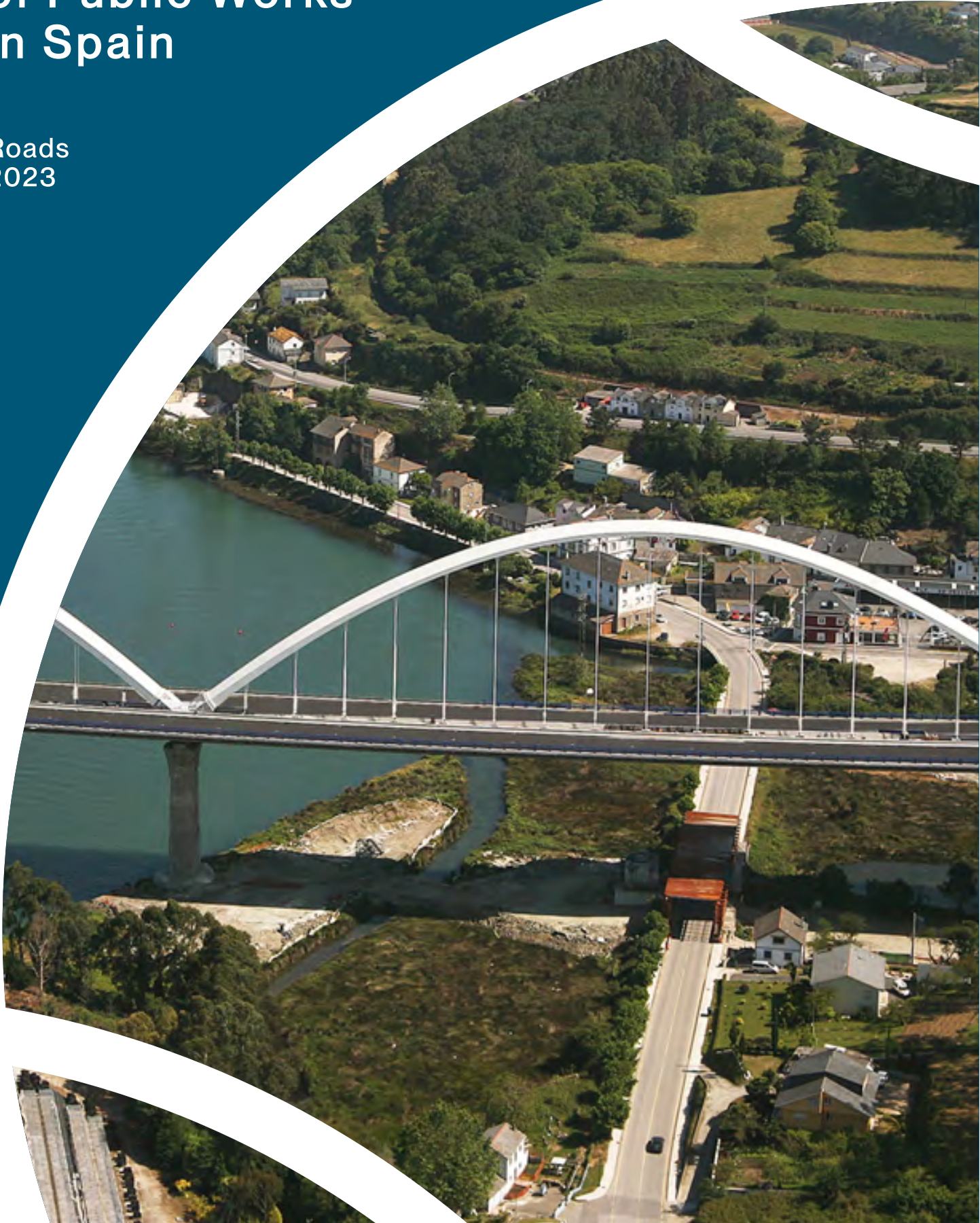


Evaluation of Public Works in Spain

Roads
2023



• The road network in Spain



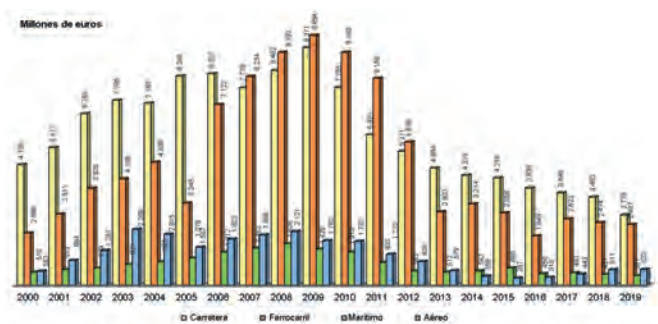
Of the national road network, 2,997 km are toll highways, 12,725 km are highways and 1,665 multilane roads.

