integrate the railway network with the other infrastructural networks serving the areas concerned, using synergy and contributing to reducing impacts. The railway corridor is superposed to the electric transmission grid corridor, which allows increasing the balancing and real-time loading of renewable energies in the medium term and will be part of the "European Supergrid 2050" in the long term. Terna – Italy's electricity transmission grid manager – has included the renewal of some of its obsolete lines in its development plan. By constructing new power stations next to RFI's new electrical substations, Terna aims to minimize the impact of the new infrastructure on the territory and connect them to the high-voltage electricity grid underground, mainly using the routes of existing linear transport infrastructures. In addition, a digital transmission grid will introduce fiber-optic coverage in current "white spots" and will connect the new stations of the Railway Route to the digital system.

Stakeholders engagement²⁴

The line connects and does not only cross regions. The connection with the industrial and production areas allows for generating important logistic initiatives in Sannio and Irpinia. The project elaborated a shared and transparent framework outward with the Local Authorities to have concrete repercussions for the local communities.²⁵ So, it was possible to promote and evaluate synergies, opportunities, and efficiency of the work and the entire infrastructural, environmental, economic, and social context.

Specifically for the certified segment, the local communities and key stakeholders have been involved in the project not only through the 'Conferenze di Servizi,' an institutional step in the approval processes, but also during the early stages of the project through continuous communication and exchange of information organized by RFI and Italferr to allow the communities to express their critical issues and proposals for improvement. These meetings helped develop and strengthen relationships with key territorial stakeholders. They enabled

²⁴ See Appendix for RFI's stakeholders.

²⁵ The public was regularly informed about the planning stages related to this project through community forums and advertising material. In the context of the EIA process, public consultations were carried out for each individual section at different times.

them to be involved in the project decision-making processes and obtain and solicit feedback from the public and private stakeholders. This feedback resulted in progress that optimized the project, reduced the impacts, and increased the value of the project itself, making the project choices more transparent and widely shared. Communication with the communities involved reduced the time required for the “Conferenze di Servizi” authorization.

Safeguarding the unique elements of the territory

The planning was conducted according to the fundamental principles of environmental protection and the interfered territorial and environmental areas. The project preserves the landscape and ecological quality of the area, minimizing at the same time the interferences with the territory crossed and ensuring high technical and qualitative standards in construction. This route, among other alternatives, has favored solutions with minor impacts on existing habitats, safeguarding, for example, flooding the main waterways present in the territory and minimizing the effects on the local wine production areas. Preference was given to design choices such as the displacement of the route, the arrangement of the stacks of viaducts outside the riverbed, the removal of existing sections replaced by tunnels, and mitigation measures such as the re-naturalization of areas, and the restoration of riparian strips and agriculture.

CONCLUSIONS

FSI/RFI used Envision after the design had been completed to objectively evaluate the project's sustainability, guidance, technical standards, and procedure. *“On the project of the Frasso T.- S. Lorenzo section, the application of Envision helped:*

- ✓ *improve the systemic vision, promoting the evaluation of a) synergies, opportunities, and b) efficiency of the work, in the context in which it is inserted; and*
- ✓ *provide a transparent framework shared with all stakeholders and the public.”²⁶*

Additional project analyses were performed to comply with the Envision protocol,²⁷ not carried out in established procedures. Constructive dialogs with the Campania Region and affected communities assisted the process, enhancing the area. Envision was used mainly to assess the standards RFI currently adopts for designing and constructing the works and managing railway assets. Since Envision was used post-design, no changes could be made to the project but identified sustainability elements that could still be improved or better documented. After the award, RFI modified its standards and processes and understood how documentation could be improved along with developing a project to make it easier to be certified with Envision. In addition, a quasi-standard certification strategy has been developed for railway network upgrades and new lines.

Following the certification, an analysis was performed by RFI to assess which criteria did not receive high points and to understand how the Envision tool could be applied to the company's processes for being more sustainable. According to RFI, key factors for an effective application of the Envision are:

- The level of design. The application of the Envision Protocol would be more suitable in the preliminary design phase than in the final design phase, as it would be to make changes to the project.
- The standardization of design. Develop standardized design documents for tender and specifications for contracts relevant to sustainability and Envision certification, incorporating relevant technical, organizational, and legal requirements to ensure greater control over sustainability aspects and increase the scores obtainable in Envision credits.

