



**Asociación  
Caminos**

**ASOCIACIÓN DE INGENIEROS DE CAMINOS,  
CANALES Y PUERTOS Y DE LA INGENIERÍA CIVIL**

**INFRASTRUCTURE REPORT CARD OF SPAIN**

**RAILWAYS REPORT 2023**

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2. "The Global Competitiveness Report (GCI)." World Economic Forum (WEF)
3. "The Global Adaptation Index (ND-Gain Indicators)." University of Notre Dame (USA)
4. "Transport in the European Union." European Commission.

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## 1. Purpose and scope

The purpose of this report is to assess the infrastructure of Railways in Spain, following the methodology established by the Spanish Association of Civil Engineers (Asociación de Ingenieros

de Caminos, Canales y Puertos y de la Ingeniería Civil, also **Asociación Caminos**). For its elaboration, support has been provided by institutions and organizations linked to Railways, as well as the expertise of engineers, technicians, and experts who have collaborated with Asociación Caminos.

This document is part of a broader study that analyzes the state of six sectors of public works in Spain: Railways, Highways, Ports, Airports, the complete Water cycle, and Urban and Metropolitan Public Transportation. The methodology includes an objective evaluation, based on the analysis of quantitative indicators from both Spain and other selected countries in our economic environment, referenced to the most representative data of each sector in an international context. It also includes a qualitative evaluation of public works in Spain, based on the opinions of a selected group of experts for each sector.

The report is complemented with several annexes:

- **Annex 1: List of tables.** Complete list of the report's tables.
- **Annex 2: List of figures.** Complete list of the report's figures.
- **Annex 3: Acronyms.**
- **Annex 4: Bibliography and references.** Details the bibliography used and the databases and publicly available documents considered and consulted in this report.
- **Annex 5: Indicators from major international organizations.** Includes detailed information about the evaluations, indices, and indicators from the main organizations that assess infrastructures.
  - “Report Card for America’s infrastructure.” American Society of Civil Engineers (ASCE)
  - “The Global Competitiveness Report (GCI)”. World Economic Forum (WEF)
  - “The Global Adaptation Index (ND-Gain Indicators)”. University of Notre Dame (EE.UU.)
  - “Transport in the European Union”. European Commission.
- **Annex 6: Indicators from the main Spanish organizations,** which includes information about the indicators from the main Spanish organizations:
  - Ministry of Transport, Mobility, and Urban Agenda (Ministerio de Transportes, Movilidad y Agenda Urbana)
  - Ministry for Ecological Transition and Demographic Challenge (Ministerio para la Transición Ecológica y el Reto Demográfico)

**Annex 7: Basic data and details of the indicators used for the quantitative evaluation.**

## 2. Description of the Railroad Infrastructure in Spain

The development of Spain's railway system is conditioned by rugged topography, characterized by the presence of two large plateaus (which occupy 55% of the territory) separated by mountain ranges and two major depressions: the valleys of the Ebro and Guadalquivir rivers. Spain has 18% of its territory above 1,000 meters, and it is the second European country with the highest average altitude (660 meters), surpassed only by Switzerland (1,340 meters). This rugged topography has significantly influenced the expansion of the railway network. Including the Balearic and Canary Islands, the national territory has 7,880 kilometers of coastline, of which 24% correspond to beaches.

The Spanish population, which in 2019 amounts to 47.1 million inhabitants, is unevenly distributed across the territory, concentrating in coastal areas and large metropolitan centers located inland. The population is predominantly urban<sup>1</sup>. 82.8% of Spanish municipalities are rural and occupy 72.8% of the country's total area<sup>2</sup>. As observed in the attached map, there are large interior areas with low population density.

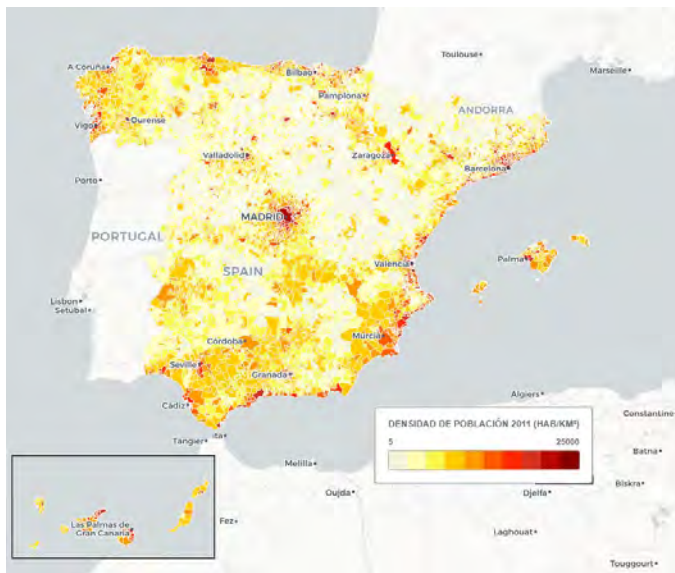


Figure 1: Distribución de la población española

<sup>1</sup> According to data from the National Institute of Statistics (INE), in the year 2022, Spain has a population of 47.4 million inhabitants, of which 37 million (79%) reside in towns and cities with more than 10,000 inhabitants, and 18.7 million (40%) in places with over 100,000 inhabitants. Madrid is the most populous city, with over 3.2 million inhabitants, followed by Barcelona (1.6 million), Valencia (0.8 million), Seville (0.7 million), and Zaragoza (0.7 million).

<sup>2</sup> Approximately 14.2% of the municipalities have an intermediate character between rural and urban, and only 3% can be classified as urban. Urban areas considered to have high population density accommodate 51% of the Spanish population; three of them (Madrid, Barcelona, and Valencia) have more than a million inhabitants, and four (Bilbao, Seville, Zaragoza, and Malaga) have populations ranging between half a million and a million inhabitants.



Historically, Spain's railway lines connect major population centers, forming a network with a radial structure centered around Madrid, complemented by transverse lines that mainly run through coastal areas.

The Spanish railway network is complex, with three different track gauges coexisting, totaling a length of 15,652 km<sup>3</sup>. The primary historical gauge in Spain, known as Iberian gauge (1,668 mm), originated in the 19th century and has a total track length of 11,211 km. In areas with challenging topography (Cantabrian coast and the Catalan and Valencian coastlines), narrow gauge lines were deployed, totaling 1,193 km of track. Since the inauguration of the first high-speed line in 1992, the most widely used gauge in the world, known as UIC or international gauge (1,435 mm), has been introduced, spanning 3,030 km. From then on, most high-speed lines were constructed with the international gauge; although some lines were built with Iberian gauge but with versatile sleepers (capable of being converted to international gauge in the future), and others with mixed tracks (featuring a third rail).

Currently, Spain boasts one of the world's best high-speed rail networks in operation, with a track length of 3,487 km as of 2020.



Figure 2: High-Speed Railway Network Map

The Spanish Railway Network can be divided into four railway categories. The first of them corresponds to the General Interest Railway Network (RFIG), defined in Law 38/2015, of September 29, of the Railway Sector, and whose Catalog of lines and sections that it comprises

<sup>3</sup> The railway network lengths are updated (2022) and correspond to the information published by the Ministry of Transport, Mobility and Urban Agenda ([Ferrovioario | Ministerio de Transportes, Movilidad y Agenda Urbana \(mitma.gob.es\)](https://www.mitma.gob.es/)).





are listed in Order FOM/710/2015, of January 30. This network is made up of the lines and sections managed by ADIF in its two public corporate entities, ADIF and ADIF Alta Velocidad, the network of Ports of the State, and LFP Perthus which manages the Figueres-Perpignan line. This network is the most extensive and handles the highest traffic, and includes the former FEVE network under ADIF since January 1, 2013.

In a second category are the regional railway networks, whose lines belong to a single autonomous community. They correspond to the networks of the Autonomous Communities of Catalonia (FGC-Ferrocarrils de la Generalitat de Catalunya), Valencia (FGV-Ferrocarrils de la Generalitat Valenciana), the Basque Country (ETS-Euskal Trenbide Sarea), and the Balearic Islands (SFM-Servicios Ferroviarios de Mallorca).

The third category comprises urban metro and tram lines, but they are not part of the study conducted by the Asociación Caminos in this sector, as they fall under the Urban Public Transport sector.

Finally, the fourth category corresponds to private lines, such as the passenger line known as the "Sóller train" that connects Palma de Mallorca and Sóller by train and tram, and the Railway of the mining and steel company of Ponferrada that connects Ponferrada with Villablino, which are also not included in this study.

According to the figures provided by the Ministry of Transport, the length of the railway network reaches 15,652 km, of which 15,302 km belong to ADIF, 837 km to the Autonomous Communities, and the remaining 32 km belong to private companies. The length of electrified lines reaches 10,338 kilometers: 9,699 km belong to ADIF (63.4% of the total network), 607 km to the Railway of the Autonomous Communities, and 32 km to private companies.

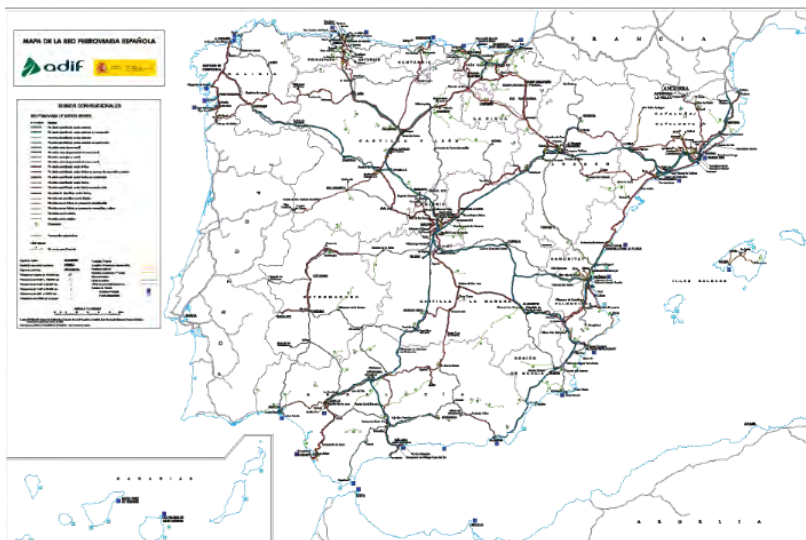
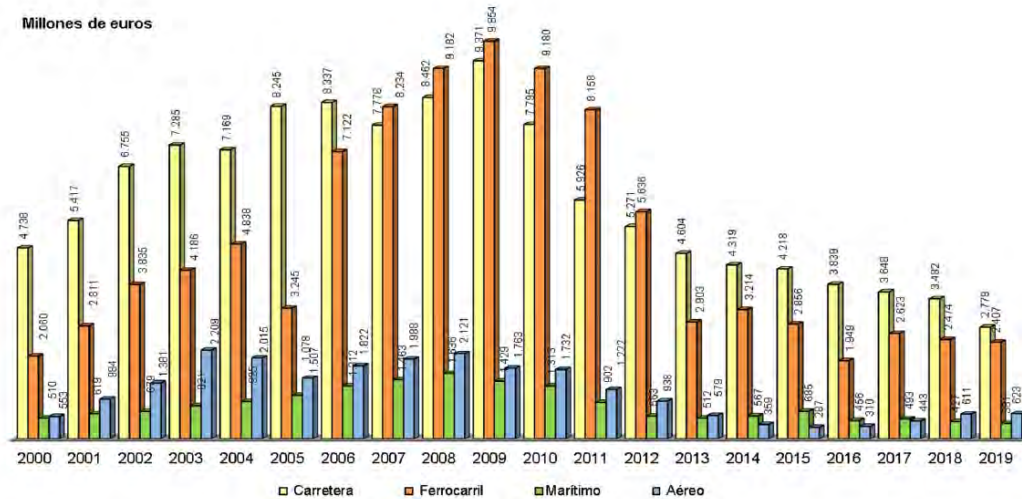


Figure 3: Spanish Railway Network 4

<sup>4</sup> This high-resolution map is available at: <https://www.adif.es/static-data/mapa/index.html>

In recent years, as a consequence of the economic crisis that started in 2008, the funding allocated to the railway network has significantly decreased (as has also occurred in other transportation infrastructures).



Fuente: Direcciones Generales y Organismos del Ministerio de Transportes, Movilidad y Agenda Urbana, RENFE Operadora, ADIF, FEVE, Diputaciones Provinciales, Cabildos Insulares y Comunidades Autónomas.

Figure 4: Investment made in infrastructure for different modes of transportation (Transportation and Infrastructure 2019. Ministry of Transport, Mobility, and Urban Agenda)

In the following table, public sector investments in railways are presented, broken down by operators and administrations <sup>5</sup>.

### Inversiones del sector público en ferrocarriles (Miles de euros) (2005-2019)

	2005	2010	2015	2017	2018	2019 (*)
<b>Ministerio de Transportes, Movilidad y Agenda Urbana</b>	1.308.566	1.659.724	23.339	7.622	6.910	9.468
Infraestructura: vía y otras inversiones <sup>(1)</sup>	1.308.566	1.659.724	23.339	7.622	6.910	9.468
<b>RENFE Operadora <sup>(2)</sup></b>	743.160	764.003	196.154	321.018	319.811	291.435
Infraestructura: vía y otras inversiones	48.929	71.340	43.780	66.616	64.969	74.889
Material móvil (material motor y remolcado)	694.231	692.663	152.374	254.402	254.842	216.546
<b>FEVE <sup>(3)</sup></b>	75.431	109.910	--	--	--	--
Infraestructura: vía y otras inversiones	52.151	71.988	--	--	--	--
Material móvil (material motor y remolcado)	23.280	37.922	--	--	--	--
<b>ADIF <sup>(2) <sup>(4)</sup></sup></b>	3.532.083	4.321.913	355.851	395.944	397.174	595.442
Infraestructura, vía, catenaria y otras inversiones	3.532.083	4.319.347	350.851	391.831	392.633	590.270
Material móvil (material motor y remolcado)	0	2.566	5.000	4.113	4.541	5.172
<b>ADIF Alta Velocidad <sup>(5)</sup></b>	--	--	1.781.269	1.346.140	1.310.378	1.199.557
Infraestructura, vía, catenaria y otras inversiones	--	--	1.781.269	1.346.140	1.310.195	1.184.417
Material móvil (material motor y remolcado)	--	--	0	0	183	15.140
<b>SEITT, S.A.</b>	--	755.512	41.499	210.272	141.388	85.236
<b>AESF (Agencia de Seguridad Ferroviaria) <sup>(3)</sup></b>	--	--	--	3.077	4.062	3.500
<b>FILIALES FERROVIARIAS <sup>(4)</sup></b>	--	--	--	1.851	7.761	805
<b>Comunidades Autónomas <sup>(5)</sup></b>	301.393	708.008	367.661	139.027	94.991	142.097
Infraestructura: vía y otras inversiones	301.393	708.008	367.661	139.027	94.991	142.097
<b>Compañías de Comunidades Autónomas <sup>(6)</sup></b>	296.991	145.963	72.406	184.698	152.855	128.609
Infraestructura: vía y otras inversiones	212.797	82.628	22.790	69.276	152.855	128.609
Material móvil (material motor y remolcado)	84.194	63.335	49.616	115.421	--	--
<b>Compañías particulares</b>	822	1.295	202	135	306	0
Infraestructura: vía y otras inversiones	822	55	197	54	204	--
Material móvil (material motor y remolcado)	0	1.240	5	81	103	--
<b>INVERSIÓN CONCESIONAL <sup>(7)</sup></b>	320.500	--	--	--	--	--
<b>TOTAL</b>	6.578.946	8.466.328	2.838.380	2.607.933	2.427.876	2.455.345
Infraestructura: vía y otras inversiones	5.456.741	7.668.602	2.631.386	2.233.916	2.101.833	2.218.487
Material móvil (material motor y remolcado)	801.705	797.726	206.995	374.017	326.043	236.858
Inversión concesional	320.500	--	--	--	--	--

Table 1: Public sector investments in railways. 2020 Report from the Railway Observatory.

<sup>5</sup> 2020 Report from the Railway Observatory in Spain: [Informe 2020 Observatorio del Ferrocarril \(mitma.gob.es\)](https://mitma.gob.es)

In 1992, with the inauguration of the Madrid-Seville line, the operation of a new line with different technical characteristics from those previously built began. This was a line with speeds exceeding 250 km/h with international gauge (1,435 mm), electrified at 25 KV AC, equipped with an LZB signaling system with ASFA backup and NEC circulation regulations. This line marked the beginning of the development of an independent network separate from conventional lines and with its own entity. As the high-speed network developed, the equipment and performance of this network improved. Currently, its design and construction are carried out in accordance with Technical Specifications for Interoperability (TSIs), with design speeds of 350 km/h and equipped with ERTMS/ETCS signaling systems at N1 and N2 levels with ASFA backup, conventional lateral signaling, electrified at 25 KV AC, and Circulation Regulations for Technical Operations (CTO).

The mandatory compliance with TSIs in the European Union for new construction and adaptation of existing lines has demonstrated significant advantages in cost reduction by harmonizing regulations, designs, manufacturing elements, and breaking technical barriers between railway lines and countries.

The initial conventional network of ADIF, before the incorporation of FEVE, was mostly made up of 1,668 gauge tracks, 3 KV DC voltage, various signaling and communication systems (telephone block, manual electrical block, automatic release block, CTC system, interlocking systems, track circuits, GPR, ...). The majority of them are equipped with the ASFA/ASFA digital train protection system that informs the driver about the status of the light signals, and all have SIL 4 safety level, without which they couldn't be operated and opened for service.

Interoperability or connectivity between the 1,668 mm gauge lines, generally supplied with 3 KV DC voltage, and the 1,435 mm gauge lines with 25 KV AC is achieved through strategic placement of variable gauge changers, allowing adapted rolling stock with variable wheelbase trains and bi-voltage catenary to run on either track.

In general, the traffic that runs on 1,668 mm and 1,000 mm gauge lines is mixed, with both passenger and freight trains, while high-speed lines are exclusively for passenger traffic, except the Mollet-Figueres-French Border AV line.

No other land or air transportation mode can currently compete with railways in terms of capacity for medium and long distances. However, Spain currently has the lowest modal share in rail freight transportation, experiencing the greatest decline in modal share compared to other advanced EU countries. The rail transport share of total land transportation in Spain is only 4%, compared to the European average of 17%. The EU aims to achieve a modal shift of 50% to rail for distances of 300 km by 2030, which poses an additional challenge for Spain's infrastructure capacity.

Regarding the organizational structure of railway management, it was transformed in the early 21st century by transposing European regulations. This transformation separated the former company RENFE into two distinct companies, ADIF and RENFE-OPERADORA. ADIF assumes the administration, management, and operation of the nationwide railway network and its assets, while RENFE-OPERADORA provides railway passenger and freight services as well as rolling stock maintenance. Since January 1, 2006, new private operators with European licenses have been allowed to enter the General State Interest Network for international or national rail freight transport, and as of 2020, effective liberalization of rail passenger transport is in place. Consequently, Renfe operadora has been restructured into four new state-owned companies: RENFE-Viajeros (passenger services), RENFE-Mercancías (freight services), RENFE-Fabricación y



mantenimiento (rolling stock manufacturing and maintenance), and Renfe-Alquiler de material ferroviario (rolling stock rental).

### 3. Methodology used to evaluate the Railways

The methodology designed by Asociación Caminos includes an objective evaluation that analyzes quantitative indicators referenced to the most representative data of each sector, as well as a qualitative evaluation based on the opinions of a selected group of experts.

The **quantitative evaluation** is conducted through a comparative study with other countries in our economic and social environment, considering the most representative indicators of the sector (both from Spain and other countries). These indicators are obtained from publicly accessible databases available in important multilateral organizations such as EUROSTAT, OECD, World Bank, UN, World Economic Forum, International Transport Forum, among others. The preference is to gather data that has been collected using comparable criteria among different countries, allowing the analysis of indicators' evolution over time.

The **qualitative evaluation** exclusively pertains to Spain and is based on the responses obtained from a questionnaire sent to a selected group of experts in the sector. The responses obtained are processed anonymously and confidentially, adhering to the current data protection legislation. Once the expert responses are processed, they are integrated (with a weight of 50%) into the quantitative assessment of the sector to obtain the final evaluation of the sector in an international context.

**To facilitate the evaluation, the analysis is grouped into eight sets of common characteristics for all sectors**, but with specificities for each sector, referred to as "Criteria": Capacity, Performance, Financing, Adaptation to the Future and Sustainable Development, Operation and Maintenance, Security, Resilience, and Engineering and Innovation.

The evaluation of each Criterion is obtained as a result of a weighted assessment of the selected Indicators for that Criterion. Once the eight Criteria indices for each sector are obtained, the Sector index is also calculated as a result of a new weighted assessment of these Criterion indicators.

To establish an international comparison of Spain's railway sector, the major countries of Europe have been selected: Germany, France, the United Kingdom, Italy, and Turkey; three countries from the Americas: the USA, Chile, and Mexico; two countries from Africa: Morocco and Egypt; and four countries from Asia: Japan, China, India, and Taiwan. Although not all countries have been evaluated for all indicators due to a lack of basic data (Taiwan has only been assessed using three indicators).

The objective indicators and expert surveys address the following questions (similar to the ASCE report) for each Criterion of each sector:

- **Capacity:** Does the provision and capacity of the public works sector meet current demands?
- **Performance:** Are the current performance and physical conditions of the public works sector adequate to meet current user expectations?
- **Financing:** What investment is allocated to financing the public works sector? How much is applied to infrastructure creation and to operation and maintenance?
- **Adaptation to the Future and Sustainable Development:** Is the capacity and performance of the public works sector prepared to meet future expectations and demands? Are the



resources and investments considered adequate to cover future sector needs? How are actions promoting environmental sustainability being implemented? Are active measures applied to achieve the established objectives for decarbonizing public works and transportation?

- **Operation and Maintenance:** Is the public works sector being operated and maintained according to its needs?
- **Security:** Is the public works sector safe for users? Are effective measures implemented to ensure safe performance and operation?
- **Resilience:** When faced with threats and adverse incidents, what is the capacity of the public works sector to prevent, protect, and minimize consequences for users, the environment, the economy, and national security? Is the public works prepared to recover its initial state within a reasonable time once the threat or adverse incident has ceased? Are there alternatives to meet the service it provides?
- **Engineering and Innovation:** Are the resources allocated to engineering in the design, construction, conservation, management, and operation of the public works sector considered adequate? Is the investment in innovation sufficient? What new techniques, materials, technologies, and operational methods are being implemented to improve public works? Is progress being made in digitalization, monitoring, and sensing throughout the complete cycle of public works? Is the information provided to users adequate?

The methodology used to assess each Indicator is the result of an adjustment and transformation process of the selected ratios. **To avoid excessive data dispersion (due to topographical, territorial, economic, population distribution peculiarities, etc.) and to minimize the effect of outlier data points, it is necessary to limit them both from above and below. After obtaining the ratios, the dispersion of the values achieved in the different countries and years considered is analyzed.**

For this purpose, two methods have been considered for each indicator to avoid dispersion. The first method considers the mean and standard deviation of the data from the historical series, assigning as limit values the mean minus 1.5 times the standard deviation and the mean plus 1.5 times the standard deviation. The second method uses percentiles of the data from the historical series, analyzing the 90th or 80th percentile and the 10th percentile. The most suitable method to limit dispersion is adopted for each Indicator in each case. In some cases, there are exceptions to this general rule, such as the Safety indicators, for which the minimum value assigned is zero, considering it as the value that should obtain the highest score.

Once these values are obtained, they are transformed on a scale from 0 to 10, with 10 being the highest value and 0 being the lowest. Next, the following rating is assigned:

Rating System of Asociación Caminos							
Asociación Caminos	0 a 2,9	3,0 a 4,9	5,0 a 5,9	6,0 a 6,9	7,0 a 7,9	8,0 a 8,9	9,0 a 9,9
	Very Insufficient	Insufficient	Sufficient	Highly Sufficient	Good	Very Good	Excellent
	F	FX	E	D	C	B	A

Table 2: Rating system for Indicators, Criteria, and Sectors

When all the Indicators for each Criterion are calculated, they are then weighted to calculate the Criterion Indicator. This weighting is done based on the importance assigned to each Indicator in forming the Criterion Indicator.

Assigning weights to each Indicator represents one of the major challenges. To address this, the input of experts is essential. Based on their experience and knowledge, they assign these weights.

It's important to note that, to form the Criterion Indicator as a weighted assessment of the Indicators, the maximum value that the Criterion Indicator can reach is the result of summing the weight assigned to each Indicator by the maximum rating (10) that the Indicator can achieve, adjusted by a reduction coefficient (which has been considered as 0.9). The application of this reduction coefficient is considered essential to balance the integration of the indicators (for example: in the "Adaptation to the Future" Criterion, growth ratios of investment in relation to the growth of motorization rates, traffic, and population are analyzed. If the motorization rate decreases due to the increase in shared vehicle use, the sector's indicator would decrease even if the traffic increases).

As an example, for the "Operation and Maintenance" Criterion, the minimum value would be 0 (zero), and the theoretical maximum value of the Safety Indicator would be 120, reduced by 10% to 108.

Indicators	Weight	Max Score	Total Max score	
I 5,1	4	10	40	Investment and maintenance as a % of national GDP
I 5,2	1	10	10	Investment in operation and maintenance per capita
I 5,3	2	10	20	Investment in operation and maintenance per equivalent km of roads
I 5,4	1	10	10	Investment in operation and maintenance per domestic road passenger traffic (€)
I 5,5	4	10	40	Investment in operation and maintenance per domestic road freight traffic (€)
<b>Total:</b>	<b>12</b>	<b>30</b>	<b>120</b>	
<b>% Max score over Max Value</b>		<b>90,0%</b>	<b>108,00</b>	

When forming the Criterion Indicator, the mean and standard deviation are not taken into account, as this would distort the Criterion Indicator by overvaluing the assessments of the integration of the Indicators. However, a reduction percentage is indeed taken into consideration.

Furthermore, since data for certain countries and certain years might not always be available, this document has chosen to calculate the ratios without considering or estimating data that is not available. Thus, unverifiable or erroneous data is not considered in the assessment of the Criterion Indicator or the Sector Indicator. In this way, the Criterion Index and Sector Index only evaluate data for which there is confirmed information, following a method to prevent it from distorting the assessment achieved by a particular country.

In the earlier example, if reliable data for Indicator I 5.5 is not available for a specific country, the assessment of the Operation and Maintenance Criterion for that country would be calculated based on the maximum value of 68 (which results from subtracting 40, the maximum score of Indicator I 6.5, from 108, which is the total maximum score of all indicators, after applying the



10% reduction coefficient). For the assessment of other countries with data in all indicators, the value of 108 would be considered as the maximum score.

In other words, each country is evaluated based on the data that is truly reliable and comparable, even if fewer indicators are used for comparison with other countries. In any case, when this effect occurs, it is noted in the assessment of Criteria and the sector.



## 4. Quantitative Indicators of Railways

For the comparative study, 67 quantitative indicators have been utilized, all referenced to the most representative data in the sector (both from Spain and other countries), obtained from publicly accessible databases available in significant multilateral organizations (EUROSTAT, OECD, World Bank, UN, World Economic Forum, International Transport Forum, UIC, etc.). The selection of indicators has taken into account the opinions of consulted experts and experience. It has also been essential to have the appropriate database to compose each indicator.

The period considered for this comparative study spans 5 years: from 2015 to 2019. It was not deemed appropriate to extend beyond 2019 due to the distortion caused by the COVID-19 pandemic on traffic and transportation, which severely disrupts the comparison of indicators during 2020 and partially in 2021.

Once the available databases were analyzed, it was deemed appropriate to use the following databases:

- *The World Bank (WB)*
  - Population
  - Area
  - GDP (US \$)
  - CO2 Emissions from fossil fuel consumption
- *World Economic Forum (WEF)*
  - Railway infrastructure quality indicators
- *University of Notre Dame (ND-GAIN)*
  - University of Notre Dame Global Adaptation Index (ND-GAIN) indicators
- *OECD- International Transport Forum (OCDE)*
  - Railway networks (European countries)
  - Accident data
  - Domestic passenger and freight traffic
  - Railway investments
  - Investments in conservation and maintenance
  - Passenger transport
  - Research, development, and innovation
- *EUROSTAT and EU*
  - National GDP (Current €)
  - Statistical Annex. Transport in the EU 2018.
  - Railway networks for European countries
  - EU Economic Investment Report 2017-2019
  - EU Alternative Fuels Observatory.
  - European Environment Agency
- *International Union of Railways (UIC)*
  - Railway networks



- Accident data
- Operating expenses
- Domestic passenger and freight traffic
  
- *Ministry of Transport, Mobility, and Urban Agency of Spain*
  - Statistical Yearbook 2019
  - Transport and Infrastructure 2019
  - Transport and Mobility Observatory 2019
  
- *Ministry for Ecological Transition*
  - Public Environmental Indicators Bank



INDICATORS RAILWAYS 2023	
<b>1 CAPACITY</b>	
C.1	Railway Lines (km) / 1,000 Inhabitants
C.2	Electrified Railway Lines (km) / 1,000 Inhabitants
C.3	High-Speed Railway Lines (km) (speed > 250 km/h) / 1,000 Inhabitants
C.4	Railway Lines (km) / Country Area (KM2)
C.5	Railway Lines (km) / Population Density
C.6	Number of Level Crossings / Railway Lines (km)
C.7	Number of Stations / km of Railway Lines
<b>2 PERFORMANCE</b>	
P.1	High-Speed Railway Lines / Railway Lines
P.2	Electrified Railway Lines / Railway Lines
P.3	Length of Railway Tracks / Railway Lines
P.4	Domestic Passenger Traffic by Railway (10 <sup>6</sup> Passenger-km) / km of Railway Tracks
P.5	Domestic Freight Traffic by Railway (10 <sup>6</sup> ton-km) / km of Railway Lines
P.6	Percentage of Freight Transport in Railways in Total Land Freight Transport
P.7	Percentage of Passenger Transport in Railways in Total Land Passenger Transport
P.8	Infrastructure Quality and Trade Index. ND Gain Index
P.9	Railway Service Efficiency (WEF)
<b>3 FINANCING</b>	
F.1	Percentage of Investment in Railways / National GDP (Current €)
F.2	Investment in Railways / Inhabitants (Current €/inhabitant)
F.3	Investment in Railways / km of Railway Lines (Current €/km)
F.4	Investment in Railways / Country Area (km2) (Current €/km2)
F.5	Investment in Railways / Domestic Passenger Traffic by Railway (10 <sup>6</sup> Passenger-km)
F.6	Investment in Railways / Domestic Freight Traffic by Railway (10 <sup>6</sup> ton-km)
F.7	Percentage of Investment in Railways / Total Investment in Land Transport Infrastructure
<b>4 Future Adaptation and Sustainability</b>	
A.1	High-Speed Railway Lines with Speed > 160 km/h / Railway Lines
A.2	Level Crossings / Railway Lines
A.3	Percentage of Passenger-km by Rail / Passenger-km (Land)
A.4	Percentage of ton-km by Rail / ton-km (Land)
A.5	CO2 Emissions from Railways / Railway Lines (Thousands of t CO2 Equiv/km of Railway Lines)
A.6	Electrified Lines / km of Railway Lines
A.7	Percentage of Renewable Energy in Transport / Energy Consumed in Transport
A.8	Development of Climate Change Mitigation Technologies related to Transport (OCDE)
<b>5 Operation and Maintenance</b>	
O.1	Investment in O&M / National GDP
O.2	Investment in O&M / Inhabitants
O.3	Investment in O&M / km of Railway Lines
O.4	Investment in O&M / Total Investment in Railways
O.5	Investment in O&M / Domestic Passenger Traffic (€)
O.6	Investment in O&M / Domestic Freight Traffic (€)
O.7	Operating Expenses / Number of Stations (€)
O.8	Operating Expenses / km of Railway Lines (€)
O.9	Operating Expenses / Population (€)
O.10	Operating Expenses / Million ton-km (€)
<b>6 Safety</b>	
S.1	Number of Fatalities / 100 km of Railway Lines
S.2	Number of Fatalities / Million Population
S.3	Number of Fatalities / Passenger-km by Rail (hundred million passenger-km)
S.4	Number of Fatalities / Freight Traffic by Rail (hundred million ton-km)
S.5	Number of Accidents / 100 km of Railway Lines
<b>7 Resilience</b>	
R.1	Number of Stations / Railway Lines
R.2	Number of Nodes / Number of Stations
R.3	Railway Density / Road Density
R.4	High-Speed Railway km / Country Area (KM2)
R.5	Transport Infrastructure. GCI Score (WEF)
<b>8 Engineering and Innovation</b>	
I.1	Increase in High-Speed Lines / Railway Lines (2019/2015)
I.2	Innovation Index. ND Gain Index
I.3	Percentage of GDP spent on Gross Domestic Expenditure on R&D (OCDE R&D)
I.4	Gross Domestic Expenditure on R&D (\$) / Population (OCDE R&D)
I.5	Percentage of GDP spent on Basic Research (OCDE R&D)
I.6	Total R&D Personnel per 1,000 Employees (OCDE R&D)
I.7	Percentage of GDP for Private Funding for R&D (OCDE R&D)
I.8	Percentage of GDP for Public Funding for R&D (OCDE R&D)
I.9	Number of Railway Transport Patents / Million Inhabitants (OCDE)
I.10	Digitalization. Participation Percentage in New Technologies. GCI Score (WEF)
I.11	Digitalization. Index of Information and Communication Technology Infrastructures. ND Index
I.12	Digitalization. Percentage of Internet Users
I.13	Engineering. Regulatory Transparency. Trade in Services Restrictiveness Index (OCDE)
I.14	Engineering. Barriers to Competition. Trade in Services Restrictiveness Index (OCDE)
I.15	Engineering. Movement Restrictions. Trade in Services Restrictiveness Index (OCDE)
I.16	Engineering. Restrictions on Entry of Foreign Engineers. Trade in Services Restrictiveness Index (OCDE)

## 4.1. Capacity

The indicators of this criterion aim to answer the question: Does the provision and capacity of the public works sector meet current demands?

To achieve this, the following indicators have been selected:

1 CAPACITY	
C.1	Railway Lines (km) / 1,000 Inhabitants
C.2	Electrified Railway Lines (km) / 1,000 Inhabitants
C.3	High-Speed Railway Lines (km) (speed > 250 km/h) / 1,000 Inhabitants
C.4	Railway Lines (km) / Country Area (KM2)
C.5	Railway Lines (km) / Population Density
C.6	Number of Level Crossings / Railway Lines (km)
C.7	Number of Stations / km of Railway Lines

Traditionally, it is widely believed that the provision and characteristics of railways determine the sector's capacity to accommodate demand. Therefore, the considered ratios pertain to railway density per inhabitants and per country area. Various types of networks have also been taken into consideration, including electrified lines and high-speed lines.

The indicators "Level Crossings / Railway Lines" and "Number of Stations / km of Railway Lines" provide information about the quality of network provision and the service offered by the railway.



## 4.1.1. Capacity Indicators

### 4.1.1.1 Indicator C.1: Railway Lines (km) / 1,000 Inhabitants

FFCC C.1	Líneas FC (km) / 1.000 Habitantes				
	2015	2016	2017	2018	2019
España	0,351	0,348	0,347	0,345	0,345
Alemania	0,471	0,469	0,467	0,463	0,462
Francia	0,411	0,405	0,413	0,401	0,400
Reino Unido	0,249	0,248	0,247	0,245	0,245
Italia	0,275	0,277	0,277	0,278	0,281
EEUU	0,470	0,465	0,461	0,457	0,455
México					
Chile					
Marruecos	0,061	0,060	0,059	0,059	0,058
Egipto	0,056	0,055	0,053	0,052	0,051
Japón	0,158	0,152	0,152	0,152	0,152
China	0,048	0,048	0,048	0,048	0,048
India	0,049	0,051	0,050	0,050	0,049
Taiwan					
Maximo:	0,471	MAX ((Media+Factor max*Desv Est.):		0,479	10
Mínimo:	0,048	MIN ((Media-Factor min *Desv );0):		0	1
Media:	0,234	Percentil 90%:	0,463	0,479	9,000
Factor max*Desv Est	0,479	Percentil 10%:	0,049	Unidad:	18,796
Factor min*Desv Est	-0,012		Desv. Est.:	0,164	

Table 3: Indicator C.1 Values: Railway Lines (km) / 1,000 Inhabitants

FFCC C.1	Líneas FC (km) / 1.000 Habitantes					Calificación 2019	
	2015	2016	2017	2018	2019		
España	7,6	7,5	7,5	7,5	7,5	BIEN	C
Alemania	9,9	9,8	9,8	9,7	9,7	EXCELENTE	A
Francia	8,7	8,6	8,8	8,5	8,5	MUY BIEN	B
Reino Unido	5,7	5,7	5,6	5,6	5,6	SUFICIENTE	E
Italia	6,2	6,2	6,2	6,2	6,3	SUFICIENTE ALTO	D
EEUU	9,8	9,7	9,7	9,6	9,6	EXCELENTE	A
México							
Chile							
Marruecos	2,1	2,1	2,1	2,1	2,1	MUY INSUFICIENTE	F
Egipto	2,1	2,0	2,0	2,0	2,0	MUY INSUFICIENTE	F
Japón	4,0	3,8	3,9	3,9	3,9	INSUFICIENTE	FX
China	1,9	1,9	1,9	1,9	1,9	MUY INSUFICIENTE	F
India	1,9	2,0	1,9	1,9	1,9	MUY INSUFICIENTE	F
Taiwan							

Table 4: Indicator C.1 Rating: Railway Lines (km) / 1,000 Inhabitants



#### 4.1.1.2 Indicator C.2: Electrified Railway Lines (km) / 1,000 Inhabitants

FFCC C.2	Líneas FC electrificadas (km) / 1.000 Habitantes				
	2015	2016	2017	2018	2019
España	0,209	0,223	0,217	0,210	0,217
Alemania	0,254	0,252	0,251	0,250	0,249
Francia	0,243	0,243	0,253	0,251	0,250
Reino Unido	0,084	0,084	0,089	0,092	0,092
Italia	0,196	0,198	0,199	0,199	0,204
EEUU	0,005	0,005	0,005	0,005	0,005
México					
Chile					
Marruecos	0,037	0,037	0,036	0,036	0,035
Egipto	0,001	0,001	0,001	0,001	0,001
Japón	0,097	0,092	0,092	0,092	0,092
China	0,024	0,029	0,029	0,029	0,029
India	0,014	0,018	0,018	0,017	0,017
Taiwan					
Maximo:	0,254	MAX ((Media+Factor max*Desv Est.):		0,254	10
Mínimo:	0,001	MIN ((Media-Factor min *Desv );0):		0	1
<b>Media:</b>	<b>0,107</b>	<b>Percentil 90%:</b>		<b>0,250</b>	<b>9,000</b>
Factor max*Desv E	0,254	<b>Percentil 10%:</b>		<b>0,005</b>	<b>Unidad:</b>
Factor min*Desv Es	-0,039	<b>Desv. Est.:</b>		<b>0,097</b>	<b>35,481</b>

Table 5: Indicator C.2 Values: Electrified Railway Lines (km) / 1,000 Inhabitants

FFCC C.2	Líneas FC electrificadas (km) / 1.000 Habitantes					Calificación 2019	
	2015	2016	2017	2018	2019		
España	8,4	8,9	8,7	8,5	8,7	MUY BIEN	B
Alemania	10,0	9,9	9,9	9,9	9,9	EXCELENTE	A
Francia	9,6	9,6	10,0	9,9	9,9	EXCELENTE	A
Reino Unido	4,0	4,0	4,2	4,3	4,3	INSUFICIENTE	FX
Italia	8,0	8,0	8,0	8,1	8,2	MUY BIEN	B
EEUU	1,2	1,2	1,2	1,2	1,2	MUY INSUFICIENTE	F
México							
Chile							
Marruecos	2,3	2,3	2,3	2,3	2,3	MUY INSUFICIENTE	F
Egipto	1,0	1,0	1,0	1,0	1,0	MUY INSUFICIENTE	F
Japón	4,5	4,3	4,3	4,3	4,3	INSUFICIENTE	FX
China	1,8	2,0	2,0	2,0	2,0	MUY INSUFICIENTE	F
India	1,5	1,6	1,6	1,6	1,6	MUY INSUFICIENTE	F
Taiwan							

Table 6: Indicator C.2 Rating: Electrified Railway Lines (km) / 1,000 Inhabitants



4.1.1.3 *Indicator C.3: High-Speed Railway Lines (km) (speed > 250 km/h) / 1,000 Inhabitants*

FFCC C.3	Lineas A.V (km) (velocidad> 250km/h) / 1.000 Habitantes				
	2015	2016	2017	2018	2019
España	0,041	0,054	0,053	0,053	0,056
Alemania	0,011	0,012	0,013	0,013	0,013
Francia	0,031	0,033	0,041	0,041	0,041
Reino Unido	0,001	0,001	0,001	0,001	0,001
Italia	0,014	0,015	0,015	0,015	0,015
EEUU					
México					
Chile					
Marruecos				0,006	0,005
Egipto					
Japón	0,022	0,020	0,020	0,022	0,022
China	0,013	0,015	0,015	0,017	0,020
India					
Taiwan					
Maximo:	0,056	MAX ((Media+Factor max*Desv Est.):		0,045	10
Mínimo:	0,001	MIN ((Media-Factor min *Desv );0):		0,000	1
Media:	0,021	Percentil 90%:	0,046	0,045	9,000
Factor max*Desv E	0,045	Percentil 10%:	0,001	Unidad:	198,564
Factor min*Desv Es	-0,003		Desv. Est.:	0,016	

Table 7: Indicator C.3 Values: High-Speed Railway Lines (km) (speed > 250 km/h) / 1,000 Inhabitants

FFCC C.3	Lineas A.V (km) (velocidad> 250km/h) / 1.000 Habitantes					Calificación 2019	
	2015	2016	2017	2018	2019		
España	9,2	10,0	10,0	10,0	10,0	EXCELENTE	A
Alemania	3,1	3,4	3,7	3,6	3,6	INSUFICIENTE	FX
Francia	7,1	7,5	9,1	9,1	9,1	EXCELENTE	A
Reino Unido	1,2	1,2	1,2	1,2	1,2	MUY INSUFICIENTE	F
Italia	3,8	4,0	4,0	4,0	4,0	INSUFICIENTE	FX
EEUU							
México							
Chile							
Marruecos				2,1	2,0	MUY INSUFICIENTE	F
Egipto							
Japón	5,4	5,0	5,0	5,5	5,5	SUFICIENTE	E
China	3,7	3,9	4,1	4,3	4,9	INSUFICIENTE	FX
India							
Taiwan							

Table 8: Indicator C.3 Rating: High-Speed Railway Lines (km) (speed > 250 km/h) / 1,000 Inhabitants



#### 4.1.1.4 Indicador C.4: Railway Lines (km) / Country Area (KM2)

FFCC C.4	Líneas FC (km) / Superficie del País (km2)					
	2015	2016	2017	2018	2019	
España	0,032	0,032	0,032	0,032	0,032	
Alemania	0,108	0,108	0,108	0,107	0,107	
Francia	0,050	0,049	0,050	0,049	0,049	
Reino Unido	0,067	0,067	0,067	0,067	0,067	
Italia	0,055	0,056	0,056	0,056	0,056	
EEUU	0,015	0,015	0,015	0,015	0,015	
México						
Chile						
Marruecos	0,005	0,005	0,005	0,005	0,005	
Egipto	0,005	0,005	0,005	0,005	0,005	
Japón	0,053	0,051	0,051	0,051	0,051	
China	0,007	0,007	0,007	0,007	0,007	
India	0,019	0,020	0,020	0,020	0,020	
Taiwan						
Maximo:	0,108	MAX ((Media+Factor max*Desv Est.):		0,084	10	
Mínimo:	0,005	MIN ((Media-Factor min *Desv );0):		0,000	1	
Media:	0,038	Percentil 90%:		0,067	9,000	
Factor max*Desv E	0,084	Percentil 10%:		0,005	Unidad:	106,959
Factor min*Desv Es	-0,009	Desv. Est.:		0,031		

Table 9: Indicator C.4 Values: Railway Lines (km) / Country Area (KM2)

FFCC C.4	Líneas FC (km) / Superficie del País (km2)					Calificación 2019	
	2015	2016	2017	2018	2019		
España	4,4	4,4	4,4	4,4	4,4	INSUFICIENTE	FX
Alemania	10,0	10,0	10,0	10,0	10,0	EXCELENTE	A
Francia	6,3	6,3	6,4	6,2	6,2	SUFICIENTE ALTO	D
Reino Unido	8,1	8,1	8,2	8,2	8,2	MUY BIEN	B
Italia	6,9	7,0	7,0	6,9	6,9	SUFICIENTE ALTO	D
EEUU	2,6	2,6	2,6	2,6	2,6	MUY INSUFICIENTE	F
México							
Chile							
Marruecos	1,5	1,5	1,5	1,5	1,5	MUY INSUFICIENTE	F
Egipto	1,6	1,6	1,6	1,6	1,6	MUY INSUFICIENTE	F
Japón	6,7	6,4	6,4	6,4	6,4	SUFICIENTE ALTO	D
China	1,7	1,7	1,7	1,7	1,7	MUY INSUFICIENTE	F
India	3,1	3,2	3,2	3,2	3,2	INSUFICIENTE	FX
Taiwan							

Table 10: Indicator C.4 Rating: Railway Lines (km) / Country Area (KM2)





### 4.1.1.5 Indicador C.5: Railway Lines (km) / Population Density

FFCC C.5	Líneas FC (km) / Densidad población				
	2015	2016	2017	2018	2019
España	177,7	176,0	175,6	174,7	174,6
Alemania	168,3	167,7	167,0	165,7	165,2
Francia	225,6	222,2	226,8	220,4	219,9
Reino Unido	60,8	60,3	60,2	59,7	59,6
Italia	82,9	83,4	83,6	83,9	84,9
EEUU	4618,7	4571,2	4533,2	4494,3	4473,8
México					
Chile					
Marruecos	27,2	26,8	26,5	26,1	25,8
Egipto	56,3	54,6	53,5	52,4	51,4
Japón	59,7	57,3	57,3	57,4	57,5
China	457,5	463,4	456,8	456,8	456,8
India	160,5	166,8	164,3	163,1	160,7
Taiwan					
Maximo:	4.618,746		Percentil 90%:	461,013	10
Mínimo:	25,822	MIN ((Media-Factor min *Desv);0):		0,000	1
Media:	546,081	Percentil 90%:	461,013	461,013	9,000
Factor max*Desv E	2.465,328	Percentil 10%:	51,816	Unidad:	0,020