For the purposes of this report, toll highways and highways, which measure 15,722 km, are considered high-capacity roads; Out of these, 11,547 km belong to the State Highway Network. The entire interurban road network of Spain (the entire national road network and interurban municipal roads) has an approximate length of 524,000 km.

In recent years, due to the economic crisis that began in 2008, budget allocations assigned to the creation and maintenance of roads significantly decreased (as it has also happened in other transport infrastructures).

The national road network of Spain in 2019 had a length of 165,470 km. It is classified into three networks depending on their ownership:

- **State Highway Network:** roads owned by the State and managed by the General Directorate of Highways of the Ministry of Transport, Mobility and Urban Agenda. It includes itineraries of general interest and which are developed by more than one Autonomous Community. The total length is 26,466km. This network channels more than 50% of total intercity traffic and more than 60% of heavy traffic.
- **Autonomous Network:** roads whose function in the transportation system affects a single Community and whose administrative management depends on the Autonomous Communities. It is made up of approximately 71,210 km.
- **Network of Provincial Councils and Councils:** provincial roads whose ownership and administrative management corresponds to the Provincial Councils and Island Councils. The length is 67,793 km.

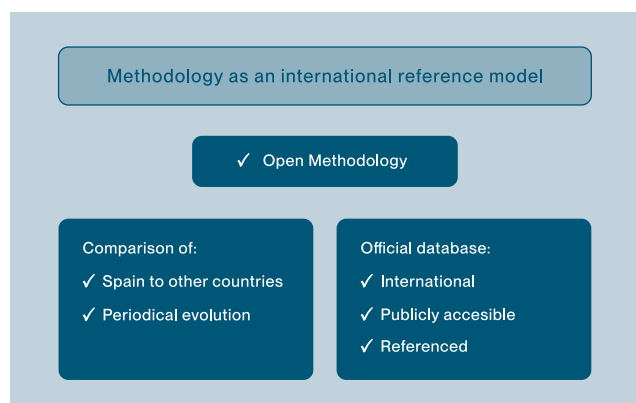


Fuente: Direcciones Generales y Organismos del Ministerio de Transportes, Movilidad y Agenda Urbana, RENFE Operadora, ADIF, FEVE, Diputaciones Provinciales, Cabildos Insulares y Comunidades Autónomas.

Investment made in infrastructure of different modes of transport (Transport and infrastructure 2019. (MITMA))

Road indicators and evaluation by experts

The study, altogether, analyzes the state of six public works sectors in Spain: Roads, Railways, Ports, Airports, Water Cycle and Urban and Metropolitan Public Transport. The methodology designed by the Asociación Caminos contains objective research, which analyzes quantitative indicators in different countries with the same economic and social environment. As well, it carries out as a qualitative evaluation, based on the opinions of a selected group of experts.



The **quantitative evaluation** is developed by carrying out a comparative study with other countries, taking into consideration the most representative indicators of the sector and obtained from publicly accessible databases which are available in important multilateral organizations (EUROSTAT, OECD, World Bank, UN, World Economic Forum, International Transport Forum, International Road Federation, World Road Association, etc.).

The countries selected in order to make an international comparison to Spain's roads are: Germany, France, the United Kingdom, Italy, Poland, Ireland, Portugal, Turkey, USA and Mexico, Japan and South Korea.

The **qualitative evaluation** refers exclusively to Spain and is based on the responses obtained from a survey questionnaire conducted and

sent to a selected group of sector experts. The responses obtained have been processed anonymously and on a confidential basis.

To facilitate the assessment, the analysis has been grouped into eight groups of common characteristics for all sectors, called "Criteria": Capacity; Performance; Financing; Adaptability to the future and sustainability; Operation and maintenance; Safety; Resilience and Engineering and Innovation.



