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Liberalization, Trans-European Corridors and EU Funds: A New Scenario in the Relationship between Rail Networks and Mediterranean Cities

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Abstract: The trans-European transport network (TEN-T) is a key factor in the relationship between railway development and urban growth in Europe, with a tangible impact on urban morphology. In this scenario, the aim of this article is to analyze how the Mediterranean Railway Corridor (EU's TEN-T strategy) is inducing new processes of railway integration in the urban system located along the Spanish Mediterranean coast. Our working hypothesis is based on the analysis of three vectors that are modifying the relationship between high-performance rail networks and cities, using new processes that have been overlooked by most of the existing scientific and EU grey literature. Firstly, the development of a trans-European transport network (TEN-T) is driving new and complex rail projects that are associated with achieving the full interoperability of the trans-European rail corridors. Secondly, the European liberalization of passenger transport is promoting rail operations with a strong urban and morphological impact, due to the resulting increase in rail services. Finally, the European response to the consequences of the 2020 COVID-19 pandemic has made it possible to launch large-scale financial operations aimed at sustainable transport projects, including rail projects. We have carried out an analysis of the academic and institutional literature and we have also considered three case studies along the Mediterranean Corridor in Spain: Barcelona, Valencia, and Murcia. For each one, we present the structure of the current rail networks, the ongoing urban integration projects driven by the Mediterranean Corridor, and the resulting implications for urban morphology, as well as the opportunities they bring from a socio-economic perspective. Therefore, we argue that there is a triple substantial change: the significance of rail and urban projects (from the national scale to throughout the European Union), the operational network (from the domestic high-speed network to the TEN-T network), and funding (from state self-financing to European CEF and RRF funds). Nonetheless, further research activities are needed to assess how the revision of the TEN-T regulation strategy will affect the urban–railway relationship.

Keywords: urban morphology; trans-European transport network; Mediterranean corridor; city morphologies; Spain

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1. Introduction

In recent decades, Spain has been characterized by a strong relationship between the development of its high-speed rail network and intense urban growth. This conjunction explains the relevance of the current topic and the need to study it carefully and rigorously. Spain is currently the second country in the world in terms of the number of kilometers of high-speed rail track in operation. According to updated data from September 2022, Spain is second in the world after China in terms of the length of its operational lines. With regard to the number of kilometers under construction, the importance of this phenomenon in Spain is even greater: Spain has 1055 km of high-speed track under construction and another 863 km are planned. If China is excluded from the list (due to the size of its territory), Spain

accounts for 20 out of every 100 kilometers of high-speed track in operation in the world and for almost a third of the kilometers of high-speed track in operation in Europe [1].

According to official data from the Railway Infrastructure Administrator (ADIF) [2], more than EUR 57.2 billion were invested from its launch in 1992 up to 2022 (thirty years of high-speed rail service in Spain). In 2022, the portfolio value of the ongoing projects associated with high-speed rail networks reached EUR 11,500 million, and the calculations for the 2021–2025 period estimated an investment of EUR 12,000 million.

As we aim to show, this strong relationship between rail transport systems and cities in Spain is due to the intensity with which both processes have increased in this country during the last decades of the 20th century and the beginning of the 21st century. From 2001 to 2021, the population of the Spanish urban system increased by more than 6.5 million inhabitants, representing a percentage increase of 20%. This was mainly driven by Spain's large urban areas (GUAs)[1] (accounting for 5.2 million), which grew from 27.6 million to 32.7 million.

It is impossible to understand the relevance of this matter without addressing both processes and their complex relationships and manifestations, especially their repercussions for the urban life, economy, and morphology of the affected cities. We argue that, following the initial phase of a radial extension of the high-speed rail (HSR) network to and from the capital of Spain, the new European transport policies, namely, rail traffic liberalization and the extension of the TEN-T network, will continue to emphasize the close relationship between rail and urban space even further. EU funds play a crucial role in this scenario. From 2000 to 2017, the European Union mobilized a total of EUR 23,731.1 million during these almost two decades, of which 47.3% went to the Spanish network. This was followed by the German (11.4%), the Italian (8.6%), the French (8.4%), and the Polish (8.4%) networks [3].

In fact, through the liberalization of long-distance rail traffic, Spain now has three different rail operators (RENFE, IRYO, and OUIGO) and four services competing against each other. This is a unique situation in Europe, making Spain a country with a first-rate rail infrastructure.

In light of this background, this article first aims to analyze the new role set aside for urban nodes, and ultimately cities, in the TEN-T network—approved in 2013 and currently under revision—as well as the problems it uncovers and the actions it promotes in urban environments. In this sense, the relationship between high-performance trains (in some cases, equivalent to high-speed trains) and cities, a relationship that has been driven by an important development phase of over 20 years in Spain, is now complemented by another relationship in which the cities' functional and morphological demands have become more complex due to the development of the TEN-T network. The requirements of the relationship between rail and city in the TEN-T network are different from those of the high-speed network. The working documents that we will analyze emphasize coordination, the integration of different modes of transport, different rail service scales, the coordination of freight and passenger traffic, and even sustainable mobility. None of this appears in the literature that we have examined on the relationship between the high-speed rail network and the city in the first 20 years of its existence (1992–2022). Due to this absence, we consider that with the approval of the regulations in 2013 that made the idea of a trans-European rail network (also a road, port, and airport network, although we will focus on rail) a reality, a new phase has begun, with new demands on the functional and morphological relationship between rail and city. Furthermore, two factors have been added in this new phase: the liberalization of long-distance transport (national and international) and new sources of European funding associated with combatting the effects of the economic crisis caused by the COVID-19 pandemic. These new sources are strongly committed to supporting rail transport.

In this article, we will offer an analysis and examination of the official documents produced by the European Commission on urban nodes and the TEN-T network. Furthermore, we will specify the urban issues and operations in European cities along the Mediterranean

Corridor within this network, focusing on the cases of three Spanish cities. We aim to show the new requirements demanded of cities, from a morphological and functional perspective, when facing rail development in a TEN-T network. Thus, the following research questions have been posed:

How do the European documents associated with the TEN-T network define urban nodes and what relationship with the transport network is proposed?

How have other factors, such as the liberalization of long-distance rail transport or the European funds associated with combatting the consequences of COVID-19, influenced the development of the railway business and its morphological consequences in cities?

What actions are being carried out regarding this matter in some cities along the Spanish Mediterranean Corridor?

Theoretical Framework: City and High-Speed Rail in Spain

Numerous academic studies in Spain have focused on analyzing the relationship between high-speed trains, cities, and the general Spanish urban system. This is not only because rail travel is conceptually linked with the concept of "urban" but also because of the significant social, economic, and morphological impact of the development of the network on cities (which, as has been shown, is strong). Developing more than twenty new high-speed lines or sections in Spain in less than twenty years (together with their complementary installations and new or expanded stations) and coordinating the insertion of new infrastructures in already consolidated urban fabrics could not fail to attract the attention of the academic community.

Thus, there are notable studies that analyze how the relationship between train and city began to develop in various Spanish cities from a historical perspective, with high-speed rail being the last chapter analyzed in this long process. Professor Carmen Delgado's studies on Spanish port cities up to the first third of the 20th century [4] and on specific territories such as the region of Cantabria [5,6] are paradigmatic. Similarly, it is important to highlight the work conducted on the whole of Spain between 1850 and 2000 [7] regarding the influence of rail on urban growth between 1850 and 1960 [8], on the development of Spain between 1860 and 1910 [9], and on the city of Bilbao between 1850 and 2000 [10]. The documented works of Horacio Capel [11,12] on rail networks and the development of the territory and the urban phenomenon must also be considered, as well as Cruz Villalón's generic work on Spanish railway planning [13]. Inmaculada Aguilar's pioneering historicist approach to the stations and urban morphology of Valencia [14,15] and the development of the network in the Valencian region [15], as well as Baron's most recent work on the political debate regarding train stations in the high-speed network [16], are also of great interest.