The application of Envision, being entirely voluntary and not required by current design standards, can be primarily oriented to the projects in which it can be most effective:

²⁶ Envision Conference, Milan, 7, May 2019. “Scenari e percorsi di sostenibilità infrastrutturale” (Infrastructural sustainability scenarios and paths). ICMQ, STANTEC, ENVISION.

²⁷ For example, the execution of a demographic and socio-economic analysis of the territories affected by the route of the Naples-Bari route. These additional procedures were performed to assess and quantify the effects of the implementation of the infrastructure upgrade, in particular the increase in the added value of the areas crossed and the repopulation and possible new business initiatives that the upgraded infrastructure and the associated complementary investments will be able to create.

- for complex environmentally and socially situations,
- to facilitate "stakeholder engagement," particularly in a sensitive context, and
- to contribute to the resilience of the project in the most vulnerable areas.

According to RFI, their first Envision certification made it possible to acquire internal expertise to reduce the person-hours allocated to the process for the next applications. The efforts could be further reduced if the information necessary to feed the credits were made more directly accessible in the project documents. In the future, FSI/RFI aims to apply Envision to enrich the transport value of the projects and the value to the communities by enhancing the natural context and integrating the surroundings.

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APPENDIX

RFI's Role: Manager of the National Railway Infrastructure²⁸

RFI is the sole manager of the national railway infrastructure, entrusted by the Ministry of Sustainable Infrastructures and Mobility through a Public Concession Act, signed in 2000, to implement the plans defined by the Government regarding the investments for the development of the infrastructure and the maintenance and management of the national rail network. Its creation responds to the European directive for separating the network manager and railway companies. Its main areas of activity are:

- Manages traffic and railway operations and maritime links in Sicily and Sardinia to ensure rail services can be continued to the islands.
- Guarantees the maintenance and efficiency of the national railway infrastructure.
- Designs and makes investments to upgrade and develop the network and its technological equipment.
- Integrates the Italian network into the trans-European transport networks.
- Defines the railway timetable annually, consistent with the rules and the criteria published in the Network Statement.
- Carries out checks on the psycho-physical fitness of the active personnel for the safety of the railway operations.
- Guarantees accessibility of stations and the services offered to travelers and, in general, to all users.
- Provides in-station assistance to persons with reduced mobility per the role of station manager assumed by the company since December 2010.
- Guarantees accessibility and usability of the freight terminals owned by the Company.

Detailed info can be found at: <https://www.rfi.it/en/about-us/Vision-mission-and-values/Our-mission.html>

RFI Stakeholders

PUBLIC/INSTITUTIONAL BODIES:

Ministry of Sustainable Infrastructure and Mobility
Ministry of Economy and Finance
Italian Transport Regulation Authority
Italian National Safety Authority for railways and road/highways infrastructure

BODIES ALLOWED TO REQUEST INFRASTRUCTURE CAPACITY

Railways Undertakings
Regions

²⁸ FS Italiane 2018 Annual Report.

Autonomous Provinces
 Framework Agreement holders
 Loaders,
 Shippers
 Combined transports operators

OTHER STAKEHOLDERS

Travelers
 Persons with Reduced Mobility
Associations and representative Bodies
National and international industry Associations
Communities and Local Authorities
European Commission and foreign Infrastructure Managers
Suppliers
Employers

RFI’s Commitment to sustainable development

In the program agreement with the State, RFI's contribution to sustainable mobility passes through projects and diversified programs, all oriented toward increasing the quality and quantity of railway transport and its integration with other transport modes.