Evaluation of the Roads (6.3)

Indicators: **Sufficient High**
Experts: **Sufficient High**

Comparative analysis of Spanish roads in an international context

	Rating	
Spain	6.4	D
Germany	7.8	C
France	7.1	C
United Kingdom	5.9	E
Italy	5.4	E
Poland	4.8	FX
Ireland	5.7	E
Turkey	3.3	FX
Portugal	5.9	E
USA	6.9	D
Mexico	3.5	FX
Japan	7.4	C
South Korea	6.6	D

The best rated country on a global level is Germany (7.8), followed by Japan (7.4), France (7.1), USA (6.9), South Korea (6.6) and Spain (6.4).

Spain is well positioned in relation to the rest of countries analyzed, standing out in the Capacity, Performance and Safety Criteria.

In Capacity, Spain achieves the highest rating, closely followed by Germany and France; In Performance it is among the first positions, along with Germany and the USA; In Safety it is also in the first positions along with the United Kingdom, Ireland, France and Germany.

However, Spain has an Insufficient Financing rating (it occupies the worst position along with Mexico, Poland and Italy). In the Innovation criterion, Spain is in an intermediate situation (5.1), due to the low financing of innovation.

Evaluation of Roads with indicators (Max 10)		
CRITERIA	RATING	
CAPACITY	8.7	B
PERFORMANCE	8.2	B
FINANCING	3.4	FX
ADAPTABILITY TO THE FUTURE AND SUSTAINABILITY	4.7	FX
OPERATION AND MAINTENANCE	5.2	E
SAFETY	8.2	C
RESILIENCE	8.0	C
ENGINEERING AND INNOVATION	5.1	E
Evaluation by Objective Indicators	6.4	D
Considered Indicators: 75		

Evaluation of Roads by experts (Max 10)		
CRITERIA	RATING	
CAPACITY	7.6	C
PERFORMANCE	6.8	D
FINANCING	4.9	FX
ADAPTABILITY TO THE FUTURE AND SUSTAINABILITY	5.3	E
OPERATION AND MAINTENANCE	5.9	E
SAFETY	6.3	D
RESILIENCE	6.1	D
ENGINEERING AND INNOVATION	6.1	D
Evaluation by Experts	6.1	D
Received responses: 29		

Key results of the report

- The high-capacity road network is one of the best and most extensive in the world, although some specific sections require improvement (for example in large urban areas, improvements in the connection of intermodal nodes and between some itineraries must be made, and in access to some ports).
- Specific itineraries and certain sections of the conventional road network require adaptations and improvements.
- It is necessary to develop a good road planning in the medium and long term which take into account mobility and future demands.
- Roads require significant financing to recover from the effects of the lack of investment in recent years. Experts estimate that the necessary investment for the coming years in all road networks altogether should be between 1% and 2% of the asset value, which is greater than 0.6% of GDP (€7.5 billion/year).
- Experts consider that it is necessary to implement service and rest areas in the high-capacity road network.
- Conventional roads require improvements in their performance and equipment.
- Most experts consider appropriate to implement a fee for the use of high-capacity roads, although it can increase traffic on the conventional road network and, with it, accidents rate.
- More emphasis should be placed on environmental preservation and non-polluting vehicles.
- It is necessary to update legislation in areas related to sustainability and the use of new technologies.
- Cost-benefit analysis must be carried out in order to study the economic viability of future investments in roads.
- It is necessary to deploy the necessary infrastructure which allows the use of new technologies and alternative vehicles instead of internal combustion vehicles.
- The absence of the investment required in conservation, maintenance and major replacement, as well as the lack of investment stability, has translated in recent years into a serious deterioration of road assets.
- The measures adopted on the roads to prevent accidents and reduce the effects of accidents are very good.
- In order to reach the accident reduction objectives, more work must be done. It is a topic that is influenced by other factors as well, not just the infrastructure part
- To facilitate R&D&i on roads, the introduction of innovative public purchasing criteria in public procurement is essential.
- The high level of Spanish road engineering has been created by engineering companies. The Administration has not achieved the required level in terms of bidding systems or project management.
- In recent years, there has been a commitment by road administrations to the BIM methodology in the field of roads.