Table 11: Indicator C.5 Values: Railway Lines (km) / Population Density

FFCC C.5	Líneas FC (km) / Densidad población					Calificación 2019	
	2015	2016	2017	2018	2019		
España	4,5	4,4	4,4	4,4	4,4	INSUFICIENTE	FX
Alemania	4,3	4,3	4,3	4,2	4,2	INSUFICIENTE	FX
Francia	5,4	5,3	5,4	5,3	5,3	SUFICIENTE	E
Reino Unido	2,2	2,2	2,2	2,2	2,2	MUY INSUFICIENTE	F
Italia	2,6	2,6	2,6	2,6	2,7	MUY INSUFICIENTE	F
EEUU	10,0	10,0	10,0	10,0	10,0	EXCELENTE	A
México							
Chile							
Marruecos	1,5	1,5	1,5	1,5	1,5	MUY INSUFICIENTE	F
Egipto	2,1	2,1	2,0	2,0	2,0	MUY INSUFICIENTE	F
Japón	2,2	2,1	2,1	2,1	2,1	MUY INSUFICIENTE	F
China	9,9	10,0	9,9	9,9	9,9	EXCELENTE	A
India	4,1	4,3	4,2	4,2	4,1	INSUFICIENTE	FX
Taiwan							

Table 12: Indicator C.5 Rating: Railway Lines (km) / Population Density



#### 4.1.1.6 Indicator C.6: Number of Level Crossings / Railway Lines (km)

FFCC C.6	Nº Pasos a Nivel / Líneas FC (km)				
	2015	2016	2017	2018	2019
España	0,196	0,195	0,194	0,195	0,194
Alemania		0,364	0,365	0,366	0,366
Francia		0,428	0,418	0,429	0,429
Reino Unido		0,362	0,361	0,361	0,360
Italia		0,221	0,221	0,221	0,221
EEUU		1,409	1,412	1,416	1,416
México					
Chile					
Marruecos		0,178	0,178	0,178	0,178
Egipto					
Japón		1,067	1,067	1,067	1,067
China					
India					
Taiwan					
Maximo:	1,416	MAX ((Media+Factor max*Desv Est.):		1,148	1
Mínimo:	0,178	MIN ((Media-Factor min *Desv );0):		0,000	10
Media:	0,518	Percentil 90%:	1,067	1,148	-9,000
Factor max*Desv E	1,148	Percentil 10%:	0,000	Unidad:	-7,840
Factor min*Desv Es	-0,112		Desv. Est.:	0,420	

Table 13: Indicator C.6 Values: Number of Level Crossings / Railway Lines (km)

FFCC C.6	Nº Pasos a Nivel / Líneas FC (km)					Calificación 2019	
	2015	2016	2017	2018	2019		
España	8,5	8,5	8,5	8,5	8,5	MUY BIEN	B
Alemania		7,1	7,1	7,1	7,1	BIEN	C
Francia		6,6	6,7	6,6	6,6	SUFICIENTE ALTO	D
Reino Unido		7,2	7,2	7,2	7,2	BIEN	C
Italia		8,3	8,3	8,3	8,3	MUY BIEN	B
EEUU		1,0	1,0	1,0	1,0	MUY INSUFICIENTE	F
México							
Chile							
Marruecos		8,6	8,6	8,6	8,6	MUY BIEN	B
Egipto							
Japón		1,6	1,6	1,6	1,6	MUY INSUFICIENTE	F
China							
India							
Taiwan							

Table 14: Indicator Rating: Number of Level Crossings / Railway Lines (km)



#### 4.1.1.7 Indicador C.7: Number of Stations / km of Railway Lines

FFCC C.7	Nº Estaciones / km líneas FC				
	2015	2016	2017	2018	2019
España	0,092	0,093	0,093	0,093	0,092
Alemania	0,148	0,147	0,147	0,147	0,148
Francia			0,105	0,107	0,107
Reino Unido		0,157	0,157	0,096	0,157
Italia		0,131	0,131	0,131	0,131
EEUU					
México					
Chile					
Marruecos					0,064
Egipto					0,137
Japón		0,086	0,107	0,168	0,137
China	0,077	0,075	0,075	0,075	0,074
India	0,112	0,108	0,110	0,109	0,109
Taiwan					
Maximo:	0,168	MAX ((Media+Factor max*Desv Est.):		0,203	10
Mínimo:	0,064	MIN ((Media-Factor min *Desv );0):		0,026	1
Media:	0,114	Percentil 90%:		0,148	9,000
Factor max*Desv E	0,203	Percentil 10%:		0,000	Unidad:
Factor min*Desv Es	0,026	Desv. Est.:		0,059	

Table 15: Indicator C.7 Values: Number of Stations / km of Railway Lines

FFCC C.7	Nº Estaciones / km líneas FC					Calificación 2019	
	2015	2016	2017	2018	2019		
España	4,4	4,4	4,4	4,4	4,4	INSUFICIENTE	FX
Alemania	7,2	7,1	7,1	7,2	7,2	BIEN	C
Francia			5,0	5,1	5,1	SUFICIENTE	E
Reino Unido		7,6	7,7	4,6	7,7	BIEN	C
Italia		6,3	6,4	6,4	6,4	SUFICIENTE ALTO	D
EEUU							
México							
Chile							
Marruecos					2,9	MUY INSUFICIENTE	F
Egipto					6,6	SUFICIENTE ALTO	D
Japón		4,1	5,2	8,2	6,6	SUFICIENTE ALTO	D
China	3,6	3,5	3,5	3,5	3,5	INSUFICIENTE	FX
India	5,4	5,2	5,3	5,2	5,2	SUFICIENTE	E
Taiwan							

Table 16: Indicator C.7 Rating: Number of Stations / km of Railway Lines



## 4.1.2. Capacity Indicator

	Índice de Capacidad					Max valor 2019
	2015	2016	2017	2018	2019	
España	46,9	48,2	48,0	47,7	47,9	63
Alemania	44,5	51,7	51,9	51,8	51,7	63
Francia	37,2	44,0	51,4	50,8	50,8	63
Reino Unido	21,2	36,0	36,2	33,1	36,3	63
Italia	27,5	42,4	42,4	42,5	42,7	63
EEUU	23,6	24,5	24,5	24,4	24,4	45
México						0
Chile						0
Marruecos	7,5	16,1	16,0	18,1	20,9	63
Egipto	6,7	6,7	6,6	6,6	13,2	45
Japón	22,7	27,4	28,5	32,0	30,4	63
China	22,7	23,1	23,1	23,4	23,9	54
India	16,0	16,2	16,2	16,2	16,1	45
Taiwan						0
Maximo:	51,872	Máximo Valor:		VER TABLA	10	
Mínimo:	6,581	MIN:		0	0	
Media:	30,225				10,000	

Table 17: Capacity Indicator Values

	Evaluación de Capacidad						Subindicadores considerados	Max valor 2019	
	2015	2016	2017	2018	Calificación 2019				
España	7,4	7,6	7,6	7,6	7,6	BIEN	C	7	63
Alemania	8,2	8,2	8,2	8,2	8,2	MUY BIEN	B	7	63
Francia	8,3	8,1	8,2	8,1	8,1	MUY BIEN	B	7	63
Reino Unido	4,7	5,7	5,7	5,3	5,8	SUFICIENTE	E	7	63
Italia	6,1	6,7	6,7	6,7	6,8	SUFICIENTE ALTO	D	7	63
EEUU	6,6	5,5	5,4	5,4	5,4	SUFICIENTE	E	5	45
México								0	0
Chile								0	0
Marruecos	2,1	3,6	3,6	3,3	3,3	INSUFICIENTE	FX	7	63
Egipto	1,9	1,9	1,8	1,8	2,9	MUY INSUFICIENTE	F	5	45
Japón	5,0	4,3	4,5	5,1	4,8	INSUFICIENTE	FX	7	63
China	4,2	4,3	4,3	4,3	4,4	INSUFICIENTE	FX	6	54
India	3,6	3,6	3,6	3,6	3,6	INSUFICIENTE	FX	5	45
Taiwan								0	0

Table 18: Capacity Criterion Rating

Subindicadores de Capacidad		Pesos	Total Max puntuación
FFCC C.1	Líneas FC (km) / 1.000 Habitantes	1	10
FFCC C.2	Líneas FC electrificadas (km) / 1.000 Habitantes	1	10
FFCC C.3	Líneas A.V (km) (velocidad> 250km/h) / 1.000 Habitantes	1	10
FFCC C.4	Líneas FC (km) / Superficie del País (km2)	1	10
FFCC C.5	Líneas FC (km) / Densidad población	1	10
FFCC C.6	Nº Pasos a Nivel / Líneas FC (km)	1	10
FFCC C.7	Nº Estaciones / km líneas FC	1	10
		7	70
		90 % Valorado de la Max. Puntuación del Criterio	63

Table 19: Weights and Maximum Reduced Score of Capacity Indicators



In the Capacity Criterion, it is advisable to delve into the deployment of high-speed rail. In this regard, the significant efforts that some countries are making for its development are noteworthy, as can be observed in the attached graphs featured in the "Atlas. High-speed rail 2021"<sup>6</sup> by the UIC<sup>7</sup>.

Length of the high-speed network in commercial operation worldwide (1964-2020)

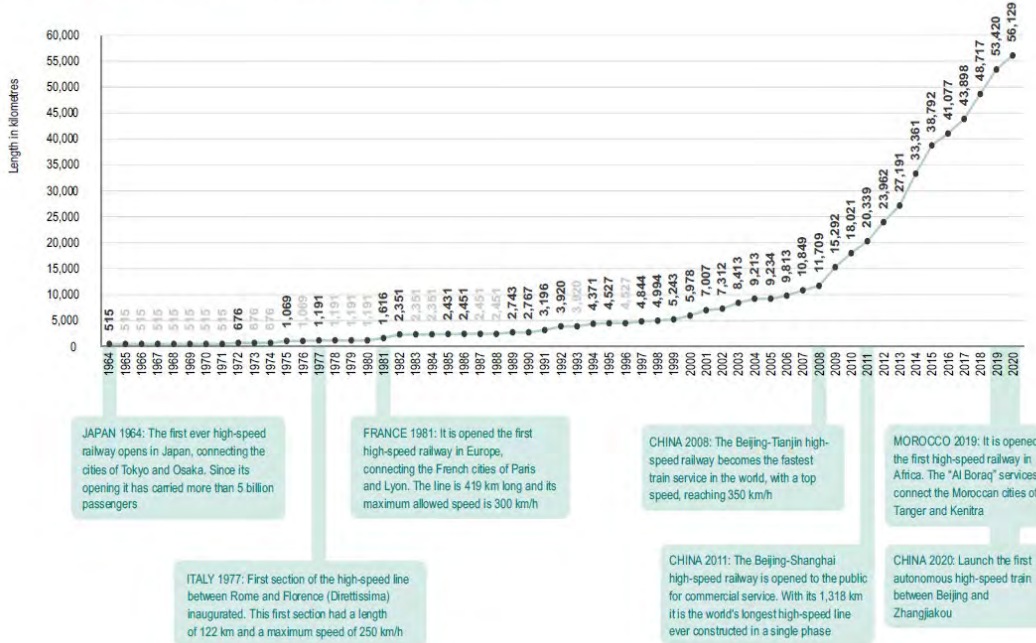
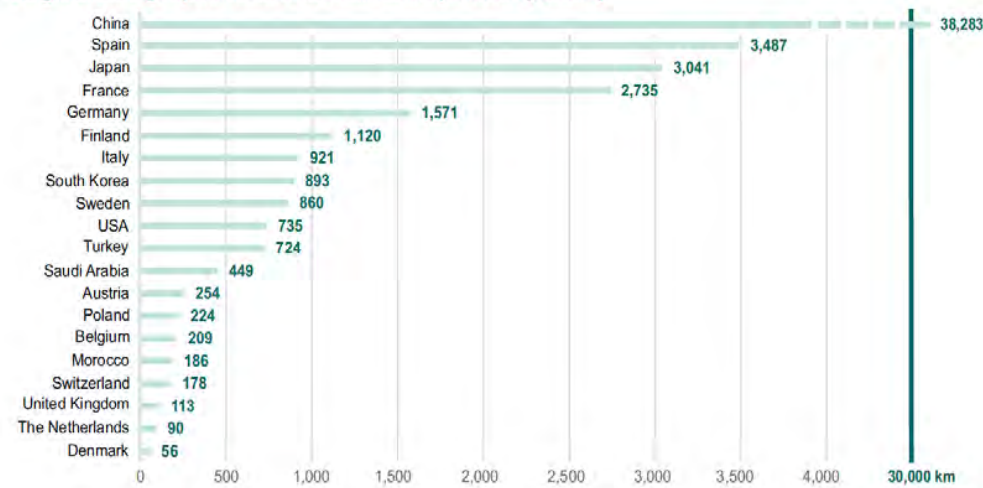


Figure 5: Evolution of the introduction of high-speed rail lines worldwide (1964-2020). UIC.

Length of the high-speed network in commercial operation by country



Source: compiled by authors based on International Union of Railways, 2020

Figure 6: Length of high-speed rail lines in operation by countries. UIC.

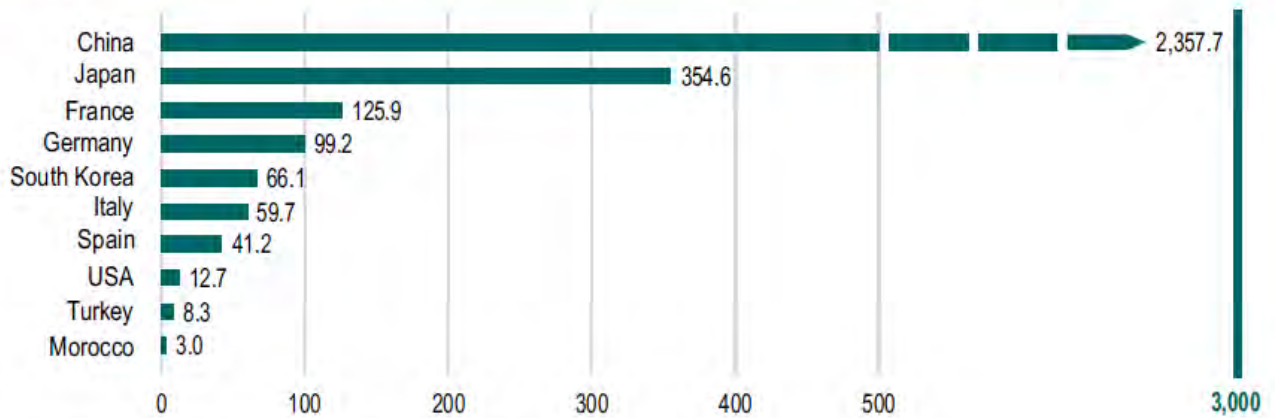
<sup>6</sup> The most recent version (2022) can be found in: [Atlas High-Speed Rail \(2022\)](https://www.uic.org/publications/atlas-high-speed-rail-2022). (uic.org)

<sup>7</sup> The UIC considers "high-speed" to be lines with speeds exceeding 200 km/h.



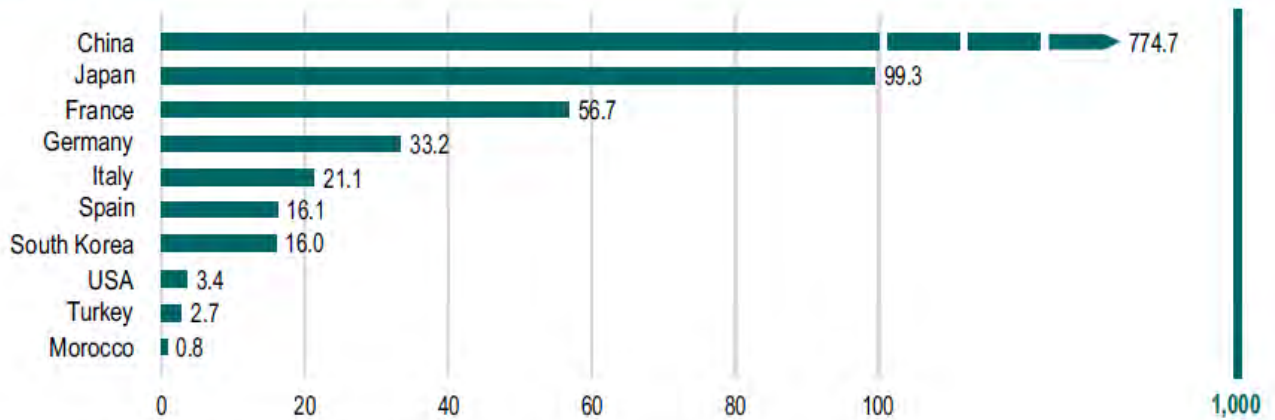
When analyzing the number of passengers and passenger-kilometers for high-speed rail, it can be observed that Spain, despite ranking second in the world for high-speed rail lines, only surpasses 40 million annual passengers and 16 million passenger-kilometers. These figures are significantly lower than the passengers transported by China (2.357 billion), Japan (354.6 million), France (125.5 million), Germany (99.2 million), and even Italy (59.7 million).

Number of passenger (millions) by countries (2019)



Source: compiled by authors based on International Union of Railways, 2021

Number of passenger.kilometre (billions) by countries (2019)



Source: compiled by authors based on International Union of Railways, 2021

Figure 7: Passengers and passenger-kilometers of high-speed rail lines (2019). UIC.

Below is the map of high-speed rail lines in Spain and Portugal as featured in the latest version of the "Atlas. High-speed rail. 2022."

## High-speed lines in Portugal and Spain



Figure 8: High-speed railway networks in Spain and Portugal (2022). UIC.

In the set of indicators comprising the Capacity Criterion, Germany obtains the highest rating with 8.2 out of 10, followed by France (8.1), and Spain (7.6). Notably low ratings are given to Egypt (2.9), Morocco (3.3), and India (3.6).

With the established indicators, European countries generally achieve the highest ratings, followed by the USA (5.4).

In indicators related to railway capacity, Spain stands out in the provision of high-speed lines and electrified lines per 1,000 inhabitants, as well as having a low number of level crossings per railway lines. However, Spain receives lower scores in terms of the number of stations per railway lines, railway lines per country area, and railway lines per population density.

Considering the Capacity Indicators as a whole, it can be deduced that in terms of infrastructure capacity and provision, the Spanish railways hold a favorable position, particularly in the high-speed rail network, which attains the highest rating (Spain surpasses France, although the difference is not highly significant).



## 4.2. Performance

This criterion addresses the question: Are the current performance and physical conditions of the public works sector suitable to meet the present expectations of users?

The chosen indicators are as follows:

2 PERFORMANCE	
P.1	High-Speed Railway Lines / Railway Lines
P.2	Electrified Railway Lines / Railway Lines
P.3	Length of Railway Tracks / Railway Lines
P.4	Domestic Passenger Traffic by Railway (10 <sup>6</sup> Passenger-km) / km of Railway Tracks
P.5	Domestic Freight Traffic by Railway (10 <sup>6</sup> ton-km) / km of Railway Lines
P.6	Percentage of Freight Transport in Railways in Total Land Freight Transport
P.7	Percentage of Passenger Transport in Railways in Total Land Passenger Transport
P.8	Infrastructure Quality and Trade Index. ND Gain Index
P.9	Railway Service Efficiency (WEF)

The indicator "High-Speed Lines / Railway Lines" demonstrates the extent of high-speed lines in relation to the total railway network. It's an important indicator to measure the quality of high-speed service provided.

The indicator "Electrified Railway Lines / Railway Lines" indicates the progress in electrification of railway lines.

The indicator "Length of Railway Tracks / Railway Lines" illustrates the utilization of railway lines. A higher length of tracks per line indicates a more efficient use of the railway.

Indicators related to passenger and freight traffic demonstrate the usage of both travelers and goods within the railway system, reflecting its efficiency.

The University of Notre Dame's Global Adaptation Index (ND-GAIN), from the state of Indiana in the USA, includes an indicator evaluating the quality of transportation and trade infrastructure. While not specific to railways<sup>8</sup>, this indicator offers an overview of overall transportation and trade infrastructure performance.

The World Economic Forum (WEF) also provides an indicator directly related to railways: "Railway Service Efficiency." The values of this indicator are considered relevant to estimate the performance of the country's railway network<sup>9</sup>.

<sup>8</sup> The indicators that make up the Global Adaptation Index of the University of Notre Dame (ND-GAIN) are detailed in an annex of this report.

<sup>9</sup> The indicators that make up the Global Competitiveness Index (GCI) of the World Economic Forum (WEF) are detailed in an annex of this report.





## 4.2.1. Performance Indicators

### 4.2.1.1 Indicator P.1: High-Speed Railway Lines / Railway Lines

FFCC P.1	Líneas A.V / Líneas FC				
	2015	2016	2017	2018	2019
España	0,117	0,155	0,153	0,154	0,161
Alemania	0,023	0,026	0,029	0,029	0,029
Francia	0,075	0,081	0,099	0,102	0,102
Reino Unido	0,005	0,005	0,005	0,005	0,005
Italia	0,051	0,054	0,054	0,054	0,054
EEUU					
México					
Chile					
Marruecos				0,095	0,088
Egipto					
Japón	0,142	0,133	0,133	0,148	0,148
China	0,283	0,303	0,325	0,355	0,410
India					
Taiwan					
Maximo:	0,410		Percentil 80%:	0,154	10
Mínimo:	0,005	MIN ((Media-Factor min *Desv ),0):		0,000	1
Media:	0,113	Percentil 80%:	0,154	0,154	9,000
Factor max*Desv E	0,268	Percentil 10%:	0,005	Unidad:	58,584
Factor min*Desv Es	-0,042		Desv. Est.:	0,103	

Table 20: Indicator P.1 Values: High-Speed Railway Lines / Railway Lines

FFCC P.1	Líneas A.V / Líneas FC					Calificación 2019	
	2015	2016	2017	2018	2019		
España	7,9	10,0	10,0	10,0	10,0	EXCELENTE	A
Alemania	2,3	2,5	2,7	2,7	2,7	MUY INSUFICIENTE	F
Francia	5,4	5,7	6,8	6,9	7,0	BIEN	C
Reino Unido	1,3	1,3	1,3	1,3	1,3	MUY INSUFICIENTE	F
Italia	4,0	4,2	4,2	4,2	4,2	INSUFICIENTE	FX
EEUU							
México							
Chile							
Marruecos				6,6	6,2	SUFICIENTE ALTO	D
Egipto							
Japón	9,3	8,8	8,8	9,7	9,7	EXCELENTE	A
China	10,0	10,0	10,0	10,0	10,0	EXCELENTE	A
India							
Taiwan							

Table 21: Indicator P.1 Rating: High-Speed Railway Lines / Railway Lines



## 4.2.1.2 Indicador P.2: Electrified Railway Lines / Railway Lines

FFCC P.2	Líneas FC electrificadas / Líneas FC				
	2015	2016	2017	2018	2019
España	0,596	0,642	0,626	0,609	0,630
Alemania	0,539	0,537	0,537	0,540	0,540
Francia	0,591	0,602	0,612	0,625	0,625
Reino Unido	0,335	0,337	0,360	0,376	0,377
Italia	0,713	0,716	0,716	0,716	0,725
EEUU	0,011	0,011	0,011	0,011	0,011
México					
Chile					
Marruecos	0,609	0,610	0,610	0,610	0,610
Egipto	0,013	0,013	0,013	0,013	0,013
Japón	0,616	0,608	0,608	0,608	0,608
China	0,494	0,605	0,605	0,605	0,605
India	0,296	0,352	0,352	0,352	0,352
Taiwan					
Maximo:	0,725		Percentil 90%:	0,637	10
Mínimo:	0,011	MIN ((Media-Factor min *Desv );0):		0,099	1
<b>Media:</b>	<b>0,455</b>		Percentil 90%:	0,637	9,000
Factor max*Desv Es	0,812		Percentil 10%:	0,013	Unidad:
Factor min*Desv Es	0,099		Desv. Est.:	0,238	16,706

Table 22: Indicator P.2 Values: Electrified Railway Lines / Railway Lines

FFCC P.2	Líneas FC electrificadas / Líneas FC					Calificación 2019	
	2015	2016	2017	2018	2019		
España	9,3	10,0	9,8	9,5	9,9	EXCELENTE	A
Alemania	8,4	8,3	8,3	8,4	8,4	MUY BIEN	B
Francia	9,2	9,4	9,6	9,8	9,8	EXCELENTE	A
Reino Unido	4,9	5,0	5,4	5,6	5,6	SUFICIENTE	E
Italia	10,0	10,0	10,0	10,0	10,0	EXCELENTE	A
EEUU	1,0	1,0	1,0	1,0	1,0	MUY INSUFICIENTE	F
México							
Chile							
Marruecos	9,5	9,5	9,5	9,5	9,5	EXCELENTE	A
Egipto	1,0	1,0	1,0	1,0	1,0	MUY INSUFICIENTE	F
Japón	9,6	9,5	9,5	9,5	9,5	EXCELENTE	A
China	7,6	9,5	9,5	9,5	9,5	EXCELENTE	A
India	4,3	5,2	5,2	5,2	5,2	SUFICIENTE	E
Taiwan							

Table 23: Indicator P.2 Rating: Electrified Railway Lines / Railway Lines



### 4.2.1.3 Indicator P.3: Length of Railway Tracks / Railway Lines

FFCC P.3	Longitud de vías FC / Líneas FC				
	2015	2016	2017	2018	2019
España	1,295	1,361	1,351	1,354	1,352
Alemania	1,752	1,745	1,746	1,754	1,755
Francia	1,989	1,989	1,989	1,989	1,989
Reino Unido	1,963	1,963	1,945	1,951	1,952
Italia	1,454	1,456	1,458	1,460	1,460
EEUU	1,716	1,716	1,718	1,719	1,719
México					
Chile					
Marruecos	1,719	1,709	1,752	1,809	1,809
Egipto	1,840	1,857	1,857	1,857	1,857
Japón	1,075	1,121	1,121	1,121	1,121
China	2,064	2,194	2,194	2,194	2,194
India	1,361	1,375	1,375	1,375	1,375
Taiwan					
Maximo:	2,194	MAX ((Media+Factor max*Desv Est.):		2,145	10
Mínimo:	1,075	MIN ((Media-Factor min *Desv );0):		1,215	1
<b>Media:</b>	<b>1,680</b>	<b>Percentil 90%:</b>	1,989	0,930	9,000
Factor max*Desv E	2,145	<b>Percentil 10%:</b>	1,317	<b>Unidad:</b>	9,674
Factor min*Desv Es	1,215		<b>Desv. Est.:</b>	<b>0,310</b>	

Table 24: Indicator P.3 Values: Length of Railway Tracks / Railway Lines

FFCC P.3	Longitud de vías FC / Líneas FC					Calificación 2019	
	2015	2016	2017	2018	2019		
España	1,8	2,4	2,3	2,4	2,3	MUY INSUFICIENTE	F
Alemania	6,2	6,1	6,1	6,2	6,2	SUFICIENTE ALTO	D
Francia	8,5	8,5	8,5	8,5	8,5	MUY BIEN	B
Reino Unido	8,2	8,2	8,1	8,1	8,1	MUY BIEN	B
Italia	3,3	3,3	3,4	3,4	3,4	INSUFICIENTE	FX
EEUU	5,9	5,8	5,9	5,9	5,9	SUFICIENTE	E
México							
Chile							
Marruecos	5,9	5,8	6,2	6,7	6,7	SUFICIENTE ALTO	D
Egipto	7,1	7,2	7,2	7,2	7,2	BIEN	C
Japón	1,0	1,0	1,0	1,0	1,0	MUY INSUFICIENTE	F
China	9,2	10,0	10,0	10,0	10,0	EXCELENTE	A
India	2,4	2,5	2,5	2,5	2,5	MUY INSUFICIENTE	F
Taiwan							

Table 25: Indicator P.3 Rating: Length of Railway Tracks / Railway Lines



#### 4.2.1.4 Indicator P.4: Domestic Passenger Traffic by Railway (10<sup>6</sup> Passenger-km) / km of Railway Tracks

FFCC P.4	Tráfico interior de viajeros por FC (10 <sup>6</sup> Viajeros-km) / km vías de FC				
	2015	2016	2017	2018	2019
España	1,238	1,212	1,258	1,299	1,311
Alemania	1,359	1,398	1,417	1,457	1,514
Francia	1,928	1,940	2,011	2,015	2,100
Reino Unido	2,386	2,452	2,505	2,548	2,587
Italia	2,150	2,135	2,174	2,265	2,310
EEUU	0,139	0,139	0,129	0,124	0,126
México					
Chile					
Marruecos	1,519	1,445	1,332	1,290	1,290
Egipto					
Japón	19,784	20,008	20,266	20,463	20,159
China	8,748	8,547	9,143	9,612	9,992
India	13,125	12,487	12,612	12,612	12,612
Taiwan					
Maximo:	20,463		Percentil 70%:	4,375	10
Mínimo:	0,124	MIN ((Media-Factor min *Desv );0):		0,000	1
Media:	5,293	Percentil 70%:	4,375	4,375	9,000
Factor max*Desv E:	14,782	Percentil 10%:	1,105	Unidad:	2,057
Factor min*Desv E:	-4,195		Desv. Est.:	6,326	

Table 26: Indicator P.4 Values: Domestic Passenger Traffic by Railway (10<sup>6</sup> Passenger-km) / km of Railway Tracks

FFCC P.4	Tráfico interior de viajeros por FC (10 <sup>6</sup> Viajeros-km) / km vías de FC					Calificación 2019	
	2015	2016	2017	2018	2019		
España	3,5	3,5	3,6	3,7	3,7	INSUFICIENTE	FX
Alemania	3,8	3,9	3,9	4,0	4,1	INSUFICIENTE	FX
Francia	5,0	5,0	5,1	5,1	5,3	SUFICIENTE	E
Reino Unido	5,9	6,0	6,2	6,2	6,3	SUFICIENTE ALTO	D
Italia	5,4	5,4	5,5	5,7	5,8	SUFICIENTE	E
EEUU	1,3	1,3	1,3	1,3	1,3	MUY INSUFICIENTE	F
México							
Chile							
Marruecos	4,1	4,0	3,7	3,7	3,7	INSUFICIENTE	FX
Egipto							
Japón	10,0	10,0	10,0	10,0	10,0	EXCELENTE	A
China	10,0	10,0	10,0	10,0	10,0	EXCELENTE	A
India	10,0	10,0	10,0	10,0	10,0	EXCELENTE	A
Taiwan							

Table 27: Indicator P.4 Rating: Domestic Passenger Traffic by Railway (10<sup>6</sup> Passenger-km) / km of Railway Tracks



4.2.1.5 *Indicator P.5: Domestic Freight Traffic by Railway (10<sup>6</sup> ton-km) / km of Railway Lines*

FFCC P.5	Tráfico interior de mercancías por FC (10 <sup>6</sup> tn-km) / km vías FC				
	2015	2016	2017	2018	2019
España	0,512	0,484	0,481	0,493	0,476
Alemania	1,730	1,912	1,947	1,929	1,916
Francia	0,668	0,646	0,649	0,638	0,630
Reino Unido	0,607	0,534	0,541	0,541	0,529
Italia	0,856	0,929	0,912	0,901	0,870
EEUU	9,813	8,981	9,512	9,826	9,206
México					
Chile					
Marruecos	1,310	1,318	1,054	1,021	1,021
Egipto					
Japón	0,996	0,985	1,004	0,897	0,926
China	17,374	16,165	18,319	19,582	20,507
India	7,515	6,735	7,106	7,106	7,106
Taiwan					
Maximo:	20,507		Percentil 70%:	3,383	10
Mínimo:	0,476	MIN ((Media-Factor min *Desv );0):		0,000	1
<b>Media:</b>	<b>4,154</b>		Percentil 70%:	3,383	9,000
Factor max*Desv Es	12,671		Percentil 10%:	0,527	Unidad:
Factor min*Desv Es	-4,363		Desv. Est.:	5,678	

Table 28: Indicator P.5 Values: Domestic Freight Traffic by Railway (10<sup>6</sup> ton-km) / km of Railway Lines

FFCC P.5	Tráfico interior de mercancías por FC (10 <sup>6</sup> tn-km) / km vías FC					Calificación 2019	
	2015	2016	2017	2018	2019		
España	2,4	2,3	2,3	2,3	2,3	MUY INSUFICIENTE	F
Alemania	5,6	6,1	6,2	6,1	6,1	SUFICIENTE ALTO	D
Francia	2,8	2,7	2,7	2,7	2,7	MUY INSUFICIENTE	F
Reino Unido	2,6	2,4	2,4	2,4	2,4	MUY INSUFICIENTE	F
Italia	3,3	3,5	3,4	3,4	3,3	INSUFICIENTE	FX
EEUU	10,0	10,0	10,0	10,0	10,0	EXCELENTE	A
México							
Chile							
Marruecos	4,5	4,5	3,8	3,7	3,7	INSUFICIENTE	FX
Egipto							
Japón	3,6	3,6	3,7	3,4	3,5	INSUFICIENTE	FX
China	10,0	10,0	10,0	10,0	10,0	EXCELENTE	A
India	10,0	10,0	10,0	10,0	10,0	EXCELENTE	A
Taiwan							

Table 29: Indicator P.5 Rating: Domestic Freight Traffic by Railway (10<sup>6</sup> ton-km) / km of Railway Lines



#### 4.2.1.6 Indicador P.6: Percentage of Freight Transport in Railways in Total Land Freight Transport

FFCC P.6	% Participación del transporte de mercancías en FFCC en el total del transporte terrestre de mercancías				
	2015	2016	2017	2018	2019
España	4,7%	4,5%	4,2%	4,2%	3,9%
Alemania	23,1%	24,9%	25,3%	25,4%	25,3%
Francia	17,6%	16,9%	16,3%	15,6%	15,2%
Reino Unido	10,2%	10,2%	10,2%	10,2%	10,2%
Italia	14,1%	15,6%	14,7%	14,0%	12,6%
EEUU	38,0%	35,3%	36,8%	36,8%	36,8%
México					
Chile					
Marruecos					
Egipto					
Japón	9,5%	9,2%	9,3%	8,4%	8,5%
China	19,2%	18,5%	19,0%	18,9%	20,80%
India					
Taiwan					
Maximo:	38,00%	MAX ((Media+Factor max*Desv Est.):		31,47%	10
Mínimo:	3,87%	MIN ((Media-Factor min *Desv );0):		2,23%	1
<b>Media:</b>	<b>16,85%</b>	<b>Percentil 90%:</b>		35,45%	29,24%
Factor max*Desv E	31,47%	<b>Percentil 10%:</b>		4,67%	<b>Unidad:</b> 30,779
Factor min*Desv Es	2,23%	<b>Desv. Est.:</b>		9,75%	

Table 30: Indicator P.6 Values: Percentage of Freight Transport in Railways in Total Land Freight Transport

FFCC P.6	% Participación del transporte de mercancías en FFCC en el total del transporte terrestre de mercancías					Calificación 2019	
	2015	2016	2017	2018	2019		
España	1,8	1,7	1,6	1,6	1,5	MUY INSUFICIENTE	F
Alemania	7,4	8,0	8,1	8,1	8,1	MUY BIEN	B
Francia	5,7	5,5	5,3	5,1	5,0	SUFICIENTE	E
Reino Unido	3,4	3,4	3,4	3,4	3,4	INSUFICIENTE	FX
Italia	4,7	5,1	4,8	4,6	4,2	INSUFICIENTE	FX
EEUU	10,0	10,0	10,0	10,0	10,0	EXCELENTE	A
México							
Chile							
Marruecos							
Egipto							
Japón	3,2	3,1	3,2	2,9	2,9	MUY INSUFICIENTE	F
China	6,2	6,0	6,2	6,1	6,7	SUFICIENTE ALTO	D
India							
Taiwan							

Table 31: Indicator del P.6 Rating: Percentage of Freight Transport in Railways in Total Land Freight Transport



#### 4.2.1.7 *Indicator P.7: Percentage of Passenger Transport in Railways in Total Land Passenger Transport*

FFCC P.7	% Participación del transporte de pasajeros en FFCC en el total del transporte terrestre de pasajeros				
	2015	2016	2017	2018	2019
España	6,7%	6,6%	7,0%	7,1%	7,1%
Alemania	8,3%	8,4%	8,9%	9,1%	9,4%
Francia	11,1%	10,9%	11,4%	11,2%	11,7%
Reino Unido	9,5%	9,7%	9,6%	9,7%	9,7%
Italia	6,3%	6,1%	5,9%	6,3%	6,3%
EEUU	0,6%	0,5%	0,5%	0,5%	0,5%
México					
Chile					
Marruecos					
Egipto					
Japón	32,7%	32,6%	32,6%	32,5%	32,1%
China					
India	6,9%	6,2%	5,6%	5,6%	5,6%
Taiwan					
Maximo:	32,70%	MAX ((Media+Factor max*Desv Est.):		23,80%	10
Mínimo:	0,50%	MIN ((Media-Factor min *Desv );0):		0,00%	1
<b>Media:</b>	<b>10,22%</b>	<b>Percentil 90%:</b>	<b>32,12%</b>	23,80%	9,000
Factor max*Desv Est	23,80%	<b>Percentil 10%:</b>	<b>0,56%</b>	<b>Unidad:</b>	37,810
Factor min*Desv Est	-3,36%		<b>Desv. Est.:</b>	<b>9,06%</b>	: Desv. Est.

Table 32: Indicator P.7 Values: Percentage of Passenger Transport in Railways in Total Land Passenger Transport

FFCC P.7	% Participación del transporte de pasajeros en FFCC en el total del transporte terrestre de pasajeros					Calificación 2019	
	2015	2016	2017	2018	2019		
España	3,5	3,5	3,7	3,7	3,7	INSUFICIENTE	FX
Alemania	4,1	4,2	4,4	4,4	4,6	INSUFICIENTE	FX
Francia	5,2	5,1	5,3	5,2	5,4	SUFICIENTE	E
Reino Unido	4,6	4,7	4,6	4,7	4,7	INSUFICIENTE	FX
Italia	3,4	3,3	3,2	3,4	3,4	INSUFICIENTE	FX
EEUU	1,2	1,2	1,2	1,2	1,2	MUY INSUFICIENTE	F
México							
Chile							
Marruecos							
Egipto							
Japón	10,0	10,0	10,0	10,0	10,0	EXCELENTE	A
China							
India	3,6	3,3	3,1	3,1	3,1	INSUFICIENTE	FX
Taiwan							

Table 33: Indicator P.7 Rating: Percentage of Passenger Transport in Railways in Total Land Passenger Transport



4.2.1.8 *Indicator P.8: Infrastructure Quality and Trade Index. ND Gain Index*

FFCC P.8	Índice de calidad de la infraestructura de transporte y el comercio. ND Gain Index				
	2015	2016	2017	2018	2019
España	0,322	0,329	0,313	0,297	0,297
Alemania	0,159	0,144	0,153	0,162	0,162
Francia	0,257	0,254	0,255	0,256	0,256
Reino Unido	0,210	0,204	0,226	0,249	0,249
Italia	0,312	0,310	0,302	0,295	0,295
EEUU	0,213	0,217	0,231	0,244	0,244
México	0,522	0,541	0,546	0,551	0,551
Chile	0,520	0,571	0,515	0,459	0,459
Marruecos	0,607	0,651	0,655	0,659	0,659
Egipto	0,521	0,494	0,527	0,559	0,559
Japón	0,224	0,232	0,212	0,192	0,192
China	0,331	0,320	0,320	0,321	0,321
India	0,485	0,426	0,481	0,536	0,536
Taiwan					
Maximo:	0,659	MAX ((Media+Factor max*Desv Est.):		0,596	1
Mínimo:	0,144	MIN ((Media-Factor min *Desv );0):		0,133	10
<b>Media:</b>	<b>0,364</b>	<b>Percentil 90%:</b>		0,559	0,463
Factor max*Desv Es	0,596	<b>Percentil 10%:</b>		0,197	Unidad:
Factor min*Desv Es	0,133	<b>Desv. Est.:</b>		0,154	-9,000
					-19,431

Table 34: Indicator P.8 Values: Infrastructure Quality and Trade Index. ND Gain Index

FFCC P.8	Índice de calidad de la infraestructura de transporte y el comercio. ND Gain Index					Calificación 2019	
	2015	2016	2017	2018	2019		
España	6,3	6,2	6,5	6,8	6,8	SUFICIENTE ALTO	D
Alemania	9,5	9,8	9,6	9,4	9,4	EXCELENTE	A
Francia	7,6	7,6	7,6	7,6	7,6	BIEN	C
Reino Unido	8,5	8,6	8,2	7,7	7,7	BIEN	C
Italia	6,5	6,6	6,7	6,8	6,8	SUFICIENTE ALTO	D
EEUU	8,4	8,4	8,1	7,8	7,8	BIEN	C
México	2,4	2,1	2,0	1,9	1,9	MUY INSUFICIENTE	F
Chile	2,5	1,5	2,6	3,7	3,7	INSUFICIENTE	FX
Marruecos	1,0	1,0	1,0	1,0	1,0	MUY INSUFICIENTE	F
Egipto	2,5	3,0	2,3	1,7	1,7	MUY INSUFICIENTE	F
Japón	8,2	8,1	8,5	8,8	8,8	MUY BIEN	B
China	6,1	6,4	6,4	6,3	6,3	SUFICIENTE ALTO	D
India	3,2	4,3	3,2	2,2	2,2	MUY INSUFICIENTE	F
Taiwan							

Table 35: Indicator P.8 Values: Infrastructure Quality and Trade Index. ND Gain Index





4.2.1.9 Indicator P.9: Railway Service Efficiency (WEF)

FFCC P.9	Eficiencia del servicio ferroviario (WEF)				
	2015	2016	2017	2018	2019
España				73,5	72,9
Alemania				74,3	65,2
Francia				68,9	65,9
Reino Unido				60,1	55,2
Italia				48,3	52,0
EEUU				78,5	69,2
México				34,5	38,0
Chile				33,4	36,0
Marruecos				44,3	48,9
Egipto				42,8	45,9
Japón				94,1	96,0
China				59,0	59,0
India				57,9	57,0
Taiwan				71,5	73,8
Maximo:	96,000	MAX ((Media+Factor max*Desv Est.):		84,733	10
Mínimo:	33,400	MIN ((Media-Factor min *Desv );0):		34,988	1
<b>Media:</b>	<b>59,861</b>	<b>Percentil 90%:</b>	<b>75,560</b>	49,745	9,000
Factor max*Desv E	84,733	<b>Percentil 10%:</b>	<b>37,400</b>	<b>Unidad:</b>	0,181
Factor min*Desv Es	34,988		<b>Desv. Est.:</b>	<b>16,582</b>	

Table 36: Indicator P.9 Values: Railway Service Efficiency (WEF)

FFCC P.9	Eficiencia del servicio ferroviario (WEF)					Calificación 2019	
	2015	2016	2017	2018	2019		
España				8,0	7,9	BIEN	C
Alemania				8,1	6,5	SUFICIENTE ALTO	D
Francia				7,1	6,6	SUFICIENTE ALTO	D
Reino Unido				5,5	4,7	INSUFICIENTE	FX
Italia				3,4	4,1	INSUFICIENTE	FX
EEUU				8,9	7,2	BIEN	C
México				1,0	1,5	MUY INSUFICIENTE	F
Chile				1,0	1,2	MUY INSUFICIENTE	F
Marruecos				2,7	3,5	INSUFICIENTE	FX
Egipto				2,4	3,0	INSUFICIENTE	FX
Japón				10,0	10,0	EXCELENTE	A
China				5,3	5,3	SUFICIENTE	E
India				5,1	5,0	SUFICIENTE	E
Taiwan				7,6	8,0	MUY BIEN	B

Table 37: Indicator P.9 Rating: Railway Service Efficiency (WEF)



4.2.2. Performance Indicator

	Índice de Prestaciones					Max valor 2019
	2015	2016	2017	2018	2019	
España	36,4	39,6	39,7	47,9	48,0	81
Alemania	47,4	48,8	49,3	57,5	56,1	81
Francia	49,3	49,6	51,0	58,1	57,8	81
Reino Unido	39,5	39,7	39,6	45,1	44,3	81
Italia	40,6	41,3	41,2	44,9	45,1	81
EEUU	37,8	37,7	37,4	46,0	44,4	72
México	2,4	2,1	2,0	2,9	3,4	18
Chile	2,5	1,5	2,6	4,7	4,8	18
Marruecos	25,0	24,8	24,3	33,9	34,3	63
Egipto	10,5	11,2	10,6	12,3	12,9	36
Japón	55,1	54,1	54,6	65,3	65,4	81
China	59,2	61,8	62,0	67,3	67,9	72
India	33,5	35,4	34,1	38,2	38,0	63
Taiwan				7,6	8,0	9
Maximo:	67,859	Máximo Valor:		VER TABLA	10	
Mínimo:	1,481	MIN:		0	0	
Media:	35,780					10,000
		Desv. Estándar:		20,888		

Table 38: Performance Indicator Values

	Evaluación de Prestaciones						Subindicadores considerados	
	2015	2016	2017	2018	Calificación 2019			
España	5,1	5,5	5,5	5,9	5,9	SUFICIENTE	E	9
Alemania	6,6	6,8	6,8	7,1	6,9	SUFICIENTE ALTO	D	9
Francia	6,9	6,9	7,1	7,2	7,1	BIEN	C	9
Reino Unido	5,5	5,5	5,5	5,6	5,5	SUFICIENTE	E	9
Italia	5,6	5,7	5,7	5,5	5,6	SUFICIENTE	E	9
EEUU	6,0	6,0	5,9	6,4	6,2	SUFICIENTE ALTO	D	8
México	2,7	2,3	2,2	1,6	1,9	MUY INSUFICIENTE	F	2
Chile	2,7	1,6	2,9	2,6	2,7	MUY INSUFICIENTE	F	2
Marruecos	5,6	5,5	5,4	5,4	5,5	SUFICIENTE	E	7
Egipto	3,9	4,1	3,9	3,4	3,6	INSUFICIENTE	FX	4
Japón	7,6	7,5	7,6	8,1	8,1	MUY BIEN	B	9
China	9,4	9,8	9,8	9,3	9,4	EXCELENTE	A	8
India	6,2	6,6	6,3	6,1	6,0	SUFICIENTE ALTO	D	7
Taiwan				8,5	8,9	MUY BIEN	B	1

Table 39: Performance Criterion Rating

Subindicadores de Prestaciones		Pesos	Total Max puntuación	Total Max puntuación reducida
FFCC P.1	Líneas A.V / Líneas FC	1	10	9
FFCC P.2	Líneas FC electrificadas / Líneas FC	1	10	9
FFCC P.3	Longitud de vías FC / Líneas FC	1	10	9
FFCC P.4	Tráfico interior de viajeros por FC (10*6 Viajeros-km) / km vías de FC	1	10	9
FFCC P.5	Tráfico interior de mercancías por FC (10*6 tn-km) / km vías FC	1	10	9
FFCC P.6	% Participación del transporte de mercancías en FFCC en el total del transporte terrestre de mercancías	1	10	9
FFCC P.7	% Participación del transporte de pasajeros en FFCC en el total del transporte terrestre de pasajeros	1	10	9
FFCC P.8	Índice de calidad de la infraestructura de transporte y el comercio. ND Gain Index	1	10	9
FFCC P.9	Eficiencia del servicio ferroviario (WEF)	1	10	9
		9	90	
		90 % Valorado de la Max. Puntuación del Criterio	81	81

Table 40: Weights and Maximum Reduced Score of Performance Indicators

In the Performance Criterion, the highest ratings are achieved by France (7.1), Germany (6.9), Japan (8.1), Taiwan (8.9), and China (9.4). Spain falls within the mid-range (5.9), surpassed by the USA (6.2) and India (6.0).