Another line of study has focused on a contemporary and current perspective, with a special focus on the development of the high-speed network. Most of these works analyze the economic impact and territorial effects on the Spanish city system. Here, the studies by Álvarez-Palau [17], Bellet [18], Bellet, Alonso, and Casellas [19], Gutiérrez Puebla [20], Ureña [21], Bellet and Ureña [22], or Ureña et al. must be mentioned [23]. Without clear differentiation, other studies also point to urban morphological impacts, such as that by Bellet and Gutiérrez [24], who propose a model and typology of situations between high-speed trains and urban and urbanized space in Spain, Santos [25] (focusing on all of Spain), Viana [26] (focusing on Barcelona), Alonso and Bellet [27], and Bellet and Alonso [28] (focusing on Zaragoza). It should be noted that it is not only large cities that have been analyzed in this way. Due to the progress of stations and cities connected to the high-speed network, there are also studies that focus on medium-sized cities in Spain, such as the work of Santos [29], Bellet [30] (focusing on the city of Lleida), Bellet, Alonso and Casellas [31] (focusing on Segovia), Saus [32] (focusing on Valladolid), and Sastre [33] (focusing on Girona). Even cities characterized as "peripheral" (Ciudad Real, Guadalajara, or Segovia) have made scientific contributions, such as the study by Ribalaygua [34] (also including seven French cities) or Bellet [35]. In this brief summary of works, we cannot fail to mention positions that are critical of the Spanish high-speed rail model (AVE), such as

the works by Albalate and Bel [36], Bel, Estache, and Forcaud [37], and Romero et al. [38], and that discuss the relationship between cities and high-speed trains in Spain, such as those published by Santos [39–41]. However, the literature analyzed here does not take into account the relationship between the urban areas and European transport corridors. Thus, it is necessary to consult the institutional documents of the European Commission.

Finally, on an urban morphological scale, two major types of urban operations [18] can be derived from this experience: the remodeling of the arterial rail network to better integrate the railway into the city and the implementation of urban projects associated with the new centrality in the surroundings of the stations or on the land occupied by former rail facilities. In this way, authors such as Bellet and Gutiérrez [24] have defined five models for the implementation of high-speed trains in cities in Spain. The first was based on a new rail system outside the urban centers (Ciudad Real, Figueres, Burgos, or Pamplona); the second consisted of the construction of an external diversion for through traffic and the movement of large installations outside, freeing up land for large urban operations (Seville, Zaragoza, and Valladolid); the third focused on a slight reorganization to improve the urban structure (Córdoba, León, Almería, and Valencia); the fourth focused on the refurbishment of stations rather than on changes to the railway model (Lleida, Málaga, Logroño, and Gijón) and finally, the fifth model focused on a new railway model that imposed conditions on the city, especially in the case of peripheral stations (Antequera, Camp de Tarragona, Requena-Utiel, and Guadalajara).

2. Materials and Methods

To further study the influence of the configuration of the TEN-T network on the new plans for rail development and their consequences for urban morphology, we have used a series of key materials, some of which are unpublished. The sources are the following:

1. Official Work Plans of the European Coordinator for the Mediterranean Corridor of the European Commission for 2020–2021 and 2022–2023.
2. Official documents from the Spanish infrastructure manager, ADIF, on high-speed rail transport and investments in the 20 years of existence of this type of transport (1992–2022).
3. Personal notes from the authors' participation in the ordinary meetings of the European Forum of the Mediterranean Corridor (European Commission) between 2018 and 2023.
4. Presentations by different Spanish cities and the rest of the European Union in the Thematic Working Group meetings dedicated to urban nodes within the activities of the European Mediterranean Corridor of the TEN-T network.
5. Fieldwork on work sites in three cities along the Mediterranean Corridor in Spain: Barcelona, Valencia, and Murcia.

Many of these sources have been directly provided by those involved, without previous publication. They are unpublished or have been circulated in the internal meetings of the European Mediterranean Corridor. This documentary analysis made it possible to establish a comparative pattern between urban nodes and rail in relation to the TEN-T network and the Mediterranean Corridor project. It has been necessary to use documental sources in which the "urban node" and its relationship with rail infrastructure is defined for comparative analysis and to simultaneously establish a new perspective in comparison with the traditional plans for the extension of the national high-speed network.

This material was ordered according to the work plans of the European coordinator of the Mediterranean Corridor, which specify the new functions established by the TEN-T network project and its consequences for urban morphology and functionality in the affected nodes. From there, the plans and presentations of different European cities in the periodic work sessions of the European Forum of the Corridor and thematic sessions on urban nodes were analyzed in the general context. The aim was to detect regularities in the problems presented and in the actions analyzed. Lastly, we focused on studying three Spanish cities included in the Mediterranean Corridor project.

Thus, a connection can be found between three fundamental dimensions:

1. The general considerations of the working documents of the European Coordinator for the Mediterranean Corridor (part of the TEN-T network) regarding the issue of urban nodes and their morphological and functional needs concerning the said network. These documents are compulsorily written by the different coordinators of the TEN-T network, and they have allowed us to explore this relationship between rail and urban nodes.
2. The case studies of European cities as the general context for a practical response to the previous considerations.
3. The case studies of Spanish cities according to specific actions resulting from their inclusion in the TEN-T network and, specifically, the Mediterranean Corridor.

For these specific case studies, we have analyzed the unpublished material presented by different European cities along the Mediterranean Corridor in internal work sessions that the authors of this article have been able to attend as members of the technical team of the Office of the Mediterranean Corridor of the Spanish government. In particular, we have briefly analyzed the cases presented by different stakeholders in Lyon, Budapest, Marseille, and Milan from 2016 to 2017. In more detail, we have studied projects associated with the work plans of the Spanish Mediterranean Corridor in Barcelona, Valencia, and Murcia up until the present day.

3. Results

3.1. Theoretical Research: The Significance of Urban Nodes in the TEN-T Network Literature

Until well into the 21st century, national developments in the high-speed network were the only vector that explained the significant growth of long- and medium-distance rail activity in Europe. However, after 2011, with the European Union's political decision to reform the trans-European transport network, which until then had been limited, the number of operational kilometers and the needs of certain stations began to increase due to the development of this network. Furthermore, cities were not only impacted by the network but they also became fundamental points for the definition of the network itself. Thus, the relationship between railway corridors and cities became even stronger, with a new scale of action.

In this case, rather than analyzing the development of the TEN-T network, we are interested in highlighting the fact that cities were already an essential component when it began to take shape. To this end, we have analyzed the original methodological study (Transport and Mobility Leuven [42]) that led to the creation of the TEN-T network and its articulation in the subsequent regulations of 2013.

From the beginning, the methodological and theoretical program that was to inspire the creation of the TEN-T network adopted a purely urban position, to the point that cities (under the terminology of "urban nodes") were essential components according to the needs of which the network was designed. In addition, the study considered a complete series of first-level geographical criteria and even incorporated the results of some studies and terminologies that were—and still are—new in terms of the urban articulations that were emerging. In fact, the methodological study carried out for the European Commission expressly cites the space of flow paradigms, as well as urban–regional-based spatial configurations such as mega-city regions, city regions, functional urban regions, the European urban hierarchy (in its five categories: global nodes, European engines, strong MEGAs, potential MEGAs, and weak MEGAs) and studies on mega-regions in the United States. However, what did the European Commission understand by "urban node"? This is defined in Article 3, point p:

> "Urban node' means an urban area where the transport infrastructure of the trans-European transport network, such as ports including passenger terminals, airports, railway stations, logistic platforms and freight terminals located in and

> around an urban area, is connected with other parts of that infrastructure and with the infrastructure for regional and local traffic" [43]

As can be seen, the Commission envisions an urban area in which an essential role is played by infrastructure, in addition to its interconnection and connection to a smaller network. Regulation 1315 goes even further by dedicating the entirety of Article 30 to "urban nodes".

These urban nodes played an essential role in the network planning methodology, which was based on three basic factors:

1. The combination of geographical and economic criteria;
2. The identification of urban nodes as a framework for the network;
3. Multimodal connections between nodes, based on traffic flow.

Thus, the first step in the methodological process of building the network was to identify the so-called "main European nodes". These were those areas that were of the greatest strategic importance for the European Union as a whole. There were two classes: primary nodes (P) and secondary nodes (S). Urban primary nodes were identified according to the following criteria:

- Capital city of each member state;
- All metropolitan growth areas (following ESPON criteria);
- Conurbations of urban clusters (including their corresponding peripheries), as defined by the corresponding LUZ (larger urban zones, according to EUROSTAT and Urban Audit)
- The main border-crossing point for each mode of transport (between member states and between member states and non-EU neighbors).

These were joined by other non-urban nodes, which were, however, of equal importance in the future map of the network. It is on this basis (that of urban nodes and transport nodes) that the TEN-T network and the Union's strategic transport corridors were created. Thus, not only did it transform limited sections into a network, but it also "Europeanized" transport policy (Jensen and Richardson [44] and Boira and Berzi [45]) by altering the logic of the projects and by considering their added value and the connection between the 88 defined urban nodes (regardless of the national "interests" of the member states), as the following text points out:

> "Urban nodes play an important role within the multimodal Core Network, with regard to their infrastructure both for passengers and for freight. Apart from their wide range of economic, social and cultural functions, for the Union's transport system, they are particularly relevant in the following respect: (1) they connect network links—both of the core and the comprehensive networks; (2) they interconnect transport modes, thus enhancing multimodality; (3) they connect long distance and/or international with regional and local transport (passengers and freight)" [46]

In summary, we can conclude that the urban dimension was particularly significant in the methodological genesis of the TEN-T network (Figure 1).