Final evaluation of Roads (Max 10)		
CRITERIA	RATING	
CAPACITY	8.1	B
PERFORMANCE	7.5	C
FINANCING	4.1	FX
ADAPTABILITY TO THE FUTURE AND SUSTAINABILITY	5.0	E
OPERATION AND MAINTENANCE	5.6	E
SAFETY	7.2	C
RESILIENCE	7.1	C
ENGINEERING AND INNOVATION	5.6	E
Final Weighted Evaluation	6.3	D

• Capacity (8.1)

Does the provision and capacity of the public works sector meet the current demands?

▪ Evaluation by Indicators

km roads / 1000 inhabitants
km interurban roads / 1000 inhabitants
km high capacity roads / 1000 inhabitants
km roads / country area (km2)
km interurban roads / country area (km2)
km high capacity roads / surface area of the country (km2)
equivalent km of high-capacity roads / surface area of the country (km2)
high capacity roads / population density

Rating		
Spain	8.7	B
Germany	8.0	B
France	8.6	B
United Kingdom	4.8	FX
Italy	5.5	E
Poland	5.3	E
Ireland	6.0	D
Turkey	2.0	F
Portugal	6.0	D
USA	7.2	C
Mexico	3.4	FX
Japan	4.9	FX
South Korea	6.0	D

In the indicators related to road capacity, Spain stands out in the roads provision per inhabitant, especially in km of high-capacity roads per 1,000 inhabitants (0.37), closely followed by the USA (0.33) and Portugal (0.30). Analyzing the indicators together, it can be deduced that, in terms of capacity and equipment, Spanish roads are in a very good position, especially the

large capacity network.

Experts rate Spanish roads with a 7.6.

Lower rating than the one obtained by the indicators (8.7).

▪ Evaluation by experts and comments

1.1. How do you rate the high-capacity road network from the point of view of capacity and territory coverage?	8.2	B
1.2. How do you value the infrastructure of conventional roads from the point of view of capacity and territory coverage?	8.1	B
1.3. How do you assess the capacity of roads to absorb the current demand?	7.5	C
1.4. How do you assess the capacity of current roads to absorb the foreseeable future demand in the next 10 years?	6.6	D
Capacity Evaluation by experts	7.6	C

- The Spanish high-capacity road network is one of the best and most extensive in the world, although there are specific sections that require improvements (for example

in large urban areas, also improvements must be carried out in connecting intermodal nodes and between some itineraries, and in accessing to some ports).

- Some sections of the conventional road network also require adaptations and improvements.

It is necessary to develop a good road planning in the medium and long term which takes into account mobility and future demands.

Some experts recommend transforming conventional roads with a higher accident rate and greater capacity problems into 2+1 roads, with a physical separation between directions of traffic. They also suggest promoting collective transportation with park-and-ride parking on the outskirts of cities and the construction of reserved bus platforms or lanes (publicly or privately managed).

There should be a consistent and realistic road policy in all administrations agreed for a long-term basis by all political forces.

• Performance (7.5)

Are the current provision and physical conditions of the public works sector adequate to meet current user expectations?

▪ Evaluation by Indicators

Total vehicle fleet / 1,000 inhabitants
Total vehicle fleet/km of roads
Total vehicle fleet / km of high-capacity roads
Total vehicle fleet / km of interurban roads
km of high-capacity roads / km of interurban roads
Internal road passenger traffic (10 ⁶ Travelers-km) / km interurban roads
Internal road freight traffic (10 ⁶ tn-km) / km Interurban roads
Route Factor (Road distance / direct distance)
Annual hours of road congestion
Highway connectivity. GCI Score (WEF)
Quality of road infrastructure. GCI Score (WEF)

Rating		
Spain	8.2	B
Germany	7.0	C
France	8.0	B
United Kingdom	4.1	FX
Italy	5.0	E
Poland	6.2	D
Ireland	6.8	D
Turkey	4.0	FX
Portugal	7.3	C
USA	8.1	B
Mexico	5.3	E
Japan	4.1	FX
South Korea	5.4	E

Regarding Performance, the best rating is for Spain, the US and France. The case of Japan is very significant, as it obtains a low rating for the "Vehicle fleet/km of roads" ratio. High-capacity roads", probably because high-capacity roads in urban and peri-urban areas have not been contemplated. In Spain, due to its rugged terrain and high average altitude (over 660 m) since 18% of the territory is above 1,000 m, the "Route Factor" (Distance by road

between the most important cities/Distance in a straight line between the same cities) reaches a value of 1.249, higher than all the European countries analyzed (except Turkey (1.4)). Experts rate the performance of Spain's roads more strictly (6.8) than the rate obtained with the quantitative indicators (8.2).