In the indicator "High-Speed Lines / Railway Lines," China stands out with a remarkable ratio (0.410), followed at a considerable distance by Spain (0.161) and Japan (0.148). The fourth country with the best ratio is France (0.102). The rest of the countries have significantly lower ratios.

For the indicator "Electrified Railway Lines / 1,000 Inhabitants," France and Germany stand out (0.25), followed by Spain (0.217), and Italy (0.204). European countries lead the world in railway line electrification.

The indicator "Number of Level Crossings / Railway Lines" demonstrates the effort made by countries to eliminate them. Spain is in the best position among the analyzed European countries (0.194), while Japan has the worst ratio (1.067).

Conversely, the indicator "Number of Stations / Railway Lines" portrays Spain with the worst ratio among European countries (0.092), and one of the lowest among the analyzed countries.

The World Economic Forum's (WEF) indicator related to railways, "Railway Service Efficiency," awards the highest score to Japan (96 out of 100), followed by Taiwan (73) and Spain (72.9). The collective set of indicators from WEF that comprise "The Global Competitiveness Index" (GCI) applies to 141 countries worldwide. Spain ranks seventh in the "2nd Pillar: Infrastructure" (with a rating of 90 out of a maximum of 100).

### 4.3. Financing

The question that this criterion aims to answer is: What investment is allocated to funding the public works sector? How much is dedicated to infrastructure creation? And how much to operation and maintenance?

Infrastructure funding is a crucial criterion for assessing infrastructure quality and includes two distinct elements: investment for infrastructure creation and investment for conservation, operation, and maintenance. In countries with mature railway infrastructure, less overall investment is allocated compared to countries where it's still being developed. Consequently, a significant percentage is directed towards conservation relative to creation. Conversely, in countries where infrastructure is yet to be established and is in development, the investment allocated to infrastructure creation is substantial compared to conservation investment. Unfortunately, it's not always straightforward to separate investment for creation from investment for conservation.

For the purpose of this report, the following indicators have been considered:

3 FINANCING	
F.1	Percentage of Investment in Railways / National GDP (Current €)
F.2	Investment in Railways / Inhabitants (Current €/inhabitant)
F.3	Investment in Railways / km of Railway Lines (Current €/km)
F.4	Investment in Railways / Country Area (km <sup>2</sup> ) (Current €/km <sup>2</sup> )
F.5	Investment in Railways / Domestic Passenger Traffic by Railway (10 <sup>6</sup> Passenger-km)
F.6	Investment in Railways / Domestic Freight Traffic by Railway (10 <sup>6</sup> ton-km)
F.7	Percentage of Investment in Railways / Total Investment in Land Transport Infrastructure

One of the most representative indicators is railway investment relative to the national GDP. The evolution of this indicator over the years provides valuable insights into the degree of infrastructure development in the country and the state of its conservation. A high percentage of GDP (above 0.7% or 0.8%) indicates that the railway network is in a creation phase, as seen in the case of China (0.74) and, to a lesser extent, France (0.48), the United Kingdom (0.53), and India (0.4). In general terms, if this percentage drops below 0.4%, it suggests that new infrastructure is not being created. Additionally, if this percentage falls below 0.2-0.3%, it's an indication that the investment also inadequately covers the needs of conservation, maintenance, and management of the infrastructure.

The other investment-related indicators behave similarly to the investment-to-GDP ratio, making them complementary and providing disaggregated information. Investment data have been extracted from the OECD's "Rail infrastructure investment" (current €).



## 4.3.1. Financing Indicators

### 4.3.1.1 Indicator F.1: Percentage of Investment in Railways / National GDP (Current €)

FFCC F.1	%Inversión en FC / PIB nacional (€corrientes)				
	2015	2016	2017	2018	2019
España	0,24%	0,15%	0,19%	0,18%	0,18%
Alemania	0,14%	0,11%	0,13%	0,14%	0,15%
Francia	0,39%	0,39%	0,41%	0,42%	0,48%
Reino Unido	0,55%	0,54%	0,55%	0,68%	0,53%
Italia	0,17%	0,21%	0,19%	0,16%	0,24%
EEUU	0,09%	0,07%	0,07%	0,06%	0,06%
México	0,11%	0,14%	0,16%	0,14%	0,07%
Chile					
Marruecos					
Egipto					
Japón	0,22%	0,20%	0,31%	0,35%	0,38%
China	1,13%	1,04%	0,96%	0,83%	0,74%
India	0,50%	0,48%	0,45%	0,44%	0,40%
Taiwan					
Maximo:	1,13%	MAX ((Media+Factor max*Desv Est.):		0,73%	10
Mínimo:	0,06%	MIN ((Media-Factor min *Desv);0):		0,00%	1
<b>Media:</b>	<b>0,34%</b>	<b>Percentil 90%:</b>		0,69%	9,000
Factor max*Desv Es	0,73%	<b>Percentil 10%:</b>		0,09%	<b>Unidad:</b> 1229,103
Factor min*Desv Es	-0,05%	<b>Desv. Est.:</b>		0,26%	

Table 41: Indicator F.1 Values: Percentage of Investment in Railways / National GDP (Current €)

FFCC F.1	%Inversión en FC / PIB nacional (€corrientes)					Calificación 2019	
	2015	2016	2017	2018	2019		
España	4,0	2,8	3,3	3,2	3,2	INSUFICIENTE	FX
Alemania	2,7	2,4	2,6	2,8	2,9	MUY INSUFICIENTE	F
Francia	5,8	5,7	6,0	6,1	6,9	SUFICIENTE ALTO	D
Reino Unido	7,8	7,7	7,8	9,4	7,5	BIEN	C
Italia	3,1	3,6	3,3	3,0	3,9	INSUFICIENTE	FX
EEUU	2,1	1,9	1,8	1,7	1,7	MUY INSUFICIENTE	F
México	2,3	2,7	3,0	2,7	1,9	MUY INSUFICIENTE	F
Chile							
Marruecos							
Egipto							
Japón	3,7	3,5	4,8	5,4	5,7	SUFICIENTE	E
China	10,0	10,0	10,0	10,0	10,0	EXCELENTE	A
India	7,1	6,9	6,5	6,4	5,9	SUFICIENTE	E
Taiwan							

Table 42: Indicator F.1 Rating: Percentage of Investment in Railways / National GDP (Current €)



### 4.3.1.2 Indicador F.2: Investment in Railways / Inhabitants (Current €/inhabitant)

FFCC F.2	Inversión en FC / habitantes (€corrientes/habitantes)				
	2015	2016	2017	2018	2019
España	56,3	35,6	47,5	46,3	47,1
Alemania	67,8	63,0	69,1	74,1	83,6
Francia	128,9	129,1	139,5	147,6	172,9
Reino Unido	225,2	201,4	197,6	248,9	199,0
Italia	47,1	58,1	54,4	47,3	71,1
EEUU	45,7	38,6	35,3	32,1	35,3
México	9,4	11,0	13,2	11,5	6,3
Chile					
Marruecos					
Egipto					
Japón	69,8	72,2	106,9	119,2	138,6
China	80,5	75,9	74,5	69,0	67,4
India	7,4	7,5	7,7	7,7	7,6
Taiwan					
Maximo:	248,915	MAX ((Media+Factor max*Desv Est.):		169,299	10
Mínimo:	6,279	MIN ((Media-Factor min *Desv );0):		0,000	1
<b>Media:</b>	<b>76,182</b>	<b>Percentil 90%:</b>	<b>175,408</b>	169,299	9,000
Factor max*Desv E	169,299	<b>Percentil 10%:</b>	<b>7,732</b>	<b>Unidad:</b>	<b>0,053</b>
Factor min*Desv Es	-16,936		<b>Desv. Est.:</b>	<b>62,078</b>	

Table 43: Indicator F.2 Values: Investment in Railways / Inhabitants (Current €/inhabitant)

FFCC F.2	Inversión en FC / habitantes (€corrientes/habitantes)					Calificación 2019	
	2015	2016	2017	2018	2019		
España	4,0	2,9	3,5	3,5	3,5	INSUFICIENTE	FX
Alemania	4,6	4,4	4,7	4,9	5,4	SUFICIENTE	E
Francia	7,9	7,9	8,4	8,8	10,0	EXCELENTE	A
Reino Unido	10,0	10,0	10,0	10,0	10,0	EXCELENTE	A
Italia	3,5	4,1	3,9	3,5	4,8	INSUFICIENTE	FX
EEUU	3,4	3,1	2,9	2,7	2,9	MUY INSUFICIENTE	F
México	1,5	1,6	1,7	1,6	1,3	MUY INSUFICIENTE	F
Chile							
Marruecos							
Egipto							
Japón	4,7	4,8	6,7	7,3	8,4	MUY BIEN	B
China	5,3	5,0	5,0	4,7	4,6	INSUFICIENTE	FX
India	1,4	1,4	1,4	1,4	1,4	MUY INSUFICIENTE	F
Taiwan							

Table 44: Indicator F.2 Rating: Investment in Railways / Inhabitants (Current €/inhabitant)



### 4.3.1.3 Indicador F.3: Investment in Railways / km of Railway Lines (Current €/km)

FFCC F.3	Inversión en FC / km de líneas de FC (€corrientes/km líneas)				
	2015	2016	2017	2018	2019
España	160.179	102.493	136.974	134.167	136.383
Alemania	144.049	134.428	147.976	159.959	180.966
Francia	313.645	319.015	337.760	367.667	431.828
Reino Unido	903.023	812.835	799.939	1.015.593	813.532
Italia	171.276	209.912	196.342	170.133	253.054
EEUU	97.332	83.034	76.586	70.311	77.553
México					
Chile					
Marruecos					
Egipto					
Japón	441.901	476.524	705.048	785.084	911.499
China	1.689.231	1.571.693	1.566.267	1.450.367	1.416.100
India	150.749	147.656	154.791	154.791	154.791
Taiwan					
Maximo:	1.689.231,420	MAX ((Media+Factor max*Desv Est.):		1.165.382,427	10
Mínimo:	70.311,297	MIN ((Media-Factor min *Desv );0):		0,00	1
<b>Media:</b>	<b>460.765,285</b>	<b>Percentil 90%:</b>	<b>1.255.897,506</b>	1165382,427	9,000
Factor max*Desv E	1.165.382,427	<b>Percentil 10%:</b>	<b>99.396,350</b>	<b>Unidad:</b>	<b>0,000</b>
Factor min*Desv Es	-243.851,856		<b>Desv. Est.:</b>	<b>469.744,761</b>	

Table 45: Indicator F.3 Values: Investment in Railways / km of Railway Lines (Current €/km)

FFCC F.3	Inversión en FC / km de líneas de FC (€corrientes/km líneas)					Calificación 2019	
	2015	2016	2017	2018	2019		
España	2,2	1,8	2,1	2,0	2,1	MUY INSUFICIENTE	F
Alemania	2,1	2,0	2,1	2,2	2,4	MUY INSUFICIENTE	F
Francia	3,4	3,5	3,6	3,8	4,3	INSUFICIENTE	FX
Reino Unido	8,0	7,3	7,2	8,8	7,3	BIEN	C
Italia	2,3	2,6	2,5	2,3	3,0	MUY INSUFICIENTE	F
EEUU	1,8	1,6	1,6	1,5	1,6	MUY INSUFICIENTE	F
México							
Chile							
Marruecos							
Egipto							
Japón	4,4	4,7	6,4	7,1	8,0	MUY BIEN	B
China	10,0	10,0	10,0	10,0	10,0	EXCELENTE	A
India	2,2	2,1	2,2	2,2	2,2	MUY INSUFICIENTE	F
Taiwan							

Table 46: Indicator F.3 Rating: Investment in Railways / km of Railway Lines (Current €/km)



4.3.1.4 *Indicator F.4: Investment in Railways / Country Area (km2) (Current €/km2)*

FFCC F.4	Inversión de FC / Superficie del País (km2) (€corrientes/km2)				
	2015	2016	2017	2018	2019
España	5.165	3.275	4.378	4.285	4.384
Alemania	15.503	14.520	15.971	17.185	19.431
Francia	15.619	15.690	17.001	18.034	21.181
Reino Unido	60.203	54.230	53.590	67.908	54.587
Italia	9.494	11.694	10.938	9.451	14.056
EEUU	1.492	1.269	1.168	1.069	1.179
México	585	690	841	741	408
Chile					
Marruecos					
Egipto					
Japón	23.494	24.274	35.916	39.992	46.432
China	11.656	10.984	10.946	10.136	9.897
India	2.934	3.009	3.154	3.154	3.154
Taiwan					
Maximo:	67.907,721	MAX ((Media+Factor max*Desv Est.):		42.095,537	10
Mínimo:	407,763	MIN ((Media-Factor min *Desv );0):		0,00	1
<b>Media:</b>	<b>15.726,909</b>	<b>Percentil 90%:</b>	<b>47.147,564</b>	42095,537	9,000
Factor max*Desv E	42.095,537	<b>Percentil 10%:</b>	<b>1.045,802</b>	<b>Unidad:</b>	<b>0,000</b>
Factor min*Desv Es	-10.641,719		<b>Desv. Est.:</b>	<b>17.579,085</b>	

Table 47: Indicator F.4 Values: Investment in Railways / Country Area (km2) (Current €/km2)

FFCC F.4	Inversión de FC / Superficie del País (km2) (€corrientes/km2)					Calificación 2019	
	2015	2016	2017	2018	2019		
España	2,1	1,7	1,9	1,9	1,9	MUY INSUFICIENTE	F
Alemania	4,3	4,1	4,4	4,7	5,2	SUFICIENTE	E
Francia	4,3	4,4	4,6	4,9	5,5	SUFICIENTE	E
Reino Unido	10,0	10,0	10,0	10,0	10,0	EXCELENTE	A
Italia	3,0	3,5	3,3	3,0	4,0	INSUFICIENTE	FX
EEUU	1,3	1,3	1,2	1,2	1,3	MUY INSUFICIENTE	F
México	1,1	1,1	1,2	1,2	1,1	MUY INSUFICIENTE	F
Chile							
Marruecos							
Egipto							
Japón	6,0	6,2	8,7	9,6	10,0	EXCELENTE	A
China	3,5	3,3	3,3	3,2	3,1	INSUFICIENTE	FX
India	1,6	1,6	1,7	1,7	1,7	MUY INSUFICIENTE	F
Taiwan							

Table 48: Indicator F.4 Rating: Investment in Railways / Country Area (km2) (Current €/km2)





4.3.1.5 *Indicator F.5: Investment in Railways / Domestic Passenger Traffic by Railway (10<sup>6</sup> Passenger-km)*

FFCC F.5	Inversión de FC / Tráfico interior de viajeros por FC (10 <sup>6</sup> Viajeros-km)				
	2015	2016	2017	2018	2019
España	99.954	62.130	80.584	76.247	76.920
Alemania	60.489	55.119	59.782	62.595	68.099
Francia	81.794	82.672	84.428	91.740	103.398
Reino Unido	192.821	168.876	164.222	204.285	161.089
Italia	54.801	67.538	61.919	51.448	75.036
EEUU	406.893	347.513	345.231	328.661	356.710
México	815.025	915.598	1.066.452	915.148	509.866
Chile					
Marruecos					
Egipto					
Japón	20.773	21.248	31.038	34.229	40.339
China	93.551	83.827	78.089	68.785	64.603
India	8.437	8.602	8.929	8.929	8.929
Taiwan					
Maximo:	1.066.451,613	MAX ((Media+Factor max*Desv Est.):		555.254,149	10
Mínimo:	8.437,157	MIN ((Media-Factor min *Desv );0):		0,000	1
<b>Media:</b>	<b>178.707,796</b>	<b>Percentil 90%:</b>	<b>417.190,315</b>	555254,149	9,000
Factor max*Desv E:	555.254,149	<b>Percentil 10%:</b>	<b>19.588,202</b>	<b>Unidad:</b>	<b>0,000</b>
Factor min*Desv Es	-197.838,556		<b>Desv. Est.:</b>	<b>251.030,902</b>	

Table 49: Indicator F.5 Values: Investment in Railways / Domestic Passenger Traffic by Railway (10<sup>6</sup> Passenger-km)

FFCC F.5	Inversión de FC / Tráfico interior de viajeros por FC (10 <sup>6</sup> Viajeros-km)					Calificación 2019	
	2015	2016	2017	2018	2019		
España	2,6	2,0	2,3	2,2	2,2	MUY INSUFICIENTE	F
Alemania	2,0	1,9	2,0	2,0	2,1	MUY INSUFICIENTE	F
Francia	2,3	2,3	2,4	2,5	2,7	MUY INSUFICIENTE	F
Reino Unido	4,1	3,7	3,7	4,3	3,6	INSUFICIENTE	FX
Italia	1,9	2,1	2,0	1,8	2,2	MUY INSUFICIENTE	F
EEUU	7,6	6,6	6,6	6,3	6,8	SUFICIENTE ALTO	D
México	10,0	10,0	10,0	10,0	9,3	EXCELENTE	A
Chile							
Marruecos							
Egipto							
Japón	1,3	1,3	1,5	1,6	1,7	MUY INSUFICIENTE	F
China	2,5	2,4	2,3	2,1	2,0	MUY INSUFICIENTE	F
India	1,1	1,1	1,1	1,1	1,1	MUY INSUFICIENTE	F
Taiwan							

Table 50: Indicator F.5 Rating: Investment in Railways / Domestic Passenger Traffic by Railway (10<sup>6</sup> Passenger-km)



4.3.1.6 *Indicator F.6: Investment in Railways / Domestic Freight Traffic by Railway (10<sup>6</sup> ton-km)*

FFCC F.6	Inversión de FC / Tráfico interior de mercancías por FC (10 <sup>6</sup> tn-km)				
	2015	2016	2017	2018	2019
España	5.165	3.275	4.378	4.285	4.384
Alemania	15.503	14.520	15.971	17.185	19.431
Francia	15.619	15.690	17.001	18.034	21.181
Reino Unido	60.203	54.230	53.590	67.908	54.587
Italia	9.494	11.694	10.938	9.451	14.056
EEUU	1.492	1.269	1.168	1.069	1.179
México	585	690	841	741	408
Chile					
Marruecos					
Egipto					
Japón	23.494	24.274	35.916	39.992	46.432
China	11.656	10.984	10.946	10.136	9.897
India	2.934	3.009	3.154	3.154	3.154
Taiwan					
Maximo:	67.907,721	MAX ((Media+Factor max*Desv Est.):		42.095,537	10
Mínimo:	407,763	MIN ((Media-Factor min *Desv );0):		0,000	1
<b>Media:</b>	<b>15.726,909</b>	<b>Percentil 90%:</b>	<b>47.147,564</b>	42095,537	9,000
Factor max*Desv E	42.095,537	<b>Percentil 10%:</b>	<b>1.045,802</b>	<b>Unidad:</b>	<b>0,000</b>
Factor min*Desv Es	-10.641,719		<b>Desv. Est.:</b>	<b>17.579,085</b>	

Table 51: Indicator F.6 Values: Investment in Railways / Domestic Freight Traffic by Railway (10<sup>6</sup> ton-km)

FFCC F.6	Inversión de FC / Tráfico interior de mercancías por FC (10 <sup>6</sup> tn-km)					Calificación 2019	
	2015	2016	2017	2018	2019		
España	2,1	1,7	1,9	1,9	1,9	MUY INSUFICIENTE	F
Alemania	4,3	4,1	4,4	4,7	5,2	SUFICIENTE	E
Francia	4,3	4,4	4,6	4,9	5,5	SUFICIENTE	E
Reino Unido	10,0	10,0	10,0	10,0	10,0	EXCELENTE	A
Italia	3,0	3,5	3,3	3,0	4,0	INSUFICIENTE	FX
EEUU	1,3	1,3	1,2	1,2	1,3	MUY INSUFICIENTE	F
México	1,1	1,1	1,2	1,2	1,1	MUY INSUFICIENTE	F
Chile							
Marruecos							
Egipto							
Japón	6,0	6,2	8,7	9,6	10,0	EXCELENTE	A
China	3,5	3,3	3,3	3,2	3,1	INSUFICIENTE	FX
India	1,6	1,6	1,7	1,7	1,7	MUY INSUFICIENTE	F
Taiwan							

Table 52: Indicator F.6 Rating: Investment in Railways / Domestic Freight Traffic by Railway (10<sup>6</sup> ton-km)



### 4.3.1.7 Indicator F.7: Percentage of Investment in Railways / Total Investment in Land Transport Infrastructure

FFCC F.7	%Inversión en FC / inversión total en infraestructura de transporte terrestre				
	2015	2016	2017	2018	2019
España	38,02%	29,93%	37,51%	38,13%	39,17%
Alemania	36,10%	33,30%	33,10%	32,70%	33,90%
Francia	45,74%	47,80%	50,60%	50,11%	53,09%
Reino Unido	61,79%	61,21%	59,17%	60,96%	57,97%
Italia	33,58%	48,03%	47,47%	29,57%	49,17%
EEUU	16,32%	12,96%	11,98%	11,00%	10,95%
México	21,10%	28,60%	43,30%	38,70%	26,00%
Chile					
Marruecos					
Egipto					
Japón	24,00%	22,00%	30,10%	33,50%	34,80%
China	21,27%	19,04%	16,57%	14,84%	13,39%
India	41,33%	44,25%			
Taiwan					
Maximo:	61,79%	MAX ((Media+Factor max*Desv Est.):		57,01%	10
Mínimo:	10,95%	MIN ((Media-Factor min *Desv );0):		12,95%	1
<b>Media:</b>	<b>34,98%</b>	<b>Percentil 90%:</b>	55,04%	44,06%	9,000
Factor max*Desv E	57,01%	<b>Percentil 10%:</b>	14,26%	<b>Unidad:</b>	20,424
Factor min*Desv Es	12,95%		<b>Desv. Est.:</b>	14,69%	

Table 53: Indicator F.7 Values: Percentage of Investment in Railways / Total Investment in Land Transport Infrastructure

FFCC F.7	%Inversión en FC / inversión total en infraestructura de transporte terrestre					Calificación 2019	
	2015	2016	2017	2018	2019		
España	6,1	4,5	6,0	6,1	6,4	SUFICIENTE ALTO	D
Alemania	5,7	5,2	5,1	5,0	5,3	SUFICIENTE	E
Francia	7,7	8,1	8,7	8,6	9,2	EXCELENTE	A
Reino Unido	10,0	10,0	10,0	10,0	10,0	EXCELENTE	A
Italia	5,2	8,2	8,0	4,4	8,4	MUY BIEN	B
EEUU	1,7	1,0	1,0	1,0	1,0	MUY INSUFICIENTE	F
México	2,7	4,2	7,2	6,3	3,7	INSUFICIENTE	FX
Chile							
Marruecos							
Egipto							
Japón	3,3	2,8	4,5	5,2	5,5	SUFICIENTE	E
China	2,7	2,2	1,7	1,4	1,1	MUY INSUFICIENTE	F
India	6,8	7,4					
Taiwan							

Table 54: Indicator F.7 Rating: Percentage of Investment in Railways / Total Investment in Land Transport Infrastructure



#### 4.3.2. Financing Indicator

	Índice de Financiación					Max valor 2019
	2015	2016	2017	2018	2019	
España	23,2	17,4	21,1	20,9	21,2	63
Alemania	25,8	24,1	25,3	26,3	28,4	63
Francia	35,8	36,2	38,3	39,6	44,1	63
Reino Unido	59,9	58,7	58,6	62,6	58,4	63
Italia	22,1	27,5	26,5	21,1	30,3	63
EEUU	19,2	16,8	16,4	15,8	16,5	63
México	18,8	20,8	24,2	22,9	18,3	54
Chile						0
Marruecos						0
Egipto						0
Japón	29,5	29,6	41,3	45,6	49,2	63
China	37,5	36,3	35,6	34,5	34,0	63
India	21,9	22,2	14,6	14,5	14,0	54
Taiwan						0
Maximo:	62,553	Máximo Valor:		VER TABLA	10	
Mínimo:	14,028	MIN:		0	0	
Media:	30,070				10,000	

Table 55: Financing Indicator Values

Subindicadores de Financiación		Pesos	Total Max puntuación	Total Max puntuación reducida
FFCC F.1	% Inversión en FC / PIB nacional (€ corrientes)	1	10	9
FFCC F.2	Inversión en FC / habitantes (€ corrientes/habitantes)	1	10	9
FFCC F.3	Inversión en FC / km de líneas de FC (€ corrientes/km líneas)	1	10	9
FFCC F.4	Inversión de FC / Superficie del País (km2) (€ corrientes/km2)	1	10	9
FFCC F.5	Inversión de FC / Tráfico interior de viajeros por FC (10^6 Viajeros-km)	1	10	9
FFCC F.6	Inversión de FC / Tráfico interior de mercancías por FC (10^6 tn-km)	1	10	9
FFCC F.7	% Inversión en FC / inversión total en infraestructura de transporte terrestre	1	10	9
		7	70	
		90 % Valorado de la Max. Puntuación del Criterio	63	63

Table 56: Financing Indicator Weights

	Evaluación de Financiación					Calificación 2019		Subindicadores considerados
	2015	2016	2017	2018				
España	3,7	2,8	3,4	3,3	3,4	INSUFICIENTE	FX	7
Alemania	4,1	3,8	4,0	4,2	4,5	INSUFICIENTE	FX	7
Francia	5,7	5,8	6,1	6,3	7,0	BIEN	C	7
Reino Unido	9,5	9,3	9,3	9,9	9,3	EXCELENTE	A	7
Italia	3,5	4,4	4,2	3,3	4,8	INSUFICIENTE	FX	7
EEUU	3,0	2,7	2,6	2,5	2,6	MUY INSUFICIENTE	F	7
México	3,5	3,8	4,5	4,2	3,4	INSUFICIENTE	FX	6
Chile								0
Marruecos								0
Egipto								0
Japón	4,7	4,7	6,6	7,2	7,8	BIEN	C	7
China	5,9	5,8	5,7	5,5	5,4	SUFICIENTE	E	7
India	3,5	3,5	2,7	2,7	2,6	MUY INSUFICIENTE	F	6
Taiwan								0

Table 57: Financing Criterion Rating



As previously mentioned, the most relevant indicator is railway investment as a percentage of GDP. The average value across the analyzed countries and years is 0.34%, with a maximum of 1.13% reached in 2015 by China. Spain has a low value, 0.18% of GDP in 2019. The highest value in 2019 is held by China (0.74%), which has maintained high investment levels over the past five years. Japan and India have elevated ratios: 0.38% and 0.4% respectively. Among European countries, the United Kingdom (0.53%) and France (0.48%) are the highest investors. The USA has the lowest investment relative to GDP (0.06%) in 2019. It's possible that this indicator might be biased due to the omission of certain investments.

Some interesting insights derived from the used indicators are summarized in the following table:

<b>Indicator</b>	<b>Average</b>	<b>Min Value</b>	<b>Max Value</b>
% of investment in railway lines relative to GDP	<b>0,34%</b>	<b>0,06%</b>	<b>1.13%</b>
Investment in railway lines per capita	<b>76€</b>	<b>6,3€</b>	<b>248€</b>
Investment in railway lines per kilometer of lines	<b>460.765€</b>	<b>70.311€</b>	<b>1.689.231€</b>
Investment in railway lines per unit of area (km2)	<b>15.726€</b>	<b>407€</b>	<b>67.907€</b>

The significant variation in the results presented in the previous table reflects a reality: countries that, during the analyzed years in the report (2015-2019), are creating new infrastructure or undergoing substantial transformations in their networks tend to have higher values. This indicates a substantial commitment to the development and improvement of their railway networks, especially in the realm of high-speed rail.

Spain receives an insufficient final score in this Criterion (3.4), the lowest rating among the analyzed European countries. The highest rating is achieved by the United Kingdom (9.3), followed by China (7.8), Japan (7.8), and France (7.0). The lowest ratings are attributed to India and the USA (2.6).



#### 4.4. Adaptation to the future and Sustainability

The questions posed in this criterion are: Is the capacity and performance of the public works sector prepared to meet future expectations and demands? Are the resources and investments considered adequate to address the sector's future needs? How are actions promoting environmental sustainability being implemented? Are active measures being taken to achieve the established objectives for decarbonizing public works and transportation?

The chosen indicators are as follows:

4 Future Adaptation and Sustainability	
A.1	High-Speed Railway Lines with Speed > 160 km/h / Railway Lines
A.2	Level Crossings / Railway Lines
A.3	Percentage of Passenger-km by Rail / Passenger-km (Land)
A.4	Percentage of ton-km by Rail / ton-km (Land)
A.5	CO <sub>2</sub> Emissions from Railways / Railway Lines (Thousands of t CO <sub>2</sub> Equiv/km of Railway Lines)
A.6	Electrified Lines / km of Railway Lines
A.7	Percentage of Renewable Energy in Transport / Energy Consumed in Transport
A.8	Development of Climate Change Mitigation Technologies related to Transport (OCDE)

In the report, it has been considered that the preparedness of infrastructure for future demands is related to the ratio of high-speed lines (>160 km/h) to total lines, the elimination of level crossings, the percentages of passenger and freight traffic in relation to total traffic in land transport modes, and electrified lines.

Three environmental indicators have also been considered: CO<sub>2</sub> emissions from railways / Railway lines, the percentage of renewable energy in relation to the total energy consumed by transportation, and the development of technologies for mitigating climate change related to transportation.

Information for the countries Mexico, Chile, Morocco, and Taiwan could not be found, and as a result, this criterion has not been evaluated for these countries.



#### 4.4.1. Adaptation to the future and Sustainability Indicators

##### 4.4.1.1 Indicator A.1: High-Speed Railway Lines with Speed > 160 km/h / Railway Lines

FFCC A.1	Líneas FC con Velocidad > 160 km/h / Líneas FC				
	2015	2016	2017	2018	2019
España	0,117	0,331	0,327	0,331	0,334
Alemania	0,023	0,065	0,068	0,069	0,069
Francia	0,075	0,083	0,101	0,104	0,104
Reino Unido	0,005	0,007	0,007	0,007	0,007
Italia	0,051	0,219	0,219	0,219	0,219
EEUU					
México					
Chile					
Marruecos				0,095	0,088
Egipto					
Japón	0,142	0,133	0,133	0,148	0,148
China	0,283	0,303	0,325	0,355	0,410
India					
Taiwan					
Maximo:	0,410	MAX ((Media+Factor max*Desv Est.):		0,333	10
Mínimo:	0,005	MIN ((Media-Factor min *Desv);0):			1
Media:	0,155	Percentil 90%:	0,331	0,333	9,000
Factor max*Desv Es	0,333	Percentil 10%:	0,007	Unidad:	26,994
Factor min*Desv Es	-0,024		Desv. Est.:	0,119	

Table 58: Indicator A.1 Values: High-Speed Railway Lines with Speed > 160 km/h / Railway Lines

FFCC A.1	Líneas FC con Velocidad > 160 km/h / Líneas FC					Calificación 2019	
	2015	2016	2017	2018	2019		
España	4,2	9,9	9,8	9,9	10,0	EXCELENTE	A
Alemania	1,6	2,8	2,8	2,9	2,9	MUY INSUFICIENTE	F
Francia	3,0	3,2	3,7	3,8	3,8	INSUFICIENTE	FX
Reino Unido	1,1	1,2	1,2	1,2	1,2	MUY INSUFICIENTE	F
Italia	2,4	6,9	6,9	6,9	6,9	SUFICIENTE ALTO	D
EEUU							
México							
Chile							
Marruecos				3,6	3,4	INSUFICIENTE	FX
Egipto							
Japón	4,8	4,6	4,6	5,0	5,0	SUFICIENTE	E
China	8,6	9,2	9,8	10,0	10,0	EXCELENTE	A
India							
Taiwan							

Table 59: Indicator A.1 Rating: High-Speed Railway Lines with Speed > 160 km/h / Railway Lines



#### 4.4.1.2 Indicador A.2: Level Crossings / Railway Lines

FFCC A.2	Pasos a Nivel / Líneas FC				
	2015	2016	2017	2018	2019
España	<b>0,196</b>	<b>0,195</b>	<b>0,194</b>	<b>0,195</b>	<b>0,194</b>
Alemania		<b>0,364</b>	<b>0,365</b>	<b>0,366</b>	<b>0,366</b>
Francia		<b>0,428</b>	<b>0,418</b>	<b>0,429</b>	<b>0,429</b>
Reino Unido		<b>0,362</b>	<b>0,361</b>	<b>0,361</b>	<b>0,360</b>
Italia		<b>0,221</b>	<b>0,221</b>	<b>0,221</b>	<b>0,221</b>
EEUU					
México					
Chile					
Marruecos				<b>0,178</b>	<b>0,178</b>
Egipto					
Japón		<b>1,067</b>	<b>1,067</b>	<b>1,067</b>	<b>1,067</b>
China					
India					
Taiwan					
Maximo:	1,067	MAX ((Media+Factor max*Desv Est.):		<b>0,850</b>	<b>1</b>
Mínimo:	0,178	MIN ((Media-Factor min *Desv );0):			<b>10</b>
<b>Media:</b>	<b>0,411</b>	<b>Percentil 90%:</b>	<b>1,067</b>	0,850	-9,000
Factor max*Desv E	0,850	<b>Percentil 10%:</b>	<b>0,194</b>	<b>Unidad:</b>	<b>-10,592</b>
Factor min*Desv Es	-0,028		<b>Desv. Est.:</b>	<b>0,293</b>	

Table 60: Indicator A.2 Values: Level Crossings / Railway Lines

FFCC A.2	Pasos a Nivel / Líneas FC					Calificación 2019	
	2015	2016	2017	2018	2019		
España	<b>7,9</b>	<b>7,9</b>	<b>7,9</b>	<b>7,9</b>	<b>7,9</b>	<b>BIEN</b>	<b>C</b>
Alemania		<b>6,1</b>	<b>6,1</b>	<b>6,1</b>	<b>6,1</b>	<b>SUFICIENTE ALTO</b>	<b>D</b>
Francia		<b>5,5</b>	<b>5,6</b>	<b>5,5</b>	<b>5,5</b>	<b>SUFICIENTE</b>	<b>E</b>
Reino Unido		<b>6,2</b>	<b>6,2</b>	<b>6,2</b>	<b>6,2</b>	<b>SUFICIENTE ALTO</b>	<b>D</b>
Italia		<b>7,7</b>	<b>7,7</b>	<b>7,7</b>	<b>7,7</b>	<b>BIEN</b>	<b>C</b>
EEUU							
México							
Chile							
Marruecos				<b>8,1</b>	<b>8,1</b>	<b>MUY BIEN</b>	<b>B</b>
Egipto							
Japón		<b>1,0</b>	<b>1,0</b>	<b>1,0</b>	<b>1,0</b>	<b>MUY INSUFICIENTE</b>	<b>F</b>
China							
India							
Taiwan							

Table 61: Indicator A.2 Rating: Level Crossings / Railway Lines





#### 4.4.1.3 Indicator A.3: Percentage of Passenger-km by Rail / Passenger-km (Land)

FFCC A.3	%Pasajeros-km FC / Pasajeros-km (Terrestre)				
	2015	2016	2017	2018	2019
España	4,69%	4,48%	4,18%	4,16%	3,87%
Alemania	23,12%	24,89%	25,32%	25,44%	25,34%
Francia	17,63%	16,88%	16,26%	15,56%	15,20%
Reino Unido	10,16%	10,16%	10,16%	10,16%	10,16%
Italia	14,15%	15,62%	14,67%	14,02%	12,58%
EEUU	38,00%	35,30%	36,80%	36,80%	36,80%
México					
Chile					
Marruecos					
Egipto					
Japón	9,53%	9,18%	9,32%	8,43%	8,55%
China	19,17%	18,54%	18,98%	18,90%	20,80%
India					
Taiwan					
Maximo:	38,00%	MAX ((Media+Factor max*Desv Est.):		31,47%	10
Mínimo:	3,87%	MIN ((Media-Factor min *Desv );0):		2,23%	1
<b>Media:</b>	<b>16,85%</b>	<b>Percentil 90%:</b>	35,45%	29,24%	9,000
Factor max*Desv E	31,47%	<b>Percentil 10%:</b>	4,67%	<b>Unidad:</b>	30,779
Factor min*Desv Es	0,022		<b>Desv. Est.:</b>	9,75%	

Table 62: Indicator A.3 Values: Percentage of Passenger-km by Rail / Passenger-km (Land)

FFCC A.3	%Pasajeros-km FC / Pasajeros-km (Terrestre)					Calificación 2019	
	2015	2016	2017	2018	2019		
España	1,8	1,7	1,6	1,6	1,5	MUY INSUFICIENTE	F
Alemania	7,4	8,0	8,1	8,1	8,1	MUY BIEN	B
Francia	5,7	5,5	5,3	5,1	5,0	SUFICIENTE	E
Reino Unido	3,4	3,4	3,4	3,4	3,4	INSUFICIENTE	FX
Italia	4,7	5,1	4,8	4,6	4,2	INSUFICIENTE	FX
EEUU	10,0	10,0	10,0	10,0	10,0	EXCELENTE	A
México							
Chile							
Marruecos							
Egipto							
Japón	3,2	3,1	3,2	2,9	2,9	MUY INSUFICIENTE	F
China	6,2	6,0	6,2	6,1	6,7	SUFICIENTE ALTO	D
India							
Taiwan							

Table 63: Indicator A.3 Rating: Percentage of Passenger-km by Rail / Passenger-km (Land)



4.4.1.4 Indicator A.4: Percentage of ton-km by Rail / ton-km (Land)

FFCC A.4	%t-km FC / t-km (Terrestre)				
	2015	2016	2017	2018	2019
España	6,70%	6,60%	7,03%	7,09%	7,14%
Alemania	8,32%	8,40%	8,90%	9,12%	9,42%
Francia	11,07%	10,88%	11,38%	11,16%	11,67%
Reino Unido	9,54%	9,66%	9,64%	9,67%	9,68%
Italia	6,28%	6,07%	5,91%	6,30%	6,34%
EEUU	0,56%	0,55%	0,50%	0,50%	0,50%
México					
Chile					
Marruecos					
Egipto					
Japón	32,70%	32,63%	32,58%	32,48%	32,08%
China					
India	6,90%	6,17%	5,56%	5,56%	5,56%
Taiwan					
Maximo:	32,70%	MAX ((Media+Factor max*Desv Est.):		23,80%	10
Mínimo:	0,50%	MIN ((Media-Factor min *Desv );0):			1
<b>Media:</b>	<b>10,22%</b>	<b>Percentil 90%:</b>	<b>32,12%</b>	23,80%	9,000
Factor max*Desv Es	23,80%	<b>Percentil 10%:</b>	<b>0,56%</b>	<b>Unidad:</b>	37,810
Factor min*Desv Es	-0,034		<b>Desv. Est.:</b>	<b>9,06%</b>	

Table 64: Indicator A.4 Values: Percentage of ton-km by Rail / ton-km (Land)

FFCC A.4	%t-km FC / t-km (Terrestre)					Calificación 2019	
	2015	2016	2017	2018	2019		
España	3,5	3,5	3,7	3,7	3,7	INSUFICIENTE	FX
Alemania	4,1	4,2	4,4	4,4	4,6	INSUFICIENTE	FX
Francia	5,2	5,1	5,3	5,2	5,4	SUFICIENTE	E
Reino Unido	4,6	4,7	4,6	4,7	4,7	INSUFICIENTE	FX
Italia	3,4	3,3	3,2	3,4	3,4	INSUFICIENTE	FX
EEUU	1,2	1,2	1,2	1,2	1,2	MUY INSUFICIENTE	F
México							
Chile							
Marruecos							
Egipto							
Japón	10,0	10,0	10,0	10,0	10,0	EXCELENTE	A
China							
India	3,6	3,3	3,1	3,1	3,1	INSUFICIENTE	FX
Taiwan							

Table 65: Indicator A.4 Rating: Percentage of ton-km by Rail / ton-km (Land)



4.4.1.5 *Indicator A.5: CO2 Emissions from Railways / Railway Lines (Thousands of t CO2 Equiv/km of Railway Lines)*

FFCC A.5	Emisiones CO2 procedente del FFCC / Líneas FC (Miles de t CO2 Equiv/km líneas de FFCC)				
	2015	2016	2017	2018	2019
España	1,639	1,495	1,473	1,512	1,538
Alemania	2,648	2,721	2,251	1,957	2,135
Francia	1,914	1,555	1,577	1,423	1,430
Reino Unido	12,602	12,473	12,307	12,255	12,768
Italia	0,428	0,291	0,641	0,861	0,844
EEUU					
México					
Chile					
Marruecos					
Egipto					
Japón	2,634	2,630	2,630	2,633	2,621
China					
India					
Taiwan					
Maximo:	12,768	MAX ((Media+Factor max*Desv Est.):		9,722	10
Mínimo:	0,291	MIN ((Media-Factor min *Desv );0):			1
<b>Media:</b>	<b>3,530</b>	<b>Percentil 90%:</b>		12,324	9,722
Factor max*Desv E	9,722	<b>Percentil 10%:</b>		0,824	<b>Unidad:</b>
Factor min*Desv Es	-2,663	<b>Desv. Est.:</b>		4,128	

Table 66: Indicator A.5 Values: CO2 Emissions from Railways / Railway Lines (Thousands of t CO2 Equiv/km of Railway Lines)

FFCC A.5	Emisiones CO2 procedente del FFCC / Líneas FC (Miles de t CO2 Equiv/km líneas de FFCC)					Calificación 2019	
	2015	2016	2017	2018	2019		
España	2,5	2,4	2,4	2,4	2,4	MUY INSUFICIENTE	F
Alemania	3,5	3,5	3,1	2,8	3,0	INSUFICIENTE	FX
Francia	2,8	2,4	2,5	2,3	2,3	MUY INSUFICIENTE	F
Reino Unido	10,0	10,0	10,0	10,0	10,0	EXCELENTE	A
Italia	1,4	1,3	1,6	1,8	1,8	MUY INSUFICIENTE	F
EEUU							
México							
Chile							
Marruecos							
Egipto							
Japón	3,4	3,4	3,4	3,4	3,4	INSUFICIENTE	FX
China							
India							
Taiwan							

Table 67: Indicator A.5 Rating: CO2 Emissions from Railways / Railway Lines (Thousands of t CO2 Equiv/km of Railway Lines)



#### 4.4.1.6 Indicador A.6: Electrified Lines / km of Railway Lines

FFCC A.6	Líneas electrificadas / Km Líneas FC				
	2015	2016	2017	2018	2019
España	0,596	0,642	0,626	0,609	0,630
Alemania	0,539	0,537	0,537	0,540	0,540
Francia	0,591	0,602	0,612	0,625	0,625
Reino Unido	0,335	0,337	0,360	0,376	0,377
Italia	0,713	0,716	0,716	0,716	0,725
EEUU	0,011	0,011	0,011	0,011	0,011
México					
Chile					
Marruecos	0,609	0,610	0,610	0,610	0,610
Egipto	0,013	0,013	0,013	0,013	0,013
Japón	0,616	0,608	0,608	0,608	0,608
China	0,494	0,605	0,605	0,605	0,605
India	0,296	0,352	0,352	0,352	0,352
Taiwan					
Maximo:	0,725	MAX ((Media+Factor max*Desv Est.):		0,812	10
Mínimo:	0,011	MIN ((Media-Factor min *Desv );0):		0,099	1
<b>Media:</b>	<b>0,455</b>	<b>Percentil 90%:</b>	<b>0,637</b>	0,713	9,000
Factor max*Desv E	0,812	<b>Percentil 10%:</b>	<b>0,013</b>	<b>Unidad:</b>	<b>12,616</b>
Factor min*Desv Es	0,099		<b>Desv. Est.:</b>	<b>0,238</b>	

Table 68: Indicator A.6 Values: Electrified Lines / km of Railway Lines

FFCC A.6	Líneas electrificadas / Km Líneas FC					Calificación 2019	
	2015	2016	2017	2018	2019		
España	7,3	7,9	7,7	7,4	7,7	BIEN	C
Alemania	6,6	6,5	6,5	6,6	6,6	SUFICIENTE ALTO	D
Francia	7,2	7,3	7,5	7,6	7,6	BIEN	C
Reino Unido	4,0	4,0	4,3	4,5	4,5	INSUFICIENTE	FX
Italia	8,7	8,8	8,8	8,8	8,9	MUY BIEN	B
EEUU	1,0	1,0	1,0	1,0	1,0	MUY INSUFICIENTE	F
México							
Chile							
Marruecos	7,4	7,5	7,5	7,5	7,5	BIEN	C
Egipto	1,0	1,0	1,0	1,0	1,0	MUY INSUFICIENTE	F
Japón	7,5	7,4	7,4	7,4	7,4	BIEN	C
China	6,0	7,4	7,4	7,4	7,4	BIEN	C
India	3,5	4,2	4,2	4,2	4,2	INSUFICIENTE	FX
Taiwan							

Table 69: Indicator A.6 Rating: Electrified Lines / km of Railway Lines



4.4.1.7 Indicator A.7: Percentage of Renewable Energy in Transport / Energy Consumed in Transport

FFCC A.7	% Energía renovable en transporte / Energía consumida en transporte				
	2015	2016	2017	2018	2019
España	5,10%	5,20%	5,80%	6,90%	7,60%
Alemania	6,60%	7,00%	7,00%	7,90%	7,60%
Francia	8,40%	8,40%	8,80%	9,00%	9,20%
Reino Unido	4,50%	5,00%	4,80%	6,50%	8,90%
Italia	6,50%	7,40%	6,50%	7,70%	9,00%
EEUU					
México					
Chile					
Marruecos					
Egipto					
Japón					
China					
India					
Taiwan					
Maximo:	9,20%	MAX ((Media+Factor max*Desv Est.):		9,25%	10
Mínimo:	4,50%	MIN ((Media-Factor min *Desv );0):		4,93%	1
<b>Media:</b>	<b>7,09%</b>	<b>Percentil 90%:</b>	8,96%	4,32%	9,000
Factor max*Desv Es	9,25%	<b>Percentil 10%:</b>	5,04%	<b>Unidad:</b>	208,099
Factor min*Desv Es	0,049		<b>Desv. Est.:</b>	<b>1,44%</b>	

Table 70: Indicator A.7 Values: Percentage of Renewable Energy in Transport / Energy Consumed in Transport

FFCC A.7	% Energía renovable en transporte / Energía consumida en transporte					Calificación 2019	
	2015	2016	2017	2018	2019		
España	1,4	1,6	2,8	5,1	6,6	SUFICIENTE ALTO	D
Alemania	4,5	5,3	5,3	7,2	6,6	SUFICIENTE ALTO	D
Francia	8,2	8,2	9,1	9,5	9,9	EXCELENTE	A
Reino Unido	1,0	1,1	1,0	4,3	9,3	EXCELENTE	A
Italia	4,3	6,1	4,3	6,8	9,5	EXCELENTE	A
EEUU							
México							
Chile							
Marruecos							
Egipto							
Japón							
China							
India							
Taiwan							