In 2016, a collegiate document from all the European coordinators of the TEN-T Core Network was presented at the TEN-T Days event held in Rotterdam [47]. This document contains a chapter dedicated to urban nodes under the title "Effectively integrating urban nodes", which points out their importance: "Urban nodes have become an integral part of the development of the trans-European network (TEN-T)". Following this statement, the document highlights three specific challenges: the need to address new actions in urban nodes to ensure correct future mobility, the need to solve first- and last-mile movements, and the necessary coordination between urban nodes and nodes in the network. Lastly, it states the need for extraordinary funding to address these challenges, highlighting that in the first call of 2014 for CEF (Connecting Europe Facility) funding, EUR 49 million was awarded to projects in urban nodes, which was doubled in the 2015 call.

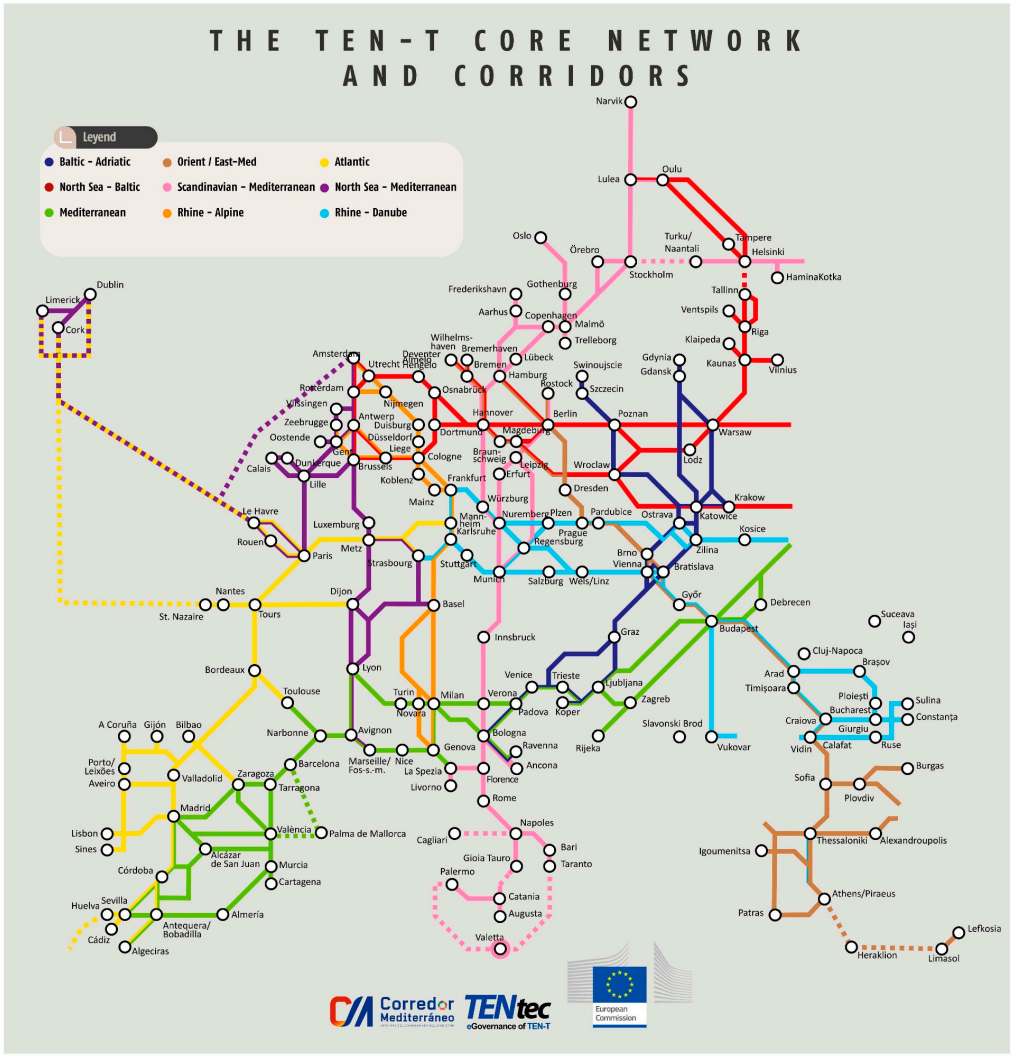

Figure 1. Trans-European transport network corridors. Source: Office of the Government Commissioner for the Mediterranean Corridor from DG MOVE (European Commission).

The second document was presented at the European Forum of the Mediterranean Corridor on June 2023 [48]; Isabelle Vandoorne, Deputy Head of the Unit, Research and Innovation (and Urban Mobility) of the DG MOVE, described the challenges that cities have to face when dealing with the TEN-T network, challenges that did not appear along with the traditional agenda of the arrival of high-speed trains in a city, especially as rail freight transport and local and regional mobility are considered to be within the same functional plan for infrastructure planning.

The great majority of the EU population is concentrated in cities, towns, and regions. Cities often represent the first and last mile of passenger and freight transport and, thus, it is necessary to improve coordination between long-distance and local/regional mobility and the related planning. The objectives are to ensure the effective functioning of the trans-European transport network and the seamless mobility of passengers and freight within, into, out of, and through urban nodes.

Furthermore, we have analyzed the most recent work plans of the European coordinator for the Mediterranean Corridor from 2020 and 2022. The first 2020 Work Plan (WP20) [49] includes, as a center of interest, the necessary coordination between the international, regional, and local rail traffic that converges in cities to ensure "a seamless flow of high-speed passenger and freight flows", taking into account functionality and a morphological solution. According to the WP20, this phenomenon must be closely monitored

in Valencia, Madrid, Barcelona, Milan, and Budapest. Lastly, this document emphasizes concerns regarding the physical and functional connection between cities and the TEN-T network: "In conclusion, together with cross-border links and interoperability issues and improvement of rail connections to ports, the resolution of major bottlenecks in urban nodes is one of the main challenges for the development of the Mediterranean Corridor".

In the fifth Work Plan of 2022 (WP22) [50], the space dedicated to urban nodes increases significantly (incorporating 17 references). For the first time, it highlights the ongoing revision of the regulations, which will make it possible to add new cities to the previous list of nodes, including Palma de Mallorca, Toulouse, Nice, and Genoa. Thus, urban nodes are of the same political interest to the Commission as the Green Deal or the financial contributions of the Recovery and Resilience Facility (RRF). There is also a new chapter (3.3) on the development of urban nodes in 2030, which integrates key concepts such as the last mile, multimodality, bottlenecks, and missing links:

> "Urban nodes represent most of the points of origin and destination of transport flows on the Corridors. The effectiveness of the Corridors is therefore impacted by the effectiveness of the first and last miles of the journeys in those urban nodes and it is important to ensure sufficient multimodal connections. Urban nodes can also contain bottlenecks and missing links on the Corridors; conversely, they can be impacted by the negative aspects of traffic on the Corridors in terms of pollution, noise, and safety".

The European Commission's proposal for the revision of Regulation 1315/2013 gives great importance to urban nodes, to the extent that it modifies some of the chapters contained in the original 2013 document.

Specifically, the Commission's revision proposal insists that it is necessary to ensure that neither potential capacity bottlenecks nor insufficient network connectivity within urban nodes can hinder multimodality along the trans-European transport network. In addition, by 2025, 424 cities identified in the new TEN-T regulation document (Annex II) must first have multimodal passenger hubs, including parking and transport facilities, to improve first- and last-mile connections and enhance the capacities needed for long-distance connectivity via rail and other modes of transport within and between cities. Secondly, by 2025, they will need to develop a sustainable urban mobility plan (SUMP[2]) that includes measures to integrate different modes of transport and promote zero-emission mobility [51]. Large airports should also have rail connections (high-speed where possible).

Furthermore, the proposal for the revision of the 2013 regulation document incorporates new urban nodes into the initial scheme, extending the network. In Spain, the cities that form part of the TEN-T network increased, as shown in the following table (Table 1) and they, thus, incorporated new requirements into their mobility and transport policies because of this affiliation.

Table 1. Urban nodes in the revision of European Regulation 1315/2013.