▪ Evaluation by experts and comments

2.1. How do you value the performance that roads provide to users?	7.7	C
2.2. How do you value the equipment and services provided in the high-capacity network?	7.2	C
2.3. How do you value the equipment and services provided on the conventional road network?	6.6	D
2.4. How do you value traffic management and information to road users?	6.1	D
2.5. How do you consider the coverage of the territory of the road network?	7.7	C
2.6. How do you value information to the user in incidents that occur on the road network?	5.7	E
Performance Evaluation by experts	6.8	D

- Experts consider that it is necessary to extend the implementation of service and rest areas in the high-capacity road network.

- The network equipment and the services provided have a wide range for improvement. Conventional roads require improvements in their performance and equipment.

- Road-vehicle interaction must be improved, providing quality information in real time.

- It is advisable to better manage heavy traffic in certain sections and periods where congestion problems occur.

• Financing (4.1)

Indicators: **Insufficient**
Experts: **Insufficient**

Which amount of investment is allocated to financing the public works sector? Which amount is applied to the creation of infrastructure? And what about for operations and maintenance?

• Evaluation by Indicators

% Investment in roads / national GDP		
Investment in roads / inhabitants (current €)		
Investment in roads / km of roads (current €)		
Investment in roads/vehicle fleet (current €)		
Road investment / Country Surface (km ²) (current €)		
Investment in roads / km high capacity roads		
Road investment / Internal road passenger traffic (Mill. Passengers-km)		
Road investment / Internal road freight traffic (Mill. tn-km)		
Investment in roads / Total investment in land transportation infrastructure		

Rating		
Spain	3.4	FX
Germany	6.6	D
France	5.4	E
United Kingdom	5.0	E
Italy	3.2	FX
Poland	3.0	FX
Ireland	5.1	E
Turkey	5.4	E
Portugal		
USA	6.4	D
Mexico	2.7	F
Japan	10.0	A
South Korea	10.0	A

A high percentage of investment in roads is made in relation to GDP (greater than 0.8%) indicates that the network is in the process of creation (Poland, Japan and South Korea), or that the network is being renewed (as in the case of Japan). If this percentage falls below 0.4, it indicates that no new infrastructure is being created; Also, if this percentage drops from 0.3%, the investment does not adequately cover the conservation, maintenance and management needs.

• Evaluation by experts and comments

3.1. How do you value the current investment by all public administrations in the creation and conservation of roads?	4.4	FX
3.2. How do you assess the consistency and stability of the current sources of financing for the roads by all public administrations?	4.5	FX
3.3. How do you think investment in roads are being managed by all public administrations?	5.3	E
3.4. How do you consider the current participation of private investment in the design, construction and/or operation of roads in Spain?	5.2	E
Financing Evaluation by experts	4.9	FX

long-term political agreement to stabilize investments.

- Some experts consider it appropriate to implement a fee for the use of high-capacity roads, although it may increase traffic on the conventional road network and, as a result, increase the accident rates.
- It is considered essential to adequately maintain the roads in order to avoid the loss of their heritage value.

Roads require that the amount of financing is significantly increased in order to recover from the effects of the lack of investment the recent years. Experts estimate that the investment which is necessary for the coming years should be between 1% and 2% of the asset value, which is higher than 0.6% of the GDP (€7.5 billion/year) in all of the road networks. They also consider it is essential to reach a great

• Adaptability to the future and sustainability (5.0)

Indicators: **Insufficient**
Experts: **Sufficient**

Is the capacity and performance of the public works sector prepared to meet the future expectations and demands? Are the resources and investment adequate to cover the future needs of the sector? How are actions which provide environmental sustainability being applied? Are active measures being applied to meet the objectives established to decarbonize public works and transportation?