Table 71: Indicator A.7 Rating: Percentage of Renewable Energy in Transport / Energy Consumed in Transport



#### 4.4.1.8 Indicator A.8: Development of Climate Change Mitigation Technologies related to Transport (OCDE)

FFCC A.8	Desarrollo de Tecnologías de mitigación del cambio climático relacionado con el transporte (OCDE)				
	2015	2016	2017	2018	2019
España	1,850	0,890	0,580	0,910	0,840
Alemania	4,250	4,480	5,120	7,270	4,770
Francia	4,160	3,940	4,460	5,120	4,930
Reino Unido	3,010	3,200	3,160	4,770	3,880
Italia	2,200	1,650	2,590	3,790	2,120
EEUU	2,800	3,170	2,920	3,280	2,070
México	1,870	1,300	2,020	3,750	1,680
Chile	0,820				0,340
Marruecos		2,000			4,430
Egipto	2,470	4,630	1,880	3,200	
Japón	3,100	3,080	2,940	4,310	2,400
China	0,730	1,100	1,120	1,100	0,900
India	1,190	1,650	1,590	2,080	1,330
Taiwan					
Maximo:	7,270	MAX ((Media+Factor max*Desv Est.):		4,946	10
Mínimo:	0,340	MIN ((Media-Factor min *Desv );0):		0,474	1
<b>Media:</b>	<b>2,710</b>	<b>Percentil 90%:</b>	<b>4,672</b>	4,472	9,000
Factor max*Desv E	4,946	<b>Percentil 10%:</b>	<b>0,897</b>	<b>Unidad:</b>	<b>2,012</b>
Factor min*Desv Es	0,474		<b>Desv. Est.:</b>	<b>1,491</b>	

Table 72: Indicator A.8 Values: Development of Climate Change Mitigation Technologies related to Transport (OCDE)

FFCC A.8	Desarrollo de Tecnologías de mitigación del cambio climático relacionado con el transporte (OCDE)					Calificación 2019	
	2015	2016	2017	2018	2019		
España	3,8	1,8	1,2	1,9	1,7	MUY INSUFICIENTE	F
Alemania	8,6	9,1	10,0	10,0	9,6	EXCELENTE	A
Francia	8,4	8,0	9,0	10,0	10,0	EXCELENTE	A
Reino Unido	6,1	6,5	6,4	9,6	7,9	BIEN	C
Italia	4,5	3,4	5,3	7,7	4,3	INSUFICIENTE	FX
EEUU	5,7	6,4	5,9	6,6	4,2	INSUFICIENTE	FX
México	3,8	2,7	4,1	7,6	3,4	INSUFICIENTE	FX
Chile	1,7				1,0	MUY INSUFICIENTE	F
Marruecos		4,1			9,0	EXCELENTE	A
Egipto	5,0	9,4	3,8	6,5			
Japón	6,3	6,2	6,0	8,7	4,9	INSUFICIENTE	FX
China	1,5	2,3	2,3	2,3	1,9	MUY INSUFICIENTE	F
India	2,4	3,4	3,2	4,2	2,7	MUY INSUFICIENTE	F
Taiwan							

Table 73: Indicator A.8 Rating: Development of Climate Change Mitigation Technologies related to Transport (OCDE)



#### 4.4.2. Adaptation to the future and Sustainability Indicator

	Índice de Adaptación al Futuro y Desarrollo					Max valor 2019
	2015	2016	2017	2018	2019	
España	32,3	36,7	37,1	40,0	41,6	72
Alemania	36,3	45,5	46,4	48,1	47,4	72
Francia	40,6	45,3	47,9	49,0	49,5	72
Reino Unido	30,3	37,1	37,2	43,9	47,1	72
Italia	29,3	42,6	42,5	47,6	46,6	72
EEUU	17,9	18,6	18,1	18,8	16,4	36
México	3,8	2,7	4,1	7,6	3,4	9
Chile	1,7				1,0	9
Marruecos	7,4	11,5	7,5	19,1	27,9	36
Egipto	6,0	10,4	4,8	7,5	1,0	9
Japón	35,3	35,8	35,6	38,5	34,7	63
China	22,4	24,8	25,6	25,8	26,0	36
India	9,5	10,9	10,5	11,5	10,0	27
Taiwan						
Maximo:	49,483	Máximo Valor:		VER TABLA	10	
Mínimo:	1,000	MIN:				
Media:	26,158				10,000	

Table 74: Adaptation to the future and Sustainability Indicator Values

	Evaluación de Adaptación al Futuro y Desarrollo Sostenible						Subindicadores considerados	
	2015	2016	2017	2018	Calificación 2019			
España	4,5	5,1	5,1	5,6	5,8	SUFICIENTE	E	8
Alemania	5,8	6,3	6,4	6,7	6,6	SUFICIENTE ALTO	D	8
Francia	6,4	6,3	6,7	6,8	6,9	SUFICIENTE ALTO	D	8
Reino Unido	4,8	5,2	5,2	6,1	6,5	SUFICIENTE ALTO	D	8
Italia	4,7	5,9	5,9	6,6	6,5	SUFICIENTE ALTO	D	8
EEUU	5,0	5,2	5,0	5,2	4,6	INSUFICIENTE	FX	4
México	4,2	3,0	4,6	8,4	3,8	INSUFICIENTE	FX	1
Chile	1,9				1,1	MUY INSUFICIENTE	F	1
Marruecos	8,3	6,4	8,3	7,1	7,8	BIEN	C	4
Egipto	3,3	5,8	2,7	4,2	1,1	MUY INSUFICIENTE	F	1
Japón	6,5	5,7	5,6	6,1	5,5	SUFICIENTE	E	7
China	6,2	6,9	7,1	7,2	7,2	BIEN	C	4
India	3,5	4,0	3,9	4,3	3,7	INSUFICIENTE	FX	3
Taiwan								

Table 75: Adaptation to the future and Sustainability Indicator Rating

Subindicadores de Adaptación al Futuro y Desarrollo Sostenible		Pesos	Total Max puntuación	Total Max puntuación reducida
FFCC A.1	Líneas FC con Velocidad > 160 km/h / Líneas FC	1	10	9
FFCC A.2	Pasos a Nivel / Líneas FC	1	10	9
FFCC A.3	% Pasajeros-km FC / Pasajeros-km (Terrestre)	1	10	9
FFCC A.4	% t-km FC / t-km (Terrestre)	1	10	9
FFCC A.5	Emisiones CO2 procedente del FFCC / Líneas FC (Miles de t CO2 Equiv/km líneas de FFCC)	1	10	9
FFCC A.6	Líneas electrificadas / Km Líneas FC	1	10	9
FFCC A.7	% Energía renovable en transporte / Energía consumida en transporte	1	10	9
FFCC A.8	Desarrollo de Tecnologías de mitigación del cambio climático relacionado con el transporte (OCDE)	1	10	9
		8	80	
		90 % Valorado de la Max. Puntuación del Criterio	72	72

Table 76: Weights and maximum reduced scores of the Future Adaptation and Sustainability Indicator

The indicator "Lines with Speed > 160 km/h / Total Lines," which corresponds to high-speed lines, serves as a valuable criterion to understand the status of the network concerning the reduction of internal combustion trains and the modernization of rail transport. Notably, China (0.41) and Spain (0.334) stand out among all countries, surpassing the values of Italy (0.219), Japan (0.14), and France (0.104).

Spain, along with Japan, also performs well in the elimination of level crossings.

Ratios related to passenger-km traveled by rail in comparison to passenger-km traveled across all land transport modes indicate the utilization of rail transport. The values are highly variable, ranging from Spain's minimum (3.87%) to the maximum presented by the USA (36.8%) and China (20.8%). It is widely known that passenger rail transport in Spain is limited despite the extensive high-speed network. In this regard, Spain faces an important challenge to increase these percentages in the coming years and align with neighboring countries.

Regarding the ratio related to freight traffic ("% t-km Railway / t-km Land"), Spain presents a higher value (7.14%), similar to Italy (6.3%), though lower than Germany (9.4%) and France (11.6%).

The average percentage of renewable energy in total energy consumed in transportation is 7%. Spain has 7.6%, similar to Germany and lower than France, the United Kingdom, and Italy.

In the final index of future adaptation and sustainable development, the highest-rated country is China (7.2). The evaluation of Morocco (7.8) should not be considered accurate; the initial data may not be correct. Spain receives a lower rating than European countries, similar to Japan.



#### 4.5. Operation and maintenance

The questions addressed in this criterion are: Is the public infrastructure being operated and maintained according to its needs? Is the necessary investment being made to ensure proper conservation and maintenance?

The chosen indicators for this criterion are as follows:

5 Operation and Maintenance	
O.1	Investment in O&M / National GDP
O.2	Investment in O&M / Inhabitants
O.3	Investment in O&M / km of Railway Lines
O.4	Investment in O&M / Total Investment in Railways
O.5	Investment in O&M / Domestic Passenger Traffic (€)
O.6	Investment in O&M / Domestic Freight Traffic (€)
O.7	Operating Expenses / Number of Stations (€)
O.8	Operating Expenses / km of Railway Lines (€)
O.9	Operating Expenses / Population (€)
O.10	Operating Expenses / Million ton-km (€)

It should be noted that separating investment in operation and maintenance from investment in infrastructure creation is often very challenging: budget allocations are not always clearly defined, and in some cases, the national accounting of certain countries does not distinguish this separation, which can lead to unreliable data.

Investment needs for operation, conservation, and maintenance are linked to the condition of the infrastructure and the requirements for adapting to new technical, functional, and technological demands. There has been much debate among experts about the necessary investment for proper maintenance. While there is no widespread consensus on an exact percentage, it is generally considered that the necessary investment in maintenance should fall between 2% and 4% of the asset value of the infrastructure, depending on its condition. Calculating the asset value requires establishing consensus criteria that can approach reality. Some attempts have been made to determine asset value, but the criteria to use are not standardized, and verifiable and reliable data are often lacking.

Similarly to what was mentioned regarding the Financing Criterion, the percentage of GDP allocated to conservation represents an indicator that can provide insight into the adequacy of investment for conservation needs. To further specify and complement this indicator, investment per capita, investment per kilometer of railway lines, and the percentage of investment allocated to conservation relative to total investment have also been considered.

Conservation data has been obtained from the UIC (International Union of Railways). However, it may not fully reflect the reality of conservation investment, as the boundary between investment in creation and investment in conservation is quite blurred. Additionally, there are private operators for whom reliable information may not be available.

Data for Mexico, Chile, Morocco, Egypt, and Taiwan could not be obtained, so these countries have not been evaluated in this criterion.

Where possible, expenses for conservation and operational costs have been considered separately, although the data is not up-to-date and may not be very reliable.



#### 4.5.1. Operation and maintenance indicators

##### 4.5.1.1 Indicator O.1: Investment in O&M / National GDP

FFCC O.1	Inversión en O&P / PIB nacional				
	2015	2016	2017	2018	2019
España	0,00063	0,00061	0,00091	0,00079	0,00087
Alemania					
Francia	0,00148	0,00149	0,00152	0,00146	0,00142
Reino Unido	0,00207	0,00212	0,00220	0,00282	0,00274
Italia	0,00105	0,00098	0,00133	0,00237	0,00221
EEUU					
México					
Chile					
Marruecos					
Egipto					
Japón					
China					
India	0,01083	0,01043	0,00929	0,00923	0,00837
Taiwan					
Maximo:	0,011	MAX ((Media+Factor max*Desv Est.):		0,008	10
Mínimo:	0,001	MIN ((Media-Factor min *Desv);0):			1
<b>Media:</b>	<b>0,003</b>	<b>Percentil 90%:</b>		0,009	9,000
Factor max*Desv Es	0,008	<b>Percentil 10%:</b>		0,001	Unidad: 1092,571
Factor min*Desv Es	-0,002	<b>Desv. Est.:</b>		0,003	

Table 77: Indicator O.1 Values: Investment in O&M / National GDP

FFCC O.1	Inversión en O&P / PIB nacional					Calificación 2019	
	2015	2016	2017	2018	2019		
España	1,7	1,7	2,0	1,9	1,9	MUY INSUFICIENTE	F
Alemania							
Francia	2,6	2,6	2,7	2,6	2,6	MUY INSUFICIENTE	F
Reino Unido	3,3	3,3	3,4	4,1	4,0	INSUFICIENTE	FX
Italia	2,1	2,1	2,5	3,6	3,4	INSUFICIENTE	FX
EEUU							
México							
Chile							
Marruecos							
Egipto							
Japón							
China							
India	10,0	10,0	10,0	10,0	10,0	EXCELENTE	A
Taiwan							

Table 78: Indicator O.1 Rating: Investment in O&M / National GDP



#### 4.5.1.2 Indicador O.2: Investment in O&M / Inhabitants

FFCC O.2	Inversión en O&P / habitantes				
	2015	2016	2017	2018	2019
España	14,540	14,528	22,675	20,257	22,859
Alemania					
Francia	48,774	49,901	52,344	51,471	51,526
Reino Unido	84,021	78,810	78,455	102,865	103,751
Italia	28,668	27,512	38,142	69,346	66,450
EEUU					
México					
Chile					
Marruecos					
Egipto					
Japón					
China					
India	15,999	16,360	16,116	15,996	15,763
Taiwan					
Maximo:	103,751	MAX ((Media+Factor max*Desv Est.):		87,662	10
Mínimo:	14,528	MIN ((Media-Factor min *Desv );0):		0,908	1
<b>Media:</b>	<b>44,285</b>	<b>Percentil 90%:</b>	<b>81,936</b>	86,754	9,000
Factor max*Desv E	87,662	<b>Percentil 10%:</b>	<b>15,856</b>	<b>Unidad:</b>	<b>0,104</b>
Factor min*Desv Es	0,908		<b>Desv. Est.:</b>	<b>28,918</b>	

Table 79: Indicator O.2 Values: Investment in O&M / Inhabitants

FFCC O.2	Inversión en O&P / habitantes					Calificación 2019	
	2015	2016	2017	2018	2019		
España	2,4	2,4	3,3	3,0	3,3	INSUFICIENTE	FX
Alemania							
Francia	6,0	6,1	6,3	6,2	6,3	SUFICIENTE ALTO	D
Reino Unido	9,6	9,1	9,0	10,0	10,0	EXCELENTE	A
Italia	3,9	3,8	4,9	8,1	7,8	BIEN	C
EEUU							
México							
Chile							
Marruecos							
Egipto							
Japón							
China							
India	2,6	2,6	2,6	2,6	2,5	MUY INSUFICIENTE	F
Taiwan							

Table 80: Indicator O.2 Rating: Investment in O&M / Inhabitants



### 4.5.1.3 Indicador O.3: Investment in O&M / km of Railway Lines

FFCC O.3	Inversión en O&P / km líneas FC				
	2015	2016	2017	2018	2019
España	41.396	41.770	65.332	58.667	66.251
Alemania					
Francia	118.708	123.296	126.737	128.242	128.660
Reino Unido	336.870	318.147	317.565	419.695	424.224
Italia	104.227	99.357	137.547	249.687	236.546
EEUU					
México					
Chile					
Marruecos					
Egipto					
Japón					
China					
India	327.609	322.379	322.379	322.379	322.379
Taiwan					
Maximo:	424.223,871	MAX ((Media+Factor max*Desv Est.):		395.524,206	10
Mínimo:	41.396,494	MIN ((Media-Factor min *Desv );0):		17.279,708	1
<b>Media:</b>	<b>206.401,957</b>	<b>Percentil 90%:</b>	<b>333.165,479</b>	378244,499	9,000
Factor max*Desv E	395.524,206	<b>Percentil 10%:</b>	<b>61.332,979</b>	<b>Unidad:</b>	<b>0,000</b>
Factor min*Desv Es	17.279,708		<b>Desv. Est.:</b>	<b>126.081,500</b>	

Table 81: Indicator O.3 Values: Investment in O&M / km of Railway Lines

FFCC O.3	Inversión en O&P / km líneas FC					Calificación 2019	
	2015	2016	2017	2018	2019		
España	1,6	1,6	2,1	2,0	2,2	MUY INSUFICIENTE	F
Alemania							
Francia	3,4	3,5	3,6	3,6	3,7	INSUFICIENTE	FX
Reino Unido	8,6	8,2	8,1	10,0	10,0	EXCELENTE	A
Italia	3,1	3,0	3,9	6,5	6,2	SUFICIENTE ALTO	D
EEUU							
México							
Chile							
Marruecos							
Egipto							
Japón							
China							
India	8,4	8,3	8,3	8,3	8,3	MUY BIEN	B
Taiwan							

Table 82: Indicator O.3 Rating: Investment in O&M / km of Railway Lines



#### 4.5.1.4 Indicador O.4: Investment in O&M / Total Investment in Railways

FFCC O.4	Inversión en O&P / Inversión total en FC				
	2015	2016	2017	2018	2019
España	0,258	0,408	0,477	0,437	0,486
Alemania					
Francia	0,378	0,386	0,375	0,349	0,298
Reino Unido	0,373	0,391	0,397	0,413	0,521
Italia	0,609	0,473	0,701	1,468	0,935
EEUU					
México					
Chile					
Marruecos					
Egipto					
Japón					
China					
India	2,173	2,183	2,083	2,083	2,083
Taiwan					
Maximo:	2,183	MAX ((Media+Factor max*Desv Est.):		1,883	10
Mínimo:	0,258	MIN ((Media-Factor min *Desv );0):			1
<b>Media:</b>	<b>0,830</b>	<b>Percentil 90%:</b>	<b>2,083</b>	1,883	9,000
Factor max*Desv E	1,883	<b>Percentil 10%:</b>	<b>0,358</b>	<b>Unidad:</b>	<b>4,780</b>
Factor min*Desv Es	-0,224		<b>Desv. Est.:</b>	<b>0,702</b>	

Table 83: Indicator O.4 Values: Investment in O&M / Total Investment in Railways

FFCC O.4	Inversión en O&P / Inversión total en FC					Calificación 2019	
	2015	2016	2017	2018	2019		
España	2,2	2,9	3,3	3,1	3,3	INSUFICIENTE	FX
Alemania							
Francia	2,8	2,8	2,8	2,7	2,4	MUY INSUFICIENTE	F
Reino Unido	2,8	2,9	2,9	3,0	3,5	INSUFICIENTE	FX
Italia	3,9	3,3	4,3	8,0	5,5	SUFICIENTE	E
EEUU							
México							
Chile							
Marruecos							
Egipto							
Japón							
China							
India	10,0	10,0	10,0	10,0	10,0	EXCELENTE	A
Taiwan							

Table 84: Indicator O.4 Rating: Investment in O&M / Total Investment in Railways



4.5.1.5 *Indicator O.5: Investment in O&M / Domestic Railway Passenger Traffic (€)*

FFCC O.5	Inversión en O&P / Tráfico interior de viajeros por FC (€)				
	2015	2016	2017	2018	2019
España	25.832	25.321	38.436	33.340	37.366
Alemania					
Francia	30.957	31.952	31.680	31.999	30.807
Reino Unido	71.931	66.099	65.194	84.421	84.002
Italia	33.348	31.967	43.377	75.505	70.141
EEUU					
México					
Chile					
Marruecos					
Egipto					
Japón					
China					
India	18.336	18.781	18.595	18.595	18.595
Taiwan					
Maximo:	84.420,841	MAX ((Media+Factor max*Desv Est.):		74.453,004	10
Mínimo:	18.335,721	MIN ((Media-Factor min *Desv );0):		8.473,110	1
<b>Media:</b>	<b>41.463,057</b>	<b>Percentil 90%:</b>	<b>74.075,533</b>	65979,894	9,000
Factor max*Desv E	74.453,004	<b>Percentil 10%:</b>	<b>18.595,183</b>	<b>Unidad:</b>	<b>0,000</b>
Factor min*Desv Es	8.473,110		<b>Desv. Est.:</b>	<b>21.993,298</b>	

Table 85: Indicator O.5 Values: Investment in O&M / Domestic Railway Passenger Traffic (€)

FFCC O.5	Inversión en O&P / Tráfico interior de viajeros por FC (€)					Calificación 2019	
	2015	2016	2017	2018	2019		
España	3,4	3,3	5,1	4,4	4,9	INSUFICIENTE	FX
Alemania							
Francia	4,1	4,2	4,2	4,2	4,0	INSUFICIENTE	FX
Reino Unido	9,7	8,9	8,7	10,0	10,0	EXCELENTE	A
Italia	4,4	4,2	5,8	10,0	9,4	EXCELENTE	A
EEUU							
México							
Chile							
Marruecos							
Egipto							
Japón							
China							
India	2,3	2,4	2,4	2,4	2,4	MUY INSUFICIENTE	F
Taiwan							

Table 86: Indicator O.5 Rating: Investment in O&M / Domestic Railway Passenger Traffic (€)



4.5.1.6 *Indicator O.6: Investment in O&M / Domestic Freight Traffic (€)*

FFCC O.6	Inversión en O&P / Tráfico interior de mercancías por FC (€)				
	2015	2016	2017	2018	2019
España	62.458	63.444	100.551	87.842	103.016
Alemania					
Francia	89.348	95.887	98.241	101.098	102.603
Reino Unido	282.855	303.218	301.898	397.334	410.698
Italia	83.778	73.441	103.380	189.850	186.259
EEUU					
México					
Chile					
Marruecos					
Egipto					
Japón					
China					
India	32.023	34.821	33.006	33.006	33.006
Taiwan					
Maximo:	410.698,042	MAX ((Media+Factor max*Desv Est.):		306.514,071	10
Mínimo:	32.022,999	MIN ((Media-Factor min *Desv );0):			1
<b>Media:</b>	<b>136.122,520</b>	<b>Percentil 90%:</b>	<b>302.690,145</b>	306514,071	9,000
Factor max*Desv E	306.514,071	<b>Percentil 10%:</b>	<b>33.005,799</b>	<b>Unidad:</b>	<b>0,000</b>
Factor min*Desv Es	-34.269,030		<b>Desv. Est.:</b>	<b>113.594,367</b>	

Table 87: Indicator O.6 Values: Investment in O&M / Domestic Freight Traffic (€)

FFCC O.6	Inversión en O&P / Tráfico interior de mercancías por FC (€)					Calificación 2019	
	2015	2016	2017	2018	2019		
España	2,8	2,9	4,0	3,6	4,0	INSUFICIENTE	FX
Alemania							
Francia	3,6	3,8	3,9	4,0	4,0	INSUFICIENTE	FX
Reino Unido	9,3	9,9	9,9	10,0	10,0	EXCELENTE	A
Italia	3,5	3,2	4,0	6,6	6,5	SUFICIENTE ALTO	D
EEUU							
México							
Chile							
Marruecos							
Egipto							
Japón							
China							
India	1,9	2,0	2,0	2,0	2,0	MUY INSUFICIENTE	F
Taiwan							

Table 88: Indicator O.6 Values: Investment in O&M / Domestic Freight Traffic (€)



### 4.5.1.7 Indicador O.7: Operating Expenses / Number of Stations (€)

FFCC O.7	Gasto operativo / Nº estaciones (€)				
	2015	2016	2017	2018	2019
España		1.937.917	1.937.917	1.932.756	1.941.806
Alemania	8.102.095	7.884.045	8.276.051	8.539.753	8.670.893
Francia			6.352.069	6.402.850	6.402.850
Reino Unido		1.008.644	1.001.952	1.642.354	1.001.561
Italia		4.188.610	4.177.192	4.179.091	4.179.091
EEUU					
México					
Chile					
Marruecos					
Egipto					
Japón		15.679.880	12.618.173	8.050.262	9.922.843
China		2.735.755	2.743.927	2.753.247	2.769.849
India		669.207	657.096	660.692	659.609
Taiwan					
Maximo:	15.679.879,880	MAX ((Media+Factor max*Desv Est.):		10.440.852,004	10
Mínimo:	657.096,204	MIN ((Media-Factor min *Desv );0):			1
<b>Media:</b>	<b>4.677.501,226</b>	<b>Percentil 90%:</b>	<b>8.657.778,752</b>	10440852,004	9,000
Factor max*Desv Es	10.440.852,004	<b>Percentil 10%:</b>	<b>702.442,652</b>	<b>Unidad:</b>	<b>0,000</b>
Factor min*Desv Es	-1.085.849,552		<b>Desv. Est.:</b>	<b>3.842.233,852</b>	

Table 89: Indicator O.7 Values: Operating Expenses / Number of Stations (€)

FFCC O.7	Gasto operativo / Nº estaciones (€)					Calificación 2019	
	2015	2016	2017	2018	2019		
España		2,7	2,7	2,7	2,7	MUY INSUFICIENTE	F
Alemania	8,0	7,8	8,1	8,4	8,5	MUY BIEN	B
Francia			6,5	6,5	6,5	SUFICIENTE ALTO	D
Reino Unido		1,9	1,9	2,4	1,9	MUY INSUFICIENTE	F
Italia		4,6	4,6	4,6	4,6	INSUFICIENTE	FX
EEUU							
México							
Chile							
Marruecos							
Egipto							
Japón		10,0	10,0	7,9	9,6	EXCELENTE	A
China		3,4	3,4	3,4	3,4	INSUFICIENTE	FX
India		1,6	1,6	1,6	1,6	MUY INSUFICIENTE	F
Taiwan							

Table 90: Indicator O.7 Rating: Operating Expenses / Number of Stations (€)





#### 4.5.1.8 Indicator O.8: Operating Expenses / km of Railway Lines (€)

FFCC O.8	Gasto operativo / km líneas de FC (€)				
	2015	2016	2017	2018	2019
España		179.563	179.519	179.652	178.503
Alemania	1.196.589	1.156.591	1.214.152	1.258.200	1.282.544
Francia		682.133	666.510	683.982	683.982
Reino Unido		157.940	157.292	157.591	157.041
Italia		547.653	547.686	547.882	547.947
EEUU		445.588	446.495	447.998	447.998
México					
Chile					
Marruecos					
Egipto					
Japón		1.355.926	1.355.926	1.355.926	1.355.926
China		205.390	205.390	205.390	205.390
India		72.089	72.089	72.089	72.089
Taiwan					
Maximo:	1.355.926,041	MAX ((Media+Factor max*Desv Est.):		1.244.806,747	10
Mínimo:	72.088,614	MIN ((Media-Factor min *Desv );0):			1
<b>Media:</b>	<b>559.044,514</b>	<b>Percentil 90%:</b>	<b>1.311.896,905</b>	1244806,747	9,000
Factor max*Desv E	1.244.806,747	<b>Percentil 10%:</b>	<b>123.060,333</b>	<b>Unidad:</b>	<b>0,000</b>
Factor min*Desv Es	-126.717,719		<b>Desv. Est.:</b>	<b>457.174,822</b>	

Table 91: Indicator O.8 Values: Operating Expenses / km of Railway Lines (€)

FFCC O.8	Gasto operativo / km líneas de FC (€)					Calificación 2019	
	2015	2016	2017	2018	2019		
España		2,3	2,3	2,3	2,3	MUY INSUFICIENTE	F
Alemania	9,7	9,4	9,8	10,0	10,0	EXCELENTE	A
Francia		5,9	5,8	5,9	5,9	SUFICIENTE	E
Reino Unido		2,1	2,1	2,1	2,1	MUY INSUFICIENTE	F
Italia		5,0	5,0	5,0	5,0	SUFICIENTE	E
EEUU		4,2	4,2	4,2	4,2	INSUFICIENTE	FX
México							
Chile							
Marruecos							
Egipto							
Japón		10,0	10,0	10,0	10,0	EXCELENTE	A
China		2,5	2,5	2,5	2,5	MUY INSUFICIENTE	F
India		1,5	1,5	1,5	1,5	MUY INSUFICIENTE	F
Taiwan							

Table 92: Indicator O.8 Rating: Operating Expenses / km of Railway Lines (€)



#### 4.5.1.9 Indicator O.9: Operating Expenses / Population (€)

FFCC O.9	Gasto operativo / Población (€)				
	2015	2016	2017	2018	2019
España		62	62	62	62
Alemania		542	567	583	593
Francia		276	275	275	274
Reino Unido		39	39	39	38
Italia		152	152	152	154
EEUU		207	206	205	204
México					
Chile					
Marruecos					
Egipto					
Japón		205	206	206	206
China		10	10	10	10
India		4	4	4	4
Taiwan					
Maximo:	592,613	MAX ((Media+Factor max*Desv Est.):		426,631	10
Mínimo:	3,525	MIN ((Media-Factor min *Desv );0):			1
<b>Media:</b>	<b>169,339</b>	<b>Percentil 90%:</b>	<b>409,269</b>	426,631	9,000
Factor max*Desv E	426,631	<b>Percentil 10%:</b>	<b>6,716</b>	<b>Unidad:</b>	<b>0,021</b>
Factor min*Desv Es	-87,953		<b>Desv. Est.:</b>	<b>171,528</b>	

Table 93: Indicator O.9 Values: Operating Expenses / Population (€)

FFCC O.9	Gasto operativo / Población (€)					Calificación 2019	
	2015	2016	2017	2018	2019		
España		2,3	2,3	2,3	2,3	MUY INSUFICIENTE	F
Alemania		10,0	10,0	10,0	10,0	EXCELENTE	A
Francia		6,8	6,8	6,8	6,8	SUFICIENTE ALTO	D
Reino Unido		1,8	1,8	1,8	1,8	MUY INSUFICIENTE	F
Italia		4,2	4,2	4,2	4,2	INSUFICIENTE	FX
EEUU		5,4	5,3	5,3	5,3	SUFICIENTE	E
México							
Chile							
Marruecos							
Egipto							
Japón		5,3	5,3	5,3	5,3	SUFICIENTE	E
China		1,2	1,2	1,2	1,2	MUY INSUFICIENTE	F
India		1,1	1,1	1,1	1,1	MUY INSUFICIENTE	F
Taiwan							

Table 94: Indicator O.9 Rating: Operating Expenses / Population (€)



4.5.1.10 Indicator O.10: Operating Expenses / Million ton-km (€)

FFCC O.10	Gasto operativo / Millón t-km (€)				
	2015	2016	2017	2018	2019
España		272.736	276.292	268.996	277.560
Alemania	394.643	346.647	357.146	371.833	381.245
Francia		530.493	516.651	539.204	545.455
Reino Unido		150.529	149.532	149.195	152.034
Italia		404.808	411.641	416.584	431.461
EEUU		28.917	27.323	26.525	28.312
México					
Chile					
Marruecos					
Egipto					
Japón		1.227.698	1.205.142	1.347.875	1.305.807
China		5.792	5.111	4.781	4.566
India		7.787	7.381	7.381	7.381
Taiwan					
Maximo:	1.347.875,471	MAX ((Media+Factor max*Desv Est.):		905.273,816	10
Mínimo:	4.565,635	MIN ((Media-Factor min *Desv );0):			1
<b>Media:</b>	<b>340.336,839</b>	<b>Percentil 90%:</b>	<b>809.330,014</b>	905273,816	9,000
Factor max*Desv Es	905.273,816	<b>Percentil 10%:</b>	<b>6.745,061</b>	<b>Unidad:</b>	<b>0,000</b>
Factor min*Desv Es	-224.600,138		<b>Desv. Est.:</b>	<b>376.624,652</b>	

Table 95: Indicator O.10 Values: Operating Expenses / Million ton-km (€)

FFCC O.10	Gasto operativo / Millón t-km (€)					Calificación 2019	
	2015	2016	2017	2018	2019		
España		3,7	3,7	3,7	3,8	INSUFICIENTE	FX
Alemania	4,9	4,4	4,6	4,7	4,8	INSUFICIENTE	FX
Francia		6,3	6,1	6,4	6,4	SUFICIENTE ALTO	D
Reino Unido		2,5	2,5	2,5	2,5	MUY INSUFICIENTE	F
Italia		5,0	5,1	5,1	5,3	SUFICIENTE	E
EEUU		1,3	1,3	1,3	1,3	MUY INSUFICIENTE	F
México							
Chile							
Marruecos							
Egipto							
Japón		10,0	10,0	10,0	10,0	EXCELENTE	A
China		1,1	1,1	1,0	1,0	MUY INSUFICIENTE	F
India		1,1	1,1	1,1	1,1	MUY INSUFICIENTE	F
Taiwan							

Table 96: Indicator O.10 Rating: Operating Expenses / Million ton-km (€)



## 4.5.2. Operation and maintenance Indicator

	Índice de Operación y mantenimiento					Max valor 2019
	2015	2016	2017	2018	2019	
España	14,1	25,8	30,7	28,9	30,7	90
Alemania	22,6	31,6	32,5	33,1	33,3	36
Francia	22,5	42,1	48,7	48,9	48,6	90
Reino Unido	43,2	50,5	50,4	55,9	55,8	90
Italia	20,9	38,2	44,2	61,7	57,9	90
EEUU		10,9	10,8	10,8	10,8	27
México						
Chile						
Marruecos						
Egipto						
Japón		35,3	35,3	33,3	34,9	36
China		8,1	8,1	8,1	8,1	36
India	35,2	40,5	40,4	40,4	40,4	90
Taiwan						
Maximo:	61,719	Máximo Valor:		VER TABLA	10	
Mínimo:	8,107	MIN:				
Media:	32,962				10,000	

Table 97: Operation and maintenance Indicator Values

Subindicadores de Operación y mantenimiento		Pesos	Total Max puntuación
FFCC O.1	Inversión en O&P / PIB nacional	1	10
FFCC O.2	Inversión en O&P / habitantes	1	10
FFCC O.3	Inversión en O&P / km líneas FC	1	10
FFCC O.4	Inversión en O&P / inversión total en FC	1	10
FFCC O.5	Inversión en O&P / Tráfico interior de viajeros por FC (€)	1	10
FFCC O.6	Inversión en O&P / Tráfico interior de mercancías por FC (€)	1	10
FFCC O.7	Gasto operativo / Nº estaciones (€)	1	10
FFCC O.8	Gasto operativo / km líneas de FC (€)	1	10
FFCC O.9	Gasto operativo / Población (€)	1	10
FFCC O.10	Gasto operativo / Millón t-km (€)	1	10
		10	100
		90 % Valorado de la Max. Puntuación del Criterio	90

Table 98: Operation and Maintenance Indicators Weights

	Evaluación de Operación y mantenimiento						Subindicadores considerados	
	2015	2016	2017	2018	Calificación 2019			
España	2,6	2,9	3,4	3,2	3,4	INSUFICIENTE	FX	10
Alemania	8,4	8,8	9,0	9,2	9,2	EXCELENTE	A	4
Francia	4,2	5,2	5,4	5,4	5,4	SUFICIENTE	E	10
Reino Unido	8,0	5,6	5,6	6,2	6,2	SUFICIENTE ALTO	D	10
Italia	3,9	4,2	4,9	6,9	6,4	SUFICIENTE ALTO	D	10
EEUU		4,0	4,0	4,0	4,0	INSUFICIENTE	FX	3
México								
Chile								
Marruecos								
Egipto								
Japón		9,8	9,8	9,2	9,7	EXCELENTE	A	4
China		2,3	2,3	2,3	2,3	MUY INSUFICIENTE	F	4
India	6,5	4,5	4,5	4,5	4,5	INSUFICIENTE	FX	10
Taiwan								

Table 99: Operation and maintenance Criterion Rating

It should be noted that separating investment in operation and maintenance from investment in infrastructure creation and even from operational investment itself is often very difficult. Budget allocations are not always clearly defined, and the national accounting of certain countries may not distinguish these separations, leading to potentially unreliable data.

As mentioned, the most significant ratio for evaluating the Operation and Maintenance Criterion is the percentage of investment in operation and maintenance over asset value. However, obtaining this value for railway infrastructure is not always feasible. Therefore, investment in operation and maintenance relative to GDP has been used as a proxy, although this data could not be obtained for all countries. The average value of the "Investment in O&M / National GDP" ratio is 0.003, with a maximum of 0.011 and a minimum of 0.00087, corresponding to Spain.

Another indicative ratio is the percentage of investment in operation and maintenance relative to total investment. The resulting average value is 0.83, with a maximum of 2.2 and a minimum of 0.258%. Spain has stabilized this percentage in recent years (around 0.48).

Databases related to operational expenses may not be reliable or comparable between countries due to the significant variability they exhibit. However, with the available data, the "Operating Expenses / Population" ratio has an average value of €169, with a minimum of €3.5 (India) and a maximum of €593 (Germany). Spain has a very low value in this regard (€62).

In the overall Operation and Maintenance Criterion, Spain receives an "insufficient" rating (3.4). Once again, the countries with the highest ratings are Germany and Japan (9.2), while China and Spain receive lower ratings.

#### 4.6. Safety

Within this criterion, the safety of the infrastructure is assessed. The questions this criterion aims to answer are: Is the public works sector safe for users? Are effective measures implemented to ensure safe performance and operation?

The chosen indicators are as follows:

6 Safety	
S.1	Number of Fatalities / 100 km of Railway Lines
S.2	Number of Fatalities / Million Population
S.3	Number of Fatalities / Passenger-km by Rail (hundred million passenger-km)
S.4	Number of Fatalities / Freight Traffic by Rail (hundred million ton-km)
S.5	Number of Accidents / 100 km of Railway Lines

The selection of indicators corresponds to the ones commonly used: accidents with casualties and fatalities per km of lines; accidents with casualties and fatalities per population; and casualties from internal rail passenger traffic.

The data's source is EUROSTAT and exclusively pertains to European countries, cross-referenced with the Statistical Yearbook of the Ministry of Transport. The data for the United States has been extracted from the Bureau of Transport Statistics. It was not possible to obtain updated data from UIC (International Union of Railways) as access is restricted and not available to the general public.

As mentioned in the methodological notes, for the indicators in this Criterion, the minimum value for evaluation has not followed the general rule; it has been set at zero, as society as a whole deems eliminating accidents in the rail sector an indispensable goal.



#### 4.6.1. Safety Indicators

##### 4.6.1.1 Indicator S.1: Number of Fatalities / 100 km of Railway Lines

FFCC S.1	Nº víctimas mortales / 100 km Líneas FC				
	2015	2016	2017	2018	2019
España	0,123	0,155	0,179	0,105	0,141
Alemania	0,380	0,378	0,407	0,333	0,354
Francia	0,194	0,196	0,340	0,215	0,197
Reino Unido	0,142	0,142	0,251	0,184	0,135
Italia	0,359	0,357	0,328	0,435	0,256
EEUU	0,007	0,005	0,005	0,005	0,002
México					
Chile					
Marruecos					
Egipto					
Japón					
China					
India					
Taiwan					
Maximo:	0,435	MAX ((Media+Factor max*Desv Est.):		0,410	1
Mínimo:	0,002	MIN=0:		0	10
<b>Media:</b>	<b>0,210</b>	<b>Percentil 90%:</b>	<b>0,378</b>	0,409	-9,000
Factor max*Desv Est	0,410	<b>Percentil 10%:</b>	<b>0,005</b>	<b>Unidad:</b>	<b>-21,989</b>
Factor min*Desv Est	0,010		<b>Desv. Est.:</b>	<b>0,133</b>	

Table 100: Indicator S.1 Values: Number of Fatalities / 100 km of Railway Lines

FFCC S.1	Nº víctimas mortales / 100 km Líneas FC					Calificación 2019	
	2015	2016	2017	2018	2019		
España	7,3	6,6	6,1	7,7	6,9	SUFICIENTE ALTO	D
Alemania	1,7	1,7	1,1	2,7	2,2	MUY INSUFICIENTE	F
Francia	5,8	5,7	2,5	5,3	5,7	SUFICIENTE	E
Reino Unido	6,9	6,9	4,5	6,0	7,1	BIEN	C
Italia	2,1	2,2	2,8	1,0	4,4	INSUFICIENTE	FX
EEUU	9,9	9,9	9,9	9,9	10,0	EXCELENTE	A
México							
Chile							
Marruecos							
Egipto							
Japón							
China							
India							
Taiwan							

Table 101: Indicator S.1 Rating: Number of Fatalities / 100 km of Railway Lines



#### 4.6.1.2 Indicador S.2: Number of Fatalities / Million Population

FFCC S.2	Nº víctimas mortales / Millón de Población				
	2015	2016	2017	2018	2019
España	0,431	0,538	0,622	0,363	0,488
Alemania	1,787	1,773	1,899	1,544	1,637
Francia	0,796	0,794	1,405	0,864	0,788
Reino Unido	0,353	0,351	0,621	0,451	0,329
Italia	0,988	0,990	0,909	1,208	0,720
EEUU	0,034	0,022	0,022	0,021	0,009
México					
Chile					
Marruecos					
Egipto					
Japón					
China					
India					
Taiwan					
Maximo:	1,899	MAX ((Media+Factor max*Desv Est.):		1,608	1
Mínimo:	0,009	MIN= 0:		0	10
<b>Media:</b>	<b>0,759</b>	<b>Percentil 90%:</b>	1,650	1,607	-9,000
Factor max*Desv E	1,608	<b>Percentil 10%:</b>	0,022	<b>Unidad:</b>	-5,602
Factor min*Desv Es	-0,090		<b>Desv. Est.:</b>	0,566	

Table 102: Indicator S.2 Values: Number of Fatalities / Million Population

FFCC S.2	Nº víctimas mortales / Millón de Población					Calificación 2019	
	2015	2016	2017	2018	2019		
España	7,6	7,0	6,5	8,0	7,3	BIEN	C
Alemania	1,0	1,0	1,0	1,4	1,0	MUY INSUFICIENTE	F
Francia	5,5	5,6	2,1	5,2	5,6	SUFICIENTE	E
Reino Unido	8,0	8,0	6,5	7,5	8,2	MUY BIEN	B
Italia	4,5	4,5	4,9	3,2	6,0	SUFICIENTE ALTO	D
EEUU	9,8	9,9	9,9	9,9	10,0	EXCELENTE	A
México							
Chile							
Marruecos							
Egipto							
Japón							
China							
India							
Taiwan							

Table 103: Indicator S.2 Rating: Number of Fatalities / Million Population





4.6.1.3 *Indicator S.3: Number of Fatalities / Passenger-km by Rail (hundred million passenger-km)*

FFCC S.3	Nº de víctimas/ Tráfico interior de viajeros por FC (cien mill pasajeros-km)				
	2015	2016	2017	2018	2019
España	0,046	0,075	0,073	0,134	0,108
Alemania	0,160	0,154	0,173	0,116	0,112
Francia	0,040	0,048	0,052	0,044	0,035
Reino Unido	0,016	0,015	0,011	0,012	0,006
Italia	0,079	0,080	0,070	0,153	0,034
EEUU	1,565	1,206	0,959	0,641	0,166
México					
Chile					
Marruecos					
Egipto					
Japón					
China					
India					
Taiwan					
Maximo:	1,565	MAX ((Media+Factor max*Desv Est.):		0,777	1
Mínimo:	0,006	MIN= 0:		0	10
<b>Media:</b>	<b>0,213</b>	<b>Percentil 90%:</b>	<b>0,673</b>	0,776	-9,000
Factor max*Desv E	0,777	<b>Percentil 10%:</b>	<b>0,015</b>	<b>Unidad:</b>	<b>-11,596</b>
Factor min*Desv Es	-0,352		<b>Desv. Est.:</b>	<b>0,376</b>	

Table 104: Indicator S.3 Values: Number of Fatalities / Passenger-km by Rail (hundred million passenger-km)

FFCC S.3	Nº de víctimas/ Tráfico interior de viajeros por FC (cien mill pasajeros-km)					Calificación 2019	
	2015	2016	2017	2018	2019		
España	9,5	9,1	9,2	8,5	8,8	MUY BIEN	B
Alemania	8,2	8,2	8,0	8,7	8,7	MUY BIEN	B
Francia	9,5	9,5	9,4	9,5	9,6	EXCELENTE	A
Reino Unido	9,8	9,8	9,9	9,9	9,9	EXCELENTE	A
Italia	9,1	9,1	9,2	8,2	9,6	EXCELENTE	A
EEUU	1,0	1,0	1,0	2,6	8,1	MUY BIEN	B
México							
Chile							
Marruecos							
Egipto							
Japón							
China							
India							
Taiwan							

Table 105: Indicator S.3 Rating: Number of Fatalities / Passenger-km by Rail (hundred million passenger-km)



4.6.1.4 Indicator S.4: Number of Fatalities / Freight Traffic by Rail (hundred million ton-km)

FFCC S.4	Nº Víctimas mortales/ Tráfico interior de viajeros por FC (cien mill pasajeros-km)				
	2015	2016	2017	2018	2019
España	0,077	0,094	0,106	0,060	0,080
Alemania	0,159	0,155	0,164	0,130	0,133
Francia	0,051	0,051	0,085	0,054	0,047
Reino Unido	0,030	0,029	0,052	0,037	0,027
Italia	0,115	0,115	0,103	0,132	0,076
EEUU	0,031	0,020	0,021	0,022	0,009
México					
Chile					
Marruecos					
Egipto					
Japón					
China					
India					
Taiwan					
Maximo:	0,164	MAX ((Media+Factor max*Desv Est.):		0,145	1
Mínimo:	0,009	MIN= 0:		0	10
<b>Media:</b>	<b>0,075</b>	<b>Percentil 90%:</b>	<b>0,135</b>	0,144	-9,000
Factor max*Desv Es	0,145	<b>Percentil 10%:</b>	<b>0,022</b>	<b>Unidad:</b>	<b>-62,416</b>
Factor min*Desv Es	0,006		<b>Desv. Est.:</b>	<b>0,047</b>	

Table 106: Indicator S.4 Values: Number of Fatalities / Freight Traffic by Rail (hundred million ton-km)

FFCC S.4	Nº Víctimas mortales/ Tráfico interior de viajeros por FC (cien mill pasajeros-km)					Calificación 2019	
	2015	2016	2017	2018	2019		
España	5,3	4,2	3,5	6,3	5,1	SUFICIENTE	E
Alemania	1,0	1,0	1,0	1,9	1,7	MUY INSUFICIENTE	F
Francia	6,9	6,9	4,8	6,7	7,1	BIEN	C
Reino Unido	8,2	8,2	6,8	7,8	8,4	MUY BIEN	B
Italia	2,9	2,9	3,6	1,9	5,3	SUFICIENTE	E
EEUU	8,2	8,8	8,7	8,7	9,5	EXCELENTE	A
México							
Chile							
Marruecos							
Egipto							
Japón							
China							
India							
Taiwan							

Table 107: Indicator S.4 Rating: Number of Fatalities / Freight Traffic by Rail (hundred million ton-km)



4.6.1.5 Indicator S.5: Number of Accidents / 100 km of Railway Lines

FFCC S.5	Nº Accidentes / 100 km Líneas FC				
	2015	2016	2017	2018	2019
España	0,257	0,278	0,322	0,291	0,301
Alemania	0,796	0,803	0,897	0,786	0,776
Francia	0,549	0,541	0,546	0,442	0,457
Reino Unido	0,246	0,326	0,435	0,307	0,220
Italia	0,581	0,590	0,620	0,650	0,447
EEUU	1,281	1,148	1,193	1,335	1,331
México					
Chile					
Marruecos					
Egipto					
Japón					
China					
India					
Taiwan					
Maximo:	1,335	MAX ((Media+Factor max*Desv Est.):		1,141	1
Mínimo:	0,220	MIN= 0:		0	10
<b>Media:</b>	<b>0,625</b>	<b>Percentil 90%:</b>	<b>1,202</b>	1,140	-9,000
Factor max*Desv Es	1,141	<b>Percentil 10%:</b>	<b>0,276</b>	<b>Unidad:</b>	<b>-7,898</b>
Factor min*Desv Es	0,109		<b>Desv. Est.:</b>	<b>0,344</b>	

Table 108: Indicator S.5 Values: Number of Accidents / 100 km of Railway Lines

FFCC S.5	Nº Accidentes / 100 km Líneas FC					Calificación 2019	
	2015	2016	2017	2018	2019		
España	8,0	7,8	7,5	7,7	7,6	BIEN	C
Alemania	3,7	3,7	2,9	3,8	3,9	INSUFICIENTE	FX
Francia	5,7	5,7	5,7	6,5	6,4	SUFICIENTE ALTO	D
Reino Unido	8,1	7,4	6,6	7,6	8,3	MUY BIEN	B
Italia	5,4	5,4	5,1	4,9	6,5	SUFICIENTE ALTO	D
EEUU	1,0	1,0	1,0	1,0	1,0	MUY INSUFICIENTE	F
México							
Chile							
Marruecos							
Egipto							
Japón							
China							
India							
Taiwan							

Table 109: Indicator S.5 Rating: Number of Accidents / 100 km of Railway Lines



## 4.6.2. Safety Indicator

	Índice de Seguridad				
	2015	2016	2017	2018	2019
España	37,7	34,8	32,7	38,2	35,7
Alemania	15,6	15,6	14,0	18,4	17,6
Francia	33,4	33,3	24,5	33,2	34,4
Reino Unido	41,0	40,4	34,3	38,7	41,8
Italia	24,0	23,9	25,7	19,2	31,8
EEUU	29,8	30,6	30,6	32,1	38,5
México					
Chile					
Marruecos					
Egipto					
Japón					
China					
India					
Taiwan					
Maximo:	41,833	Máximo Valor:		VER TABLA	10
Mínimo:	14,013	MIN:			
Media:	30,051				10,000

Table 110: Safety Indicator Values

Subindicadores de Seguridad		Pesos	Total Max puntuación
FFCC S.1	Nº víctimas mortales / 100 km Líneas FC	1	10
FFCC S.2	Nº víctimas mortales / Millón de Población	1	10
FFCC S.3	Nº de víctimas/ Tráfico interior de viajeros por FC (cien mill pasajeros-km)	1	10
FFCC S.4	Nº Víctimas mortales/ Tráfico interior de viajeros por FC (cien mill pasajeros-km)	1	10
FFCC S.5	Nº Accidentes / 100 km Líneas FC	1	10
		5	50
		90 % Valorado de la Max. Puntuación del Criterio	45

Table 111: Safety Indicators Weights

	Evaluación de Seguridad						Subindicadores considerados	
	2015	2016	2017	2018	Calificación 2019			
España	8,4	7,7	7,3	8,5	7,9	BIEN	C	5
Alemania	3,5	3,5	3,1	4,1	3,9	INSUFICIENTE	FX	5
Francia	7,4	7,4	5,5	7,4	7,6	BIEN	C	5
Reino Unido	9,1	9,0	7,6	8,6	9,3	EXCELENTE	A	5
Italia	5,3	5,3	5,7	4,3	7,1	BIEN	C	5
EEUU	6,6	6,8	6,8	7,1	8,6	MUY BIEN	B	5
México								
Chile								
Marruecos								
Egipto								
Japón								
China								
India								
Taiwan								

Table 112: Security Criterion Rating

The data originates from EUROSTAT and exclusively pertains to European countries, cross-referenced with the Statistical Yearbook of the Ministry of Transport. The data for the United States has been extracted from the Bureau of Transport Statistics. It was not possible to obtain updated data from UIC (International Union of Railways) as access is restricted and not available to the general public.