TEN-T Strategy	**1315/2013**		**COM (2021)812**	
Urban nodes in Spain	Medit. Corridor 5	Total 7	Medit. Corridor 19	Total 48
Urban integration approach	Soft (only on mobility)		Wider (mobility and planning)	
Planning tools	NO		SUMP	
Geographical approach	Municipalities		Functional Urban Areas	

3.2. Liberalization: More Trains in Cities

The final process in the liberalization of rail services in Europe began on 14 December 2016, when the European Parliament approved the Fourth Railway Package. This was the legal and political framework that removed the institutional, legal, and technical obstacles hindering a fully integrated and liberalized European rail network.

In Spain, the liberalization provided for in the Fourth Railway Package was transposed into Spanish law by Royal Decree–Law 23/2018 of the Railway Sector, which set December 2020 as the start date for new rail companies to enter the field of passenger transport for long-distance and high-speed services. Although this article is not the place to cover the history of the liberalization process in Spain, we can say that the infrastructure manager (ADIF) established a system by selecting three rail corridors for the implementation of this liberalization: the Madrid–Barcelona–French border, Madrid–Valencia, and Madrid–Toledo–Seville–Malaga. It established three different levels of operability for each one, categorized as packages A, B, and C. On 27 November 2019, ADIF pre-awarded the different packages as follows:

- Package A: Renfe Viajeros, a selected company with 96 AVE trains, which will occupy an average of 86% of the capacity offered for this package in all three corridors. In this way, it increases its current offer by 20%. The launch of the operation is to take place between the end of 2020 and the end of 2030.
- Package B: ILSA, with 23 Frecciarossa 1000 trains, which will occupy an average of 70% of the capacity offered for this package in all three corridors. The services of its trademark company, IRYO, began in November 2022 between Madrid and Barcelona, in December between Madrid and Valencia, and in April 2023 between Madrid and Seville.
- Package C: RIELSFERA, which will operate with 10 Alstom Duplex trains (bilevel) and occupy 100% of the capacity offered for this package in all three corridors. Its services began in May 2021 between Madrid and Barcelona and in October 2022 between Madrid and Valencia.

At the time, the calculations made by ADIF predicted a 65% increase in the capacity offered: a 50% increase in Madrid–Barcelona, 40% in Madrid–Valencia, and 60% in Madrid–Andalusia. In fact, ADIF and ADIF Alta Velocidad offered an overall capacity that was 60% higher in this process globally than previously: 189 trains per direction and per day, compared to 119 for the benchmark set in 2019 [52]. In addition, this process led the Spanish public company, Renfe, to launch low-cost high-speed services (AVLO) on the Madrid–Barcelona line in June 2021. This type of service reached the Madrid–Valencia line in February 2022, carrying almost one million passengers on this corridor in a year. The offer reached Alicante in March 2023 and Malaga and Seville (with a daily train in each direction) on 1 June 2023.

Although it is too early to have reliable data available regarding passenger increase, we can state that for the first quarter of 2023 [53], there has been a cumulative growth in track use of 11.8% compared to the first quarter of 2022, reaching 48.9 million train-km as of March 2023. Likewise, the number of travelers also grew by 11.6%, although the steepest increases occurred in stations with high-speed services, with a growth of 29.6% (for those in the conventional network, it rose by 4.9%). Overall, the increase in the ADIF Alta Velocidad network grew to 36.9% (a level higher than in the pre-COVID-19 stage).

According to the high-speed rail axes, growth in the first quarter of 2023 (the full quarter in which there were three operators of the high-speed rail service in Spain) was greater in the Madrid–Valencia corridor, which increased by 119% compared to the same quarter in 2022. This is followed by the Madrid–Barcelona axis (+57%) [54]. Recent news (May 2023) already includes new proposals for liberalized lines in the near future, such as the sections between Madrid and Murcia, that between Madrid and Valladolid, and connections with Galicia.

Figure 2 indicates this recent growth, together with the recovery in traffic levels following the COVID-19 pandemic, and the influence that the entry of new operators (OUIGO and IRYO) or services (AVLO) has had on passenger growth, far exceeding levels prior to the COVID-19 pandemic. There is general growth in the three submarkets analyzed: Madrid–Barcelona, Madrid–Valencia, and Madrid–southern Spain.

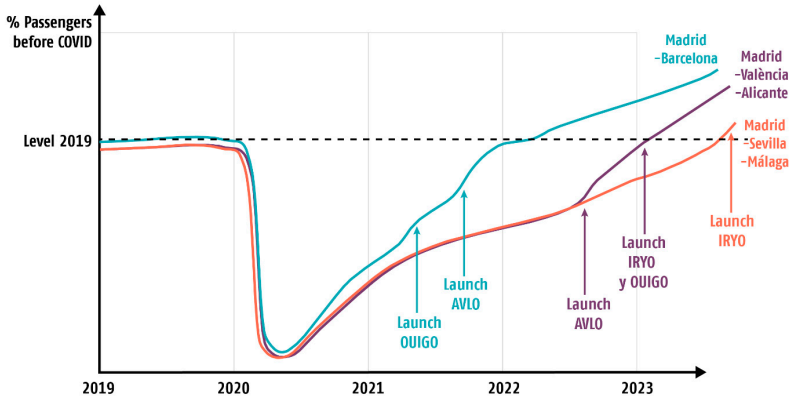

Figure 2. Growth in the number of passengers over the 2019 levels prior to COVID-19 with the start of rail liberalization services, shown by corridor. Source: ADIF.

3.3. New Sources of Funding: Next Generation Funds

To combat the economic and social consequences of the COVID-19 pandemic, in July 2020, the European Union launched the Recovery and Resilience Facility (RRF) within the Next Generation initiative, with an approximate budget of EUR 672 billion in aid and loans. Each member state wishing to benefit from this fund had to present a specific plan with the measures it had established to fulfill the requirement that at least 37% of the investments planned and covered by this fund be allocated to combating climate change and 20% to digitalization. In this context, many member states decided to allocate large investments to green infrastructure and decarbonization and, logically, rail was one of the key investment destinations.

A recent study by Europe on Rail [55] has shown that, in some areas, funds associated with transport reached 33% of the RRF plan (e.g., Romania). Moreover, in some countries, rail accounted for up to 85% of the funds associated with transport. The following table (Table 2) is a clear example of how European funds related to combating the consequences of the COVID-19 pandemic have injected new budget allocations into rail operations. As seen in previous chapters, cities are fundamental components of rail operation, directly impacting its urban morphologies.

Table 2. Main investments of RRF funds in the rail sector in Europe.

Country	Total RRF	Transportation	Transportation Out of RRF	Rail	Rail Out of Total Transport	Rail Out of Total RFF	Weighted Ranking
Germany	27,949,882,000	5,927,000	0.02%	727,000	12.27%	0.00%	6
Poland	58,100,000,000	7,518,000,000	12.94%	4,023,000,000	53.51%	6,92%	4
Romania	29,000,000,000	9,620,000,000	33.17%	5,000,000,000	51.98%	17.24%	1
France	40,000,000,000	7,700,000,000	19.25%	4,700,000,000	61.04%	11.75%	3
Spain	69,528,000,000	13,203,000,000	18.99%	6,268,000,000	47.47%	9.02%	3
Italy	191,500,000,000	33,980,000,000	17.74%	28,710,000,000	84.49%	14.99%	2
Portugal	16,644,000,000	1,547,000,000	9.29%	853,000,000	55.14%	5.12%	5

Source: https://ec.europa.eu/info/business-economy-euro/recovery-coronavirus/recovery-and-resilience-facility_en (accessed on 15 July 2023) (prepared by Cristina Costa and reviewed by Jeremie Fosse (Eco-Union).

The creation of this table led its authors to establish a ranking of these countries based on their financial commitment to railways, classifying Germany and Portugal as lagging behind, Poland and Spain as mid-runners, and Romania, France, and Italy at the top of the class. In the case of Spain (Table 3), and within its own plan, component 6 drives this important rail investment, as can be seen in the table [56].

Table 3. Main investments of RRF funds in the railway sector in Spain.

Investment/Program	Amount (Million EUR)	Award Procedure
National Transport Network: European corridors	2987.6	Direct investment
National Transport Network: Trans-European Transport Network (other actions)	1905	Direct investment
Intermodality and logistics	974.5	Direct investment
Sustainable and digital transport support program	800	Competitive calls through the ministry or regions

Source: Ministry of Transport, Mobility and Urban Agenda (MITMA), Spain.

Within this important investment area, many projects regarding stations, urban nodes, and sections of trans-European corridors in cities have received substantial funds for their development, as we will see in the next section.