• Evaluation by Indicators

Accumulated interannual growth index. Investment in roads / motorization rate (Ind. of 100 in 2015)		
Accumulated interannual growth index. Investment in roads / GDP		
Accumulated interannual growth index. Investment in roads / Internal road passenger traffic		
Accumulated interannual growth index. Road investment / Internal road freight traffic		
Accumulated interannual growth index. Investment in roads / Population		
Index of growth in greenhouse gas emissions from transportation (t CO ₂ equivalents)		
% electric and plug-in hybrid vehicles/light vehicles registered		
% of CO ₂ emission generated by road transport of total transport		
CO ₂ emissions from registered light vehicles (g/km)		
Electric vehicle charging points / million inhabitants		
% of the population in urban areas exposed to high noise levels		
% of renewable energy over the total energy consumed in transportation		
Development of Transportation-related Climate Change Mitigation Technologies (OECD)		

Rating		
Spain	4.7	FX
Germany	8.3	B
France	7.2	C
United Kingdom	8.0	B
Italy	5.7	E
Poland	4.9	FX
Ireland	7.0	C
Turkey	3.7	FX
Portugal	5.4	E
USA	7.3	C
Mexico	3.3	FX
Japan	8.0	B
South Korea	5.1	E

Spain obtains very low ratings in the indicators analyzed (in all cases well below the average), which indicates a deficit in Investment made in recent years and a deterioration in the conservation and maintenance of the road network.

In relation to environmental sustainability, greenhouse gasses emission growth rate has been analyzed in the transport activity,

taking the value 100 in 2015 as a reference. The result achieved indicates that in 2010 the country with the highest index was Spain (109.3); From 2015 to 2019, Spain has grown a 9.3%, higher than all the countries analyzed.

• Evaluation by experts and comments

4.1. How do you assess road plans to adapt to future user demands?	4.9	FX
4.2. How do you assess the adaptation of roads to the new traffic management systems?	4.9	FX
4.3. Do you consider that road regulations and legislation allow the environment to be adequately protected?	6.8	D
4.4. How do you assess the actions that are being taken to reduce CO ₂ emissions and other greenhouse gases in the construction, conservation and maintenance processes of roads?	5.9	E
4.5. How do you assess the adaptation of the services provided in the highway corridor to alternative vehicles instead of internal combustion vehicles?	4.2	FX
4.6. How do you assess the programs to adapt road infrastructure to new technologies, such as automated driving and the interaction between vehicles and the road?	4.4	FX
4.7. Do you consider adequate the measures adopted to reduce the environmental impact and the treatment of waste in the construction and maintenance of roads?	5.9	E
Adaptability to the future Evaluation by experts	5.3	E

There is an environmental impact assessment legislation that ensures the minimization of impacts to the environment. However, there is still much to be done in other areas, such as the sector decarbonization.

Cost-benefit analysis must be carried out to study the economic viability of future investments in roads.

It is necessary to deploy the infrastructure that allows the use of alternative vehicles instead of internal combustion vehicles to decarbonize the sector.

• Operation and maintenance (5.6)

Is public works being operated and maintained in accordance with your needs? Is the necessary investment being made to ensure adequate conservation and maintenance?

• Evaluation by Indicators

Investment in O&M / national GDP
Investment in O&M/inhabitants
Investment in O&M/equivalent km of roads
Investment in O&M/Total investment in roads
Investment in O&M/Inland road freight traffic (€/ million passengers-km)
Investment in O&M/Inland road freight traffic (€/ million tn-km)

Rating		
Spain	5.2	E
Germany		
France	4.0	FX
United Kingdom	4.3	FX
Italy		
Poland	2.6	F
Ireland	2.3	F
Turkey	1.6	F
Portugal		
USA	7.9	C
Mexico	4.6	FX
Japan	10.0	A
South Korea	7.1	C

Investment in operation and maintenance is very difficult to separate from investment in infrastructure creation. The most significant for the evaluation is the percentage of the investment in operation and maintenance of the equity value, but it is not possible to get this value; For this reason, investment in operation and maintenance has been used in

relation to GDP. This ratio stands at an average of 0.14%, with a maximum of 0.47% in Japan and a minimum of 0.02% in Ireland and Türkiye. Spain has a percentage of GDP of 0.15%, lower than most of the European countries analyzed.