The indicator "Number of Fatalities / 100 km of Rail Lines" has an average value of 0.21, with variations among countries ranging from a minimum of 0.002 in the United States to a maximum of 0.354 in Germany. Spain's value is 0.141, placing it in the mid-range among countries.

The second indicator analyzed, "Number of Fatalities / Million Population," shows values that are consistent with the first indicator. Germany has the highest value (1.637), while the lowest value is found in the United Kingdom (0.329). Spain's value is close to the lowest value (0.488).

The indicator "Number of Fatalities / Rail Passenger Traffic (per hundred million passenger-km)" has an average value of 0.075, with a maximum of 0.133 in Germany and a minimum of 0.009 in the United States. Spain's value is close to the average (0.08).

Overall, the highest-rated country is the United Kingdom (9.3 out of 10), followed by the United States with a score of 8.6 out of 10. Spain has a rating of 7.9.



#### 4.7. Resilience

Resilience is the capacity of a system to recover its initial state after disruptions that have altered the system have ceased. The question posed is as follows: When threats and adverse incidents occur, what is the capacity of public infrastructure to prevent, protect, and minimize the consequences for users, the environment, the economy, and national security? Is public infrastructure prepared to restore its initial state within a reasonable time once the threat or adverse incident has ceased? Are there alternatives available to maintain the provided service?

The chosen indicators are:

7 Resilience	
R.1	Number of Stations / Railway Lines
R.2	Number of Nodes / Number of Stations
R.3	Railway Density / Road Density
R.4	High-Speed Railway km / Country Area (KM2)
R.5	Transport Infrastructure. GCI Score (WEF)

To adequately address the posed question, data related to the technical characteristics of railway design should be available. This would include information about terrain conditions and their vulnerability to adverse events, drainage capacity of the infrastructure (to verify if the return period of floods is suitable for preventing inundations), stability of embankments and cuttings in the infrastructure, organization and equipment of maintenance teams to efficiently and swiftly respond to any eventualities, an integrated system for addressing winter road conditions, and more.

As obtaining all these data for the entire railway network would be a labor-intensive task, an approach has been taken to consider indirect indicators that can provide some insights into the resilience of the railway network.

The number of stations per railway lines can assess the evacuation capacity of passengers in case of disruptions on the lines.

The ratio of nodes to stations can provide an indication of the maneuvering capability in the face of disruptions.

As an alternative to railway lines, roads play a significant role in transportation. Therefore, the railway density to road density ratio has been considered.

The presence of a well-developed high-capacity railway network, such as high-speed lines, can also indicate the ability to efficiently transport people from one point to another within a short timeframe.

An indicator developed by the World Economic Forum that evaluates a country's transportation infrastructure has also been considered. A country with a robust transportation network is generally better prepared and more resilient in the face of disruptions in the overall transportation system.



## 4.7.1. Resilience Indicators

### 4.7.1.1 Indicator R.1: Number of Stations / Railway Lines

FFCC C.1	Nº de estaciones / líneas FC				
	2015	2016	2017	2018	2019
España	0,092	0,093	0,093	0,093	0,092
Alemania	0,148	0,147	0,147	0,147	0,148
Francia			0,105	0,107	0,107
Reino Unido		0,157	0,157	0,096	0,157
Italia		0,131	0,131	0,131	0,131
EEUU					
México					
Chile					
Marruecos					0,064
Egipto					0,137
Japón		0,086	0,107	0,168	0,137
China	0,077	0,075	0,075	0,075	0,074
India	0,112	0,108	0,110	0,109	0,109
Taiwan					
Maximo:	0,168	MAX ((Media+Factor max*Desv Est.):		0,158	10
Mínimo:	0,064	MIN ((Media-Factor min *Desv );0):		0,071	1
Media:	0,114	Percentil 90%:	0,151	0,087	9,000
Factor max*Desv Es	0,158	Percentil 10%:	0,075	Unidad:	103,961
Factor min*Desv Es	0,071		Desv. Est.:	0,029	

Table 113: Indicator R.1 Values: Number of Stations / Railway Lines

FFCC C.1	Nº de estaciones / líneas FC					Calificación 2019	
	2015	2016	2017	2018	2019		
España	3,2	3,2	3,2	3,3	3,2	INSUFICIENTE	FX
Alemania	9,0	8,9	8,9	8,9	9,0	EXCELENTE	A
Francia			4,5	4,7	4,7	INSUFICIENTE	FX
Reino Unido		9,9	9,9	3,6	9,9	EXCELENTE	A
Italia		7,2	7,2	7,2	7,2	BIEN	C
EEUU							
México							
Chile							
Marruecos					1,0	MUY INSUFICIENTE	F
Egipto					7,8	BIEN	C
Japón		2,6	4,8	10,0	7,8	BIEN	C
China	1,6	1,4	1,4	1,4	1,3	MUY INSUFICIENTE	F
India	5,2	4,8	5,0	5,0	5,0	SUFICIENTE	E
Taiwan							

Table 114: Indicator R.1 Rating: Number of Stations / Railway Lines



#### 4.7.1.2 Indicator R.2: Number of Nodes / Number of Stations

FFCC C.2	Nº de nodos / nº de estaciones				
	2015	2016	2017	2018	2019
España	0,031	0,031	0,031	0,031	0,031
Alemania	0,020	0,020	0,020	0,020	0,020
Francia			0,020	0,020	0,020
Reino Unido		0,033	0,032	0,053	0,032
Italia		0,027	0,027	0,027	0,027
EEUU					
México					
Chile					
Marruecos					0,007
Egipto					0,011
Japón		0,068	0,055	0,035	0,043
China	0,018	0,019	0,019	0,019	0,019
India	0,016	0,016	0,016	0,016	0,016
Taiwan					
Maximo:	0,068	MAX ((Media+Factor max*Desv Est.):		0,045	10
Mínimo:	0,007	MIN ((Media-Factor min *Desv );0):		0,007	1
<b>Media:</b>	<b>0,026</b>	<b>Percentil 90%:</b>	<b>0,038</b>	0,038	9,000
Factor max*Desv E	0,045	<b>Percentil 10%:</b>	<b>0,016</b>	<b>Unidad:</b>	<b>237,851</b>
Factor min*Desv Es	0,007		<b>Desv. Est.:</b>	<b>0,013</b>	

Table 115: Indicator R.2 Values: Number of Nodes / Number of Stations

FFCC C.2	Nº de nodos / nº de estaciones					Calificación 2019	
	2015	2016	2017	2018	2019		
España	6,8	6,8	6,8	6,7	6,8	SUFICIENTE ALTO	D
Alemania	3,9	3,9	4,0	4,0	3,9	INSUFICIENTE	FX
Francia			4,0	4,0	4,0	INSUFICIENTE	FX
Reino Unido		7,0	7,0	10,0	7,0	BIEN	C
Italia		5,8	5,8	5,8	5,8	SUFICIENTE	E
EEUU							
México							
Chile							
Marruecos					1,0	MUY INSUFICIENTE	F
Egipto					2,0	MUY INSUFICIENTE	F
Japón		10,0	10,0	7,6	9,6	EXCELENTE	A
China	3,7	3,7	3,7	3,8	3,8	INSUFICIENTE	FX
India	3,1	3,0	3,0	3,0	3,0	INSUFICIENTE	FX
Taiwan							

Table 116: Indicator R.2 Rating: Number of Nodes / Number of Stations





### 4.7.1.3 Indicator R.3: Railway Density / Road Density

FFCC C.3	Densidad de ferrocarril / Densidad de carreteras				
	2015	2016	2017	2018	2019
España	0,024	0,024	0,024	0,023	0,023
Alemania	0,060	0,060	0,060	0,060	0,060
Francia	0,025	0,024	0,025	0,024	0,024
Reino Unido	0,038	0,038	0,039	0,039	0,039
Italia	0,064	0,065	0,068	0,071	0,071
EEUU	0,023	0,023	0,022	0,022	0,022
México	0,027	0,029	0,034	0,034	0,034
Chile					
Marruecos					
Egipto					
Japón	0,057	0,055	0,055	0,055	0,055
China					
India					
Taiwan					
Maximo:	0,071	MAX ((Media+Factor max*Desv Est.):		0,066	10
Mínimo:	0,022	MIN ((Media-Factor min *Desv );0):		0,015	1
<b>Media:</b>	<b>0,041</b>	<b>Percentil 90%:</b>	<b>0,065</b>	0,052	9,000
Factor max*Desv E	0,066	<b>Percentil 10%:</b>	<b>0,023</b>	<b>Unidad:</b>	<b>173,834</b>
Factor min*Desv Es	0,015		<b>Desv. Est.:</b>	<b>0,017</b>	

Table 117: Indicator R.3 Values: Railway Density / Road Density

FFCC C.3	Densidad de ferrocarril / Densidad de carreteras					Calificación 2019	
	2015	2016	2017	2018	2019		
España	2,7	2,7	2,7	2,4	2,5	MUY INSUFICIENTE	F
Alemania	8,9	8,9	8,9	8,8	8,8	MUY BIEN	B
Francia	2,8	2,7	2,8	2,7	2,7	MUY INSUFICIENTE	F
Reino Unido	5,0	5,0	5,2	5,2	5,2	SUFICIENTE	E
Italia	9,7	9,8	10,0	10,0	10,0	EXCELENTE	A
EEUU	2,4	2,4	2,4	2,3	2,3	MUY INSUFICIENTE	F
México	3,2	3,5	4,3	4,3	4,3	INSUFICIENTE	FX
Chile							
Marruecos							
Egipto							
Japón	8,4	8,0	8,0	8,0	8,0	MUY BIEN	B
China							
India							
Taiwan							

Table 118: Indicator R.3 Rating: Railway Density / Road Density



4.7.1.4 Indicator R.4: High-Speed Railway km / Country Area (KM2)

FFCC C.4	km de AV / Superficie país (km2)				
	2015	2016	2017	2018	2019
España	0,004	0,005	0,005	0,005	0,005
Alemania	0,002	0,003	0,003	0,003	0,003
Francia	0,004	0,004	0,005	0,005	0,005
Reino Unido	0,000	0,000	0,000	0,000	0,000
Italia	0,003	0,003	0,003	0,003	0,003
EEUU					
México					
Chile					
Marruecos				0,000	0,000
Egipto					
Japón	0,008	0,007	0,007	0,008	0,008
China	0,002	0,002	0,002	0,002	0,003
India					
Taiwan					
Maximo:	0,008	MAX ((Media+Factor max*Desv Est.):		0,007	10
Mínimo:	0,000	MIN ((Media-Factor min *Desv );0):		0,000	1
<b>Media:</b>	<b>0,003</b>	<b>Percentil 90%:</b>	<b>0,007</b>	0,006	9,000
Factor max*Desv E	0,007	<b>Percentil 10%:</b>	<b>0,000</b>	<b>Unidad:</b>	<b>1395,524</b>
Factor min*Desv Es	0,000		<b>Desv. Est.:</b>	<b>0,002</b>	

Table 119: Indicator R.4 Values: High-Speed Railway km / Country Area (KM2)

FFCC C.4	km de AV / Superficie país (km2)					Calificación 2019	
	2015	2016	2017	2018	2019		
España	6,0	7,7	7,6	7,6	8,0	MUY BIEN	B
Alemania	4,2	4,6	5,1	5,1	5,1	SUFICIENTE	E
Francia	5,9	6,3	7,7	7,7	7,7	BIEN	C
Reino Unido	1,2	1,2	1,2	1,2	1,2	MUY INSUFICIENTE	F
Italia	4,7	5,0	5,0	4,9	4,9	INSUFICIENTE	FX
EEUU							
México							
Chile							
Marruecos				1,4	1,3	MUY INSUFICIENTE	F
Egipto							
Japón	10,0	10,0	10,0	10,0	10,0	EXCELENTE	A
China	3,5	3,7	3,9	4,2	4,8	INSUFICIENTE	FX
India							
Taiwan							

Table 120: Indicator R.4 Rating: High-Speed Railway km / Country Area (KM2)



4.7.1.5 *Indicator R.5: Transport Infrastructure. GCI Score (WEF)*

FFCC C.5	Infraestructura de transporte. Score GCI (WEF)				
	2015	2016	2017	2018	2019
España	90,3	90,3	90,3	90,3	90,3
Alemania	90,2	90,2	90,2	90,2	90,2
Francia	82,6	82,6	82,6	82,6	82,6
Reino Unido	81,0	81,0	81,0	81,0	81,0
Italia	73,2	73,2	73,2	73,2	73,2
EEUU	79,6	79,6	79,6	79,6	79,6
México	57,4	57,4	57,4	57,4	57,4
Chile	56,6	56,6	56,6	56,6	56,6
Marruecos	60,0	60,0	60,0	60,0	60,0
Egipto	59,1	59,1	59,1	59,1	59,1
Japón	87,8	87,8	87,8	87,8	87,8
China	68,9	68,9	68,9	68,9	68,9
India	68,1	68,1	68,1	68,1	68,1
Taiwan	79,4	79,4	79,4	79,4	79,4
Maximo:	90,300	MAX ((Media+Factor max*Desv Est.):		100,000	10
Mínimo:	56,600	MIN ((Media-Factor min *Desv );0):		55,997	1
<b>Media:</b>	<b>73,871</b>	<b>Percentil 90%:</b>	<b>90,200</b>	44,003	9,000
Factor max*Desv Est	91,746	<b>Percentil 10%:</b>	<b>57,400</b>	<b>Unidad:</b>	<b>0,205</b>
Factor min*Desv Est	55,997		<b>Desv. Est.:</b>	<b>11,916</b>	

Table 121: Indicator R.5 Values: Transport Infrastructure. GCI Score (WEF)

FFCC C.5	Infraestructura de transporte. Score GCI (WEF)					Calificación 2019	
	2015	2016	2017	2018	2019		
España	8,0	8,0	8,0	8,0	8,0	MUY BIEN	B
Alemania	8,0	8,0	8,0	8,0	8,0	MUY BIEN	B
Francia	6,4	6,4	6,4	6,4	6,4	SUFICIENTE ALTO	D
Reino Unido	6,1	6,1	6,1	6,1	6,1	SUFICIENTE ALTO	D
Italia	4,5	4,5	4,5	4,5	4,5	INSUFICIENTE	FX
EEUU	5,8	5,8	5,8	5,8	5,8	SUFICIENTE	E
México	1,3	1,3	1,3	1,3	1,3	MUY INSUFICIENTE	F
Chile	1,1	1,1	1,1	1,1	1,1	MUY INSUFICIENTE	F
Marruecos	1,8	1,8	1,8	1,8	1,8	MUY INSUFICIENTE	F
Egipto	1,6	1,6	1,6	1,6	1,6	MUY INSUFICIENTE	F
Japón	7,5	7,5	7,5	7,5	7,5	BIEN	C
China	3,6	3,6	3,6	3,6	3,6	INSUFICIENTE	FX
India	3,5	3,5	3,5	3,5	3,5	INSUFICIENTE	FX
Taiwan	5,8	5,8	5,8	5,8	5,8	SUFICIENTE	E

Table 122: Indicator R.5 Rating: Transport Infrastructure. GCI Score (WEF)



#### 4.7.2. Resilience Indicator

	Índice de Resiliencia					Max valor 2019
	2015	2016	2017	2018	2019	
España	26,6	28,3	28,3	28,1	28,4	45
Alemania	33,9	34,3	34,8	34,8	34,8	45
Francia	15,1	15,4	25,4	25,6	25,6	45
Reino Unido	12,3	29,2	29,4	26,0	29,4	45
Italia	18,9	32,3	32,5	32,5	32,5	45
EEUU	8,2	8,2	8,2	8,2	8,2	18
México	4,5	4,8	5,6	5,6	5,6	18
Chile	1,1	1,1	1,1	1,1	1,1	9
Marruecos	1,8	1,8	1,8	3,2	5,2	36
Egipto	1,6	1,6	1,6	1,6	11,5	27
Japón	26,0	38,1	40,3	43,1	42,9	45
China	12,4	12,5	12,7	13,0	13,5	36
India	11,8	11,3	11,5	11,4	11,4	27
Taiwan	5,8	5,8	5,8	5,8	5,8	9
Maximo:	43,120	Máximo Valor:		VER TABLA	10	
Mínimo:	1,123	MIN:				
Media:	16,285				10,000	

Table 123: Resilience Indicator Values

Subindicadores de Resiliencia		Pesos	Total Max puntuación
FFCC C.1	Nº de estaciones / líneas FC	1	10
FFCC C.2	Nº de nodos / nº de estaciones	1	10
FFCC C.3	Densidad de ferrocarril / Densidad de carreteras	1	10
FFCC C.4	km de AV / Superficie país (km2)	1	10
FFCC C.5	Infraestructura de transporte. Score GCI (WEF)	1	10
		5	50
		90 % Valorado de la Max. Puntuación del Criterio	45

Table 124: Resilience Indicator Weights

	Evaluación de Resiliencia						Subindicadores considerados	
	2015	2016	2017	2018	Calificación 2019			
España	5,9	6,3	6,3	6,2	6,3	SUFICIENTE ALTO	D	5
Alemania	7,5	7,6	7,7	7,7	7,7	BIEN	C	5
Francia	5,6	5,7	5,7	5,7	5,7	SUFICIENTE	E	5
Reino Unido	4,6	6,5	6,5	5,8	6,5	SUFICIENTE ALTO	D	5
Italia	7,0	7,2	7,2	7,2	7,2	BIEN	C	5
EEUU	4,6	4,6	4,6	4,5	4,5	INSUFICIENTE	FX	2
México	2,5	2,7	3,1	3,1	3,1	INSUFICIENTE	FX	2
Chile	1,2	1,2	1,2	1,2	1,2	MUY INSUFICIENTE	F	1
Marruecos	2,0	2,0	2,0	1,8	1,4	MUY INSUFICIENTE	F	4
Egipto	1,8	1,8	1,8	1,8	4,2	INSUFICIENTE	FX	3
Japón	9,6	8,5	9,0	9,6	9,5	EXCELENTE	A	5
China	3,4	3,5	3,5	3,6	3,7	INSUFICIENTE	FX	4
India	4,4	4,2	4,2	4,2	4,2	INSUFICIENTE	FX	3
Taiwan	6,4	6,4	6,4	6,4	6,4	SUFICIENTE ALTO	D	1

Table 125: Resilience Criterion Weights



The highest overall rating for this Indicator is achieved by Japan (9.5 out of 10), followed by Germany (7.7), Italy (7.2), the United Kingdom (6.5), Taiwan (6.4), and Spain (6.3). Notably, the United States receives an insufficient rating of 4.5.



#### 4.8. Engineering and Innovation

The assessment of innovation by indicators aims to address the following questions: Are the resources allocated to engineering in the design, construction, preservation, management, and operation of the public works sector adequate? Is the investment in innovation appropriate? What new techniques, materials, technologies, and operational methods are being implemented to improve public works? Is progress being made in digitization, monitoring, and sensorization throughout the entire lifecycle of public works? Is the information provided to users appropriate?

The chosen indicators are:

8 Engineering and Innovation	
I.1	Increase in High-Speed Lines / Railway Lines (2019/2015)
I.2	Innovation Index. ND Gain Index
I.3	Percentage of GDP spent on Gross Domestic Expenditure on R&D (OCDE R&D)
I.4	Gross Domestic Expenditure on R&D (\$) / Population (OCDE R&D)
I.5	Percentage of GDP spent on Basic Research (OCDE R&D)
I.6	Total R&D Personnel per 1,000 Employees (OCDE R&D)
I.7	Percentage of GDP for Private Funding for R&D (OCDE R&D)
I.8	Percentage of GDP for Public Funding for R&D (OCDE R&D)
I.9	Number of Railway Transport Patents / Million Inhabitants (OCDE)
I.10	Digitalization. Participation Percentage in New Technologies. GCI Score (WEF)
I.11	Digitalization. Index of Information and Communication Technology Infrastructures. ND Index
I.12	Digitalization. Percentage of Internet Users
I.13	Engineering. Regulatory Transparency. Trade in Services Restrictiveness Index (OCDE)
I.14	Engineering. Barriers to Competition. Trade in Services Restrictiveness Index (OCDE)
I.15	Engineering. Movement Restrictions. Trade in Services Restrictiveness Index (OCDE)
I.16	Engineering. Restrictions on Entry of Foreign Engineers. Trade in Services Restrictiveness Index (OCDE)

To comprehensively analyze engineering and innovation in railways, an in-depth understanding of new techniques, materials, and technologies applied in railways is required, along with insights into implemented innovations, the state of railway engineering, progress in digitization, and resources allocated to engineering and innovation.

One of the most significant indicators of technological advancement in railways is the increase in the number of high-speed rail lines relative to the total number of railway lines. A specific indicator related to patents has also been identified: "Number of Rail Transport Patents / Million Population (OECD)".

Despite efforts to acquire specific and reliable data from the railway infrastructure sector, concrete and verifiable railway sector data has not been found. In its absence, the state of R&D and innovation in different countries has been analyzed globally, assuming these data points to assess the state of railways. For this purpose, the database and indicators from the report "Main Science and Technology Indicators, Volume 2021," published by the OECD<sup>10</sup> in 2022, have been selected. This comprehensive report provides a set of indicators reflecting the level and structure of efforts made by OECD member countries and seven non-member economies (Argentina, People's Republic of China, Romania, Russian Federation, Singapore, and South Africa) in the field of science and technology. These indicators cover resources allocated to research and development, patent families, and international trade in R&D-intensive industries. The ND Gain

<sup>10</sup> [Main Science and Technology Indicators, Volume 2021 Issue 2 | READ online \(oecd-ilibrary.org\)](#)

Innovation Index and the number of road transport-related patents per million population from the OECD have also been considered.

To analyze the advancement of digitization, three indicators have been included: Participation in new technologies (GCI - WEF), Information and Communication Technology (ICT) Infrastructure Index (ND Gain Index, ICT infrastructure), and the number of people using the internet.

To assess the state of engineering in the railway sector, it would have been beneficial to have precise information about the training of railway engineers, the number of engineers working in design, construction, preservation, and management of railways per economic unit of investment. Economic data related to investment in engineering relative to investment in railway construction, preservation, operation, and management would have been particularly valuable. Unfortunately, obtaining such data has not been possible. Therefore, four OECD indicators related to engineering as a whole have been considered: regulatory transparency, barriers to competition, restrictions on movement of engineers, and restrictions on entry of foreign engineers. All of these are related to the Trade in Services Restrictiveness Index periodically published by the OECD<sup>11</sup>.

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<sup>11</sup> [Services Trade Restrictiveness Index \(oecd.org\)](https://www.oecd.org/)



#### 4.8.1. Engineering and Innovation Indicators

##### 4.8.1.1 Indicator I.1: Increase in High-Speed Lines / Railway Lines (2019/2015)

FFCC C.1	Incremento de líneas AV / Líneas FC (2019/2015)				
	2015	2016	2017	2018	2019
España					1,376
Alemania					1,255
Francia					1,340
Reino Unido					1,000
Italia					1,062
EEUU					
México					
Chile					
Marruecos					
Egipto					
Japón					1,000
China					1,468
India					
Taiwan					
Maximo:	1,468	MAX ((Media+Factor max*Desv Est.):		1,503	10
Mínimo:	1,000	MIN ((Media-Factor min *Desv );0):		0,925	1
Media:	1,214	Percentil 90%:	1,413	0,578	9,000
Factor max*Desv Es	1,503	Percentil 10%:	1,000	Unidad:	15,571
Factor min*Desv Es	0,925		Desv. Est.:	0,193	

Table 126: Valores del Indicador I.1: Increase in High-Speed Lines / Railway Lines (2019/2015)

FFCC C.1	Incremento de líneas AV / Líneas FC (2019/2015)					Calificación 2019	
	2015	2016	2017	2018	2019		
España					8,0	MUY BIEN	B
Alemania					6,1	SUFICIENTE ALTO	D
Francia					7,5	BIEN	C
Reino Unido					2,2	MUY INSUFICIENTE	F
Italia					3,1	INSUFICIENTE	FX
EEUU							
México							
Chile							
Marruecos							
Egipto							
Japón					2,2	MUY INSUFICIENTE	F
China					9,4	EXCELENTE	A
India							
Taiwan							

Table 127: Indicator I.1 Rating: Increase in High-Speed Lines / Railway Lines (2019/2015)





#### 4.8.1.2 Indicador I.2: Innovation Index. ND Gain Index

FFCC C.2	Índice de innovación. ND Gain Index				
	2015	2016	2017	2018	2019
España	0,282	0,276	0,217	0,152	0,128
Alemania	1,000	1,000	1,000	1,000	1,000
Francia	1,000	0,995	1,000	0,996	0,980
Reino Unido	1,000	0,988	0,941	0,905	0,843
Italia	0,672	0,682	0,667	0,690	0,722
EEUU	1,000	1,000	1,000	1,000	1,000
México	0,052	0,050	0,050	0,058	0,048
Chile	0,115	0,099	0,107	0,101	0,108
Marruecos	0,030	0,031	0,026	0,024	0,025
Egipto	0,036	0,045	0,050	0,047	0,048
Japón	1,000	1,000	1,000	1,000	1,000
China	1,000	1,000	1,000	1,000	1,000
India	0,045	0,047	0,052	0,056	0,066
Taiwan					
Maximo:	1,000	MAX:		1	10
Mínimo:	0,024	MIN:		0	1
<b>Media:</b>	<b>0,547</b>	Percentil 90%:	1,000	1,000	9,000
Factor max*Desv E	1,212	Percentil 10%:	0,045	Unidad:	9,000
Factor min*Desv E	-0,118		Desv. Est.:	0,443	

Table 128: Indicator I.2 Values: Innovation Index. ND Gain Index

FFCC C.2	Índice de innovación. ND Gain Index					Calificación 2019	
	2015	2016	2017	2018	2019		
España	3,5	3,5	3,0	2,4	2,1	MUY INSUFICIENTE	F
Alemania	10,0	10,0	10,0	10,0	10,0	EXCELENTE	A
Francia	10,0	10,0	10,0	10,0	9,8	EXCELENTE	A
Reino Unido	10,0	9,9	9,5	9,1	8,6	MUY BIEN	B
Italia	7,0	7,1	7,0	7,2	7,5	BIEN	C
EEUU	10,0	10,0	10,0	10,0	10,0	EXCELENTE	A
México	1,5	1,4	1,4	1,5	1,4	MUY INSUFICIENTE	F
Chile	2,0	1,9	2,0	1,9	2,0	MUY INSUFICIENTE	F
Marruecos	1,3	1,3	1,2	1,2	1,2	MUY INSUFICIENTE	F
Egipto	1,3	1,4	1,4	1,4	1,4	MUY INSUFICIENTE	F
Japón	10,0	10,0	10,0	10,0	10,0	EXCELENTE	A
China	10,0	10,0	10,0	10,0	10,0	EXCELENTE	A
India	1,4	1,4	1,5	1,5	1,6	MUY INSUFICIENTE	F
Taiwan							

Table 129: Indicator I.2 Rating: Innovation Index. ND Gain Index



4.8.1.3 *Indicator I.3: Percentage of GDP spent on Gross Domestic Expenditure on R&D (OCDE R&D)*

FFCC C.3	% del PIB destinado al Gasto interior bruto en I+D (OCDE R&D)				
	2015	2016	2017	2018	2019
España	1,22%	1,19%	1,21%	1,24%	1,25%
Alemania	2,93%	2,94%	3,05%	3,11%	3,17%
Francia	2,23%	2,22%	2,20%	2,20%	2,19%
Reino Unido	1,63%	1,64%	1,66%	1,70%	1,71%
Italia	1,34%	1,37%	1,37%	1,42%	1,46%
EEUU	2,79%	2,85%	2,91%	3,01%	3,18%
México	0,43%	0,39%	0,33%	0,31%	0,28%
Chile	0,38%	0,37%	0,36%	0,37%	0,34%
Marruecos					
Egipto					
Japón	3,24%	3,11%	3,17%	3,22%	3,21%
China	2,06%	2,10%	2,12%	2,14%	2,23%
India					
Taiwan					
Maximo:	3,24%	MAX ((Media+Factor max*Desv Est.):		3,35%	10
Mínimo:	0,28%	MIN ((Media-Factor min *Desv );0):		0,35%	1
<b>Media:</b>	<b>1,85%</b>	<b>Percentil 90%:</b>	<b>3,17%</b>	2,99%	9,000
Factor max*Desv Est	3,35%	<b>Percentil 10%:</b>	<b>0,37%</b>	<b>Unidad:</b>	<b>300,539</b>
Factor min*Desv Est	0,35%		<b>Desv. Est.:</b>	<b>1,00%</b>	

Table 130: Indicator I.13 Values: Percentage of GDP spent on Gross Domestic Expenditure on R&D (OCDE R&D)

FFCC C.3	% del PIB destinado al Gasto interior bruto en I+D (OCDE R&D)					Calificación 2019	
	2015	2016	2017	2018	2019		
España	3,6	3,5	3,6	3,7	3,7	INSUFICIENTE	FX
Alemania	8,7	8,8	9,1	9,3	9,5	EXCELENTE	A
Francia	6,6	6,6	6,5	6,5	6,5	SUFICIENTE ALTO	D
Reino Unido	4,8	4,9	4,9	5,0	5,1	SUFICIENTE	E
Italia	4,0	4,1	4,1	4,2	4,3	INSUFICIENTE	FX
EEUU	8,3	8,5	8,7	9,0	9,5	EXCELENTE	A
México	1,2	1,1	1,0	1,0	1,0	MUY INSUFICIENTE	F
Chile	1,1	1,0	1,0	1,0	1,0	MUY INSUFICIENTE	F
Marruecos							
Egipto							
Japón	9,7	9,3	9,5	9,6	9,6	EXCELENTE	A
China	6,1	6,2	6,3	6,4	6,6	SUFICIENTE ALTO	D
India							
Taiwan							

Table 131: Indicator I.3 Rating: Percentage of GDP spent on Gross Domestic Expenditure on R&D (OCDE R&D)



4.8.1.4 *Indicator I.4: Gross Domestic Expenditure on R&D (\$) / Population (OCDE R&D)*

FFCC C.4	Gasto interior bruto en I+D (\$) / Población (OCDE R&D)				
	2015	2016	2017	2018	2019
España	427	444	479	506	522
Alemania	1.397	1.487	1.617	1.717	1.763
Francia	909	952	977	1.019	1.070
Reino Unido	701	733	770	811	838
Italia	498	550	575	619	649
EEUU	1.581	1.651	1.740	1.892	2.066
México	79	76	66	63	57
Chile	86	86	87	94	86
Marruecos					
Egipto					
Japón	1.326	1.263	1.315	1.361	1.364
China	266	284	303	334	376
India					
Taiwan					
Maximo:	2.066	MAX ((Media+Factor max*Desv Est.):		1.684	10
Mínimo:	57	MIN ((Media-Factor min *Desv );0):			1
<b>Media:</b>	<b>799</b>	<b>Percentil 90%:</b>	<b>1.658</b>	1684,032	9,000
Factor max*Desv E	1.684	<b>Percentil 10%:</b>	<b>85</b>	<b>Unidad:</b>	<b>0,005</b>
Factor min*Desv Es	-87		<b>Desv. Est.:</b>	<b>590</b>	

Table 132: Indicator I.4 Values: Gross Domestic Expenditure on R&D (\$) / Population (OCDE R&D)

FFCC C.4	Gasto interior bruto en I+D (\$) / Población (OCDE R&D)					Calificación 2019	
	2015	2016	2017	2018	2019		
España	3,3	3,4	3,6	3,7	3,8	INSUFICIENTE	FX
Alemania	8,5	8,9	9,6	10,0	10,0	EXCELENTE	A
Francia	5,9	6,1	6,2	6,4	6,7	SUFICIENTE ALTO	D
Reino Unido	4,7	4,9	5,1	5,3	5,5	SUFICIENTE	E
Italia	3,7	3,9	4,1	4,3	4,5	INSUFICIENTE	FX
EEUU	9,4	9,8	10,0	10,0	10,0	EXCELENTE	A
México	1,4	1,4	1,4	1,3	1,3	MUY INSUFICIENTE	F
Chile	1,5	1,5	1,5	1,5	1,5	MUY INSUFICIENTE	F
Marruecos							
Egipto							
Japón	8,1	7,7	8,0	8,3	8,3	MUY BIEN	B
China	2,4	2,5	2,6	2,8	3,0	INSUFICIENTE	FX
India							
Taiwan							

Table 133: Indicator I.4 Rating: Gross Domestic Expenditure on R&D (\$) / Population (OCDE R&D)



#### 4.8.1.5 Indicador I.5: Percentage of GDP spent on Basic Research (OCDE R&D)

FFCC C.5	% del PIB destinado a gasto en investigación básica (OCDE R&D)				
	2015	2016	2017	2018	2019
España	0,27%	0,26%	0,26%	0,26%	0,29%
Alemania					
Francia	0,54%	0,50%	0,50%	0,50%	0,50%
Reino Unido	0,27%	0,30%	0,29%	0,31%	0,31%
Italia	0,33%	0,32%	0,30%	0,31%	0,31%
EEUU	0,46%	0,46%	0,46%	0,47%	0,48%
México	0,14%	0,12%	0,10%	0,09%	0,09%
Chile					
Marruecos					
Egipto					
Japón	0,39%	0,39%	0,42%	0,41%	0,40%
China	0,10%	0,11%	0,12%	0,12%	0,13%
India					
Taiwan					
Maximo:	0,54%	MAX ((Media+Factor max*Desv Est.):		0,52%	10
Mínimo:	0,09%	MIN ((Media-Factor min *Desv );0):		0,10%	1
<b>Media:</b>	<b>0,31%</b>	<b>Percentil 90%:</b>	<b>0,50%</b>	0,42%	9,000
Factor max*Desv E	0,52%	<b>Percentil 10%:</b>	<b>0,11%</b>	<b>Unidad:</b>	<b>2136,303</b>
Factor min*Desv Es	0,10%		<b>Desv. Est.:</b>	<b>0,14%</b>	

Table 134: Indicador I.5 Values: Percentage of GDP spent on Basic Research (OCDE R&D)

FFCC C.5	% del PIB destinado a gasto en investigación básica (OCDE R&D)					Calificación 2019	
	2015	2016	2017	2018	2019		
España	4,7	4,4	4,4	4,4	5,1	SUFICIENTE	E
Alemania							
Francia	10,0	9,6	9,6	9,6	9,6	EXCELENTE	A
Reino Unido	4,7	5,3	5,1	5,5	5,5	SUFICIENTE	E
Italia	5,9	5,7	5,3	5,5	5,5	SUFICIENTE	E
EEUU	8,7	8,7	8,7	8,9	9,1	EXCELENTE	A
México	1,9	1,4	1,0	1,0	1,0	MUY INSUFICIENTE	F
Chile							
Marruecos							
Egipto							
Japón	7,2	7,2	7,9	7,6	7,4	BIEN	C
China	1,0	1,2	1,4	1,4	1,7	MUY INSUFICIENTE	F
India							
Taiwan							

Table 135: Indicador I.5 Rating: Percentage of GDP spent on Basic Research (OCDE R&D)



4.8.1.6 Indicador I.6: Total R&D Personnel per 1,000 Employees (OCDE R&D)

FFCC C.6	Nº total de personal en I+D por cada 1.000 empleados (OCDE R&D)				
	2015	2016	2017	2018	2019
España	11	11	11	11	11
Alemania	15	15	16	16	16
Francia	16	16	16	16	16
Reino Unido	13	13	14	14	15
Italia	11	12	13	14	14
EEUU					
México	2	2	2	2	2
Chile	2	2	2	2	2
Marruecos					
Egipto					
Japón	13	13	13	13	13
China	5	5	5	6	6
India					
Taiwan					
Maximo:	16,000	MAX ((Media+Factor max*Desv Est.):		18,243	10
Mínimo:	1,500	MIN ((Media-Factor min *Desv );0):		2,033	1
<b>Media:</b>	<b>10,138</b>	<b>Percentil 90%:</b>	<b>16,000</b>	16,210	9,000
Factor max*Desv E	18,243	<b>Percentil 10%:</b>	<b>1,820</b>	<b>Unidad:</b>	<b>0,555</b>
Factor min*Desv Es	2,033		<b>Desv. Est.:</b>	<b>5,403</b>	

Table 136: Indicador I.6 Values: Total R&D Personnel per 1,000 Employees (OCDE R&D)

FFCC C.6	Nº total de personal en I+D por cada 1.000 empleados (OCDE R&D)					Calificación 2019	
	2015	2016	2017	2018	2019		
España	6,0	6,0	6,0	6,0	6,0	SUFICIENTE ALTO	D
Alemania	8,2	8,2	8,8	8,8	8,8	MUY BIEN	B
Francia	8,8	8,8	8,8	8,8	8,8	MUY BIEN	B
Reino Unido	7,1	7,1	7,6	7,6	8,2	MUY BIEN	B
Italia	6,0	6,5	7,1	7,6	7,6	BIEN	C
EEUU							
México	1,0	1,0	1,0	1,0	1,0	MUY INSUFICIENTE	F
Chile	1,0	1,0	1,0	1,0	1,0	MUY INSUFICIENTE	F
Marruecos							
Egipto							
Japón	7,1	7,1	7,1	7,1	7,1	BIEN	C
China	2,6	2,6	2,6	3,2	3,2	INSUFICIENTE	FX
India							
Taiwan							

Table 137: Indicador I.6 Rating: Total R&D Personnel per 1,000 Employees (OCDE R&D)



#### 4.8.1.7 Indicador I.7: Percentage of GDP for Private Funding for R&D (OCDE R&D)

FFCC C.7	%del PIB de Financiación privada destinada a I+D ( OCDE R&D)				
	2015	2016	2017	2018	2019
España	0,56%	0,56%	0,58%	0,61%	0,61%
Alemania	1,93%	1,92%	2,02%	2,05%	2,04%
Francia	1,23%	1,24%	1,24%	1,24%	1,24%
Reino Unido	0,80%	0,85%	0,89%	0,93%	0,92%
Italia	0,67%	0,71%	0,74%	0,78%	0,82%
EEUU	1,76%	1,83%	1,84%	1,93%	2,08%
México	0,07%	0,07%	0,06%	0,05%	0,05%
Chile	0,12%	0,13%	0,11%	0,11%	0,11%
Marruecos					
Egipto					
Japón	2,53%	2,43%	2,48%	2,55%	2,54%
China	1,54%	1,60%	1,62%	1,64%	1,70%
India					
Taiwan					
Maximo:	2,55%	MAX ((Media+Factor max*Desv Est.):		2,35%	10
Mínimo:	0,05%	MIN ((Media-Factor min *Desv );0):		0,10%	1
<b>Media:</b>	<b>1,16%</b>	<b>Percentil 90%:</b>	<b>2,12%</b>	2,25%	9,000
Factor max*Desv E	2,35%	<b>Percentil 10%:</b>	<b>0,11%</b>	<b>Unidad:</b>	<b>399,648</b>
Factor min*Desv Es	-0,03%		Desv. Est.:	<b>0,79%</b>	
		<b>Percent. 90&lt;Media+Factor*Desv. Est.</b>			

Table 138: Indicator I.7 Values: Percentage of GDP for Private Funding for R&D (OCDE R&D)

FFCC C.7	%del PIB de Financiación privada destinada a I+D ( OCDE R&D)					Calificación 2019	
	2015	2016	2017	2018	2019		
España	2,8	2,8	2,9	3,0	3,0	INSUFICIENTE	FX
Alemania	8,3	8,3	8,7	8,8	8,8	MUY BIEN	B
Francia	5,5	5,6	5,6	5,6	5,6	SUFICIENTE	E
Reino Unido	3,8	4,0	4,2	4,3	4,3	INSUFICIENTE	FX
Italia	3,3	3,4	3,6	3,7	3,9	INSUFICIENTE	FX
EEUU	7,6	7,9	8,0	8,3	8,9	MUY BIEN	B
México	1,0	1,0	1,0	1,0	1,0	MUY INSUFICIENTE	F
Chile	1,1	1,1	1,0	1,0	1,0	MUY INSUFICIENTE	F
Marruecos							
Egipto							
Japón	10,0	10,0	10,0	10,0	10,0	EXCELENTE	A
China	6,8	7,0	7,1	7,2	7,4	BIEN	C
India							
Taiwan							

Table 139: Indicator I.7 Rating: Percentage of GDP for Private Funding for R&D (OCDE R&D)



#### 4.8.1.8 Indicator I.8: Percentage of GDP for Public Funding for R&D (OCDE R&D)

FFCC C.8	%del PIB de Financiación pública destinada a I+D (OCDE R&D)				
	2015	2016	2017	2018	2019
España	0,50%	0,48%	0,47%	0,47%	0,47%
Alemania	0,82%	0,84%	0,84%	0,87%	0,88%
Francia	0,79%	0,72%	0,71%	0,69%	0,69%
Reino Unido	0,45%	0,43%	0,43%	0,44%	0,46%
Italia	0,51%	0,48%	0,44%	0,47%	0,47%
EEUU	0,69%	0,66%	0,65%	0,66%	0,66%
México	0,34%	0,30%	0,25%	0,24%	0,22%
Chile	0,16%	0,17%	0,17%	0,17%	0,15%
Marruecos					
Egipto					
Japón	0,50%	0,47%	0,47%	0,47%	0,47%
China	0,44%	0,42%	0,42%	0,43%	0,46%
India					
Taiwan					
Maximo:	0,88%	MAX ((Media+Factor max*Desv Est.):		0,79%	10
Mínimo:	0,15%	MIN ((Media-Factor min *Desv );0):		0,20%	1
<b>Media:</b>	<b>0,50%</b>	<b>Percentil 90%:</b>	<b>0,79%</b>	0,59%	9,000
Factor max*Desv E	0,79%	<b>Percentil 10%:</b>	<b>0,22%</b>	<b>Unidad:</b>	<b>1527,280</b>
Factor min*Desv Es	0,20%		Desv. Est.:	<b>0,20%</b>	

Table 140: Indicator I.8 Values: Percentage of GDP for Public Funding for R&D (OCDE R&D)

FFCC C.8	%del PIB de Financiación pública destinada a I+D (OCDE R&D)					Calificación 2019	
	2015	2016	2017	2018	2019		
España	5,5	5,2	5,1	5,1	5,1	SUFICIENTE	E
Alemania	10,0	10,0	10,0	10,0	10,0	EXCELENTE	A
Francia	10,0	8,9	8,8	8,4	8,4	MUY BIEN	B
Reino Unido	4,8	4,5	4,5	4,6	4,9	INSUFICIENTE	FX
Italia	5,7	5,2	4,6	5,1	5,1	SUFICIENTE	E
EEUU	8,4	8,0	7,8	8,0	8,0	MUY BIEN	B
México	3,1	2,5	1,7	1,6	1,3	MUY INSUFICIENTE	F
Chile	1,0	1,0	1,0	1,0	1,0	MUY INSUFICIENTE	F
Marruecos							
Egipto							
Japón	5,5	5,1	5,1	5,1	5,1	SUFICIENTE	E
China	4,6	4,3	4,3	4,5	4,9	INSUFICIENTE	FX
India							
Taiwan							