FS Italiane group specifically aims to help achieve the following sustainable development goals as part of the United Nations 2030 Agenda for sustainable development:



For more info, please visit <https://www.fsitaliane.it/content/fsitaliane/en/sustainability.html>

Environmental Impact Assessment²⁹

The EIA independent procedures for the six project sections analyzed the impact of project implementation and railway operations, including the impact on animals, plants, habitats, water and soil, air and climate, landscape, and cultural heritage. Construction activities will cause some disruptions that are monitored and, in any case, limited in time. The main impact factors concern landscape and habitat modifications during construction, particularly protected sites. Mitigation measures for these impacts include using eco-friendly construction materials, planting autochthonous trees, and preserving natural corridors for animals. During operation, the primary impact factors concern noise and permanent land acquisition. Mitigation measures for noise emissions include the installation of noise barriers. Land acquisition, particularly in protected areas, was designed to mitigate as much as possible its impact on habitats.

The EIA procedure for this section²⁹ started on 3/6/2010. This project was within the scope of special legislation (law 443/2001), which allowed the EIA to be carried out at the preliminary design stage. On 31/5/2010, the public was informed from the national newspapers and was given until 30/7/2010 to comment. With prescriptions to be implemented in the following design stages, the EIA committee issued an EIA positive opinion in 2011 (CTVIA Opinion no. 629 4/2/2011). Following this opinion, the competent authorities, i.e., the Ministry of Environment and the Ministry of Cultural Heritage, issued the environmental decision for this section.

²⁹ European Investment Bank, Environmental and Social Data Sheet, Luxembourg, 17, September 2020.

ENVISION®: An Overview

Sudha Patel Dave

October 2019

WHAT IS ENVISION?

Envision is a framework that provides the guidance needed to initiate systemic change in the planning, design, and delivery of sustainable and resilient infrastructure. Infrastructure is the "underlying structure" of a country and its economy. The fixed installations that the country needs to function, generally built by governments and are publicly owned.

Envision is a decision-making guide, not a set of prescriptive measures. Envision provides sustainability metrics for all types and sizes of infrastructures. It helps users assess the extent to which their project contributes to sustainability conditions across the full range of social, economic, and environmental indicators.

Energy	Water	Waste	Transportation	Landscape	Information
Distribution	Treatment	Solid waste	Airports	Public Realm	Telecom
Hydroelectric	Distribution	Recycling	Roads / Highways	Parks	Cables
Coal	Capture / Storage	Hazardous	Bikes / Pedestrians	Ecosystem Services	Internet
Natural Gas	Stormwater	Waste	Railways	Natural Infrastructure	Phones
Wind	Flood Control	Collection & Transfer	Transit	Environmental Remediation	Data Centers
Solar	Nutrient Management		Ports		Sensors
Biomass			Waterways		

The Institute for Sustainable Infrastructure (ISI) was founded by the American Public Works Association (APWA), the American Society of Civil Engineers (ASCE), and the American Council of Engineering Companies (ACEC). Envision was developed in collaboration between ISI and the Zofnass Program for Sustainable Infrastructure at the Harvard University Graduate School of Design. Envision's initial version was offered in 2012, and Envision v3 was launched in 2018 and is currently in use. ISI website (www.sustainableinfrastructure.org) provides information about the organization, memberships, and various initiatives.

WHAT IS SUSTAINABLE DEVELOPMENT?

UN defines sustainable development as development that meets the needs of the present without compromising future generations' ability to meet their own needs. Sustainable development calls for concerted efforts towards building an inclusive, sustainable, and resilient future for people and the planet. For sustainable development to be achieved, it is crucial to harmonize three core elements: economic growth, social inclusion, and environmental protection. These elements are interconnected, and all are crucial for the wellbeing of individuals and societies. In 2015, countries adopted the 2030 Agenda for Sustainable Development and its 17 Sustainable Development Goals (SDGs). Envision supports these goals, particularly Goal no. 11, "Sustainable Cities and Communities."








ENVISION USE

Envision is used globally. More than 8,000 professionals worldwide have attained the designation of "ENV SP" (Envision Sustainability Professional). Several hundred companies and organizations have joined as 'Envision Qualified Company' – they are ISI members and have at least one Envision Sustainability Professional on staff. Several agencies (public entities, ranging from small-town government departments to large, multi-jurisdictional agencies) have also joined ISI as "Envision Supported Agencies" - an international network of infrastructure owners using Envision and have an Envision Sustainability Professional on staff. While most ISI members are in the USA and Canada, the membership and projects are spreading to other countries such as Italy.