4. Case Studies

The TEN-T network is a factor in the structuring and reorganization of urban morphology. Works and projects aimed at the creation of new passenger stations, intermodal freight terminals, and new or improved railway routes have a direct impact on the quality of public space, as well as its functionality and accessibility on a local, metropolitan, regional, and international scale.

The commitment to the development of more efficient, safer, and more competitive rail transport in the urban and metropolitan context involves important planning efforts and the integration of the built space and its flows. The lack of adequate financial resources often makes it difficult to carry out such projects and fulfill their potential for innovation. However, the inclusion of an urban node in a trans-European transport corridor enables access to sources of funding, such as the Connecting Europe Facility (CEF) or the more recent Recovery and Resilience Facility (RRF).

4.1. European Cities along the Mediterranean Corridor: Concerns and Actions

As we have highlighted, and as an indirect response to the previously seen problem of the relationship between urban nodes and the TEN-T network (Figure 3), different European cities along the Mediterranean Corridor presented a series of interventions through various forums for debate and analysis. These emphasized the following:

- The morphological and functional consequences of their status as an urban node in the TEN-T network.
- Urban nodes need to be analyzed, not only in the context of the core network corridor (CNC) but also in a regional framework.
- Due to the relevant costs, it is necessary to finance many of these projects from different sources, especially EU Funds.
- CNC Fora could be useful for learning lessons from other success stories.

Lyon [57] is a fundamental node for the Mediterranean Corridor and the North Sea-Mediterranean Corridor. International traffic, together with 1200 regional and metropolitan trains per day, creates congestion. To combat this challenge in the short term, work has been started (since 2020) on measures to restore the quality of passenger and freight traffic and improve rail capacity, with an investment of EUR 506 million (16% of which is funded by the EU). In the long term (2025–2035), studies worth EUR 6.5 million (30% funded by the EU) have been initiated to extend the line by 40%.

In Budapest [58], three corridors converge: the Mediterranean, the Orient–East Mediterranean, and the Rhine–Danube. In this case, in addition to short-term improvements, a plan has been in place since 2021 to redefine its rail network via Horizon 2030.

Figure 3. The Mediterranean Corridor and its urban nodes, with case study cities. Source: Office of the Government Commissioner for the Mediterranean Corridor.

With its port and freight terminals, Marseille [59] belongs to two multimodal corridors (the North Sea–Mediterranean and the Mediterranean). The strong growth of regional trains (over 80% between 2004 and 2015), together with an increase in frequency (+3%), has saturated its transport network, with negative consequences in both environmental and financial terms. Thus, measures are being put in place to increase the network's capacity and speed, as well as the flow and strength of the platform. As Marseille is a crucial node in the TEN-T network, the construction of a new underground station and section is planned.

Lastly, Milan [60], a city that also belongs to the Mediterranean and Rhine–Alpine Corridors, exhibits complex rail traffic patterns due to the lack of integration of freight flow with all types of passenger flow (high-speed, long-distance, and local traffic). As a result, the finalization of the "gate stations system" has been proposed, which is a set of hubs for different types of traffic (in conjunction with suburban traffic).

4.2. The Case Study of the Spanish Mediterranean Corridor: Barcelona, Valencia, and Murcia

The Mediterranean Corridor in Spain is redefining mobility and urban space in each of the large and medium-sized cities it crosses. This European Corridor crosses Spain from south to north, with a double route (Figure 3) connecting the main Spanish ports, airports, logistics, and industrial areas through the rail network. We have considered cases in which the three processes that we have analyzed converge from a general perspective: they are cities affected by the transport liberalization processes that belong to the Mediterranean Corridor of the TEN-T network and have received European funds, some of which are from the most recent initiatives such as the Next Generation funds. For each one, we will present the structure of the current rail networks, including ongoing urban integration projects driven by the Mediterranean Corridor and the implications for urban morphology, as well as the opportunities from a socio-economic perspective. Due to their size, technical characteristics, compliance with requirements, and the innovative potential of ongoing projects in urban mobility, we have selected the nodes of Barcelona, Valencia, and Murcia (Figure 4). It must be said that the selected projects are effectively financed on a multilevel and largely by European funds, but they represent aspirations and lines of work of urban planning prior to the pandemic, to liberalization, and even to the formation of the European network and the Next Generation funds. The impulse of cities in terms of sustainability, intermodality, and urban integration has been promoted in a generalized way for cities since the Sustainable Economy Law of 2009.

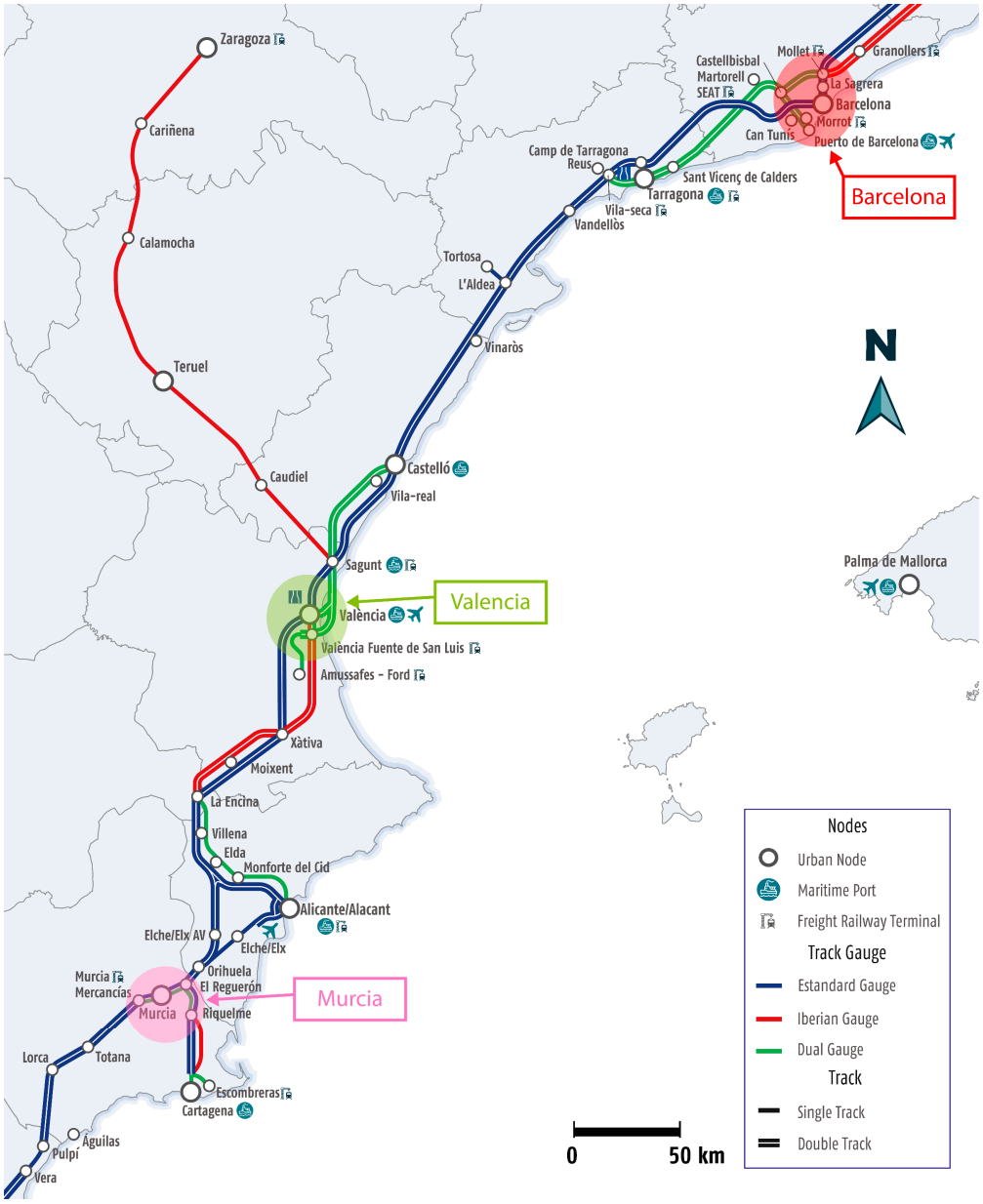

Figure 4. Case studies analyzed and features of the rail infrastructure in Horizon 2030. Source: Office of the Government Commissioner for the Mediterranean Corridor.