Table 141: Indicator I.8 Rating: Percentage of GDP for Public Funding for R&D (OCDE R&D)



4.8.1.9 *Indicator I.9: Number of Railway Transport Patents / Million Inhabitants (OCDE)*

FFCC C.9	Número de patentes del Transporte ferroviario / Millón habitantes (OCDE)				
	2015	2016	2017	2018	2019
España	0,000	0,000	0,000	0,064	0,042
Alemania	0,159	0,285	0,230	0,169	0,181
Francia	0,203	0,217	0,105	0,186	0,045
Reino Unido	0,031	0,046	0,015	0,008	
Italia	0,049	0,066	0,017	0,099	0,084
EEUU	0,062	0,067	0,066	0,037	0,040
México					
Chile					
Marruecos					
Egipto					
Japón	0,055	0,059	0,016	0,059	0,016
China	0,006	0,023	0,010	0,014	0,013
India	0,002	0,001	0,004	0,003	0,001
Taiwan					
Maximo:	0,285	MAX ((Media+Factor max*Desv Est.):		0,175	10
Mínimo:	0,000	MIN ((Media-Factor min *Desv);0):		0,000	1
<b>Media:</b>	<b>0,065</b>	<b>Percentil 90%:</b>	<b>0,185</b>	0,175	9,000
Factor max*Desv Est	0,175	<b>Percentil 10%:</b>	<b>0,002</b>	<b>Unidad:</b>	<b>51,448</b>
Factor min*Desv Est	-0,045		<b>Desv. Est.:</b>	<b>0,073</b>	

Table 142: Indicator I.9 Values: Number of Railway Transport Patents / Million Inhabitants (OCDE)

FFCC C.9	Número de patentes del Transporte ferroviario / Millón habitantes (OCDE)					Calificación 2019	
	2015	2016	2017	2018	2019		
España	1,0	1,0	1,0	4,3	3,2	INSUFICIENTE	FX
Alemania	9,2	10,0	10,0	9,7	10,0	EXCELENTE	A
Francia	10,0	10,0	6,4	10,0	3,3	INSUFICIENTE	FX
Reino Unido	2,6	3,3	1,8	1,4			
Italia	3,5	4,4	1,8	6,1	5,3	SUFICIENTE	E
EEUU	4,2	4,4	4,4	2,9	3,0	INSUFICIENTE	FX
México							
Chile							
Marruecos							
Egipto							
Japón	3,8	4,0	1,8	4,0	1,8	MUY INSUFICIENTE	F
China	1,3	2,2	1,5	1,7	1,7	MUY INSUFICIENTE	F
India	1,1	1,0	1,2	1,1	1,1	MUY INSUFICIENTE	F
Taiwan							

Table 143: Indicator I.9 Rating: Number of Railway Transport Patents / Million Inhabitants (OCDE)





4.8.1.10 Indicator I.10: Digitalization. Participation Percentage in New Technologies. GCI Score (WEF)

FFCC C.10	Digitalización. %Participación en la nuevas tecnologías. Puntuación GCI (WEF)				
	2015	2016	2017	2018	2019
España					98,3%
Alemania					92,1%
Francia					96,6%
Reino Unido					98,3%
Italia					95,5%
EEUU					98,3%
México					94,4%
Chile					82,0%
Marruecos					77,5%
Egipto					53,9%
Japón					98,3%
China					90,5%
India					95,5%
Taiwan					92,0%
<b>Maximo:</b>	<b>98,30%</b>	<b>MAX ((Media+Factor max*Desv Est.):</b>		<b>100,00%</b>	<b>10</b>
<b>Mínimo:</b>	<b>53,90%</b>	<b>MIN ((Media-Factor min *Desv );0):</b>		<b>71,95%</b>	<b>1</b>
<b>Media:</b>	<b>90,23%</b>	<b>Percentil 90%:</b>	<b>98,30%</b>	<b>28,05%</b>	<b>9,000</b>
<b>Factor max*Desv E:</b>	<b>108,51%</b>	<b>Percentil 10%:</b>	<b>78,85%</b>	<b>Unidad:</b>	<b>32,086</b>
<b>Factor min*Desv E:</b>	<b>71,95%</b>		<b>Desv. Est.:</b>	<b>12,19%</b>	

Table 144: Indicator I.10 Values: Digitalization. Participation Percentage in New Technologies. GCI Score (WEF)

FFCC C.10	Digitalización. %Participación en la nuevas tecnologías. Puntuación GCI (WEF)					Calificación 2019	
	2015	2016	2017	2018	2019		
España					9,5	EXCELENTE	A
Alemania					7,5	BIEN	C
Francia					8,9	MUY BIEN	B
Reino Unido					9,5	EXCELENTE	A
Italia					8,6	MUY BIEN	B
EEUU					9,5	EXCELENTE	A
México					8,2	MUY BIEN	B
Chile					4,2	INSUFICIENTE	FX
Marruecos					2,8	MUY INSUFICIENTE	F
Egipto					1,0	MUY INSUFICIENTE	F
Japón					9,5	EXCELENTE	A
China					7,0	SUFICIENTE ALTO	D
India					8,6	MUY BIEN	B
Taiwan					7,4	BIEN	C

Table 145: Indicator I.10 Rating: Digitalization. Participation Percentage in New Technologies. GCI Score (WEF)



4.8.1.11 Indicator I.11: Digitalization. Index of Information and Communication Technology Infrastructures. ND Index

FFCC C.11	Digitalización. Índice de las Infraestructuras de tecnologías de información y comunicación. (ND Index)				
	2015	2016	2017	2018	2019
España	0,622	0,632	0,648	0,656	0,671
Alemania	0,698	0,694	0,699	0,706	0,710
Francia	0,698	0,706	0,713	0,719	0,725
Reino Unido	0,702	0,712	0,701	0,703	0,710
Italia	0,542	0,554	0,566	0,598	0,603
EEUU	0,620	0,650	0,654	0,657	0,661
México	0,466	0,475	0,488	0,498	0,512
Chile	0,530	0,550	0,548	0,556	0,560
Marruecos	0,415	0,418	0,428	0,438	0,463
Egipto	0,371	0,381	0,394	0,406	0,436
Japón	0,670	0,679	0,678	0,680	0,687
China	0,479	0,497	0,519	0,535	0,558
India	0,295	0,300	0,303	0,308	0,331
Taiwan					
Maximo:	0,725	MAX		1	10
Mínimo:	0,295	MIN ((Media-Factor min *Desv );0):		0,374	1
<b>Media:</b>	<b>0,566</b>	<b>Percentil 90%:</b>	<b>0,706</b>	0,385	9,000
Factor max*Desv E	0,758	<b>Percentil 10%:</b>	<b>0,386</b>	<b>Unidad:</b>	<b>23,405</b>
Factor min*Desv E	0,374		<b>Desv. Est.:</b>	<b>0,128</b>	

Table 146: Indicator I.11 Values: Digitalization. Index of Information and Communication Technology Infrastructures. ND Index

FFCC C.11	Digitalización. Índice de las Infraestructuras de tecnologías de información y comunicación. (ND Index)					Calificación 2019	
	2015	2016	2017	2018	2019		
España	6,8	7,1	7,4	7,6	8,0	MUY BIEN	B
Alemania	8,6	8,5	8,6	8,8	8,9	MUY BIEN	B
Francia	8,6	8,8	8,9	9,1	9,2	EXCELENTE	A
Reino Unido	8,7	8,9	8,7	8,7	8,9	MUY BIEN	B
Italia	4,9	5,2	5,5	6,3	6,4	SUFICIENTE ALTO	D
EEUU	6,8	7,5	7,6	7,6	7,7	BIEN	C
México	3,2	3,4	3,7	3,9	4,2	INSUFICIENTE	FX
Chile	4,7	5,1	5,1	5,3	5,4	SUFICIENTE	E
Marruecos	2,0	2,0	2,3	2,5	3,1	INSUFICIENTE	FX
Egipto	1,0	1,2	1,5	1,8	2,5	MUY INSUFICIENTE	F
Japón	7,9	8,1	8,1	8,2	8,3	MUY BIEN	B
China	3,5	3,9	4,4	4,8	5,3	SUFICIENTE	E
India	1,0	1,0	1,0	1,0	1,0	MUY INSUFICIENTE	F
Taiwan							

Table 147: Indicator I.11 Rating: Digitalization. Index of Information and Communication Technology Infrastructures. ND Index



#### 4.8.1.12 Indicator I.12: Digitalization. Percentage of Internet Users

FFCC C.12	Digitalización. % de personas que usan internet				
	2015	2016	2017	2018	2019
España	78,7%	81,7%	84,6%	86,1%	90,7%
Alemania	87,6%	86,0%	84,4%	87,0%	88,1%
Francia	78,0%	79,3%	80,5%	82,0%	83,3%
Reino Unido	92,0%	91,2%	90,4%	90,7%	92,5%
Italia	58,1%	60,6%	63,1%	74,4%	78,0%
EEUU	74,6%	81,0%	87,3%	88,5%	90,0%
México	57,4%	60,7%	63,9%	65,8%	70,1%
Chile	76,6%	79,5%	82,3%		
Marruecos	57,1%	59,5%	61,8%	64,8%	74,4%
Egipto	37,8%	41,4%	45,0%	46,9%	57,3%
Japón	91,1%	91,4%	91,7%	91,3%	92,7%
China	50,3%	52,3%	54,3%		
India	17,0%	18,0%	19,0%	20,1%	21,0%
Taiwan					
<b>Maximo:</b>	<b>92,70%</b>	<b>MAX</b>		<b>100,00%</b>	<b>10</b>
<b>Mínimo:</b>	<b>17,00%</b>	<b>MIN ((Media-Factor min *Desv );0):</b>		<b>38,18%</b>	<b>1</b>
<b>Media:</b>	<b>70,21%</b>	<b>Percentil 90%:</b>	<b>91,20%</b>	<b>61,82%</b>	<b>9,000</b>
<b>Factor max*Desv Est:</b>	<b>102,23%</b>	<b>Percentil 10%:</b>	<b>41,40%</b>	<b>Unidad:</b>	<b>14,558</b>
<b>Factor min*Desv Est:</b>	<b>38,18%</b>		<b>Desv. Est.:</b>	<b>21,35%</b>	

Table 148: Indicator I.12 Values: Digitalization. Percentage of Internet Users

FFCC C.12	Digitalización. % de personas que usan internet					Calificación 2019	
	2015	2016	2017	2018	2019		
España	6,9	7,3	7,8	8,0	8,6	MUY BIEN	B
Alemania	8,2	8,0	7,7	8,1	8,3	MUY BIEN	B
Francia	6,8	7,0	7,2	7,4	7,6	BIEN	C
Reino Unido	8,8	8,7	8,6	8,6	8,9	MUY BIEN	B
Italia	3,9	4,3	4,6	6,3	6,8	SUFICIENTE ALTO	D
EEUU	6,3	7,2	8,2	8,3	8,5	MUY BIEN	B
México	3,8	4,3	4,7	5,0	5,6	SUFICIENTE	E
Chile	6,6	7,0	7,4				
Marruecos	3,8	4,1	4,4	4,9	6,3	SUFICIENTE ALTO	D
Egipto	1,0	1,5	2,0	2,3	3,8	INSUFICIENTE	FX
Japón	8,7	8,7	8,8	8,7	8,9	MUY BIEN	B
China	2,8	3,1	3,3				
India	1,0	1,0	1,0	1,0	1,0	MUY INSUFICIENTE	F
Taiwan							

Table 149: Indicator I.12 Rating: Digitalization. Percentage of Internet Users



4.8.1.13 *Indicator I.13: Engineering. Regulatory Transparency. Trade in Services Restrictiveness Index (OCDE)*

FFCC C.13	Ingeniería. Transparencia regulatoria. Índice de restricción del comercio de servicios (OCDE)				
	2015	2016	2017	2018	2019
España	0,028	0,028	0,028	0,028	0,028
Alemania	0,014	0,014	0,014	0,014	0,028
Francia	0,028	0,028	0,028	0,014	0,014
Reino Unido	0,028	0,028	0,028	0,028	0,028
Italia	0,028	0,028	0,028	0,028	0,028
EEUU	0,014	0,014	0,014	0,014	0,014
México	0,028	0,028	0,042	0,042	0,042
Chile	0,042	0,042	0,042	0,042	0,042
Marruecos					
Egipto					
Japón	0,000	0,000	0,000	0,000	0,000
China	0,000	0,000	0,000	0,000	0,000
India	0,042	0,042	0,042	0,042	0,042
Taiwan					
Maximo:	0,042	MAX ((Media+Factor max*Desv Est.):		0,045	1
Mínimo:	0,000	MIN ((Media-Factor min *Desv );0):		0,001	10
<b>Media:</b>	<b>0,023</b>	<b>Percentil 90%:</b>	<b>0,042</b>	0,044	-9,000
Factor max*Desv E	0,045	<b>Percentil 10%:</b>	<b>0,000</b>	<b>Unidad:</b>	<b>-204,883</b>
Factor min*Desv Es	0,001		<b>Desv. Est.:</b>	<b>0,015</b>	

Table 150: Indicator I.13 Values: Engineering. Regulatory Transparency. Trade in Services Restrictiveness Index (OCDE)

FFCC C.13	Ingeniería. Transparencia regulatoria. Índice de restricción del comercio de servicios (OCDE)					Calificación 2019	
	2015	2016	2017	2018	2019		
España	4,5	4,5	4,5	4,5	4,5	INSUFICIENTE	FX
Alemania	7,4	7,4	7,4	7,4	4,5	INSUFICIENTE	FX
Francia	4,5	4,5	4,5	7,4	7,4	BIEN	C
Reino Unido	4,5	4,5	4,5	4,5	4,5	INSUFICIENTE	FX
Italia	4,5	4,5	4,5	1,0	4,5	INSUFICIENTE	FX
EEUU	7,4	7,4	7,4	7,4	7,4	BIEN	C
México	4,5	4,5	1,7	1,7	1,7	MUY INSUFICIENTE	F
Chile	1,7	1,7	1,7	1,7	1,7	MUY INSUFICIENTE	F
Marruecos							
Egipto							
Japón	10,0	10,0	10,0	10,0	10,0	EXCELENTE	A
China	10,0	10,0	10,0	10,0	10,0	EXCELENTE	A
India	1,7	1,7	1,7	1,7	1,7	MUY INSUFICIENTE	F

Table 151: Indicator I.13 Rating: Engineering. Regulatory Transparency. Trade in Services Restrictiveness Index (OCDE)



4.8.1.14 Indicator I.14: Engineering. Barriers to Competition. Trade in Services Restrictiveness Index (OCDE)

FFCC C.14	Ingeniería. Barreras a la competencia. Índice de restricción del comercio de servicios (OCDE)				
	2015	2016	2017	2018	2019
España	0,009	0,009	0,009	0,009	0,009
Alemania	0,019	0,019	0,019	0,019	0,019
Francia	0,009	0,009	0,009	0,009	0,009
Reino Unido					
Italia	0,009	0,009	0,009	0,009	0,009
EEUU	0,000	0,000	0,000	0,000	0,000
México	0,000	0,000	0,000	0,000	0,000
Chile	0,009	0,009	0,009	0,009	0,009
Marruecos					
Egipto					
Japón	0,000	0,000	0,000	0,000	0,000
China	0,019	0,000	0,000	0,000	0,000
India	0,000	0,000	0,000	0,000	0,000
Taiwan					
Maximo:	0,019	MAX ((Media+Factor max*Desv Est.):		0,015	1
Mínimo:	0,000	MIN ((Media-Factor min *Desv );0):		0,000	10
<b>Media:</b>	<b>0,006</b>	<b>Percentil 90%:</b>	<b>0,015</b>	0,015	-9,000
Factor max*Desv E	0,015	<b>Percentil 10%:</b>	<b>0,000</b>	<b>Unidad:</b>	<b>-584,990</b>
Factor min*Desv Es	-0,004		<b>Desv. Est.:</b>	<b>0,006</b>	

Table 152: Indicator I.14 Values: Engineering. Barriers to Competition. Trade in Services Restrictiveness Index (OCDE)

FFCC C.14	Ingeniería. Barreras a la competencia. Índice de restricción del comercio de servicios (OCDE)					Calificación 2019	
	2015	2016	2017	2018	2019		
España	4,8	4,8	4,8	4,8	4,8	INSUFICIENTE	FX
Alemania	1,0	1,0	1,0	1,0	1,0	MUY INSUFICIENTE	F
Francia	4,8	4,8	4,8	4,8	4,8	INSUFICIENTE	FX
Reino Unido							
Italia	4,8	4,8	4,8	4,8	4,8	INSUFICIENTE	FX
EEUU	10,0	10,0	10,0	10,0	10,0	EXCELENTE	A
México	10,0	10,0	10,0	10,0	10,0	EXCELENTE	A
Chile	4,8	4,8	4,8	4,8	4,8	INSUFICIENTE	FX
Marruecos							
Egipto							
Japón	10,0	10,0	10,0	10,0	10,0	EXCELENTE	A
China	1,0	10,0	10,0	10,0	10,0	EXCELENTE	A
India	10,0	10,0	10,0	10,0	10,0	EXCELENTE	A
Taiwan							

Table 153: Indicator I.14 Rating: Engineering. Barriers to Competition. Trade in Services Restrictiveness Index (OCDE)



4.8.1.15 *Indicator I.15: Engineering. Movement Restrictions. Trade in Services Restrictiveness Index (OCDE)*

FFCC C.15	Ingeniería. Restricciones al movimiento. Índice de restricción del comercio de servicios (OCDE)				
	2015	2016	2017	2018	2019
España	0,048	0,048	0,048	0,048	0,048
Alemania	0,097	0,097	0,097	0,097	0,097
Francia	0,065	0,081	0,081	0,081	0,081
Reino Unido	0,097	0,097	0,113	0,113	0,113
Italia	0,323	0,323	0,323	0,323	0,323
EEUU	0,129	0,129	0,129	0,129	0,129
México	0,129	0,129	0,129	0,129	0,129
Chile	0,065	0,065	0,065	0,065	0,065
Marruecos					
Egipto					
Japón	0,048	0,048	0,048	0,048	0,048
China	0,065	0,065	0,065	0,065	0,048
India	0,097	0,097	0,097	0,097	0,097
Taiwan					
Maximo:	0,323	MAX ((Media+Factor max*Desv Est.):		0,219	1
Mínimo:	0,048	MIN ((Media-Factor min *Desv );0):		0,000	10
<b>Media:</b>	<b>0,107</b>	<b>Percentil 90%:</b>	0,129	0,219	-9,000
Factor max*Desv E	0,219	<b>Percentil 10%:</b>	0,048	<b>Unidad:</b>	-41,135
Factor min*Desv Es	-0,004		<b>Desv. Est.:</b>	0,074	

Table 154: Indicator I.15 Values: Engineering. Movement Restrictions. Trade in Services Restrictiveness Index (OCDE)

FFCC C.15	Ingeniería. Restricciones al movimiento. Índice de restricción del comercio de servicios (OCDE)					Calificación 2019	
	2015	2016	2017	2018	2019		
España	8,0	8,0	8,0	8,0	8,0	MUY BIEN	B
Alemania	6,0	6,0	6,0	6,0	6,0	SUFICIENTE ALTO	D
Francia	7,3	6,7	6,7	6,7	6,7	SUFICIENTE ALTO	D
Reino Unido	6,0	6,0	5,4	5,4	5,4	SUFICIENTE	E
Italia	1,0	1,0	1,0	1,0	1,0	MUY INSUFICIENTE	F
EEUU	4,7	4,7	4,7	4,7	4,7	INSUFICIENTE	FX
México	4,7	4,7	4,7	4,7	4,7	INSUFICIENTE	FX
Chile	7,3	7,3	7,3	7,3	7,3	BIEN	C
Marruecos							
Egipto							
Japón	8,0	8,0	8,0	8,0	8,0	MUY BIEN	B
China	7,3	7,3	7,3	7,3	8,0	MUY BIEN	B
India	6,0	6,0	6,0	6,0	6,0	SUFICIENTE ALTO	D
Taiwan							

Table 155: Indicator I.15 Rating: Engineering. Movement Restrictions. Trade in Services Restrictiveness Index (OCDE)



4.8.1.16 *Indicator I.16: Engineering. Restrictions on Entry of Foreign Engineers. Trade in Services Restrictiveness Index (OCDE)*

FFCC C.16	Ingeniería. Restricciones a la entrada de ingenieros del extranjero. Índice de restricción del comercio de servicios (OCDE)				
	2015	2016	2017	2018	2019
España	0,047	0,047	0,047	0,047	0,047
Alemania	0,047	0,047	0,047	0,047	0,047
Francia	0,024	0,024	0,024	0,024	0,024
Reino Unido	0,024	0,024	0,024	0,024	0,024
Italia	0,071	0,071	0,071	0,071	0,071
EEUU	0,024	0,024	0,024	0,024	0,024
México	0,071	0,071	0,071	0,071	0,071
Chile	0,024	0,024	0,024	0,024	0,024
Marruecos					
Egipto					
Japón	0,012	0,012	0,024	0,024	0,024
China	0,142	0,130	0,130	0,118	0,118
India	0,083	0,083	0,083	0,083	0,083
Taiwan					
Maximo:	0,142	MAX ((Media+Factor max*Desv Est.):		0,103	1
Mínimo:	0,012	MIN ((Media-Factor min *Desv);0):		0,000	10
<b>Media:</b>	<b>0,051</b>	<b>Percentil 90%:</b>	<b>0,087</b>	0,103	-9,000
Factor max*Desv E	0,103	<b>Percentil 10%:</b>	<b>0,024</b>	<b>Unidad:</b>	<b>-87,113</b>
Factor min*Desv Es	0,000		<b>Desv. Est.:</b>	<b>0,035</b>	

Table 156: Indicator I.16 Values: Engineering. Restrictions on Entry of Foreign Engineers. Trade in Services Restrictiveness Index (OCDE)

FFCC C.16	Ingeniería. Restricciones a la entrada de ingenieros del extranjero. Índice de restricción del comercio de servicios (OCDE)					Calificación 2019	
	2015	2016	2017	2018	2019		
España	1,0	1,0	1,0	1,0	1,0	MUY INSUFICIENTE	F
Alemania	5,9	5,9	5,9	5,9	5,9	SUFICIENTE	E
Francia	7,9	7,9	7,9	7,9	7,9	BIEN	C
Reino Unido	7,9	7,9	7,9	7,9	7,9	BIEN	C
Italia	3,8	3,8	3,8	3,8	3,8	INSUFICIENTE	FX
EEUU	7,9	7,9	7,9	7,9	7,9	BIEN	C
México	3,8	3,8	3,8	3,8	3,8	INSUFICIENTE	FX
Chile	7,9	7,9	7,9	7,9	7,9	BIEN	C
Marruecos							
Egipto							
Japón	9,0	9,0	7,9	7,9	7,9	BIEN	C
China	1,0	1,0	1,0	1,0	1,0	MUY INSUFICIENTE	F
India	2,8	2,8	2,8	2,8	2,8	MUY INSUFICIENTE	F
Taiwan							

Table 157: Indicator I.16 Rating: Engineering. Restrictions on Entry of Foreign Engineers. Trade in Services Restrictiveness Index (OCDE)



## 4.8.2. Engineering and Innovation Indicator

	Índice de Ingeniería e Innovación					Max valor 2019
	2015	2016	2017	2018	2019	
España	62,5	62,6	63,0	66,5	84,4	144
Alemania	100,0	101,0	102,9	103,7	115,2	135
Francia	106,7	105,1	101,8	108,5	118,6	144
Reino Unido	78,5	80,0	77,7	78,2	89,3	126
Italia	62,1	64,1	61,8	66,9	82,7	144
EEUU	99,9	102,1	103,3	103,1	114,3	126
México	41,1	40,6	37,2	37,5	46,3	126
Chile	40,6	41,4	41,7	34,5	38,8	108
Marruecos	7,0	7,4	7,9	8,6	13,4	36
Egipto	3,3	4,1	4,9	5,4	8,7	36
Japón	115,1	114,3	112,2	114,6	124,1	144
China	60,5	71,4	72,0	70,3	89,2	135
India	25,0	24,9	25,2	25,1	33,7	81
Taiwan					7,4	27
Maximo:	124,113	Máximo Valor:		VER TABLA	10	
Mínimo:	3,326	MIN:				
Media:	63,972				10,000	

Table 158: Engineering and Innovation Indicator Values

Subindicadores de Ingeniería e Innovación		Pesos	Total Max puntuación
FFCC C.1	Incremento de líneas AV / Líneas FC (2019/2015)	1	10
FFCC C.2	Índice de innovación. ND Gain Index	1	10
FFCC C.3	% del PIB destinado al Gasto interior bruto en I+D (OCDE R&D)	1	10
FFCC C.4	Gasto interior bruto en I+D (\$) / Población (OCDE R&D)	1	10
FFCC C.5	% del PIB destinado a gasto en investigación básica (OCDE R&D)	1	10
FFCC C.6	Nº total de personal en I+D por cada 1.000 empleados (OCDE R&D)	1	10
FFCC C.7	% del PIB de Financiación privada destinada a I+D ( OCDE R&D)	1	10
FFCC C.8	% del PIB de Financiación pública destinada a I+D (OCDE R&D)	1	10
FFCC C.9	Número de patentes del Transporte ferroviario / Millón habitantes (OCDE)	1	10
FFCC C.10	Digitalización. % Participación en la nuevas tecnologías. Puntuación GCI (WEF)	1	10
FFCC C.11	Digitalización. Índice de las Infraestructuras de tecnologías de información y comunicación. (ND Index)	1	10
FFCC C.12	Digitalización. % de personas que usan internet	1	10
FFCC C.13	Ingeniería. Transparencia regulatoria. Índice de restricción del comercio de servicios (OCDE)	1	10
FFCC C.14	Ingeniería. Barreras a la competencia. Índice de restricción del comercio de servicios (OCDE)	1	10
FFCC C.15	Ingeniería. Restricciones al movimiento. Índice de restricción del comercio de servicios (OCDE)	1	10
FFCC C.16	Ingeniería. Restricciones a la entrada de ingenieros del extranjero. Índice de restricción del comercio de servicios (OCDE)	1	10
		16	160
		90 % Valorado de la Max. Puntuación del Criterio	144

Table 159: Engineering and Innovation Indicators Weights





	Evaluación de Ingeniería e Innovación							Subindicadores considerados
	2015	2016	2017	2018	Calificación 2019			
España	5,0	5,0	5,0	5,3	5,9	SUFICIENTE	E	16
Alemania	8,6	8,6	8,8	8,9	8,5	MUY BIEN	B	15
Francia	8,5	8,3	8,1	8,6	8,2	MUY BIEN	B	16
Reino Unido	6,7	6,8	6,6	6,7	7,1	BIEN	C	14
Italia	4,9	5,1	4,9	5,3	5,7	SUFICIENTE	E	16
EEUU	8,5	8,7	8,8	8,8	9,1	EXCELENTE	A	14
México	3,5	3,5	3,2	3,2	3,7	INSUFICIENTE	FX	14
Chile	3,8	3,8	3,9	3,5	3,6	INSUFICIENTE	FX	12
Marruecos	2,6	2,8	2,9	3,2	3,7	INSUFICIENTE	FX	4
Egipto	1,2	1,5	1,8	2,0	2,4	MUY INSUFICIENTE	F	4
Japón	9,1	9,1	8,9	9,1	8,6	MUY BIEN	B	16
China	4,8	5,7	5,7	6,0	6,6	SUFICIENTE ALTO	D	15
India	3,5	3,5	3,5	3,5	4,2	INSUFICIENTE	FX	9
Taiwan					2,8	MUY INSUFICIENTE	F	1

Table 160: Engineering and Innovation Criterion Rating

The selected indicators provide insights into the state of engineering and innovation in the railway sector. The "Increase in High-Speed Lines / Total Lines (2019/2015)" indicator reflects the innovative capacity of the railway network to implement high-speed systems. China leads with a ratio of 1.468, followed by Spain (1.376) and France (1.340).

The OECD indicators related to research and development shed light on the global strategic position of countries across all sectors of the economy in terms of research. The "% of GDP Allocated to Gross Domestic Expenditure on R&D" indicator shows a wide spectrum among the analyzed countries: ranging from a maximum of 3.21% (Japan) to a minimum of 0.28% (Mexico). Spain falls within the lower range (1.25%), surpassed by all EU countries. It's logical that the world's most technologically advanced countries invest more in R&D: Japan (3.21%), the United States (3.18%), and Germany (3.17%). France (2.19%) and the United Kingdom (1.71%) are in an intermediate position. These percentages remain fairly constant over the five-year period analyzed (2015 to 2019), highlighting the growing technological gap.

The "% of GDP from Private Sources Allocated to R&D" indicator reveals an interesting data point: the United States, Germany, and Japan exceed 2% of GDP from private funding. Private impetus undoubtedly plays a crucial role in increasing R&D financing, as indicated by the "% of GDP from Public Sources Allocated to R&D": no country surpasses 1%, and the percentage differences in investment narrow (Spain achieves results comparable to the United Kingdom, Italy, and Japan).

Looking at gross R&D investment per capita, significant differences emerge: Spain (\$522 per capita), the United States (\$2,066 per capita), and Germany (\$1,763 per capita).

The three selected indicators for evaluating digitization show similar results among the analyzed countries. Nevertheless, Spain ranks among the top countries: 90.7% of the population uses the internet (only surpassed by the United Kingdom, Japan, and South Korea); the World Economic Forum's score for the "Participation in New Technologies" indicator is 98.3% (only exceeded by South Korea); however, the Notre Dame Index for ICT Infrastructure rates Spain at 0.671, trailing behind Germany (0.710), France (0.725), the United Kingdom (0.710), and South Korea (0.732).

Due to the lack of specific economic investment data for engineering in the analyzed sector and the number of engineers and their training related to engineering, four OECD indicators have been used to assess the state of engineering: regulatory transparency, barriers to competition, restrictions on the movement of engineers, and restrictions on the entry of foreign engineers. All

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of these are linked to the Trade in Services Restrictiveness Index periodically published by the OECD. Spain falls within an intermediate position among the analyzed countries: performing well in terms of restrictions on the movement of engineers, adequate in terms of barriers to competition, and insufficient in terms of restrictions on the entry of foreign engineers and regulatory transparency.

The overall evaluation of the Engineering and Innovation criterion assigns the highest scores to the United States (9.1) and Japan (8.6), followed by Germany (8.5) and France (8.2). Spain receives a score of 5.9, ranking below China (6.6).



## 4.9. Global Evaluation of Railways based on Objective Indicators

The evaluation according to the established criteria is as follows:

	Evaluación de Capacidad							Subindicadores considerados
	2015	2016	2017	2018	Calificación 2019			
España	7,4	7,6	7,6	7,6	7,6	BIEN	C	7
Alemania	8,2	8,2	8,2	8,2	8,2	MUY BIEN	B	7
Francia	8,3	8,1	8,2	8,1	8,1	MUY BIEN	B	7
Reino Unido	4,7	5,7	5,7	5,3	5,8	SUFICIENTE	E	7
Italia	6,1	6,7	6,7	6,7	6,8	SUFICIENTE ALTO	D	7
EEUU	6,6	5,5	5,4	5,4	5,4	SUFICIENTE	E	5
México								0
Chile								0
Marruecos	2,1	3,6	3,6	3,3	3,3	INSUFICIENTE	FX	7
Egipto	1,9	1,9	1,8	1,8	2,9	MUY INSUFICIENTE	F	5
Japón	5,0	4,3	4,5	5,1	4,8	INSUFICIENTE	FX	7
China	4,2	4,3	4,3	4,3	4,4	INSUFICIENTE	FX	6
India	3,6	3,6	3,6	3,6	3,6	INSUFICIENTE	FX	5
Taiwan								0

Table 161: Capacity Criterion Rating

	Evaluación de Prestaciones							Subindicadores considerados
	2015	2016	2017	2018	Calificación 2019			
España	5,1	5,5	5,5	5,9	5,9	SUFICIENTE	E	9
Alemania	6,6	6,8	6,8	7,1	6,9	SUFICIENTE ALTO	D	9
Francia	6,9	6,9	7,1	7,2	7,1	BIEN	C	9
Reino Unido	5,5	5,5	5,5	5,6	5,5	SUFICIENTE	E	9
Italia	5,6	5,7	5,7	5,5	5,6	SUFICIENTE	E	9
EEUU	6,0	6,0	5,9	6,4	6,2	SUFICIENTE ALTO	D	8
México	2,7	2,3	2,2	1,6	1,9	MUY INSUFICIENTE	F	2
Chile	2,7	1,6	2,9	2,6	2,7	MUY INSUFICIENTE	F	2
Marruecos	5,6	5,5	5,4	5,4	5,5	SUFICIENTE	E	7
Egipto	3,9	4,1	3,9	3,4	3,6	INSUFICIENTE	FX	4
Japón	7,6	7,5	7,6	8,1	8,1	MUY BIEN	B	9
China	9,4	9,8	9,8	9,3	9,4	EXCELENTE	A	8
India	6,2	6,6	6,3	6,1	6,0	SUFICIENTE ALTO	D	7
Taiwan				8,5	8,9	MUY BIEN	B	1

Table 162: Performance Criterion Rating

	Evaluación de Financiación							Subindicadores considerados
	2015	2016	2017	2018	Calificación 2019			
España	3,7	2,8	3,4	3,3	3,4	INSUFICIENTE	FX	7
Alemania	4,1	3,8	4,0	4,2	4,5	INSUFICIENTE	FX	7
Francia	5,7	5,8	6,1	6,3	7,0	BIEN	C	7
Reino Unido	9,5	9,3	9,3	9,9	9,3	EXCELENTE	A	7
Italia	3,5	4,4	4,2	3,3	4,8	INSUFICIENTE	FX	7
EEUU	3,0	2,7	2,6	2,5	2,6	MUY INSUFICIENTE	F	7
México	3,5	3,8	4,5	4,2	3,4	INSUFICIENTE	FX	6
Chile								0
Marruecos								0
Egipto								0
Japón	4,7	4,7	6,6	7,2	7,8	BIEN	C	7
China	5,9	5,8	5,7	5,5	5,4	SUFICIENTE	E	7
India	3,5	3,5	2,7	2,7	2,6	MUY INSUFICIENTE	F	6
Taiwan								0

Table 163: Financing Criterion Rating



	Evaluación de Adaptación al Futuro y Desarrollo Sostenible							Subindicadores considerados
	2015	2016	2017	2018	Calificación 2019			
España	4,5	5,1	5,1	5,6	5,8	SUFICIENTE	E	8
Alemania	5,8	6,3	6,4	6,7	6,6	SUFICIENTE ALTO	D	8
Francia	6,4	6,3	6,7	6,8	6,9	SUFICIENTE ALTO	D	8
Reino Unido	4,8	5,2	5,2	6,1	6,5	SUFICIENTE ALTO	D	8
Italia	4,7	5,9	5,9	6,6	6,5	SUFICIENTE ALTO	D	8
EEUU	5,0	5,2	5,0	5,2	4,6	INSUFICIENTE	FX	4
México	4,2	3,0	4,6	8,4	3,8	INSUFICIENTE	FX	1
Chile	1,9				1,1	MUY INSUFICIENTE	F	1
Marruecos	8,3	6,4	8,3	7,1	7,8	BIEN	C	4
Egipto	3,3	5,8	2,7	4,2	1,1	MUY INSUFICIENTE	F	1
Japón	6,5	5,7	5,6	6,1	5,5	SUFICIENTE	E	7
China	6,2	6,9	7,1	7,2	7,2	BIEN	C	4
India	3,5	4,0	3,9	4,3	3,7	INSUFICIENTE	FX	3
Taiwan								

Table 164: Adaption to the future and Sustainability Criterion Rating

	Evaluación de Operación y mantenimiento							Subindicadores considerados
	2015	2016	2017	2018	Calificación 2019			
España	2,6	2,9	3,4	3,2	3,4	INSUFICIENTE	FX	10
Alemania	8,4	8,8	9,0	9,2	9,2	EXCELENTE	A	4
Francia	4,2	5,2	5,4	5,4	5,4	SUFICIENTE	E	10
Reino Unido	8,0	5,6	5,6	6,2	6,2	SUFICIENTE ALTO	D	10
Italia	3,9	4,2	4,9	6,9	6,4	SUFICIENTE ALTO	D	10
EEUU		4,0	4,0	4,0	4,0	INSUFICIENTE	FX	3
México								
Chile								
Marruecos								
Egipto								
Japón		9,8	9,8	9,2	9,7	EXCELENTE	A	4
China		2,3	2,3	2,3	2,3	MUY INSUFICIENTE	F	4
India	6,5	4,5	4,5	4,5	4,5	INSUFICIENTE	FX	10
Taiwan								

Table 165: Operation and maintenance Criterion Rating

	Evaluación de Seguridad							Subindicadores considerados
	2015	2016	2017	2018	Calificación 2019			
España	8,4	7,7	7,3	8,5	7,9	BIEN	C	5
Alemania	3,5	3,5	3,1	4,1	3,9	INSUFICIENTE	FX	5
Francia	7,4	7,4	5,5	7,4	7,6	BIEN	C	5
Reino Unido	9,1	9,0	7,6	8,6	9,3	EXCELENTE	A	5
Italia	5,3	5,3	5,7	4,3	7,1	BIEN	C	5
EEUU	6,6	6,8	6,8	7,1	8,6	MUY BIEN	B	5
México								
Chile								
Marruecos								
Egipto								
Japón								
China								
India								
Taiwan								

Table 166: Safety Criterion Rating



	Evaluación de Resiliencia							Subindicadores considerados
	2015	2016	2017	2018	Calificación 2019			
España	5,9	6,3	6,3	6,2	6,3	SUFICIENTE ALTO	D	5
Alemania	7,5	7,6	7,7	7,7	7,7	BIEN	C	5
Francia	5,6	5,7	5,7	5,7	5,7	SUFICIENTE	E	5
Reino Unido	4,6	6,5	6,5	5,8	6,5	SUFICIENTE ALTO	D	5
Italia	7,0	7,2	7,2	7,2	7,2	BIEN	C	5
EEUU	4,6	4,6	4,6	4,5	4,5	INSUFICIENTE	FX	2
México	2,5	2,7	3,1	3,1	3,1	INSUFICIENTE	FX	2
Chile	1,2	1,2	1,2	1,2	1,2	MUY INSUFICIENTE	F	1
Marruecos	2,0	2,0	2,0	1,8	1,4	MUY INSUFICIENTE	F	4
Egipto	1,8	1,8	1,8	1,8	4,2	INSUFICIENTE	FX	3
Japón	9,6	8,5	9,0	9,6	9,5	EXCELENTE	A	5
China	3,4	3,5	3,5	3,6	3,7	INSUFICIENTE	FX	4
India	4,4	4,2	4,2	4,2	4,2	INSUFICIENTE	FX	3
Taiwan	6,4	6,4	6,4	6,4	6,4	SUFICIENTE ALTO	D	1

Table 167: Resilience Criterion Rating

	Evaluación de Ingeniería e Innovación							Subindicadores considerados
	2015	2016	2017	2018	Calificación 2019			
España	5,0	5,0	5,0	5,3	5,9	SUFICIENTE	E	16
Alemania	8,6	8,6	8,8	8,9	8,5	MUY BIEN	B	15
Francia	8,5	8,3	8,1	8,6	8,2	MUY BIEN	B	16
Reino Unido	6,7	6,8	6,6	6,7	7,1	BIEN	C	14
Italia	4,9	5,1	4,9	5,3	5,7	SUFICIENTE	E	16
EEUU	8,5	8,7	8,8	8,8	9,1	EXCELENTE	A	14
México	3,5	3,5	3,2	3,2	3,7	INSUFICIENTE	FX	14
Chile	3,8	3,8	3,9	3,5	3,6	INSUFICIENTE	FX	12
Marruecos	2,6	2,8	2,9	3,2	3,7	INSUFICIENTE	FX	4
Egipto	1,2	1,5	1,8	2,0	2,4	MUY INSUFICIENTE	F	4
Japón	9,1	9,1	8,9	9,1	8,6	MUY BIEN	B	16
China	4,8	5,7	5,7	6,0	6,6	SUFICIENTE ALTO	D	15
India	3,5	3,5	3,5	3,5	4,2	INSUFICIENTE	FX	9
Taiwan					2,8	MUY INSUFICIENTE	F	1

Table 168: Engineering and Innovation Criterion Rating



With the ratings from the different criteria, the overall assessment of the railway sector is determined by applying weights to each criterion. The assigned weights are as follows:

Criterios de Ferrocarriles		Pesos	Total Max puntuación	Total Max puntuación reducida
FFCC I C	Capacidad	1	10	10
FFCC I P	Prestaciones	1	10	10
FFCC I F	Financiación	1	10	10
FFCC I A	Adaptación al futuro y desarrollo sostenible	1	10	10
FFCC I O	Operación y mantenimiento	1	10	10
FFCC I S	Seguridad	1	10	10
FFCC I R	Resiliencia	1	10	10
FFCC I I	Ingeniería e Innovación	1	10	10
		8	80	
		100 % Valorado de la Max. Puntuación de los Criterios	80	80

Table 169: Weights assigned to the Criteria for the formation of the Assessment of the Railway Sector

	Evaluación de la Ferrocarriles						Subindicadores considerados	Criterios		
	2015	2016	2017	2018	2019	Calificación 2019				
España	5,3	5,4	5,5	5,7	5,8	5,8	SUFICIENTE	E	67	8
Alemania	6,6	6,7	6,8	7,0	7,0	7,0	BIEN	D	60	8
Francia	6,6	6,7	6,6	6,9	7,0	7,0	BIEN	C	67	8
Reino Unido	6,6	6,7	6,5	6,8	7,0	7,0	BIEN	C	65	8
Italia	5,1	5,6	5,7	5,7	6,3	6,3	SUFICIENTE ALTO	D	67	8
EEUU	5,8	5,4	5,4	5,5	5,6	5,6	SUFICIENTE	E	48	8
México	3,3	3,0	3,5	4,1	3,2	3,2	INSUFICIENTE	FX	25	5
Chile	2,4	2,2	2,7	2,4	2,2	2,2	MUY INSUFICIENTE	F	16	4
Marruecos	4,1	4,1	4,4	4,2	4,3	4,3	INSUFICIENTE	FX	26	5
Egipto	2,4	3,0	2,4	2,7	2,9	2,9	MUY INSUFICIENTE	F	17	5
Japón	7,1	7,1	7,4	7,8	7,7	7,7	BIEN	C	55	7
China	5,7	5,4	5,5	5,5	5,6	5,6	SUFICIENTE	E	48	7
India	4,4	4,3	4,1	4,1	4,1	4,1	INSUFICIENTE	FX	43	7
Taiwan	6,4	6,4	6,4	7,4	6,0	6,0	SUFICIENTE ALTO	D	3	3

Table 170: Assessment of the Railway Sector based on Objective Indicators

The assessment of each country in each year within the overall evaluation has been conducted by referencing the maximum rating achieved by the country for the respective year (without making any adjustments or limiting the maximum and minimum), in order to avoid distorting the evaluation when data for a certain criterion is unavailable. It's important to note that in the overall assessment, only the criteria for which contrasting data is available are taken into account.

In countries where data for specific criteria is missing and therefore not evaluated, the overall sector rating could potentially increase or decrease based on the results that would have been attained for the missing criteria or criteria.

As depicted in the following table for the year 2019: Spain, Germany, France, the United Kingdom, Italy, and the United States have been evaluated for all criteria; Japan, China, and India have not been evaluated for Safety; Mexico and Chile have not been evaluated for Capacity, Operation and Maintenance, and Safety. Chile has not been evaluated for Financing. Taiwan has only been evaluated for Resilience.

The country with the highest overall rating considering the established indicators is Japan (7.7). Germany, France, and the United Kingdom have obtained the same rating (7.0). Italy has a rating of 6.3 and Spain has achieved a passing grade (5.8).

Spain received a good rating in Capacity (7.6) and Safety (7.9); a moderately sufficient rating in Resilience; a sufficient rating in Performance, Adaptation to the Future and Sustainable Development; and an insufficient rating in Financing and Operation and Maintenance.

#### 4.10. Sensitivity Analysis based on Objective Indicators

A sensitivity analysis was conducted by varying the weights assigned to each Criterion. In general terms, when the weights of the criteria are modified, the evaluation of countries fluctuates slightly without substantially altering the overall assessment. Below are the results achieved by varying the weights of the Criteria.