ENVISION FRAMEWORK

Envision v3 is a framework used to assess the sustainability impact of infrastructure projects. The Envision v3 Guidance Manual encompasses the full written framework and is available as a download to individuals who create a free account on the ISI website. It includes **64 sustainability and resilience indicators**, called 'credits,' organized around five categories (see chart below). These collectively address areas of human wellbeing, mobility, community development, collaboration, planning, economy, materials, energy, water, siting, conservation, ecology, emissions, and resilience. These indicators collectively become the foundation of what constitutes sustainability in infrastructure.

Envision Categories and subcategories				
 Quality of Life	 Leadership	 Resource Allocation	 Natural World	 Climate and Resilience
<ul style="list-style-type: none"> ▪ Wellbeing ▪ Mobility ▪ Community 	<ul style="list-style-type: none"> ▪ Collaboration ▪ Planning ▪ Economy 	<ul style="list-style-type: none"> ▪ Materials ▪ Energy ▪ Water 	<ul style="list-style-type: none"> ▪ Siting ▪ Conservation ▪ Ecology 	<ul style="list-style-type: none"> ▪ Emissions ▪ Resilience
14 credits	12 credits	14 credits	14 credits	Ten credits

Quality of Life addresses a project's impact on host and affected communities, from the health and wellbeing of individuals to the wellbeing of the larger social fabric.

Leadership: Leadership helps produce a sustainable project. Successful sustainable projects require a new way of thinking about how projects are developed and delivered.

Resource Allocation: This category is broadly concerned with the quantity, source, and characteristics of these resources and their impacts on the overall sustainability of the project.

Natural World: Infrastructure projects have an impact on the natural world around them, including habitats, species, and nonliving natural systems. How to understand and minimize negative impacts while considering how the infrastructure can interact with natural systems in a synergistic, positive way.

Climate and Resilience: The Climate and Resilience category's scope is two-fold: minimizing emissions that may contribute to climate change and other short- and long-term risks and ensuring that infrastructure projects are resilient.

LEVELS OF ACHIEVEMENT: Each subcategory has several assessment areas (performance objectives), and each area is allowed a certain number of points depending on the performance level achieved in a project.

Improved: Performance that is above conventional. Slightly exceeds regulatory requirements.


Enhanced: Sustainable performance that is on the right track. There are indications that superior performance is within reach.

Superior: Sustainable performance at a very high level.

Conserving: Performance that has achieved essentially zero negative impact.

Restorative: Performance that restores natural or social systems. It does not apply to all performance objectives.

An excerpt from the Envision v3 points table (Envision v3 Guidance Manual):

			Improved	Enhanced	Superior	Conserving	Restorative	Maximum Points
 <p>Leadership</p>	Collaboration	LD1.1 Provide Effective Leadership & Commitment	2	5	12	18	—	182
		LD1.2 Foster Collaboration & Teamwork	2	5	12	18	—	
		LD1.3 Provide for Stakeholder Involvement	3	6	9	14	18	
		LD1.4 Pursue Byproduct Synergies	3	6	12	14	18	
	Planning	LD2.1 Establish a Sustainability Management Plan	4	7	12	18	—	
		LD2.2 Plan for Sustainable Communities	4	6	9	12	16	
		LD2.3 Plan for Long-Term Monitoring & Maintenance	2	5	8	12	—	
		LD2.4 Plan for End-of-Life	2	5	8	14	—	
	Economy	LD3.1 Stimulate Economic Prosperity & Development	3	6	12	20	—	
		LD3.2 Develop Local Skills & Capabilities	2	4	8	12	16	
		LD3.3 Conduct a Life-Cycle Economic Evaluation	5	7	10	12	14	

By assessing achievement in each area, project teams establish how well the project addresses the full range of sustainability indicators and are challenged to pursue higher performance. Credits can be omitted from consideration if "not applicable" when the sustainability indicator does not exist for the project (for example: for an underground project, "QL1.5 Minimize Light Pollution" would not apply).