4.2.1. Barcelona

In the city of Barcelona, the development of the Mediterranean Corridor has had a significant impact on improving transport infrastructure and its connectivity, both regionally and internationally. Barcelona is one of the main transport nodes in the TEN-T network and has an extensive rail network. In terms of infrastructure, important projects have been carried out to modernize and expand its rail network. Barcelona-Sants Station has been integrated into the AVE network since 2007 and is an important rail node for commercial services with other Spanish and European cities. Improvements have also been made to existing infrastructures, such as the expansion and modernization of stations (including the creation of the Sagrera-Meridiana station for regional trains in 2011), the renovation of tracks, and the implementation of advanced signaling systems (ERTMS). An extremely important task regarding the Mediterranean Passenger Corridor has been the high-speed tunnel that passes under the Sagrada Familia church, allowing trains to run between Barcelona and the French border. This tunnel is a key component in the

improvement of European rail connections and has made it possible to significantly reduce travel times, operating more efficiently and quickly and providing a direct high-speed connection with Europe and the main Spanish cities.

However, the Catalan capital still lacks a true intermodal transport hub since the Barcelona-Sants station has reached the limit of both its operational limits (often being close to saturation) and physical capabilities (it has no room for growth in the urban environment). For this reason, the future La Sagrera-TAV (high-speed) station is being built in the northern part of the city. This station is designed to be the main train station in Barcelona and act as a crucial interconnection node, as it will allow the connection of high-speed trains from different directions, including those of the Mediterranean Corridor. In addition, it is designed to combine high-speed lines with regional and suburban train, metro, bus, and tram services, improving intermodality and connectivity.

The La Sagrera-TAV station project (Figure 5) originated in the planning of the high-speed network in Spain and, specifically, the connection between Madrid and Barcelona [16].

Figure 5. Location of and area affected by the La Sagrera project. Source: Office of the Government Commissioner for the Mediterranean Corridor.

In 2003, the first studies and proposals were initiated to develop a new train station in Barcelona that could handle the growing high-speed train traffic. In 2006, a location was selected in the district of Sant Andreu, in the north of Barcelona. However, the planning and development of the La Sagrera-TAV station project faced various challenges and delays. There were changes to the initial planning and technical and financial difficulties arose, affecting the progression of the project. Between 2008 and 2010, the first construction works for the station were carried out. However, soon after, they were stopped due to the financial crisis that affected Spain at that time, until the construction work resumed in 2013. Significant progress has been made in the construction of the station since then, although the project has continued to face technical and financial challenges. In this sense, European funding has been a strategic element for the continuation of these works. Currently, 65% of the work has been completed and the station is expected to be operational by 2030, according to the deadlines set by Regulation 1315/2013 on the TEN-T network. Once

finished, it will become a true gateway to Europe as the first international transport hub to be located south of the Pyrenees.

The La Sagrera operation can be summarized as the construction of a 3.7 km tunnel that integrates a six-track railway corridor, comprising a new station with eight conventional and eight high-speed tracks with parking lengths of between 200 and 400 m (Figure 6), distributed on two levels and with a single hall. In addition, there is a new area for the technical processing of trains, high-speed and medium-distance workshops, a multimodal metro connection, and a new bus station.

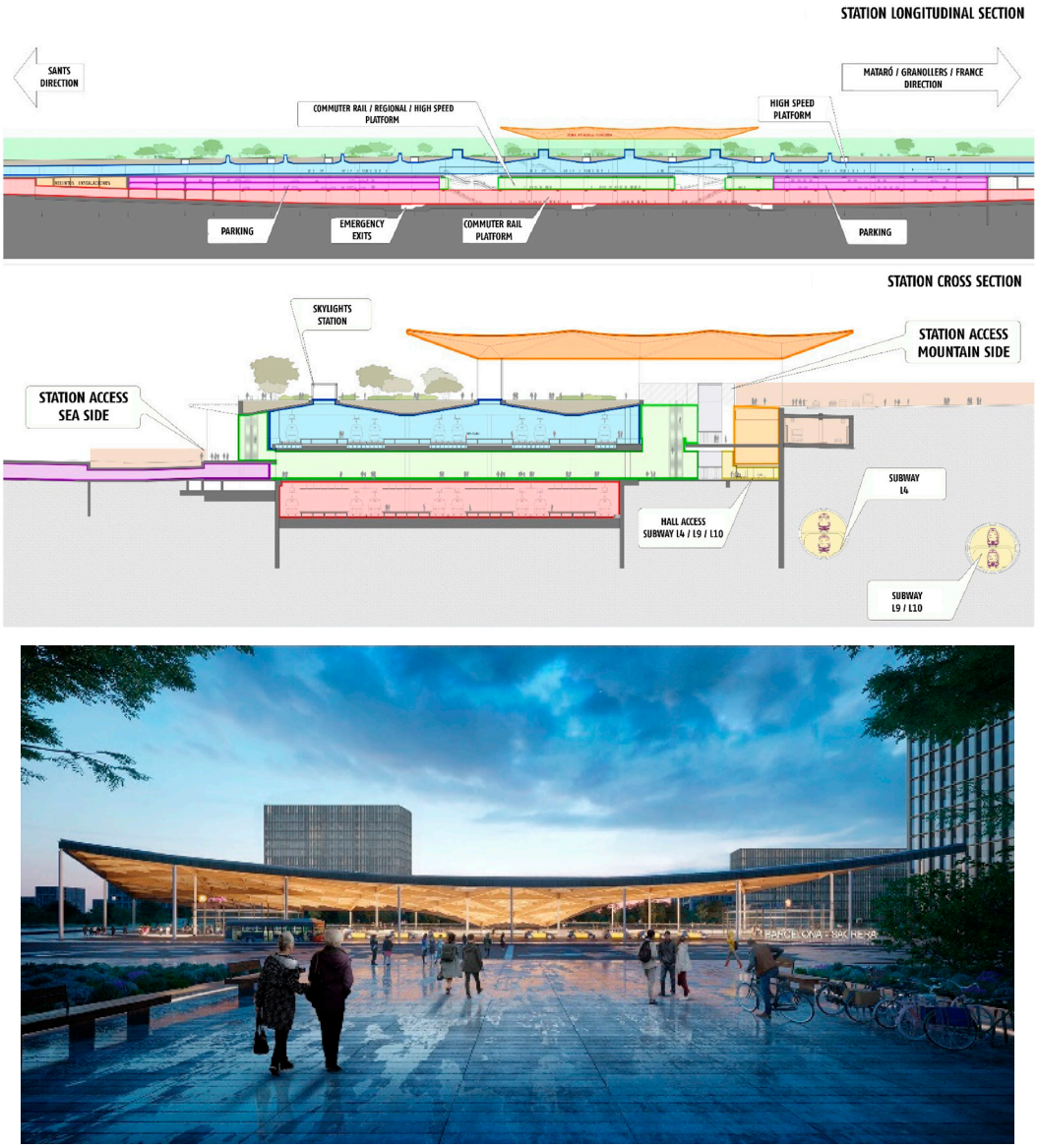

Figure 6. Diagram and rendering of the future La Sagrera station. Source: Office of the Government Commissioner for the Mediterranean Corridor.

This station will be one of the largest in Europe and is, in fact, a multimodal node. The total budget of the work amounts to more than EUR 2240 million (2009 data). According to the 2009 agreement, 50% of the budget was covered by the three governments involved (Spanish, Catalan, and the city of Barcelona), while the remaining 50% was derived from the sale of lots, offices, and hotels.

Regarding urban morphology, the new La Sagrera-TAV station represents a very relevant factor for transformation. Firstly, the urban integration works, especially the undergrounding of the tracks, will increase permeability between the neighborhoods in

the districts of Sant Martí (La Verneda and La Pau) and Sant Andreu (La Sagrera), which have historically been separated by the railway infrastructure. Secondly, the location of Barcelona's main station is in an urban area undergoing a phase of transformation (the district of Sant Martí continues its post-industrial restructuring by opting for supporting the ICT sector). The new station would significantly contribute to shifting the city's gravitational center to the north, opening up new opportunities for socio-economic growth. However, neighborhoods characterized by lower per-capita incomes could benefit from greater accessibility to public transport, improved urban space, and more job opportunities. In contrast, there is the risk of expulsion due to speculation and an increase in the cost of living. Thirdly, the project envisages the creation of a 40-hectare linear urban park that serves as an ecological corridor between the sea and the Parc de Collserola, which surrounds the city.

4.2.2. Valencia

Valencia can be understood as a highly strategic node for the Mediterranean Corridor. Due to its geographical centrality in the Spanish Mediterranean Corridor and its demographic and economic weight (it is the third city in Spain), it has historically played a key role in passenger and freight traffic between the north and south of the Mediterranean. However, the development of rail infrastructure has always been deficient, due to centralist transport policies that favor high-speed lines from Madrid to Valencia, Alicante, or Castellón without connecting the three capitals of the Valencian region to each other. Recently, within the framework of the development of the Mediterranean Corridor, the tracks and electrification of the northbound sections have been adapted and modernized to allow high-speed trains to run to Barcelona.