##### 4.10.1. Notable Weights in Capacity, Performance, and Safety (3); Significant Weight in Financing; Moderate Weights in Adaptation to the Future and Sustainable Development, and Operation and Maintenance (2); Low Weights in Resilience and Innovation (1)

Criterios de Ferrocarriles		Pesos	Total Max puntuación
FFCC I C	<b>Capacidad</b>	3	30
FFCC I P	<b>Prestaciones</b>	3	30
FFCC I F	<b>Financiación</b>	2	20
FFCC I A	<b>Adaptación al futuro y desarrollo sostenible</b>	2	20
FFCC I O	<b>Operación y mantenimiento</b>	2	20
FFCC I S	<b>Seguridad</b>	3	30
FFCC I R	<b>Resiliencia</b>	1	10
FFCC I I	<b>Ingeniería e Innovación</b>	1	10
		<b>17</b>	<b>170</b>
		100 % Valorado de la Max. Puntuación de los Criterios	<b>170</b>

Table 171: Sensitivity Analysis: Emphasized Weights on Criteria: Capacity, Performance, and Safety (Weight: 3)

Adaptación a	Evaluación de la Ferrocarriles						Subindicadores considerados	Criterios considerados	
	2015	2016	2017	2018	2019	Calificación 2019			
España	5,6	5,6	5,7	6,0	6,0	6,0	SUFICIENTE ALTO D	67	8
Alemania	6,3	6,4	6,5	6,8	6,7	6,7	SUFICIENTE ALTO D	60	8
Francia	6,7	6,8	6,6	7,0	7,1	7,1	BIEN C	67	8
Reino Unido	6,7	6,7	6,5	6,8	7,0	7,0	BIEN C	65	8
Italia	5,1	5,6	5,7	5,6	6,3	6,3	SUFICIENTE ALTO D	67	8
EEUU	5,8	5,4	5,4	5,5	5,7	5,7	SUFICIENTE E	48	8
México	3,3	3,0	3,4	4,1	3,0	3,0	INSUFICIENTE FX	25	5
Chile	2,4	2,0	2,7	2,5	2,2	2,2	MUY INSUFICIENTE F	16	4
Marruecos	4,4	4,5	4,8	4,5	4,7	4,7	INSUFICIENTE FX	26	5
Egipto	2,7	3,3	2,6	2,8	2,8	2,8	MUY INSUFICIENTE F	17	5
Japón	6,6	6,7	7,0	7,4	7,3	7,3	BIEN C	55	7
China	6,1	5,8	5,8	5,7	5,8	5,8	SUFICIENTE E	48	7
India	4,6	4,4	4,3	4,3	4,2	4,2	INSUFICIENTE FX	43	7
Taiwan	1,6	1,6	1,6	7,9	7,2	7,2	BIEN C	3	3

Table 172: Sensitivity Analysis: Emphasis on Criteria - Capacity, Performance, and Safety (Weight: 3). Evaluation of Railways





## 4.10.2.Sensitivity Analysis: Emphasis on Criteria - Capacity, Performance, and Safety (Weight: 2); Medium Weights for the Rest of the Criteria (Weight: 1)

Criterios de Ferrocarriles		Pesos	Total Max puntuación	Total Max puntuación reducida
FFCC I C	Capacidad	2	20	20
FFCC I P	Prestaciones	2	20	20
FFCC I F	Financiación	1	10	10
FFCC I A	Adaptación al futuro y desarrollo sostenible	1	10	10
FFCC I O	Operación y mantenimiento	1	10	10
FFCC I S	Seguridad	2	20	20
FFCC I R	Resiliencia	1	10	10
FFCC I I	Ingeniería e Innovación	1	10	10
		11	110	
		100 % Valorado de la Max. Puntuación de los Criterios	110	110

Table 173: Sensitivity Analysis: Emphasis on Criteria - Capacity, Performance, and Safety (Weight: 2); Rest of the Criteria (Weight: 1)

	Evaluación de la Ferrocarriles						Calificación 2019		Subindicadores considerados	Criterios considerados
	2015	2016	2017	2018	2019					
España	5,8	5,8	5,8	6,1	6,1	6,1	SUFICIENTE ALTO	D	67	8
Alemania	6,4	6,6	6,6	6,9	6,8	6,8	SUFICIENTE ALTO	D	60	8
Francia	6,9	6,9	6,7	7,1	7,2	7,2	BIEN	C	67	8
Reino Unido	6,6	6,7	6,5	6,7	7,0	7,0	BIEN	C	65	8
Italia	5,3	5,7	5,8	5,7	6,3	6,3	SUFICIENTE ALTO	D	67	8
EEUU	6,0	5,6	5,6	5,7	5,9	5,9	SUFICIENTE	E	48	8
México	3,2	2,9	3,3	3,7	3,0	3,0	INSUFICIENTE	FX	25	5
Chile	2,5	2,1	2,7	2,5	2,3	2,3	MUY INSUFICIENTE	F	16	4
Marruecos	4,0	4,2	4,5	4,2	4,4	4,4	INSUFICIENTE	FX	26	5
Egipto	2,6	3,0	2,5	2,6	3,0	3,0	INSUFICIENTE	FX	17	5
Japón	6,9	6,8	7,1	7,5	7,4	7,4	BIEN	C	55	7
China	5,9	5,8	5,8	5,8	5,9	5,9	SUFICIENTE	E	48	7
India	4,5	4,4	4,3	4,3	4,3	4,3	INSUFICIENTE	FX	43	7
Taiwan	6,4	6,4	6,4	7,8	6,8	6,8	SUFICIENTE ALTO	D	3	3

Table 174: Sensitivity Analysis: Emphasis on Criteria - Capacity, Performance, and Safety (Weight: 2); Rest of the Criteria (Weight: 1)

#### 4.11. Conclusions from Objective Indicators Evaluation

As observed in the railway sector evaluation tables, Spain falls within the intermediate range in comparison to the analyzed countries. It achieves a good rating in Capacity (7.6) and Safety (7.9); a moderate rating in Resilience; a moderate rating in Performance, Adaptation to the Future, and Sustainable Development; and a poor rating in Financing and Operation and Maintenance.

It is worth highlighting the strong overall position of Germany, France, the United Kingdom, and Japan. The United States and China achieve a similar magnitude of rating as Spain. Additionally, the very inadequate positions of Chile and Egypt are noteworthy.

##### 4.11.1. Capacity Criterion

Traditionally, the provision and characteristics of railways have been considered to determine their capacity to accommodate demand. Therefore, the considered ratios relate to railway density per capita and per country area. Various types of networks have also been taken into account, including electrified lines and high-speed lines. The indicators "Level crossings / Railway lines" and "Number of stations/km of railway lines" provide information about the quality of network provision and the service that the railway provides.

Within the Capacity Criterion, it is important to delve into the deployment of high-speed rail. In this regard, the significant efforts that some countries are making for its development are noteworthy, as can be observed in the graphs presented in the "Atlas. High-speed rail 2021"<sup>12</sup> by the UIC (International Union of Railways)<sup>13</sup>. The length of high-speed rail networks in various countries is notably prominent, with China standing out prominently, followed by Spain.

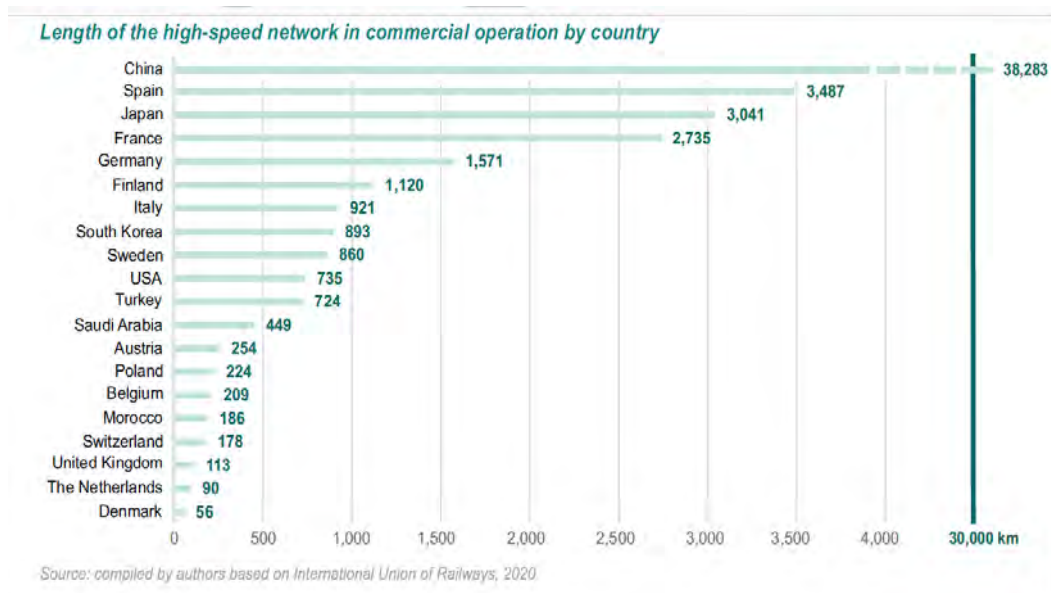


Figure 9: Length of operational high-speed rail lines by countries. UIC.

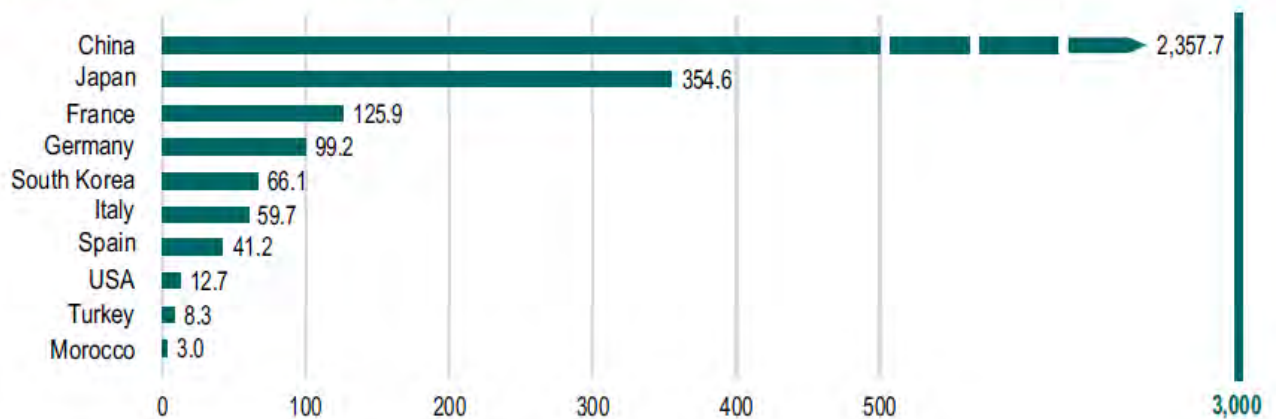
<sup>12</sup> The most recent version (2022) can be found in: [Atlas High-Speed Rail \(2022\)](https://www.uic.org/publications/atlas-high-speed-rail-2022). (uic.org)

<sup>13</sup> The UIC considers "high-speed" lines to be those with speeds exceeding 200 km/h



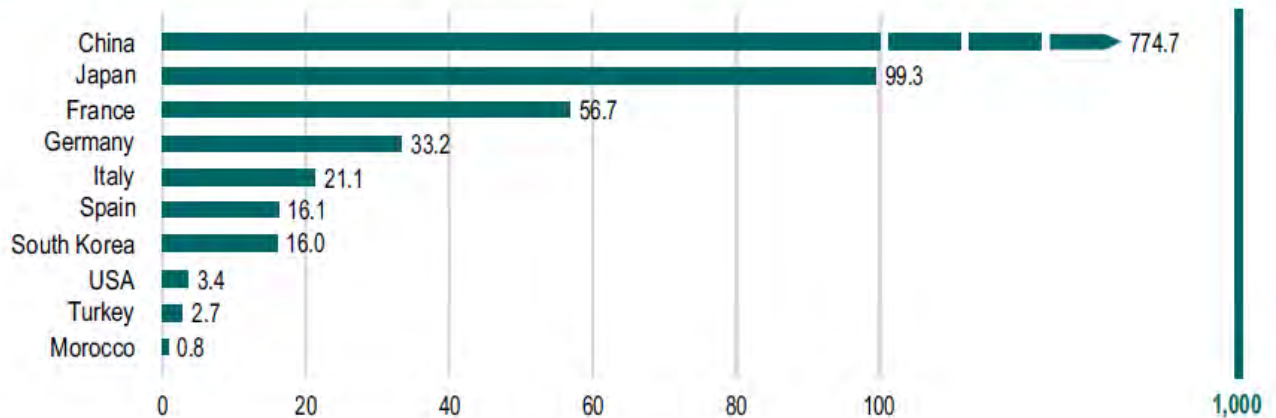
If we analyze the number of passengers and passenger-kilometers on high-speed lines, we can observe that Spain, despite being in the second position worldwide in terms of high-speed lines, only slightly surpasses 40 million passengers annually and 16 million passenger-kilometers. These figures are significantly lower than the number of passengers transported by China (2.357 billion), Japan (354.6 million), France (125 million), Germany (99.2 million), and even Italy (59.7 million).

Number of passenger (millions) by countries (2019)



Source: compiled by authors based on International Union of Railways, 2021

Number of passenger.kilometre (billions) by countries (2019)



Source: compiled by authors based on International Union of Railways, 2021

Figure 10: Passengers and passenger-kilometers on high-speed lines (2019). UIC.

Among the indicators that make up the Capacity Criterion, the highest rating is obtained by Germany, with 8.2 out of 10, followed by France (8.1), and Spain (7.6). Notably low ratings are given to Egypt (2.9), Morocco (3.3), and India (3.6).

With the established indicators, in general, European countries receive the highest ratings, followed by the United States (5.4).

Regarding the indicators related to the capacity of the railways, Spain stands out in terms of the provision of high-speed lines and electrified lines per 1,000 inhabitants, as well as having a low number of level crossings per railway lines. However, Spain receives lower ratings in terms of the

number of stations per railway lines, the number of railway lines per country's surface area, and the number of railway lines per population density.

When considering the Capacity indicators as a whole, it can be deduced that Spain's railways are in a good position in terms of infrastructure capacity and provision, particularly in the high-speed network, which receives the highest rating (Spain surpasses France, although the difference is not very significant).

#### 4.11.2. Performance Criterion

The indicator "High-speed lines / Railway lines" shows the extent of the high-speed lines in relation to the total railway lines. It's an important indicator to measure the quality of the high-speed service provided.

The indicator "Electrified railway lines / Railway lines" shows the percentage of electrified lines among the total railway lines.

The indicator "Length of railway tracks / Railway lines" indicates the utilization of railway lines. A higher length of tracks per lines signifies a more efficient use of the railway system.

Indicators related to passenger and freight traffic demonstrate the usage of the railway system by both passengers and goods, indicating the efficiency of the system.

In the Performance Criterion, the top ratings are given to France (7.1), Germany (6.9), Japan (8.1), Taiwan (8.9), and China (9.4). Spain falls within the intermediate range (5.9), surpassed by the United States (6.2) and India (6.0).

In the indicator "High-speed lines / Railway lines," China stands out with a remarkable ratio (0.410), followed by Spain (0.161) and Japan (0.148) at a considerable distance. France holds the fourth-best ratio (0.102), while other countries have much lower ratios.

In the indicator "Electrified railway lines / 1,000 inhabitants," France and Germany have the highest ratio (0.25), followed by Spain (0.217) and Italy (0.204). European countries lead in railway line electrification globally.

The indicator "Number of level crossings / Railway lines" reflects the effort countries make to eliminate level crossings. Spain holds the best position among the analyzed European countries (0.194), while Japan has the worst ratio (1.067).

Conversely, with the indicator "Number of stations / Railway lines", Spain presents the worst ratio among European countries (0.092) and one of the poorest among the analyzed countries.

The World Economic Forum (WEF) indicator related to railways, "Railway service efficiency", awards the highest rating to Japan (96 out of 100), followed by Taiwan (73) and Spain (72.9). The overall WEF indicators that constitute "The Global Competitiveness Index" (GCI) cover 141 countries worldwide. Spain ranks seventh in the "2nd Pillar: Infrastructure" category with a score of 90 out of a maximum of 100.

#### 4.11.3. Financing Criterion

One of the most representative indicators is the railway investment as a percentage of the national GDP. The evolution of this indicator over the years provides valuable information about the level of infrastructure development in the country and the state of its maintenance. A high percentage of GDP (above 0.8%) indicates that the railway network is in the process of creation, as seen in the case of China (0.74) and to a lesser extent, France (0.48), the United Kingdom (0.53), and India (0.4). Generally, if this percentage falls below 0.4%, it suggests that new infrastructure is not being created; furthermore, if this percentage drops below 0.2-0.3%, it indicates that investment is insufficient to cover the needs of infrastructure maintenance, upkeep, and management.

The rest of the investment-related indicators behave similarly to the investment-to-GDP ratio, making them complementary and providing disaggregated information. Investment data has been extracted from the OECD's "Rail infrastructure investment" (current €).

Regarding the railway investment indicator as a % of GDP, the average value across the analyzed countries and years is 0.34%, with a maximum of 1.13% reached in 2015 by China. Spain has a low value, at 0.18% of GDP in 2019. China had the highest value in 2019 (0.74%), maintaining a high investment over the last five years. Japan and India show elevated ratios: 0.38% and 0.4%, respectively. Among European countries, the United Kingdom (0.53%) and France (0.48%) are the highest investors. The United States has the lowest investment as a percentage of GDP (0.06%) in 2019; it's possible that this indicator is skewed due to not including all investments.

Some interesting insights deduced from the utilized indicators are summarized in the following table:

Indicator	Average	Min Value	Max Value
% of railway investment as a percentage of GDP	<b>0,34%</b>	<b>0,06%</b>	<b>1.13%</b>
Railway investment per capita	<b>76€</b>	<b>6,3€</b>	<b>248€</b>
Railway investment per kilometer of lines	<b>460.765€</b>	<b>70.311€</b>	<b>1.689.231€</b>
Railway investment per unit of area (km <sup>2</sup> )	<b>15.726€</b>	<b>407€</b>	<b>67.907€</b>

The significant dispersion of results shown in the above table reflects a reality: countries that, during the years analyzed in the report (2015-2019), are creating new infrastructure or making substantial transformations in their network, present high values, indicating a significant commitment to the development and improvement of the railway network, especially high-speed rail.

Spain receives a final rating of insufficient (3.4) in this Criterion, the lowest rating among the analyzed European countries. The highest rating is achieved by the United Kingdom (9.3), followed by China (7.8), Japan (7.8), and France (7.0). The lowest ratings are received by India and the United States (2.6).

**Spain's insufficient rating in financing is evident, as it ranks among the countries that allocate the lowest percentage of GDP to fund railways. The low investment in railways and the lack of annual stability in the percentage allocated to fund them will result in a severe deterioration of the infrastructure's asset value in the medium and long term, and financing needs will increase exponentially if low investments persist.**

**Regarding the historical evolution of the Financing Criterion in the analyzed countries, it is clear that Spain is lagging behind compared to countries that are making stronger investments, such as China, India, France, and the United Kingdom.**

#### 4.11.4. Adaptation to the Future and Sustainability Criterion

In the report, it has been considered that the preparation of the infrastructure for future demands is related to the ratio of high-speed lines (> 160 km/h) to total lines, the elimination of level crossings, the percentages of passenger and freight traffic in relation to total traffic in land transport modes, and electrified lines.

Three indicators related to the environment have also been considered: CO<sub>2</sub> emissions from railways / Railway lines, the percentage of renewable energy in relation to total energy consumed for transportation, and the development of climate change mitigation technologies related to transportation.

Information for the following countries could not be found: Mexico, Chile, Morocco, and Taiwan, so this criterion has not been evaluated for these countries.

The indicator "Railway lines with Speed > 160 km/h / Railway lines," corresponding to high-speed lines, is a good criterion to understand the state of the network in terms of phasing out internal combustion trains and modernizing railway transportation. As observed, China (0.41) and Spain (0.334) stand out among all countries; significantly higher than the values achieved by Italy (0.219), Japan (0.14), and France (0.104).

Spain, along with Japan, also performs well in the elimination of level crossings.

The ratios related to passenger-km traveled by rail in relation to total passenger-km traveled by all land transport modes indicate the utilization of railways. The values are quite variable, ranging from the minimum value held by Spain (3.87%) to the maximum values presented by the US (36.8%) and China (20.8%). It is well-known that passenger rail transport in Spain is quite limited despite the extensive high-speed rail network. In this context, Spain faces a significant challenge to increase these percentages in the coming years and align itself with countries in our surroundings.

In the ratio related to freight traffic, "% t-km by rail / t-km (Land)," Spain presents a value (7.14%) similar to Italy (6.3%), though lower than Germany (9.4%) and France (11.6%).

The average percentage of renewable energy in relation to total energy consumed in transportation is 7%. Spain's value is 7.6%, similar to Germany and lower than France, the United Kingdom, and Italy.

In the final index of adaptation to the future and sustainable development, China is the highest-rated country (7.2). The evaluation of Morocco (7.8) should not be taken into account; it is possible that the initial data might not be correct. Spain receives a lower rating than European countries, similar to Japan.

#### 4.11.5. Operation and maintenance Criterion

It should be noted that separating investment in operations and maintenance from infrastructure creation is very difficult: budget items are not always well-defined, and the national accounting practices of certain countries might not distinguish this separation, leading to unreliable data.

The investment needs for operations, conservation, and maintenance are related to the state of the infrastructure and the requirements for adaptation to new technical and functional demands, as well as adaptation to new technologies. There has been much debate among experts, railway associations, and multilateral organizations about the necessary investment for proper conservation. While there is no widespread consensus on an exact percentage, it's considered that the necessary investment for conservation should range between 2% and 4% of the asset value, depending on the condition of the infrastructure. Calculating the asset value requires establishing agreed-upon criteria that can approach reality. Some attempts have been made to determine the asset value of railways, but the criteria to be used are not standardized, and verifiable and comparable data are lacking.

Similarly to what was mentioned regarding the Financing Criterion, the percentage of GDP allocated to conservation represents an indicator that can provide insight into the adequacy of investment for conservation needs. To provide more precision and context for this indicator, investment per capita, investment per kilometer, and the percentage of investment allocated to conservation in relation to total railway investment have also been considered.

Conservation data has been obtained from the UIC. However, it might not fully reflect the reality of investment in conservation, as the line between investment in creation and investment in conservation is often blurry.

Data for Mexico, Chile, Morocco, Egypt, and Taiwan could not be obtained, so these countries are not evaluated in this Criterion.

As much as possible, expenditures on conservation and operational costs have been considered separately, although the data is not up-to-date and might not be very reliable.

The most significant ratio for evaluating the Operations and Maintenance Criterion is the percentage of investment in operations and maintenance over the asset value. However, obtaining this value for railway infrastructure is not feasible. Therefore, investment in operations and maintenance in relation to GDP has been used, although it couldn't be obtained for all countries. The average value of the "Investment in O&M / National GDP" ratio is 0.003, with a maximum of 0.011 and a minimum of 0.00087, which corresponds to Spain.

Another indicative ratio is the percentage of investment in operations and maintenance in relation to total investment. The resulting average value is 0.83%, with a maximum of 2.2% and a minimum of 0.258%. Spain has stabilized this percentage in recent years (around 0.48%).

Databases related to operational expenses might not be reliable or directly comparable between countries due to significant disparities. Nonetheless, with the available data, the "Operating Expenses / Population" ratio has an average value of €169, with a minimum of €3.5 (India) and a maximum of €593 (Germany). Spain has a very low value (€62).

In the overall Operations and Maintenance Criterion, Spain receives an insufficient rating (3.4). Once again, countries with the highest ratings are Germany and Japan (9.2), while China and Spain receive lower ratings.

#### 4.11.6. Security Criterion

The choice of indicators corresponds to the ones commonly used: accidents with casualties and fatalities per km of lines; accidents with casualties and fatalities per population; and casualties per passenger-km of domestic rail traffic.

The data source is EUROSTAT and is exclusively focused on European countries, cross-referenced with the Statistical Yearbook of the Ministry of Transport. Data for the USA has been extracted from the Bureau of Transport Statistics. It was not possible to obtain updated data from UIC, as access is limited and not available to the general public.

The indicator "Number of Fatalities / 100 km of Railway Lines" has an average of 0.21 fatalities, with variations among countries ranging from a minimum of 0.002 in the USA to a maximum of 0.354 in Germany. Spain's value is 0.141, which falls within the mid-range among countries.

The second analyzed indicator, "Number of Fatalities / Million Population," aligns with the first indicator's trend. Germany stands out with a value of 1.637, and the lowest value is seen in the UK (0.329). Spain is close to the lower end (0.488).

The indicator "Number of Fatalities / Domestic Rail Passenger Traffic (hundred million passenger-km)" has an average value of 0.075, with a maximum of 0.133 in Germany and a minimum of 0.009 in the USA. Spain's value is close to the average (0.08).

Overall, the top-rated country is the UK (9.3 out of 10), followed by the USA with a score of 8.6 out of 10. Spain receives a rating of 7.9.

#### 4.11.7. Resilience Criterion

To analyze resilience, data on the technical characteristics of railway design would be required, such as terrain conditions and vulnerability to adverse phenomena, drainage capacity of the infrastructure (to ensure the return period of floods is appropriate), stability of slopes and cuttings in the infrastructure, organization and equipment of maintenance teams to efficiently and quickly respond to any eventuality, an integrated winter maintenance system, and more. Since obtaining all these data for the entire railway network would be labor-intensive, indicators that indirectly provide some insight into the resilience of the railway network have been considered.

The number of stations per railway lines allows evaluating the evacuation capacity of passengers in the event of disturbances on the lines.

The number of nodes per the number of stations also gives an indication of the ability to maneuver effectively in the face of disruptions.

Considering that the alternative to railway lines for transportation is roads, the ratio of railway density to road density has been taken into account.



The presence of a robust high-capacity railway network, such as high-speed lines, can also indicate the ability to move people from one point to another quickly and efficiently.

An indicator developed by the World Economic Forum, which assesses the transportation infrastructure of countries worldwide, has also been considered. A country with a well-developed transportation network is deemed better prepared and more resilient to disruptions in the overall transportation system.

In terms of overall assessment, Japan receives the highest score (9.5 out of 10), followed by Germany (7.7), Italy (7.2), the United Kingdom (6.5), Taiwan (6.4), and Spain (6.3). Notably, the United States receives a lower score (4.5) indicating insufficient resilience.

#### 4.11.8. Engineering and Innovation Criterion

To analyze engineering and innovation in railways, a comprehensive understanding of new techniques, materials, and technologies applied to railways is required, along with insights into implemented innovations, the state of railway engineering, progress in digitalization, and the resources allocated to engineering and innovation. One of the primary indicators of technological advancement in railways is the increase in high-speed lines relative to the total number of railway lines. Another specific indicator pertains to patents: "Number of Railway Transport Patents / Million Inhabitants (OECD)."

Despite efforts to obtain more specific data on the railway infrastructure sector, reliable and comparable data for the railway sector have not been found. In their absence, the analysis of Research and Development (R&D) status in different countries has been considered as a global proxy for assessing the state of railways. For this purpose, a selection of indicators from the report "Main Science and Technology Indicators, Volume 2021," published by the OECD in 2022<sup>14</sup>, has been chosen. This comprehensive report provides indicators reflecting the level and structure of efforts made by OECD member countries and seven non-member economies (Argentina, China, Romania, Russia, Singapore, and South Africa) in the field of science and technology. These indicators cover resources dedicated to research and development, patent families, and international trade in research-intensive industries. The ND Gain Innovation Index and the number of patents related to road transport per million OECD inhabitants have also been considered.

To analyze the progress of digitalization, three indicators have been included: Participation in New Technologies (GCI - WEF -), Index of Information and Communication Technology (ICT) Infrastructure (ND Gain Index), and the number of internet users.

For assessing the state of engineering in the railway sector, precise information about the education of railway engineers, the number of engineers involved in design, construction, maintenance, and management of railways per economic unit investment, and economic data related to engineering investment in relation to investment in construction, maintenance, operation, and management of railway networks would have been helpful. Unfortunately, this data is not available, so four OECD indicators related to engineering as a whole have been used: regulatory transparency, barriers to competition, restrictions on engineers' movement, and

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<sup>14</sup> [Main Science and Technology Indicators, Volume 2021 Issue 2 | READ online \(oecd-ilibrary.org\)](#)

restrictions on foreign engineers' entry. All of these indicators are related to the Trade in Services Restrictiveness Index periodically compiled by the OECD<sup>15</sup>.

The "Increase in High-Speed Lines / Railway Lines (2019/2015)" indicator reflects the innovative capacity of the railway network to implement high-speed systems. China stands out with a ratio of 1.468, followed by Spain (1.376) and France (1.340).

OECD indicators related to research and development show the global strategic position of countries across all sectors of the economy concerning research.

The indicator "% of GDP spent on gross domestic expenditure on R&D" varies widely among the analyzed countries: from a maximum of 3.21% (Japan) to a minimum of 0.28% (Mexico). Spain falls into the lower range (1.25%), surpassed by all EU countries. It's logical that the most technologically advanced countries in the world invest more in R&D: Japan (3.21%), USA (3.18%), Germany (3.17%). France (2.19%) and the UK (1.71%) are in an intermediate position. Over the five years analyzed (2015 to 2019), these percentages remain relatively constant, exacerbating the technological gap.

The indicator "% of GDP from private sources spent on R&D" presents an interesting data point: the USA, Germany, and Japan exceed 2% of GDP from private sources. Private impetus undoubtedly plays a determinant role in increasing R&D financing, as shown by the indicator "% of GDP from public sources spent on R&D": no country surpasses 1%, and the differences in investment percentage narrow (Spain's results are comparable to the UK, Italy, and Japan).

When observing gross R&D investment per capita, the results are similar: Spain (\$522 per capita), USA (\$2,066 per capita), and Germany (\$1,763 per capita).

The three selected indicators for evaluating digitalization present very similar results among the analyzed countries. Nevertheless, Spain ranks among the top countries: 90.7% of people use the internet (only surpassed by the UK, Japan, and South Korea); the World Economic Forum's score for the "participation in new technologies" indicator is 98.3% (only surpassed by South Korea); however, the Notre Dame University's "ICT Infrastructure Index" assigns Spain a value of 0.671, surpassed by Germany (0.710), France (0.725), the UK (0.710), and South Korea (0.732).

As previously mentioned, due to the unavailability of specific economic investment data for engineering in the analyzed sector and the number of engineers and their education related to engineering, four OECD indicators related to engineering as a whole have been used: regulatory transparency, barriers to competition, restrictions on engineers' movement, and restrictions on foreign engineers' entry. In these indicators, Spain falls into an intermediate position among the analyzed countries: very good in restrictions on engineers' movement, sufficient in barriers to competition, and insufficient in restrictions on foreign engineers' entry and regulatory transparency.

The overall evaluation of the Engineering and Innovation Criterion assigns the highest ratings to the USA (9.1) and Japan (8.6), followed by Germany (8.5) and France (8.2). Spain receives a score of 5.9, below China (6.6).

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<sup>15</sup> [Services Trade Restrictiveness Index \(oecd.org\)](https://www.oecd.org/)



## 5. Qualitative Evaluation. Surveys of Experts

As described in the methodology employed by Asociación Caminos, once the objective indicators (which have served as the basis for the objective evaluation of the sector in comparison to selected countries) were obtained, a series of questions (grouped into the eight analyzed criteria) were drafted for assessment on the same scale as the assessment of the objective indicators. The questions posed include the possibility of providing comments and suggestions in each group of criteria, to capture those criteria that experts might consider relevant and are not included in the objective indicators or the questionnaire presented.

The questions were directed at a group of experts selected by Asociación Caminos. The survey was transformed into a Google form to facilitate analysis and integration of results.

Two complementary questions are included in the questionnaire sent to the experts:

- What infrastructure and equipment actions do you consider necessary for roads in the next 10 years?
- Approximately, what is the estimated investment required to meet the infrastructure and equipment needs of the sector in the next 10 years?

Since the questions in the questionnaire are very general (evaluating the public works sector of Spain as a whole), it is difficult to provide a precise qualitative and numerical rating. Therefore, a qualitative non-numerical rating has been requested; although to integrate the result obtained with the objective numerical indicators, a numerical assignment is subsequently given to each qualitative rating.

Rating system of Asociación Caminos							
Asociación Caminos							
	VERY INSUFFICIENT	INFUFFICIENT	SUFFICIENT	HIGHLY SUFFICIENT	GOOD	VERTY GOOD	EXCELLENT
	F	FX	E	D	C	B	A

Table 175: Qualitative evaluation rating system by the experts

Rating	Numerical Assignment
Excellent	9,5
Very good	8,5
Good	7,5
Highly sufficient	6,5
Sufficient	5,5
Insufficient	4,0
Very insufficient	2,0
Insufficient criterion or no response	-

Table 176: Numerical assignment of qualitative evaluation by experts

In a schematic way, the evaluation process for each sector is as follows:

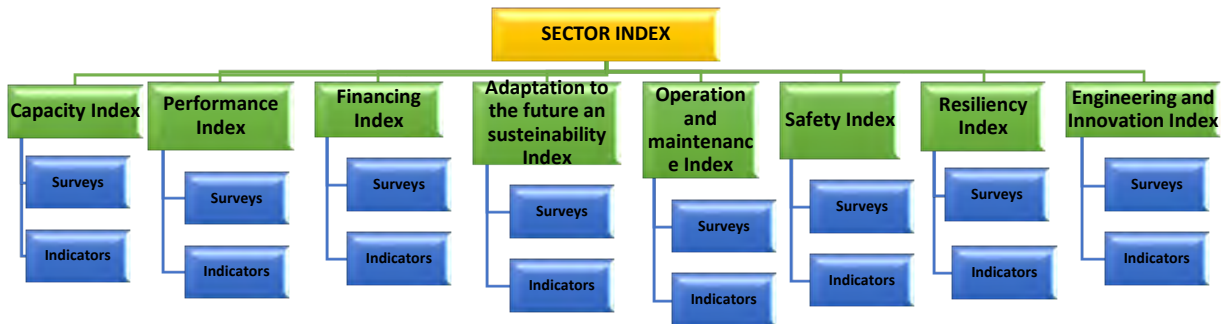


Figure 11: Scheme of the evaluation system for public works sectors

Once the responses have been obtained, the results achieved have been analyzed, combining them with the results obtained through the objective indicators.

In general<sup>16</sup>, a weighting is established for each Criterion between the quantitative indicators (expressed by objective indicators) and the qualitative evaluation from experts to obtain the Criterion Index, in the following proportions:

**A. Quantitative evaluation of each Criterion: ..... 50%**

**B. Qualitative evaluation of each Criterion by experts through surveys, questionnaires, and opinions ..... 50%**

<sup>16</sup> In some sectors, such as Ports, there is the possibility of modifying this weighting due to the difficulty of quantitative indicators accurately reflecting the reality of the sector.



## 5.1. Expert Assessment Questionnaire

A total of 33 responses have been obtained with the following results.

### 5.1.1. Capacity

Peso	EVALUACIÓN DE CAPACIDAD (Encuestas a expertos) (Max 10)			
1	1.1. ¿Cómo valora la cobertura del territorio y la infraestructura de altas prestaciones?	8,1	MUY BIEN	B
1	1.1. ¿Cómo valora la cobertura del territorio y la infraestructura de altas prestaciones?	8,2	MUY BIEN	B
1	1.3. ¿Cómo valora la capacidad de la red ferroviaria para absorber la demanda actual?	7,5	BIEN	C
1	1.4. ¿Cómo valora la capacidad de la red ferroviaria actual para absorber a la previsible demanda futura en los próximos 10 años?	9,0	EXCELENTE	A
4	<b>TOTAL EVALUACIÓN CAPACIDAD POR LOS EXPERTOS:</b>	<b>8,2</b>	<b>MUY BIEN</b>	<b>B</b>
	Maximo:	9,0		
	Mínimo:	7,5		
	Media:	<b>8,2</b>		
	Desviación Estándar:	0,6		

Table 177: Expert assessment of capacity

## Comments, suggestions, and recommendations from the experts

- The responses provided are at a peninsular level. At the insular level in the Canary Islands, coverage is very inadequate, and the introduction of high-performance rail is highly necessary due to the high motorization rate, limited territory, high demand for "guaguas" (buses), and high IMD on the main roads of the capital islands, especially in Gran Canaria.
- The high-speed rail network is constantly expanding with the construction of new lines and station adaptations, which will be ready to accommodate future demand. However, limitations and disruptions to capacity and traffic regularity can arise during the construction or adaptation phase of stations (as is the case with Chamartín station).
- Overall, we have an adequately developed rail network in the country. However, there are very isolated regions where continued investment is needed to achieve minimally dignified infrastructure, such as in Extremadura.
- The radial railway network must be completed, and efforts should start transitioning to a meshed network.
- The initial forecast that the average user would have a high-performance station within 50 km will practically be realized when the ongoing construction of lines is completed, which could be in around 10 years. Concerning the Conventional Network, it will be necessary to continue investing in its modernization, carrying out certain renovations, speed enhancements, new electrifications, and safety systems, improving efficiency and sustainability.



- For Long-Distance travel, it's the High-Speed Rail network that will be able to meet demand requirements, and once it's complete, most major population centers will be connected by this network. Regarding the conventional network, suburban rail systems in Madrid and Barcelona need expansion primarily to accommodate future demand increases, as they are currently nearing their capacity limits. Efforts are also needed to promote rail freight transport and improve connections with ports.
- Transforming the Conventional Network to standard gauge and promoting real interoperability, even with scalable, modular, and open signaling systems, would be fantastic.
- The enhancement of the Murcia-Almería line, connected with the Mediterranean Corridor, will link densely populated and economically active areas.
- In the rest of Spain, numerous actions are needed for renewal, adaptation, operational improvement, digitalization, as well as combining with other modes. It's crucial to seize the current momentum and public awareness for improving public transportation, where trains play and will play an essential role. The High-Speed Rail network is currently good, with only a few radial areas left to be connected to the capital, but the suburban and local rail network must continue to focus on mode integration and user orientation. Technological improvements in service platforms and renewable energy use are also necessary.
- Prioritize electrification of conventional lines, enhance capacity, and increase speeds by improving infrastructure. Many level crossings still need to be eliminated.
- Plan maintenance works very carefully to minimize disruptions to rail traffic.
- Follow the railway boosting plans promoted by the Ministry, which are often unfulfilled. Only efficiency measures seem to be implemented. Europe demands greater use of rail transport for both passengers and freight, and in Spain, we're going in the opposite direction compared to other European countries. A 5% usage of railways for freight transport is very significant and concerning.
- Reach areas that are currently inaccessible and begin the process of network expansion (such as in the Ruta de la Plata, central axis, etc.).
- Complete ongoing high-performance rail lines. Modernize the conventional rail network.
- New infrastructure is needed in urban areas along suburban rail lines.
- Increase budgets for maintenance of both the conventional and high-speed rail networks, and continue with upgrades to the conventional network.
- It's important to differentiate between territorial structure and infrastructure coverage, both in high-performance lines and the conventional network.
- Finish initiated Corridors.
- Plan the separation of passenger and freight lines on mixed lines.



## 5.1.2. Performance

Peso	EVALUACIÓN DE PRESTACIONES (Encuestas a expertos) (Max 10)			
1	2.1. ¿Cómo valora las prestaciones que aporta la red de ferrocarril a los usuarios?	7,7	BIEN	C
1	2.2. ¿Cómo valora el equipamiento y los servicios existentes para transporte de pasajeros en las estaciones de la red ferroviaria española?	7,5	BIEN	C
1	2.3. ¿Cómo valora el equipamiento y los servicios existentes para transporte de mercancías en las estaciones de la red ferroviaria española?	5,1	SUFICIENTE	E
1	2.4. ¿Cómo valora la situación de las conexiones de la red ferroviaria española con la red portuaria?	5,2	SUFICIENTE	E
1	2.5. ¿Cómo valora la situación de las conexiones de la red ferroviaria española con modos de movilidad urbana?	6,3	SUFICIENTE ALTO	D
1	2.6. ¿Cómo considera la cobertura del territorio de la red ferroviaria?	7,1	BIEN	C
1	2.7. ¿Cómo valora la información al usuario en los incidentes que se producen en la red ferroviaria?	4,8	INSUFICIENTE	FX
7	<b>TOTAL EVALUACIÓN PRESTACIONES POR LOS EXPERTOS:</b>	<b>6,2</b>	<b>SUFICIENTE ALTO</b>	<b>D</b>
	Maximo:	7,7		
	Mínimo:	4,8		
	Media:	<b>6,2</b>		
	Desviación Estándar:	1,2		

Table 178: Expert assessment of performance

## Comments, suggestions, and recommendations from the experts

- The difference between services in major urban centers and stations in smaller cities must be taken into account. The same level of services and quality of provision is not present everywhere. More personnel spread across the territory is needed to meet the network's needs.
- Information about incidents affecting regularity is not always prompt or sufficient.
- Rail transport is very comfortable, but its integration into cities is not always appropriate, leading to marginal or underdeveloped areas in its vicinity.
- High-performance lines provide a good service with reliability, safety, and adequate comfort. For conventional lines, modernization will be necessary to achieve satisfactory performance. It's important to continue with station accessibility plans. Rail freight participation is nearly non-existent in the market.
- Recent improvements in connections with ports need further enhancement.
- Intermodality needs improvement, as well as user support during incidents. Enhancing interconnections through multimodal stations is crucial.



- I emphasize the need to enhance effective physical and tariff-based intermodality. It's vital to have disaggregated demand knowledge; global demand data is no longer sufficient. Understanding real needs and reducing transfer times and access to rail mode are important, including in the freight sector. Digitization and coordinated planning with the territory are essential. At the urban level, leverage new Low Emission Zones to make rail the backbone of terrestrial transport.
- Obviously, providing sufficient and detailed information to users, particularly about the extent and consequences of incidents, shortly after they occur.
- Rail connections with ports are very deficient. Freight transportation by rail is also inadequate. Often, this is due to a lack of logistics managers and infrastructure that support the management and intermodality of goods. The absence of other companies competing with Renfe Mercancías suggests that something is not being done right to make rail transport attractive for investment by companies, despite reports indicating it's a more efficient and eco-friendly mode.
- Maintenance of High-Speed Rail and Conventional lines. Elimination of risks and trouble spots. Station accessibility plans. Improved freight transportation management. Continued implementation of logistics platforms to enhance user interaction and reduce transport cycles.
- It's important to remember that rail is a public mass transportation.
- Enhance connections between road and rail transportation in multimodal stations.
- Improve parking facilities in terms of service and pricing.





### 5.1.3. Financing

Peso	EVALUACIÓN DE FINANCIACIÓN (Encuestas a expertos) (Max 10)			
1	3.1. ¿Considera suficiente la inversión actual la red ferroviaria de altas prestaciones en España?	7,4	BIEN	C
1	3.2. ¿Considera suficiente la inversión actual la red ferroviaria convencional en España?	5,5	SUFICIENTE	E
1	3.3. ¿Cómo considera que se está gestionando la inversión en la red ferroviaria?	6,1	SUFICIENTE ALTO	D
1	3.4. ¿Cómo considera la actual participación de la inversión privada en la red ferroviaria?	5,1	SUFICIENTE	E
4	<b>TOTAL EVALUACIÓN FINANCIACIÓN POR LOS EXPERTOS:</b>	<b>6,0</b>	<b>SUFICIENTE ALTO</b>	<b>D</b>
	Maximo:	7,4		
	Mínimo:	5,1		
	Media:	<b>6,0</b>		
	Desviación Estándar:	1,0		

Table 179: Expert assessment of Financing

## Comments, suggestions, and recommendations from the experts

- Within the investment over recent years, high-speed rail has taken the spotlight over high-performance rail. Political criteria have sometimes taken precedence over social and economic considerations. Properly enhancing a high-performance rail network is crucial.
- Perhaps private sector involvement could enhance the rail network.
- Rail investments in Spain have been unevenly distributed among different regions due to predominantly political interests. This has led to disparities in development between regions.
- Poor management by ADIF High-Speed in constructing new lines.
- Various European funds are poorly managed, with a risk of losing them.
- The conventional network is lacking maintenance, and the high-performance network needs scrutiny in certain lines.
- Socioeconomic feasibility studies should be conducted and updated in ex-ante and ex-post phases. Political criteria shouldn't override needs and social opportunity criteria. The railway mode should be accessible to all. In Canarias, there is no railway mode, only a tram in Tenerife. Territories' realities need to be understood to plan with reasonable criteria based on social needs, demand, and sustainability.
- Truly commit to rail by allocating appropriate budget allocations to Spanish needs and European recommendations. This will make rail more attractive to private investors, which is currently almost non-existent.
- Improve fund management by streamlining tender and construction processes. Involve the private sector in improving investment definition and execution through public-private partnerships.



- The term "sufficiently high" should be removed from the surveys, as the previous milestone already covers it.
- The level of investment in the network is adequate. It might be more prudent to complete high-performance lines before initiating new ones to avoid the situation of not finishing any.



## 5.1.4. Adaptation to the future and Sustainability

Peso	EVALUACIÓN DE ADAPTACIÓN AL FUTURO Y DESARROLLO SOSTENIBLE (Encuestas a expertos) (Max 10)			
1	4.1. ¿Considera que los planes de expansión de la red ferroviaria tienen en cuenta la adaptación a las demandas futuras de los usuarios?	6,7	SUFICIENTE ALTO	D
1	4.2. ¿Cómo valora la estrategia de oferta de servicios privados de transporte por ferrocarril?	6,7	SUFICIENTE ALTO	D
1	4.3. ¿Cómo considera la adaptación de la red ferroviaria a los efectos del cambio climático?	6,9	SUFICIENTE ALTO	D
1	4.4. ¿Cómo valora las acciones que se están tomando para reducir el consumo de CO2 en la construcción, conservación y mantenimiento de la red ferroviaria?	6,8	SUFICIENTE ALTO	D
1	4.5. ¿Cómo valora las acciones que se están tomando para reducir el consumo de CO2 en el material rodante?	6,9	SUFICIENTE ALTO	D
1	4.6. ¿Cómo valora los programas de adaptación de la infraestructura ferroviaria a las nuevas tecnologías y a la información a los usuarios?	6,6	SUFICIENTE ALTO	D
1	4.7. ¿Considera adecuadas las medidas que se adoptan para reducir el impacto ambiental y el tratamiento de los residuos en la construcción y conservación de las Ferrocarrils?	5,9	SUFICIENTE	E
7	<b>TOTAL EVALUACIÓN ADAPTACIÓN AL FUTURO Y DESARROLLO SOSTENIBLE POR LOS EXPERTOS:</b>	<b>6,6</b>	<b>SUFICIENTE ALTO</b>	<b>D</b>
	Maximo:	6,9		
	Mínimo:	5,9		
	Media:	6,6		
	Desviación Estándar:	0,4		

Table 180: Expert assessment of Adaptation to the Future and Sustainability

## Comments, suggestions, and recommendations from the experts

- Demand studies conducted so far have been on aggregated demand with unreliable sensitivity analyses. Progress is being made in the right direction, but it's important to note that intermodality involves collaboration with citizens, other modes, and multidisciplinary. The new laws 7/2021 on Climate Change and the upcoming draft of Sustainable Mobility are critical for implementing sustainability measures and aligning the rail mode with user orientation.
- Rail is the most efficient and ecologically friendly land transport. Its promotion is essential. The issue in Spain is that its development has been uneven across all territories, with political interests consistently taking precedence over people's needs.
- Investment selection still tends to respond more to political rather than technical criteria, which can be negative but unavoidable. The involvement of railway companies in operations is progressing satisfactorily, although it will be challenging for them to reach the capabilities and reach of RENFE. Rail transport barely interferes with climate change. At this stage, it shouldn't significantly impact future investment planning. For the decarbonization of the railway sector, further electrification of the conventional network



and accelerated investments in rail corridors and adaptation of lines and trains to hydrogen and other new power systems will be necessary.

- Collaboration and effective involvement in mobility strategy and investment according to territory needs and knowledge.
- The investment-driven focus on rail networks should be reflected in user usage (it's more comfortable than other modes, more cost-effective for freight, and more efficient in CO<sub>2</sub> emissions). This will also increase the presence of private operators (currently very limited) and be a significant benefit to users.
- Improve investment planning management by striving for technical and profitability criteria. Decarbonize the sector by progressively eliminating the use of petroleum-derived fuels and adopting new train power systems. Continue allowing the entry of private operators and builders, which will enhance competition and efficiency in network management.