• Evaluation by experts and comments

5.1. How do you value the investment in conservation and maintenance of the roads?	4.4	FX
5.2. How do you consider the technical and organizational means applied to the operation, maintenance and maintenance of roads?	6.6	D
5.3. How do you assess the state of conservation and maintenance of the roads?	5.2	E
5.4. How do you rate the attention to winter traffic, accidents and incidents that occur on the roads?	7.5	C
Operation and maintenance Evaluation by experts	5.9	E

- The absence of the investment required in conservation, maintenance and major replacement, as well as the lack of stability of investments, has translated in recent years into a serious deterioration of the road heritage.
- Ordinary conservation is well managed and dimensioned, but there is a need to improve management and resources allocated to conservation extraordinary conservation.
- An extraordinary and urgent investment plan is necessary to improve the conservation, maintenance and rehabilitation of roads.
- The conventional network dependent on the Autonomous Communities should be the subject of rehabilitation and conditioning at very short term.

• Safety (7.2)

Is the public works sector safe for users? Are effective measures implemented to ensure safe performance and operation?

• Evaluation by Indicators

Accidents with victims / 100,000 inhabitants
Accidents with victims / km of roads
Fatalities / km of road
Fatal victims /100,000 inhabitants
Fatality rate (Number of deaths / Number of victims)
Number of victims / Internal road passenger traffic (Mill passengers-km)
Fatalities / Internal road passenger traffic (Mill passengers-km)

Rating		
Spain	8.2	B
Germany	7.6	C
France	8.1	B
United Kingdom	8.7	B
Italy	6.8	D
Poland	6.5	D
Ireland	9.2	A
Turkey	4.2	FX
Portugal	7.1	C
USA	5.9	E
Mexico		
Japan	6.3	D
South Korea	2.0	F

The average number of accidents with Victims is 313 per 100,000 inhabitants; France and Poland stand out with minimum rates (around 80); Germany, Japan, Portugal, the USA and South Korea have very high rates (over 300) and in the case of the USA it exceeds 500.

The fatalities per 100,000 inhabitants are very high in the USA (11) and South Korea (13) and moderate in the rest of the countries (around 4 in most European countries). The best-rated countries are Ireland, the United Kingdom, Spain and France. Turkey and South Korea are the least valued and with lower rates.

• Evaluation by experts and comments

6.1. How do you assess the measures currently adopted to prevent road accidents?	6.6	D
6.2. How do you assess road equipment to prevent or reduce the effects of accidents on the high-capacity network?	7.1	C
6.3. How do you value road equipment to prevent or reduce the effects of accidents on the conventional network?	5.5	E
6.4. How do you consider the measures that are being taken to reduce road accidents in the future?	5.9	E
Safety Evaluation by experts	6.3	D

- Continuous improvement of road safety should be considered a top priority, particularly on conventional roads.
- Spain has good accident data compared to other neighboring countries.
- The measures adopted on roads to prevent accidents and reduce the effects of accidents are good, although work must continue to be done for reducing accidents. It is also necessary to address the set of causes that produce accidents, which are influenced by many factors, not just infrastructure.

• Resilience (7.1)

Indicators: **Very Good**
Experts: **Sufficient High**

When threats and adverse incidents occur, which is the capacity of public works to prevent, protect and minimize the consequences for users, the environment, the economy and national security? Is the public work sector prepared to recover its initial state within a reasonable time when the threat or adverse incident has ceased? Are there alternatives to attend to the service you provide?

• Evaluation by Indicators

Rail density / Highway density
km of roads / Country area (km2)
km secondary roads / km main roads
km of high-capacity roads / Country area (km2)
Transportation infrastructure, GCI Score (WEF)

	Rating	
Spain	8.0	B
Germany	9.3	A
France	7.7	C
United Kingdom	5.8	E
Italy	6.8	D
Poland	6.0	D
Ireland	3.9	FX
Turkey	2.8	F
Portugal	4.9	FX
USA	4.4	FX
Mexico	2.8	F
Japan	6.5	D
South Korea	6.9	D

To respond appropriately with indicators to the questions formulated, data should be available regarding the characteristics of road design techniques and boundary conditions. Since it has not been possible to obtain all this data, it has been decided to take into consideration the alternative transport to roads, both through the Railway system and the existence of

alternative roads. For this reason, the chosen indicators refer to the density of the railway in relation to the density of the roads and the kilometers of roads in relation to the surface of the country.