There are different projects underway in the urban node of Valencia. In 2003, an agreement was signed between the central government, the regional government, the city council, the network manager, and the railway operator to carry out an ambitious project to remodel the city's arterial rail network. The aim was to integrate the future Madrid–Valencia high-speed line (operational to the Joaquín Sorolla station since 2010) with the Mediterranean Corridor through a nine-kilometer tunnel running below the city center. In addition, it aimed to build a new "Central" metro station in the current Nord (North) Station, the integration of which will be part of the project. With this operation, the railway structure in the metropolitan area will be reshaped and the new station will become an important transport node, connecting different train lines, including the high-speed link, and improving intermodality and accessibility in the city. As mentioned above, to do this, it will be necessary to build a through-tunnel that will cross the city from north to south (Figure 7) and will involve two suburban stations (Aragón and Universitats), which will undoubtedly alter the mobility of the city and its metropolitan area.

The first step of this ambitious project is the excavation of a new access channel, which will involve the undergrounding of a railway entrance from Madrid and the Mediterranean Corridor. With work starting in March 2023, the project is a clear example of rail integration and the morphological impact on the urban fabric, as not only does it bury the roads and create new avenues and parks on the surface but it also reorganizes transport flow and will completely renovate the València Joaquin Sorolla high-speed rail station. This last operation came about to respond to the increase in demand caused by the liberalization of passenger transport and the development of the Mediterranean Corridor. The aim is to integrate the railway infrastructure into the urban fabric while increasing station capacity in a way that is compatible with the future Central Station and the through-tunnel (the second phase of redistribution of the arterial railway of Valencia). With this second phase, the redevelopment of the railway area will be completed with the construction of Parc Central, a large green area of more than 244,000 m^2. The undergrounding of the tracks (Figure 8), together with the creation of a park that is among the largest in the city in terms of surface area, will connect the Extramurs, Eixample, Jesus, and Quatre Carrers districts and their respective neighborhoods.

Figure 7. Functional diagram of the Parc Central and Access Canal project, with through-tunnel and new north station (Aragón). Source: ADIF.

Figure 8. The current and future situations after the undergrounding of the tracks. Source: ADIF.

Greater and better accessibility to the city's historic center will generate benefits for neighborhoods that currently suffer from spatial segregation and have a lower-than-average income per capita, such as Malilla, La Creu Coberta, and Sant Marcel·lí. New opportunities for socio-economic development beyond logistics, rail, and port activities could then be created.

The projects currently underway consist of the undergrounding of all tracks to access the València Nord stations (suburban and medium-distance) and València Joaquín Sorolla (high-speed and standard gauge) stations with a 1200-meter tunnel. These works will require the diversion of the city's south collector for a new two-kilometer section. At the same time, the transformation of the València Joaquín Sorolla station has already been initiated, with new platforms and the refurbishment of current ones to adapt them to the new track yard defined by the access channel. These consist of ten standard-gauge tracks, six of which are 200 m long and four of which are 400 m long. Likewise, the passenger building is to be completely remodeled with a new raised lobby, as well as the urbanization of the surrounding area and a new parking lot.

All this work is to be undertaken with a budget of EUR 443 million, 50% of which will be financed by the general administration of the State, 25% by the Regional Government, and the other 25% by the City Council of Valencia. In addition, EUR 164 million is expected to be financed by Next Generation European funds.

4.2.3. Murcia

Regarding the city of Murcia, important initiatives have been carried out for the development of the Mediterranean Corridor and the arrival of the high-speed rail link from Madrid (with lines that will use the same infrastructure). From a regional perspective, the aim of the Mediterranean Corridor is to connect the main nodes (Murcia, Cartagena, and Lorca) toward both Almeria and Valencia and the north, as well as the rest of Europe, always using the standard gauge. Regarding connections with Madrid, this involves a new high-speed section that is already in operation (since December 2022). From the mid-1960s, the cities of Murcia were an international destination for trains coming from the French city of Montpellier. However, in recent decades, the supply of international services decreased until they completely disappeared at the end of 2013. In this sense, the role of the Mediterranean Corridor, together with the liberalization of rail services, is a great opportunity to renew this connection through an interoperable and more efficient network. This will allow the arrival of both daytime and night-time trains and promote more decarbonized tourism.

Regarding the city of Murcia, the development of the Mediterranean Corridor will mean the complete undergrounding of railway tracks as they pass through the main urban center (5.3 km), spanning the districts of Barriomar and Nonduermas, together with the creation of a new urban station (Figure 9).

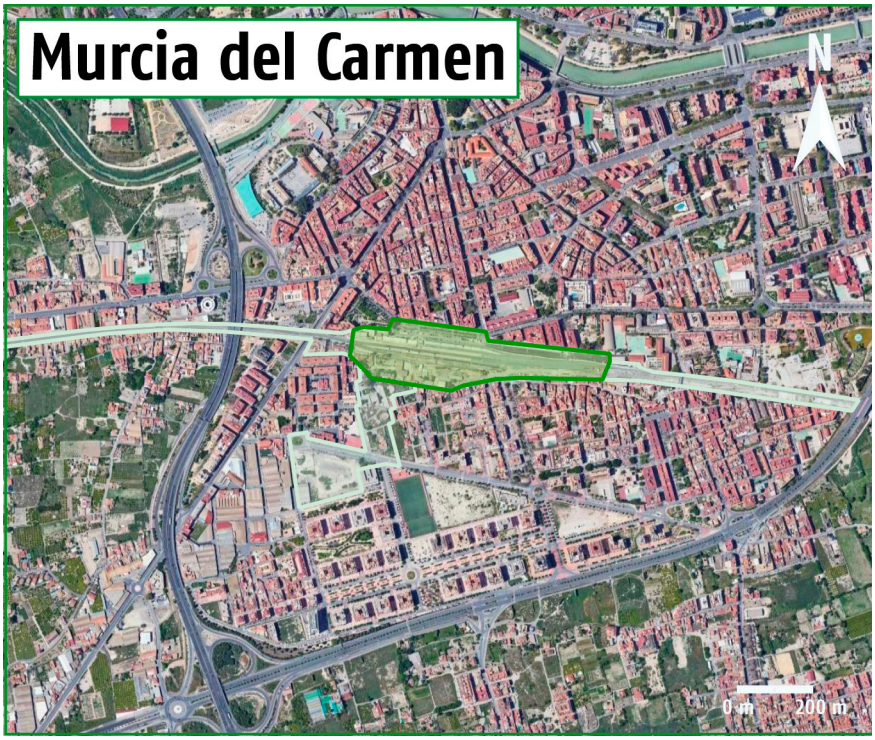

Figure 9. Location of and area affected by undergrounding in Murcia. Source: Office of the Government Commissioner for the Mediterranean Corridor.

It is important to highlight the fact that the development of the Mediterranean Corridor in Murcia has faced challenges and delays in its implementation. The initial project did not predict the undergrounding of the tracks (for economic reasons) but assumed the installation of screens on the surface that would have accentuated the city's urban fragmentation. After demonstrations and actions were taken against the works, a citizen protest movement managed to ensure that the railway infrastructure manager (ADIF) modified the project to include the complete undergrounding of the tracks. This event has contributed to improving the urban integration of the Mediterranean Corridor in the city of Murcia and to shaping its urban morphology in a more integrated, permeable, and seamless way. The cost

of the project is more than EUR 340 million, partly financed by European ERDF funds. The increase in the number of tracks in the future station (up to seven platforms for passengers and one exclusively for goods) will allow long- and medium-distance and suburban traffic to increase. The undergrounding process will also lead to the redevelopment of the entire surrounding area and the complete urban integration of the Santiago el Mayor neighborhood, which is located south of the tracks (Figure 10). It is one of the lowest-income neighborhoods in the city of Murcia and was previously separated from the rest of the city by the railway infrastructure. Together, the projects affect several neighborhoods with an overall population of 40,000 people.

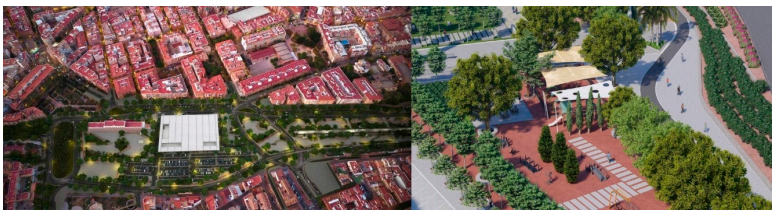

Figure 10. Future layout of the Murcia undergrounding project. Source: ADIF.