### 5.1.5. Operation and Maintenance

EVALUACIÓN DE OPERACIÓN Y MANTENIMIENTO (Encuestas a expertos) (Max 10)				
1	5.1. ¿Cómo valora la inversión en conservación y mantenimiento de la red ferroviaria española?	5,8	SUFICIENTE	E
1	5.2. ¿Considera que los medios aplicados a la operación, conservación y mantenimiento de la red ferroviaria son los adecuados para atender las demandas de los usuarios?	5,9	SUFICIENTE	E
1	5.3. ¿Cómo valora el estado de conservación y mantenimiento de las vías de la red convencional?	5,1	SUFICIENTE	E
1	5.4. ¿Cómo valora las medidas que se adoptan con relación a la vialidad invernal y a las incidencias que se producen en la red ferroviaria?	6,4	SUFICIENTE ALTO	D
4	<b>TOTAL EVALUACIÓN OPERACIÓN Y MANTENIMIENTO POR LOS EXPERTOS:</b>	<b>5,8</b>	<b>SUFICIENTE</b>	<b>E</b>
	Maximo:	6,4		
	Mínimo:	5,1		
	Media:	<b>5,8</b>		
	Desviación Estándar:	0,5		

Table 181: Expert assessment of Operation and Maintenance

### Comments, suggestions, and recommendations from the experts

- Routine maintenance is well-sized, but managing extraordinary maintenance needs improvement.
- There's significant disparity between different administrations.
- It's necessary to change the railway maintenance model and demand indicators to achieve objectives.
- There's technical capacity, but there's a lack of investment and management capacity within the Administration.
- The major problem with maintenance lies in regional railway systems, where investment is clearly insufficient due to limited regional funding and their low investment capacity.
- More funding needs to be allocated to railway maintenance. The state of railways varies widely based on the responsible administration and its budget. Generally, they manage available funds well.
- The condition of the tracks in the railway network is very good.
- Improved management of extraordinary maintenance, especially concerning tracks.
- Promote agile management teams within the Administration and provide them with adequate budgets.
- Public administrations should recognize where it's most cost-effective to invest their money. Ensuring citizen mobility should be a priority, suggesting greater spending on railway maintenance and less on other non-vital areas.
- There's a need for better coordination between administrations.
- It would be advisable to review administrative procedures to simplify certain aspects whenever possible.
- There's a significant need for improvement in extraordinary maintenance.



## 5.1.6. Safety

Peso	EVALUACIÓN DE SEGURIDAD (Encuestas a expertos) (Max 10)			
1	6.1. ¿Cómo valora las medidas adoptadas en la actualidad para prevenir la siniestralidad en la red ferroviaria (Comisión de Investigación de accidentes ferroviarios, etc.)?	7,0	SUFICIENTE ALTO	D
1	6.2. ¿Cómo valora el nivel de siniestralidad que se produce en la red de ferrocarril convencional en España?	7,7	BIEN	C
1	6.3. ¿Cómo valora el equipamiento de la red ferroviaria convencional para prevenir o reducir los efectos de los accidentes?	7,4	BIEN	C
1	6.4. ¿Cómo considera las medidas adoptadas para reducir en el futuro la siniestralidad en la red ferroviaria convencional?	7,1	BIEN	C
1	6.5. ¿Cómo valora la inversión que se realiza relativa a la seguridad de la red ferroviaria convencional para prevenir o reducir los efectos los accidentes?	6,5	SUFICIENTE ALTO	D
5	<b>TOTAL EVALUACIÓN SEGURIDAD POR LOS EXPERTOS:</b>	<b>7,1</b>	<b>BIEN</b>	<b>C</b>
	Maximo:	7,7		
	Mínimo:	6,5		
	Media:	7,1		
	Desviación Estándar:	0,4		

Table 182: Expert assessment of Safety

## Comments, suggestions, and recommendations from the experts

- There are still too many cases of accidents in the railways.
- There's significant disparity between different administrations.
- The installed ITS systems are insufficient, as well as traffic surveillance to combat reckless driving.
- The reference point is still the number of fatalities. However, the number of accidents isn't considered. Furthermore, fatalities can decrease due to improved passive vehicle safety. The contribution of infrastructure needs to be evaluated further.
- Spain has good accident data compared to other countries in our region. This demonstrates that things are being done correctly. The equipment of the railways varies greatly depending on the network's importance. In the state railway network, it's good, but in other railways with less traffic, improvement is logical.
- At present, I consider that the measures taken in the railways to prevent accidents and reduce the effects of accidents are very effective. We need to continue working towards the accident reduction goals, but it's a topic influenced by other factors, not just the infrastructure aspect.
- More emphasis should be placed on the PCA (accident-prone points) and measures should be adopted at all of them.
- Improve the ITS systems and use drones for traffic surveillance.
- Prioritize low-cost actions that yield high returns on investment and continue paying attention to vulnerable users.



- The work on road safety audits should continue.
- The equipment on the conventional network needs improvement.



## 5.1.7. Resilience

Peso	EVALUACIÓN DE RESILIENCIA (Encuestas a expertos) (Max 10)			
1	7.1. ¿Cómo valora la capacidad de la red ferroviaria para recuperar, en un tiempo razonable, el estado de servicio inicial cuando se producen situaciones adversas?	7,2	BIEN	C
1	7.2. ¿Cómo valora las medidas adoptadas para prevenir la infraestructura ferroviaria de la red convencional ante incidentes naturales o provocados?	6,2	SUFICIENTE ALTO	D
1	7.3. ¿Cómo valora las medidas adoptadas para prevenir la infraestructura ferroviaria de la red de alta velocidad ante incidentes naturales o provocados?	7,5	BIEN	C
1	7.4. ¿Cómo valora las alternativas existentes a la red ferroviaria en España cuando se produce un corte en el servicio?	6,0	SUFICIENTE ALTO	D
1	7.5. ¿Cómo valora los planes de contingencia que se aplican en la red ferroviaria para prevenir la infraestructura ante incidentes naturales o provocados?	7,0	SUFICIENTE ALTO	D
5	<b>TOTAL EVALUACIÓN RESILIENCIA POR LOS EXPERTOS:</b>	<b>6,8</b>	<b>SUFICIENTE ALTO</b>	<b>D</b>
	Maximo:	7,5		
	Mínimo:	6,0		
	Media:	<b>6,8</b>		
	Desviación Estándar:	0,6		

Table 183: Expert assessment of Resilience

## Comments, suggestions, and recommendations from the experts

- Safety measures on conventional rail networks are often inadequate or nonexistent, unlike high-speed networks. High-speed networks are newer infrastructures with more economic resources invested in their construction.
- Prevention of climate-related or catastrophe-induced contingencies isn't sufficiently implemented, even though the railway system doesn't exhibit good elasticity in responding to potential contingencies.
- Improvements in quality and reliability always make the system more compact and resilient.
- Railway lines should be protected in the best possible way from acts of vandalism and potential accidents. It's true that in most cases, these measures are high-cost and not very feasible.
- There are software applications and detection and communication systems that need to be implemented in networks for the prevention and notification of potential contingencies. However, the involvement of agents such as train drivers and maintenance personnel in this prevention process cannot be eliminated or limited. The allocation of resources for incident resolution should be increased.



### 5.1.8. Engineering and Innovation

Peso	EVALUACIÓN DE INGENIERÍA E INNOVACIÓN (Encuestas a expertos) (Max 10)			
1	8.1. ¿Considera que la inversión en la ingeniería de diseño, construcción, gestión y conservación de la red ferroviaria es adecuada?	6,4	SUFICIENTE ALTO	D
1	8.2. ¿Cómo valora los conocimientos y la actitud técnica de los ingenieros ferroviarios actuales?	7,8	BIEN	C
1	8.3. ¿Considera adecuados y ajustados a las nuevas tecnologías los conocimientos impartidos en las universidades a los ingenieros?	6,0	SUFICIENTE ALTO	D
1	8.4. ¿Cómo valora la utilización de nuevas técnicas y materiales en la construcción, conservación y mantenimiento de la infraestructura ferroviaria?	7,3	BIEN	C
1	8.5. ¿Cómo valora las medidas adoptadas en la licitación pública para favorecer la innovación en la infraestructura ferroviaria?	6,1	SUFICIENTE ALTO	D
1	8.6. ¿Cómo valora la adaptación de la red ferroviaria convencional a los sistemas de seguridad más recientes?	7,1	BIEN	C
1	8.7. ¿Cómo valora la investigación, desarrollo e innovación que se está desarrollando en España con relación a la red ferroviaria?	6,7	SUFICIENTE ALTO	D
1	8.8. ¿Cómo valora la tecnología actual que se está aplicando en la red ferroviaria?	7,5	BIEN	C
1	8.9. ¿Cómo considera el avance en la digitalización y monitorización del comportamiento de los elementos de la red ferroviaria?	7,1	BIEN	C
9	<b>TOTAL EVALUACIÓN INGENIERÍA E INNOVACIÓN POR LOS EXPERTOS:</b>	<b>6,9</b>	<b>SUFICIENTE ALTO</b>	<b>D</b>
	Maximo:	7,8		
	Mínimo:	6,0		
	Media:	<b>6,9</b>		
	Desviación Estándar:	0,6		

Table 184: *Expert assessment of Engineering and Innovation*

### Comments, suggestions, and recommendations from the experts

- Sustainability and alternative energy training should be promoted in schools, along with training in territorial planning with a social perspective on transportation modes. Spain has a great human and professional value in the railway field, and it should be preserved, strengthened, and made known.
- Training in universities in subjects related to railway construction and maintenance is very scarce, if not nonexistent.
- The research being conducted by Spanish engineers is considered appropriate. However, we still have a very uneven landscape, where regions like Extremadura have not a single kilometer of electrified line in service.



- Risk studies and various applications are updated significantly. Both teaching and advanced studies are sufficiently updated. Emerging innovations are gradually being implemented.
- Digitization of projects throughout their lifecycle is fundamental for improving the entire chain. Investing in digitization like BIM (Building Information Modeling) is crucial because it provides greater knowledge and reduces uncertainty. It's a key tool for dialogue, strategic decisions, and in a system as rigid as the railway, having the entire network modeled makes it easier to take measures.
- It would be beneficial to provide students, at least in a basic manner, with knowledge of the various techniques and applications used in the railway sector within different university programs.
- There's a need to advance in security systems and risk management.
- Greater investment in new communication and train control systems is needed. Developing railway infrastructure across the entire Spanish territory uniformly, without political interests as seen in recent decades, is crucial.



## 5.2. Supplementary Questionnaire

Among the issues presented to the experts, a supplementary questionnaire has been included with the following questions:

- CP.1**                    **What infrastructure and equipment needs for the Spanish railway network (both conventional and high-performance) do you consider necessary in the next 10 years?**
- CP.2**                    **In approximately how much investment do you estimate is needed to develop the infrastructure and equipment needs in the Spanish railway network for the next 10 years?**

### **CP.1 What infrastructure and equipment needs for the Spanish railway network (both conventional and high-performance) do you consider necessary in the next 10 years?**

- Improvement in digitalization of projects, disaggregated demand studies, and integrated energy studies in the project. No new line should be approved without having a self-consumption mode. Necessary focus on both physical and tariff intermodality. It is very important to invest in the railway mode in the Canary Islands.
- Continue developing the high-speed network to interconnect more cities, promote rail freight transport by improving connections with the Spanish port network and coordination with major last-mile logistics centers, renovation and improvement of stations to meet new requirements (interoperability/accessibility/sustainability), renovation and enhancement of performance in the existing conventional network to increase its reliability, increase investment in R&D for new materials/traction systems/technologies to improve railway safety/operability/sustainability, increase investment in the conservation and maintenance of existing infrastructure, superstructure, and rolling stock.
- More investment in the conventional network. Elimination of level crossings, electrification, and modification of signaling systems. Study the possibility of building passing loops or sidings on some single-track conventional lines to increase capacity and respond more agilely to incidents.
- In the high-speed network, I understand that the infrastructure needs are covered or planned.
- In the conventional network, with very limiting alignments, making radical improvements is very difficult, perhaps the most relevant, although costly, would be related to the installation of ERTMS (European Rail Traffic Management System).
- In some regions like Extremadura, there is a need for an electrified railway network with modern signaling and train control systems like ERTMS. High-speed rail should reach all communities on the peninsula and not just those chosen for political interests. If all citizens pay the same taxes, they should also have access to the same public services.
- Complete the radial network and accelerate meshing.
- Finish the initiated High-Speed lines. Eliminate black spots and improve safety and risk prevention in AVE and Conventional networks. In the latter, continue electrifying and



improving capacity with a good selection of investments. Implement new technologies at a good pace.

- Digitalization of information and improvement of predictive maintenance.
- Expand and improve the suburban network.
- Implement ERTMS throughout the national network.
- Digitalization.
- Emphasize the development of technologies that favor predictive maintenance and proper handling and use of data, digital twins, full implementation of the ERTMS system, 5G, completion of pending electrification sections, focus on facilities for hydrogen fueling (aimed at low-traffic lines), incorporation of artificial intelligence technologies, increase in sensorized systems, real implementation of intelligent and user-adapted stations, improvement of logistics terminals in all aspects: facilities and management, smart grid management.
- Complete the pending High-Speed Network.
- Modernization of conventional network signaling systems and increased budget to complete the High-Speed network and its maintenance.
- In the conventional network, change the gauge and adapt stations for the passage of 750 m long freight trains. In the high-speed network, monitor its life cycle and adapt accordingly for renewal.
- Improve the Conventional Network, especially the Suburban Network.
- Improve productivity and explore new operating models for rail freight transport. Completion and commissioning of initiated high-speed lines, Murcia-Almería, Badajoz, A Coruña, and the Mediterranean corridor.
- In my opinion, there is a lack of coordination between RENFE and ADIF and a lack of clear direction to define actions.
- At least around 9 billion euros in current value as of 2023 for both networks (conventional and high-speed) over the next 10 years.
- Transformation of gauge to 1,435 mm throughout the network, completion of the Mediterranean corridor to Algeciras, and connection with Portugal through a high-quality line.
- Capacity enhancement in access to major cities.

## **CP.2.- In approximately how much investment do you estimate is needed to develop the infrastructure and equipment needs in the Spanish railway network for the next 10 years?**

- Many billions, but our planet and people will appreciate it.
- A reasonable annual investment, taking into account ADIF's own limitations.
- Capable human resources, the complexity of many existing administrative procedures, etc. could be estimated around 3 billion euros.
- A strong commitment should be made to this mode of transport, so with the help of Europe and the development of the TEN network, it could be several billion euros.
- An appropriate allocation of funds with the possibility of implementation would be 3 billion euros annually.
- Tens of millions of euros.
- 80 billion euros.
- 8 billion euros per year.



- 20 billion euros.
- 20 billion euros per year.
- It will depend on the actions to be carried out, but not less than 1.5 billion euros.
- 40 billion euros.
- More than a specific amount, in my opinion, there is no clear idea of the objectives and the lack of coordination is too evident. The focus is on political aspects of the positions held rather than on what needs to be done.
- Probably not less than 15 billion euros in current value as of 2023 (conventional and high-speed) over the next 10 years.
- 100 billion euros.



### 5.3. Evaluation of the railways by the experts

Taking into account the assessment provided by the experts across different Criteria, the overall result of the railway evaluation by the experts is as follows:

VALORACIÓN DE LOS FERROCARRILES POR LOS EXPERTOS				
Pesos del criterio	CRITERIOS	CALIFICACIÓN AICCP		
1	CAPACIDAD	8,2	MUY BIEN	B
1	PRESTACIONES	6,2	SUFICIENTE ALTO	D
1	FINANCIACIÓN	6,0	SUFICIENTE ALTO	D
1	ADAPTACIÓN AL FUTURO Y DESARROLLO SOSTENIBLE	6,6	SUFICIENTE ALTO	D
1	OPERACIÓN Y MANTENIMIENTO	5,8	SUFICIENTE	E
1	SEGURIDAD	7,1	BIEN	C
1	RESILIENCIA	6,8	SUFICIENTE ALTO	D
1	INGENIERÍA E INNOVACIÓN	6,9	SUFICIENTE ALTO	D
<b>VALORACIÓN DE LOS FERROCARRILES POR LOS EXPERTOS</b>		<b>6,7</b>	<b>SUFICIENTE ALTO</b>	<b>D</b>
<b>Respuestas recibidas:</b>		<b>33</b>		

Table 185: Railway Evaluation by Experts



## 6. Overall Assessment by Objective Indicators and Experts

VALORACIÓN DE LOS FERROCARRILES POR LOS EXPERTOS				
Pesos del criterio	CRITERIOS	CALIFICACIÓN AICCP		
1	CAPACIDAD	8,2	MUY BIEN	B
1	PRESTACIONES	6,2	SUFICIENTE ALTO	D
1	FINANCIACIÓN	6,0	SUFICIENTE ALTO	D
1	ADAPTACIÓN AL FUTURO Y DESARROLLO SOSTENIBLE	6,6	SUFICIENTE ALTO	D
1	OPERACIÓN Y MANTENIMIENTO	5,8	SUFICIENTE	E
1	SEGURIDAD	7,1	BIEN	C
1	RESILIENCIA	6,8	SUFICIENTE ALTO	D
1	INGENIERÍA E INNOVACIÓN	6,9	SUFICIENTE ALTO	D
<b>VALORACIÓN DE LOS FERROCARRILES POR LOS EXPERTOS</b>		<b>6,7</b>	<b>SUFICIENTE ALTO</b>	<b>D</b>
<b>Respuestas recibidas:</b>		<b>33</b>		

Table 186: Overall Evaluation by Experts

VALORACIÓN DE LOS FERROCARRILES POR INDICADORES OBJETIVOS				
Pesos del criterio	CRITERIOS	CALIFICACIÓN AICCP		
1	CAPACIDAD	7,6	BIEN	C
1	PRESTACIONES	5,9	SUFICIENTE	E
1	FINANCIACIÓN	3,4	INSUFICIENTE	FX
1	ADAPTACIÓN AL FUTURO Y DESARROLLO SOSTENIBLE	5,8	SUFICIENTE	E
1	OPERACIÓN Y MANTENIMIENTO	3,4	INSUFICIENTE	FX
1	SEGURIDAD	7,9	BIEN	C
1	RESILIENCIA	6,3	SUFICIENTE ALTO	D
1	INGENIERÍA E INNOVACIÓN	5,9	SUFICIENTE	E
<b>VALORACIÓN DE LOS FERROCARRILES POR INDICADORES OBJETIVOS</b>		<b>5,8</b>	<b>SUFICIENTE</b>	<b>E</b>
<b>Indicadores considerados:</b>		<b>67</b>		

Table 187: Overall Evaluation by Objective Indicators



VALORACIÓN GLOBAL DE LOS FERROCARRILES				
Pesos del criterio	CRITERIOS	CALIFICACIÓN AICCP		
1	CAPACIDAD	7,9	BIEN	C
1	PRESTACIONES	6,1	SUFICIENTE ALTO	D
1	FINANCIACIÓN	4,7	INSUFICIENTE	FX
1	ADAPTACIÓN AL FUTURO Y DESARROLLO SOSTENIBLE	6,2	SUFICIENTE ALTO	D
1	OPERACIÓN Y MANTENIMIENTO	4,6	INSUFICIENTE	FX
1	SEGURIDAD	7,5	BIEN	C
1	RESILIENCIA	6,5	SUFICIENTE ALTO	D
1	INGENIERÍA E INNOVACIÓN	6,4	SUFICIENTE ALTO	D
VALORACIÓN GLOBAL DE LOS FERROCARRILES		6,2	SUFICIENTE ALTO	D
Respuestas recibidas: 33		Indicadores considerados: 67		

Table 188: Final Evaluation by Objective Indicators and Experts

Diferencias (Indicadores- expertos)	
CRITERIOS	Diferencia (Max 10)
CAPACIDAD	-0,6
PRESTACIONES	-0,3
FINANCIACIÓN	-2,7
ADAPTACIÓN AL FUTURO Y DESARROLLO SOSTENIBLE	-0,9
OPERACIÓN Y MANTENIMIENTO	-2,4
SEGURIDAD	0,8
RESILIENCIA	-0,4
INGENIERÍA E INNOVACIÓN	-1,0
Diferencias (indicadores-expertos)	-0,9

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- 2. "The Global Competitiveness Report (GCI)." World Economic Forum (WEF)**
- 3. "The Global Adaptation Index (ND-Gain Indicators)." University of Notre Dame (USA)**
- 4. "Transport in the European Union." European Commission.**

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## ANNEXE 3

### Acronyms

ASCE	AMERICAN SOCIETY OF CIVIL ENGINEERS
BTS	BUREAU OF TRANSPORTATION STATISTICS (USA)
DGMT	DIRECTORATE GENERAL FOR MOBILITY AND TRANSPORT (EC)
EC	EUROPEAN COMMISSION
FRA	FEDERAL RAILROAD ADMINISTRATION
ITF	INTERNATIONAL TRANSPORT FORUM
OECD	ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT
EE.UU.	THE UNITED STATES OF AMERICA
USDT	U.S. DEPARTMENT OF TRANSPORTATION
WB	THE WORLD BANK
WEF	WORLD ECONOMIC FORUM
GCI	GLOBAL COMPETITIVENESS INDEX (WEF)
LPI	LOGISTIC PERFORMANCE INDEX (WB)
PCA	PRINCIPAL COMPONENT ANALYSIS
UIC	UNIÓN INTERNACIONAL DE FERROCARRILES



## ANNEXE 4

### Bibliography and references

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- World Economic Forum. *Global Competitiveness Index (GCI)*
- <https://ec.europa.eu/transport/>
- <http://www.worldbank.org/>
- <https://www.weforum.org/>
- <https://www.itf-oecd.org/>
- <http://ec.europa.eu/eurostat/>
- <http://observatoriotransporte.fomento.es>

## ANNEXE 5

### Railway Indicators from Major International Organizations

For the Railways sector, indicators from the following international organizations have been analyzed:

- OECD-International Transport Forum. <https://www.itf-oecd.org/>
- EUROSTAT. [https://ec.europa.eu/info/departments/eurostat-european-statistics\\_es](https://ec.europa.eu/info/departments/eurostat-european-statistics_es)
- World Bank. <https://worldroadstatistics.org/>
- World Economic Forum <https://www.weforum.org/>
- Comisión Europea [https://ec.europa.eu/commission/index\\_es](https://ec.europa.eu/commission/index_es)
- International Energy Agency <https://www.iea.org/>
- Federal Highway Administration (FHWA) from USA <https://www.fhwa.dot.gov/>
- American Society of Civil Engineers. <https://www.fhwa.dot.gov/>

These international organizations, which have been used as references, also possess a supplementary database enabling the development of new quantitative indices. These foundational data, thoughtfully selected, along with information sourced from country-specific databases, have constituted the primary source of information for crafting railway indicators.

Following is detailed information about evaluations, indices, and indicators from the key organizations that assess railways:

- "Report Card for America's Infrastructure" American Society of Civil Engineers (ASCE):
- "The Global Competitiveness Report". World Economic Forum.
- "Transport in the European Union". European Commission.

## 1.- “Report Card for America’s infrastructure.” American Society of Civil Engineers (ASCE)

The "Report Card for America's Infrastructure" by ASCE (American Society of Civil Engineers) is the reference used by the Asociación Caminos for the preparation of this report. The report exclusively focuses on the scope of the United States, without conducting comparative studies with other countries or describing the specific methodology employed. The established indicators are not known, but the report provides generalized results with a rating that allows us to conclude whether the analyzed sectors of public works and services in the U.S. have improved or deteriorated compared to the previous period.

The latest edition of the "Infrastructure Report Card"<sup>17</sup> from 2021, analyzes eight criteria: capacity, physical condition, financing, future needs, operation and maintenance, public safety, resilience, and innovation.



Figure 12: Criteria analyzed in the IRC Report, ASCE 2021

As can be seen in the table below, the assessment system used by Asociación Caminos is similar to the ASCE<sup>18</sup> system.

ESPAÑA	0,0 a 2,9	3,0 a 4,9	5,0 a 5,9	6,0 a 6,9	7,0 a 7,9	8,0 a 8,9	9,0 a 10
	SUSPENSO		APROBADO		NOTABLE		SOBRESALIENTE
ECTS	FAIL	FAIL	SUFFICIENT	SATISFACTORY	GOOD	VERY GOOD	EXCELLENT
	F	FX	E	D	C	B	A
ASOCIACIÓN CAMINOS	MUY INSUFICIENTE	INSUFICIENTE	SUFICIENTE	SUFICIENTE ALTO	BIEN	MUY BIEN	EXCELENTE
	F	FX	E	D	C	B	A
INFORME ASCE	CRITICAL	FAILING	POOR		MEDIOCRE	GOOD	EXCEPTIONAL
	1 (F)	2 (F)	3 (D)		4 (C)	4 (B)	5 (A)
GPA EEUU 1	F		C B-	B	B+		A
GPA EEUU 2	F		D- D	D+ C-	C C+	B- B	B+ A- A

Table 190: Rating system of the sector index used by Asociación Caminos and its equivalence with the system used in this report

The full global report can be found at: [https://infrastructurereportcard.org/wp-content/uploads/2020/12/National\\_IRC\\_2021-report.pdf](https://infrastructurereportcard.org/wp-content/uploads/2020/12/National_IRC_2021-report.pdf)

<sup>17</sup> [National\\_IRC\\_2021-report-2.pdf \(infrastructurereportcard.org\)](https://infrastructurereportcard.org/wp-content/uploads/2020/12/National_IRC_2021-report-2.pdf)

<sup>18</sup> The ASCE system uses letters accompanied by "+" and "-" signs to indicate if it is slightly above or below the assigned letter level. To create an equivalent system, the Report of Asociación Caminos, which quantifies the state of the sector numerically on a scale of 0 to 10, allows for a correspondence with the previously published Infrastructure Report Card (IRC) reports.

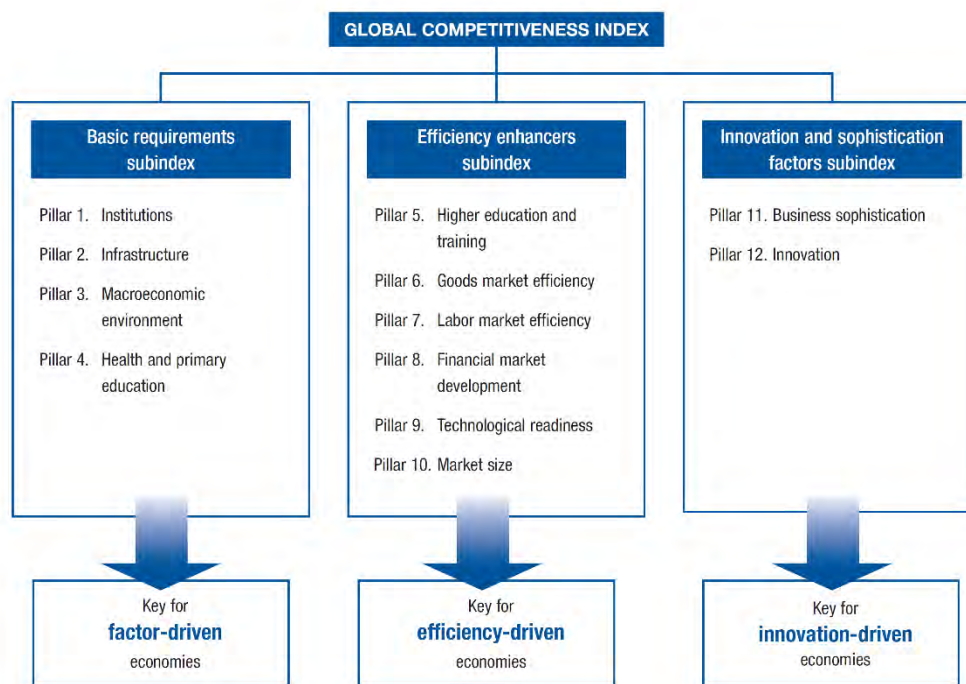
## 2.- “The Global Competitiveness Report”. World Economic Forum

The World Economic Forum (WEF) produces a series of annual economic reports. Among them, the "Global Competitiveness Report (2019)" <sup>19</sup> provides an analysis of countries with data from the year 2019, creating a list of indicators and a main index called the Global Competitiveness Index (GCI).

This global competitiveness index combines 114 components grouped into twelve policy domains or "pillars" that measure, through an indicator, three main categories or "sub-indices." Each category assesses the development of each "pillar" for the 141 participating countries.

The main categories are:

- S1: Basic Requirements
- S2: Enhancers of Efficiency
- S3: Innovation and Complexity Factors



Fuente: World Economic Forum

Figure 13: Outline of the Composition of the GCI Indicator by the WEF

Infrastructure is considered a fundamental requirement for a country's development, and it has sufficient significance to be part of one of the four pillars comprising Subindex 1 - Basic Requirements. The assessment of its indicator is carried out through nine main components based on survey ratings and objective data.

<sup>19</sup> [WEF\\_TheGlobalCompetitivenessReport2019.pdf \(weforum.org\)](#)



The calculation of the Global Competitiveness Index (GCI) is based on successive aggregations of ratings of the disaggregated indicator levels until the overall GCI is obtained. The weighting of the three main categories (subindices) depends on the development level of each country. To determine the weight of each pillar, a percentage weight is assigned to each indicator in advance, and the value of each component of the pillar is obtained from a series of surveys, adjusted with objective data to which a weight is assigned. The maximum rating is 100 and the minimum is 0.

Pillar 2: Infrastructure represents 8.3% of weight in the overall index, with the following weighting:

<b>Pillar 2: Infrastructure</b>	<b>8.3%</b>
<b>A. Transport infrastructure</b>	<b>50%<sup>2</sup></b>
I. Road	25%
2.01 Quality of road network	
2.02 Quality of road infrastructure	
II. Rail	25%
2.03 Railroad density	
2.04 Efficiency of train services	
III. Air	25%
2.05 Airport connectivity	
2.06 Efficiency of air transport services	
IV. Sea	25%
2.07 Liner shipping connectivity <sup>3</sup>	
2.08 Efficiency of seaport services	
<b>B. Utility infrastructure</b>	<b>50%</b>
I. Electricity	50%
2.09 Electricity access	
2.10 Electricity quality	
II. Water	50%
2.11 Exposure to unsafe drinking water	
2.12 Reliability of water supply	

Figure 14: Weighting of the Infrastructure Indicator in the 2019 GCI (Global Competitiveness Index) by the WEF (World Economic Forum)

Railways represent 25% of the total transport infrastructure rating.

Spain's score in the infrastructure pillar is 90.3 out of 100, ranking seventh out of 141 countries worldwide.

Indicator	Score	Change	Rank
<b>2nd pillar: Infrastructure</b> 0–100	-	90.3 ↑	7
<b>Transport infrastructure</b> 0–100	-	83.6 ↑	9
2.01 Road connectivity 0–100 (best)	100.0	100.0 ↑	1
2.02 Quality of road infrastructure 1–7 (best)	5.7	78.4 ↑	11
2.03 Railroad density km/1,000 km <sup>2</sup>	31.1	77.9 ↑	28
2.04 Efficiency of train services 1–7 (best)	5.4	72.9 ↓	9
2.05 Airport connectivity score	813,743.1	100.0 =	8
2.06 Efficiency of air transport services 1–7 (best)	5.6	76.9 ↑	18
2.07 Liner shipping connectivity 0–100 (best)	90.1	90.1 ↑	11
2.08 Efficiency of seaport services 1–7 (best)	5.4	73.0 ↑	16
<b>Utility infrastructure</b> 0–100	-	97.0 ↑	19
2.09 Electricity access % of population	100.0	100.0 =	2
2.10 Electricity supply quality % of output	9.5	94.3 ↓	56
2.11 Exposure to unsafe drinking water % of population	0.4	100.0 =	19
2.12 Reliability of water supply 1–7 (best)	6.6	93.6 ↑	16

Figure 15: Indicadores de infraestructuras del Indicador GCI del WEF (2019)

In railways, a commonly used indicator is railway density. Spain achieves a score of 77.9% and ranks 28th in this indicator.

Spain's overall assessment in the Global Competitiveness Index (GCI) is 75%, positioning it 23rd out of 141 countries.

## Spain 23rd / 141

Global Competitiveness Index 4.0 2019 edition

Rank in 2018 edition: 26th/140

**Performance Overview** Key ◇ Previous edition ▲ High-income group average □ Europe and North America average 2019

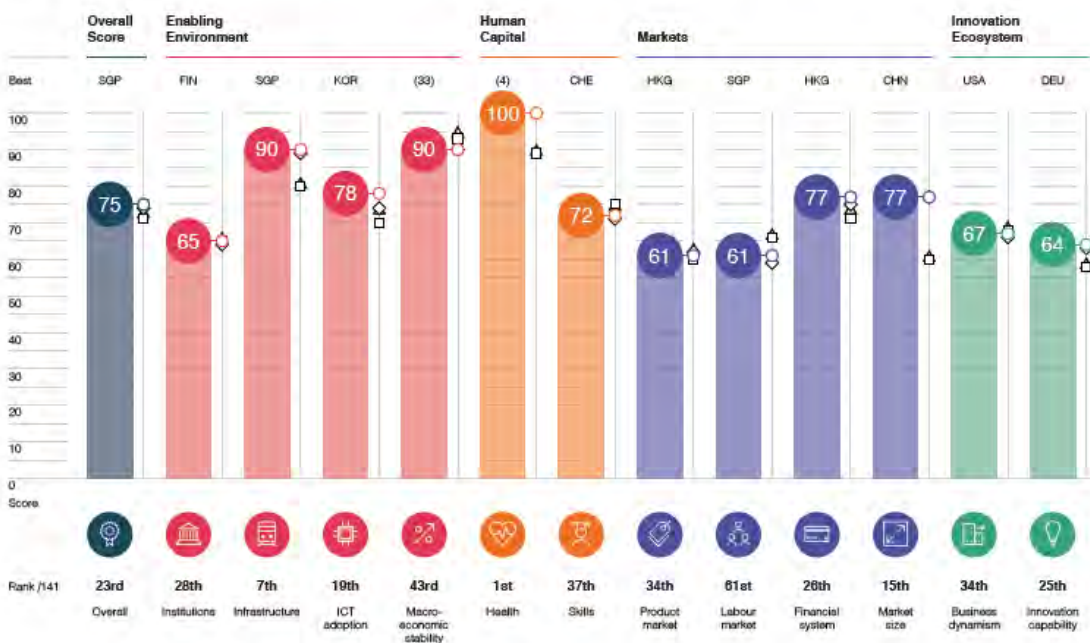


Figure 16: Spain's overall assessment in the GCI indicator of the World Economic Forum (2019)

### 3.- “The Global Adaptation Index (ND-Gain Indicators)” University of Notre Dame (EE.UU.)

The Global Adaptation Index (ND-GAIN)<sup>20</sup> by the University of Notre Dame is an open-source index that assesses a country's **vulnerability**<sup>21</sup> to climate change and its **readiness**<sup>22</sup> to utilize public and private sector investment for implementing adaptation actions to address climate change. The ND-GAIN index comprises over 74 variables, forming 45 basic indicators to measure the vulnerability and readiness of 192 UN member countries from 1995 to the present (due to data availability, ND-GAIN measures vulnerability for 182 countries and readiness for 184 countries).

Government agencies, multilateral organizations, NGOs, and many other entities that study the climate change adaptation measures implemented by countries use this classification and the associated indicators to evaluate countries' efforts in relation to climate change. All countries, to varying degrees, face the challenges of climate change adaptation. Some countries are more vulnerable to climate change impacts due to their geographic location or socioeconomic conditions. Additionally, certain countries are better prepared to take adaptation actions by leveraging public and private sector investments through national government policies, societal awareness, and the capacity of the private sector to engage. ND-GAIN measures both dimensions: vulnerability and readiness.

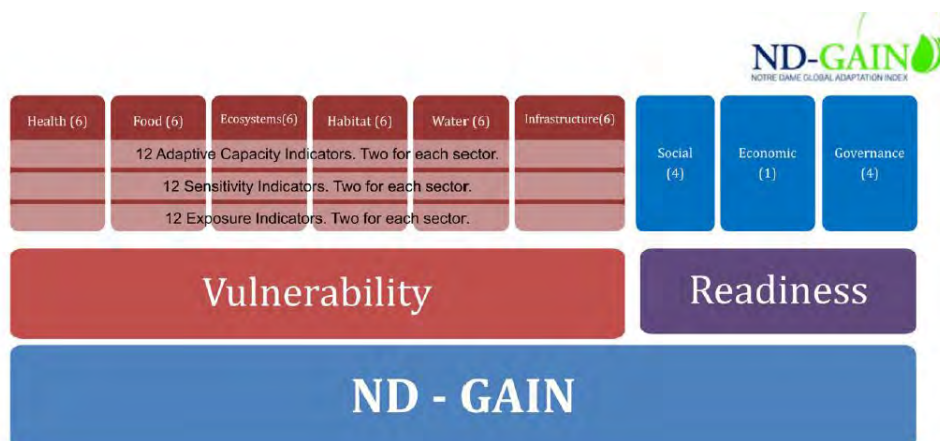


Figure 17: Resumen de los Indicadores de vulnerabilidad y preparación de ND Gain

The vulnerability is composed of 36 indicators grouped into three components (each component has 12 indicators) and six sectors (each sector has 6 indicators). The readiness consists of 9 indicators, grouped into three sectors.

<sup>20</sup> [Rankings // Notre Dame Global Adaptation Initiative // University of Notre Dame \(nd.edu\)](#)

<sup>21</sup> ND-GAIN defines the concept of Vulnerability as: The propensity or predisposition of human societies to be negatively affected by climate threats.

<sup>22</sup> ND-GAIN defines the concept of Readiness as: The willingness to make effective use of investments for adaptation actions due to a secure and efficient business and governmental environment.



The ND-GAIN index can be represented as a scatter plot matrix of readiness versus vulnerability.



Figure 18: Scatter plot: Vulnerability vs. Readiness by ND Gain

For assessment purposes: a higher vulnerability score indicates higher vulnerability ("worse"), a higher readiness score indicates greater readiness ("better"). Thus, vulnerability indicators are measured between 1 (lowest score) and 0 (highest score). Readiness indicators are measured between 1 (highest score) and 0 (lowest score).

The latest published ranking is from the year 2020 and shows the following results:

Rank	Country	Income group	Score
1	Norway	Upper	75.4
2	Finland	Upper	72.0
3	Switzerland	Upper	71.0
4	Sweden	Upper	71.3
5	Denmark	Upper	71.1
6	Singapore	Upper	70.6
7	Austria	Upper	70.1
8	Germany	Upper	69.8
9	Iceland	Upper	69.8
10	New Zealand	Upper	69.7
11	United Kingdom	Upper	69.4
12	Luxembourg	Upper	68.6
13	Australia	Upper	68.5
14	Canada	Upper	67.5
15	Republic of Korea	Upper	67.2
16	France	Upper	66.9
17	Netherlands	Upper	66.6
18	United States	Upper	66.2
19	Japan	Upper	65.5
20	Slovenia	Upper	64.1
21	Ireland	Upper	64.0
22	Estonia	Upper	62.8
23	Belgium	Upper	62.7
24	Czech Republic	Upper	62.6
25	Portugal	Upper	62.2
26	Spain	Upper	61.8

Figure 19: Global ranking of the ND Gain Index for 2020

In the global ND Gain index, Spain ranks 28th with a score of 61.8 (the top country, Norway, has a score of 75.4).

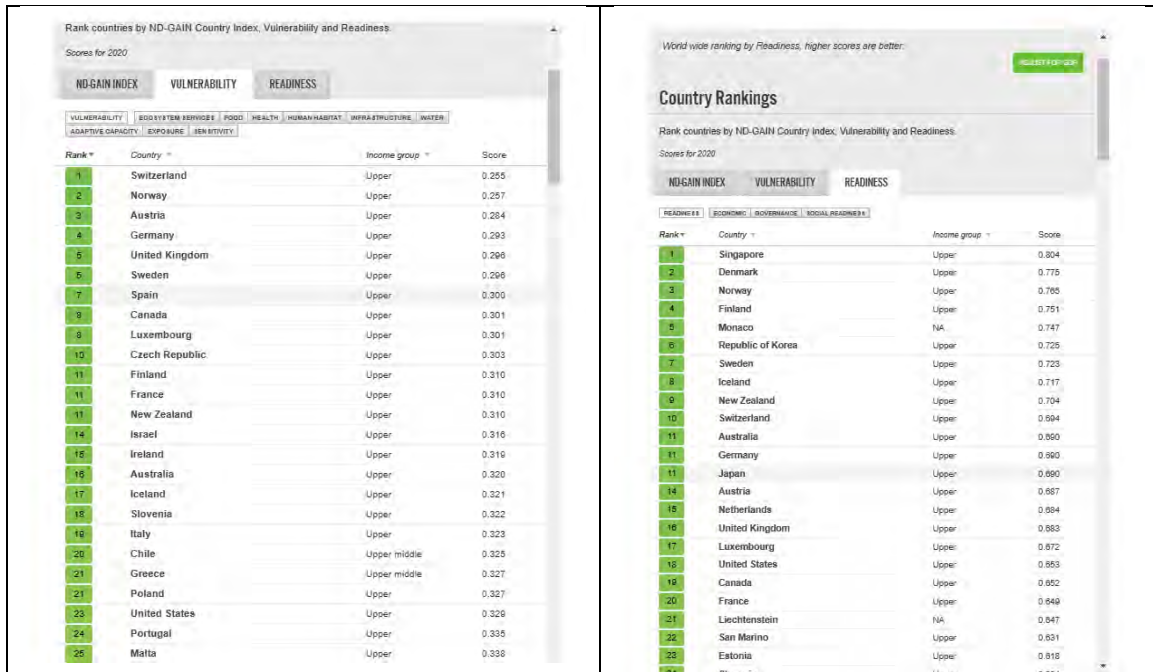


Figure 20: Ranking of Vulnerability and Preparedness in the 2020 ND Gain Index

In vulnerability, Spain ranks 7th with a score of 0.300 (the top country, Switzerland, has a score of 0.255). In preparedness, Spain scores 0.536 (the highest-scoring country is Singapore with 0.804).

The profile of Spain<sup>23</sup> breaks down the results of all the indicators.

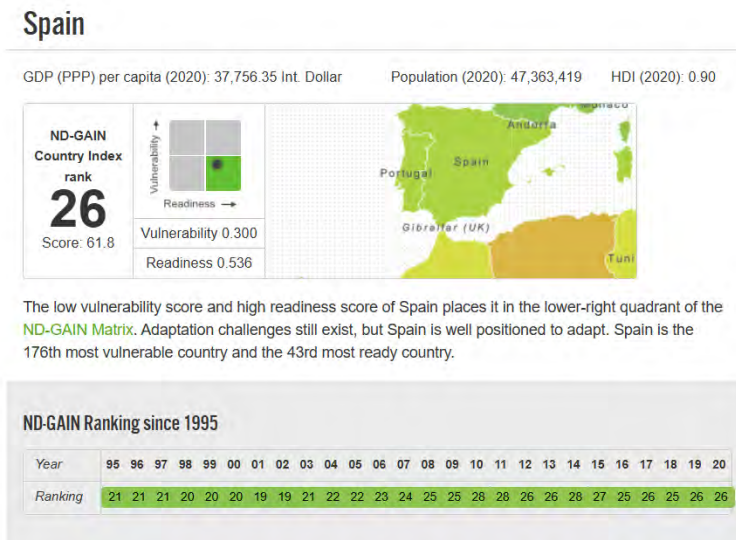


Figure 21: Position of Spain in the scatterplot and annual assessment of ND Gain

<sup>23</sup> [Matrix // Notre Dame Global Adaptation Initiative // University of Notre Dame \(nd.edu\)](https://matrix.nd.edu/)

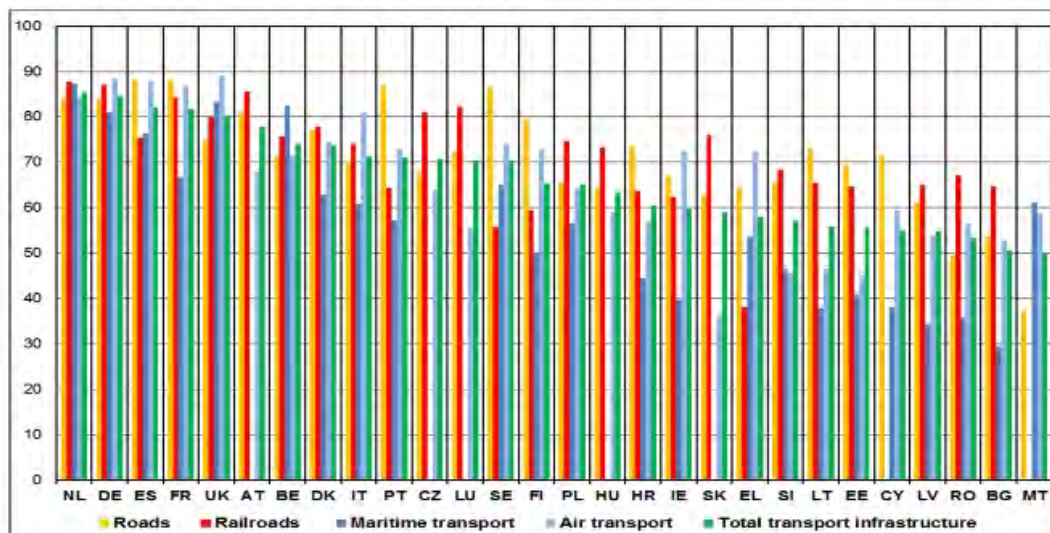
#### 4.- “Transport in the European Union. Current Trends and Issues”. European Commission<sup>24</sup>

In this report, published by the European Commission in March 2019 and led by the Directorate-General for Mobility and Transport, issues of mobility in the EU and the implications of transportation on climate change are addressed.

It contains information from all European Union countries on various transportation-related matters.

Of particular relevance is the classification of EU countries in relation to the satisfaction of their citizens regarding the quality of major infrastructures: Roads, Railways, Maritime Transport, and Air Transport. It also provides an overall assessment of the infrastructure across EU countries.

Figure 5: Satisfaction with infrastructure quality (2018)



Source: World Economic Forum, The Global Competitiveness Report database 2018. Scale from 1 to 100 [best]. The countries were ranked on their overall performance on transport infrastructure. Note that after a change in methodology, the 2018 edition of the Global Competitiveness Report is of limited comparability to previous editions.

Figure 22: Satisfaction with the quality of the infrastructure, European Commission. 2019

Below is the information on transportation in Spain along with indicators and a summary of the World Bank, World Economic Forum, and other OECD indices.

<sup>24</sup> <https://ec.europa.eu/transport/sites/transport/files/2018-transport-in-the-eu-current-trends-and-issues.pdf>

## ANNEXE 6

### **Indicators from the main Spanish organizations for Railways**

In Spain, there are several key organizations that provide data on railways:

- Ministry of Transport, Mobility, and Urban Agenda:
  - Observatory of Transport and Logistics of Spain  
[http://observatoriotransporte.fomento.es/OTLE/LANG\\_CASTELLANO/](http://observatoriotransporte.fomento.es/OTLE/LANG_CASTELLANO/)
  - Railway Observatory of Spain  
[https://cdn.mitma.gob.es/portal-web-drupal/ferroviario/observatorio/ofe\\_2020.pdf](https://cdn.mitma.gob.es/portal-web-drupal/ferroviario/observatorio/ofe_2020.pdf)
  - Statistical Yearbook  
<https://www.fomento.gob.es/informacion-para-el-ciudadano/informacion-estadistica/anuario-estadisticas-de-sintesis-y-boletin/anuario-estadistico>
- Ministry for Ecological Transition and Demographic Challenge:
  - Public Bank of Environmental Indicators
  - Guide for the Elaboration of Studies on the Physical Environment: Content and Methodology

To complete the information, you can refer to the international transport comparison published by the Ministry of Transport, Mobility, and Urban Agenda (MITMA): [Anuario estadístico 2019 - Capítulo 19. Comparación internacional de los transportes \(mitma.gob.es\)](#)