• Evaluation by experts and comments

7.1. How do you assess the ability of roads to recover, in a reasonable time, the initial state of service when adverse situations occur?	6.6	D
7.2. Do you consider that the regulations and legislation allow to adopt measures to prevent road infrastructure from natural or provoked incidents?	6.4	D
7.3. How do you assess the capacity of roads to protect and minimize the effects on users and the environment in risk situations?	6.1	D
7.4. How do you assess alternatives to roads when road closures occur due to natural or induced causes?	5.6	E
7.5. How do you assess the contingency plans that are applied on roads to prevent infrastructure from natural or provoked incidents?	5.9	E
Resilience Evaluation by experts	6.1	D

- It is necessary to have resilient contingency plans against catastrophes caused by natural causes, terrorist attacks, cyberattacks and bioterrorism.
- The study and implementation of measures to enhance the interconnection between transport modes should be considered a top priority.

• Engineering and Innovation (5.6)

Indicators: **Sufficient**
Experts: **Good**

Are the resources allocated to engineering in the design, construction, conservation, management and operation of the public works sector considered adequate? Is investment in innovation appropriate? What new techniques, materials, technologies and operating methods are being implemented to improve public works? Is progress being made in digitalization, monitoring and sensorization during the complete cycle of public works? Is the information adequate for users?

• Evaluation by Indicators

% of GDP allocated to Gross Domestic Expenditure on R&D (OECD R&D)
Gross domestic expenditure on R&D (\$) / Population (OECD R&D)
% of GDP allocated to spending on basic research (OECD R&D)
Total number of R&D personnel per 1,000 employees (OECD R&D)
% of GDP of private financing allocated to R&D (OECD R&D)
% of GDP of public financing allocated to R&D (OECD R&D)
Digitization. Digitization. Participation in new technologies. (WEF)
Digitization. ICT Infrastructure Index. (ND Index)
Digitization. Number of people who use the internet
Resident patent applications (per million inhabitants)
Engineering. Regulatory transparency. (OECD)
Engineering. Barriers to competition. (OECD)
Engineering. Restrictions on movement. (OECD)
Engineering. Restrictions on the entry of engineers from abroad
Innovation index. ND Gain Index
Number of patents related to road transport/Million inhabitants

	Rating	
Spain	5.1	E
Germany	7.6	C
France	7.6	C
United Kingdom	6.7	D
Italy	4.6	FX
Poland	4.3	FX
Ireland	5.2	E
Turkey	2.8	F
Portugal	4.6	FX
USA	8.4	B
Mexico	2.5	F
Japan	9.1	A
South Korea	10.0	A

To analyze engineering and innovation on the roads it has been decided to consider the state of R&D&I in the different countries, assuming this data to analyze the condition of the roads. They have selected the database and indicators contained in the report: Main Science and Technology Indicators, Volume 2021, published in 2022 by the OECD. The most technologically advanced countries in the world invest the

highest percentage of their GDP in R&D are South Korea (4.63%), USA (3.18%), Japan (3.21%), Germany (3.17%)

• Evaluation by experts and comments

8.1. Do you consider that the investment in design, construction and conservation engineering is adequate?	5.0	E
8.2. How do you assess the knowledge and technical attitude of road engineers?	7.9	C
8.3. Do you consider the knowledge imparted in universities to engineers to be suitable and aligned with new technologies?	5.7	E
8.4. How do you value the use of new techniques and materials in the construction, conservation and maintenance of roads?	6.8	D
8.5. How do you assess the measures adopted in the tender to favor the innovation?	5.2	E
8.6. How do you value the research, development and innovation that is being developed in Spain in relation to roads?	6.0	D
8.7. How do you value the current technology that is being applied on the roads?	6.5	D
8.8. How do you consider the progress in digitalization and monitoring of the behavior of road elements?	6.1	D
Evaluation of engineering and innovation by experts	7.6	C

- To facilitate R&D&I on roads, the introduction of innovative public purchasing criteria in public procurement is essential.
- Road infrastructure requires detailed analysis to deploy rapid supply systems for alternative vehicles instead of internal combustion vehicles and, in the medium term, allow autonomous driving vehicles.
- It is necessary to analyze the adaptation of road infrastructure to new technologies, such as continuous monitoring of infrastructure and its equipment and automated driving.
- The use of new materials must be allowed and construction procedures must be more flexible. As well as applying BIM technology.
- The high level of Spanish road engineering has been generated by engineering companies. The Administration has not been achieved the required level in terms of bidding systems or project management.



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