BONUS POINTS FOR INNOVATION: The Envision framework encourages innovative methods and performance beyond the credit requirements' expectations. A project may earn these points for any of the five categories for innovation, exceptional performance, and additional aspects of sustainability. These bonus points are added to the total score.

USES OF THE ENVISION RATING SYSTEM

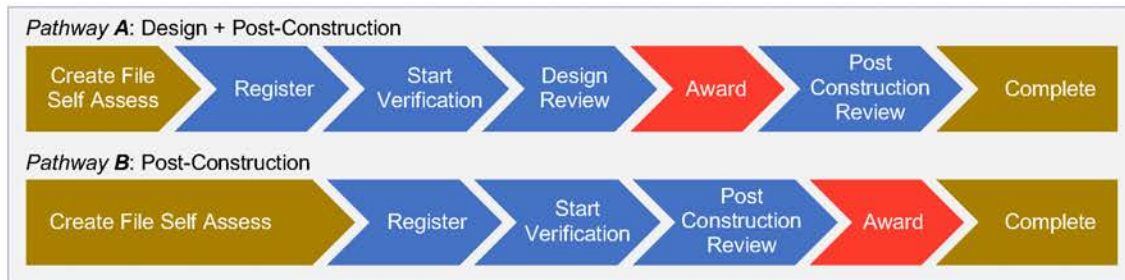
Envision framework is valuable to the infrastructure industry in several different ways:

Guidance: Envision framework guides the project teams about the sustainable development of infrastructure projects and their key challenges. It provides guidance to recognize the social, environmental, and economic systems within which sustainable development must occur. Some of the major factors to be considered are population growth, climate change, and resource constraints, which have a tremendous impact on infrastructure projects.

Help Identify Improvement Opportunities: Project teams can conduct self-assessment using Envision rating system. Many of the Envision credits are interrelated. Each credit includes a list of potentially related credits, which help the project teams leverage the synergies by these connections to improve their project's overall sustainability.

Communication: Successful sustainable projects require a new way of thinking about how projects are developed and delivered. Project teams are most successful if they communicate and collaborate early on, involving various people- the sponsors, various stakeholders, including the public and regulatory agencies.

Apply for Award: Projects may choose to pursue one of two verification pathways:



A project may choose to pursue verification either after the design phase (at or after 95% design completion) or after the construction phase (at or after construction completion.). The project team can submit their self-assessment online scoresheet to ISI for third-party verification. Designated third-party verifiers complete verification, and ISI staff provides oversight and quality control throughout the process. After verification, ISI confers an award for the project.

AWARD LEVELS: There are four levels of awards given to projects after verification is completed. To receive recognition, projects must achieve a minimum percentage of the total applicable Envision points. Projects can be recognized at four award levels: **Verified** 20%; **Silver** 30%; **Gold** 40%; and **Platinum** 50%.

ENVISION SUSTAINABILITY PROFESSIONALS (ENV SP)

ISI provides training to infrastructure professionals to help them leverage the resource to its fullest potential. Individuals who complete the ENV SP Training course and exam are conferred the Envision Sustainability Professional (ENV SP) designation. The course is available online as seven 1-hour modules. In-person credential training is available as full-day workshops delivered by approved ISI trainers. The credential exam is available online, consists of 75 multiple choice questions, and requires a passing score of at least 75% in three attempts. ENV SPs then need to maintain their credential annually by completing a designated amount of continuous education and submitting an annual renewal fee.

The ENV SP Directory on the ISI website lists more than 8,000 individuals who have achieved ENV SP designation. Seventy-three of them are approved ISI trainers as well.

While ISI members and ENV SPs are primarily located in the USA and Canada, some ENV SPs are in other countries. For example, Italy has 114 people with the designation, while in Southeast Asia (Bangladesh, India, Pakistan, and Sri Lanka), there are three individuals with this designation (2 in India and 1 in Pakistan). There are 4 ENV SPs in Saudi Arabia.

REFERENCES:

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