In a similar way to La Sagrera-TAV and Valencia's Parc Central, the presence of a multimodal transport node would act as a catalyst for the urban renewal of the neighborhood of Santiago el Mayor, boosting local economic development and increasing its attractiveness for investment in urban development projects. In turn, this could generate employment and stimulate the socio-economic fabric of the area.

5. Discussion and Conclusions

This documentary analysis has allowed us to obtain the key to interpretation, vectors of action, and project dimensions that are absent, in our opinion, from other railway development plans in cities. In this sense, three fundamental elements can be highlighted. Firstly, it is important to point out a logical conclusion regarding the focus of the Spanish academic community, especially in geography, on an analysis of the interrelation between urban systems, territorial development, morphology, and rail, especially high-speed rail. Secondly, the particularity in the case of Spain which is, as Bellet and Alonso wrote: "the European country where the arrival of high-speed trains has been associated with the most intense changes in the shape and physical structure of cities" (author's translation from Spanish) [28]. Thirdly, and in line with these same authors, it can be said that the introduction of a high-speed rail network in Spain was understood to be a great opportunity to mitigate the historical problems of railway integration inherited from earlier times. In addition, challenging solutions were chosen for this integration, especially regarding underground works, as these operations tried to solve other urban problems at the same time. Finally, all these actions converged in a period of expansion in the real estate cycle, which promoted urban projects of a speculative nature.

Here, we have considered actions with a strong urban morphological impact (especially in stations and urban sections that affect the structure of the city where they are developed), mainly due to the increase in rail services brought about by the European liberalization of passenger transport with new private operators. In addition, we argue that the development of the TEN-T network promotes new railway operations with significant urban consequences. These are not strictly associated with the development of the "national" high-speed network, but instead with the achievement of the full interoperability of the trans-European railway corridors defined by the TEN-T network. Thirdly, we highlight the fact that the European response to the consequences of the 2020 COVID-19 pandemic has made it possible to launch large-scale financial operations aimed at sustainable transport projects such as railways, financing both rail integration operations and the development of an infrastructure associated with the railways.

We, therefore, understand that there is a substantial threefold change: the significance of rail and urban projects (from the national scale to that of the European Union), the operational network (from the domestic high-speed network to the TEN-T network), and funding (from state self-financing to European CEF and RRF funds). These changes are interesting to study for an updated version of the relationship between high-performance rail services and cities.

The urban, political, economic, and functional nodes constitute the basis of a configuration linked by the transport corridors. Since, from the perspective of both methodology and content, it is clear that the EU's priority transport network had a clearly urban inspiration when it was launched at the end of the first decade of the 21st century, we can now analyze its subsequent development until the present. This is satisfactory proof of our starting hypothesis, which considered the TEN-T network to be an urban-based network that is beginning to construct a new "urban–regional spatial configuration" in the style of those analyzed by Harrison and Hoyler [61,62].

We believe that we have proven this hypothesis in a strategic segment of the European Mediterranean Corridor as it passes through Spain (Barcelona–Murcia), examining the case studies of three cities affected by these new processes. In the cases of Barcelona, Valencia, and Murcia, we have seen how liberalization, the involvement of the TEN-T network, and the existence of new sources of funding have influenced important operations that have positively affected urban morphology. This, therefore, promotes better rail integration (of all types, including suburban trains, medium- and long-distance travel, and freight). Furthermore, it allows better surface connections for neighborhoods that are currently separated by train tracks, while also providing them with new centrality and new public facilities. The importance of the relationship between the TEN-T network and urban nodes in this segment of the Corridor (as in others) will continue to grow when the revision of European regulations (currently under discussion) is approved and establishes, as stated above, new requirements for sustainability, multimodality and the integration of mandatory transport networks for its urban nodes. Table 4 shows a summary of our research regarding the specific cases being analyzed.

Table 4. Summary of the case studies analyzed.

		Barcelona	**Valencia**	**Murcia**
Socioeconomic indicators				
Population (2020) [a]	Millions inhab.	4.61	1.62	0.65
Population (2030) [b]	Millions inhab.	4.53	1.59	0.63
Population density (2020) [b]	inhabitants/ha	222.34	186.3	96.61
Population density (2030) [b]	inhabitants/ha	189.08	146.3	73.19
Average income per person [c]	Thousand EUR per capita	16.750	13.873	11.178
Affected neighborhood by the railway project [e] and average income per person [c,d]	Name	La Verneda i la Pau, La Sagrera	Malilla, La Creu Coberta and Sant Marcel·lí	Santiago el Mayor
	Thousand EUR per capita	14.370	10.800	9.992
Mediterranean Railway Corridor's projects				
Main project	Million EUR	La Sagrera TAV	Parc Central and Access Canal	El Carmen
EU Funds [e]		48.8 (NGEU)	163 (NGEU)	ERDF
Railway Station		New station	Renovated station	Renovated station
Functionality		Transport HUB—Reticular	Transport HUB	Linear
Urban landscape		Linear green area (40 ha)	Core green area and permeability	Fringe and permeability
Centralities		Displacement (Northern)	Reinforcing existing core	Reinforcing existing core

Sources: [a] OECD (Functional Urban Areas), [b] European Commission-JRC, [c] INE, [d] Barcelona City Council (2020), [e] ADIF (2023).

In this sense, we hope that a new phase of beneficial relations between rail and urban morphology will be experienced in other parts of the Spanish state, as well as in other EU states, following the changes that have been analyzed here. As the processes under discussion (liberalization, the TEN-T network, and the associated financing) progress, we will enter a phase that is much richer and more complex than the previous one, which has been dominated by the national perspective, the absolute predominance of long-distance high-speed rail services (exclusively for passengers), and the self-financing of operations through the sale of assets, although with European financing for the development of high-speed lines. Therefore, we propose a change in the perception of the relationship between high-speed rail networks and urban morphology, in line with Table 5, which we have already begun to address (Boira and Berzi [45]) via the "Europeanization" of national transport infrastructures and networks.

Table 5. The relationship between train and city: a new perspective.

	Previous Stage	**New Stage**
Scale and vision	National	European
Focus	High-speed network	TEN-T corridors
Funding	State aid with European aid	Greater weight of specific ordinary (CEF) and extraordinary (Next Generation) programs
Consequences	Self-financing (speculation?)	Public interest

This process of extending the practical framework of the relationship between rail and city, with the inclusion of TEN-T networks and other factors such as the increase in traffic due to liberalization, will have significant functional and morphological consequences for the urban future of Europe and must be closely studied in the future. We hope to study this line of research in greater depth by analyzing the results of the revision of the EU regulations that govern the trans-European transport networks in the following months. As has been seen, these regulations, currently in the process of a trialogue between European institutions, define new obligations for urban nodes in the network, of which there are over 400 throughout the European Union. It will then be time to analyze the new requirements for cities in detail. We intend to continue working with the internal documents of the Commission, especially those related to the new Urban Agenda for the EU, which is increasingly linked to the policies of the trans-European transport network, and with the Corridor forums, especially for the Mediterranean, which are the primary space for reflection, policy formulation, and exchanging ideas.

Apart from the technical considerations, this change in perspective will not come about without resistance. An essential future topic will be the opposition of some states to Brussels being the place from which certain decisions are made on sensitive aspects such as urban mobility and the integration of the planning of services and infrastructures in a European context.

Lastly, as a future hypothesis, we must state that the development of the trans-European network and, especially, the Mediterranean Corridor (due to its strong urban system and the touristic draw of its regions and countries) will enable new trans-national and trans-frontier high-speed and UIC-gauge railway services. The liberalization of services may progress through seeking territories and connections that, until now, have not been serviced by the high-speed radial network.

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Conflicts of Interest: The authors declare no conflict of interest.

Notes

[1] The Large Urban Areas (GAUs) are 86 areas with more than 50,000 inhabitants (single or multi-state), grouping a total of 755 municipalities in which 32 million people live (2019). This means that 69.29% of the total population lives in 9.3% of Spanish municipalities

[2] The SUMP concept was launched, on a European scale, in 2013. However, its first guidelines were not drafted until 2019. It was incorporated into the new urban mobility scheme in 2021 and introduced into the TEN-T network regulation review process. In 2022 the concept was reviewed by the Expert Group on Urban Mobility (EGUM) and in 2023 it was articulated as a Commission recommendation for national plans, with its meaning being fully updated ten years after its launch (Urban mobility within the trans-European network. Urban Nodes. DG Move B3. Brussels, 2023).

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