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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 (EE.UU.)
4. "Transport in the European Union". European Commission.
5. "World Bank – Urban Transport Data Analysis Tool"
6. "Unión Internacional del Transporte Público (UITP)"

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1. Purpose and scope

The purpose of this report is to assess the infrastructure of Urban Public Transportation 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 Urban Public Transportation, 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.
 - “Urban Transport Data Analysis Tool. World Bank”
 - “Unión Internacional del Transporte Público (UITP)”
- **Annex 6: Indicators from the main Spanish organizations,** which includes information about the indicators from the main Spanish organizations:



2. Description of the infrastructure of urban and metropolitan public transportation in Spain

Urban and metropolitan public transportation is a complex and dynamic system that connects urban centers and metropolitan areas of major cities, facilitating the movement of people. The system's complexity is determined by the structure of the urban core and the surrounding metropolitan area. As a dynamic system, it continuously adapts to city growth and people's mobility needs. The infrastructure of the system consists of various modes of transportation such as buses, metro, trains, trams, etc., which interact with each other and have connection nodes and transfer stations.

The efficiency of metropolitan public transportation depends on various factors, with the territorial and demographic structure of the metropolitan area being a key highlight.

As indicated by the Metropolitan Mobility Observatory (OMM)¹, which gathers data from 23 Spanish metropolitan areas² spanning an area of 62,200 km² (12.3% of the national territory) and with a population of over 25 million inhabitants (more than 54% of Spain's total population), the main figures summarizing metropolitan mobility in the year 2019 are as follows:

- In 2019, there were 3.848 billion public transportation trips: 1.876 billion bus trips and 1.972 billion trips on rail modes. Compared to 2018, there was a 3.2% increase in total trips across the analyzed areas.
- The annual demand in 2019 for these areas amounted to 27.570 billion passenger-kilometers, with 36% attributed to buses and 63% to rail modes.
- The average travel distances for different modes in 2019 were as follows: 5.5 km for urban buses, 6.9 km for the metro, 17.7 km for metropolitan buses, 19.1 km for Cercanías Renfe (a commuter rail service), and 18.7 km for narrow gauge and regional railways.
- The total length of bus lines in the 23 metropolitan areas reached 165,830 km, while the length of railway networks was 3,587 km.
- To meet the demand, the public transportation authorities (ATP) of these metropolitan areas provided a total of 1.019 billion vehicle-kilometers, with 674 million attributed to bus systems and 345 million to rail modes (excluding Cercanías Renfe services).
- Improvements in engine technology and fuel types for urban buses continue: in 2019, the most commonly used fuel was Compressed Natural Gas (CNG) at 38%, while 37% of the fleet used diesel. Hybrid buses showed improvement at 11.3%, 8.6% used biodiesel, and there was a slight increase in the proportion of electric buses (3.4%).

¹ The Metropolitan Mobility Observatory (OMM) is an initiative for analysis and reflection established by the Public Transportation Authorities (ATP) of the main Spanish metropolitan areas. It is funded by the Ministry of Transport, Mobility, and Urban Agenda, with support from the Ministry for Ecological Transition and Demographic Challenge, the Directorate General of Traffic (DGT), Renfe (the national railway company), and other institutions such as the Association of Urban and Metropolitan Public Transportation (ATUC Sustainable Mobility), the Spanish Federation of Municipalities and Provinces (FEMP), INECO, IDAE, and the labor union Comisiones Obreras (CC.OO.). It is produced annually at the Transportation Research Center (TRANSyT) of the Technical University of Madrid (Universidad Politécnica de Madrid - UPM). <https://observatoriomovilidad.es/>

² In the OMM reports, the term "metropolitan area" refers to the geographical scope of each Public Transportation Authority's jurisdiction.



- In 2019, a total of 756 million euros were invested in the 17 most significant areas, with 72% allocated to infrastructure (new or improved) and 28% to acquiring new rolling stock. Regarding transportation modes, 72% of investments were made in rail modes.
- Tariff revenues across the areas amounted to 2.285 billion euros, with operating costs reaching 3.117 billion euros, resulting in an average coverage ratio of 59%.

The general characteristics of the metropolitan areas in 2019 are reflected in the following table from the OMM:

	Área metropolitana							Ciudad Capital			Ratio Concentración población**
	Superficie (km ²)	Población	Densidad (hab/km ²)	Nº municipios	Superficie urbanizada (km ²)	Ratio Superficie*	Densidad urbana (hab/km ²)	Superficie (km ²)	Población	Densidad (hab/Km ²)	
Madrid	8.028	6.663.394	830	179	919	11%	7.247	605	3.266.126	5.399	49%
Barcelona	3.239	5.118.678	1.580	164	634	20%	8.074	101	1.636.762	16.150	32%
Valencia	1.551	1.822.608	1.175	60	306	20%	5.956	138	794.288	5.742	44%
Sevilla	4.221	1.489.789	353	45	226	5%	6.598	141	688.592	4.873	46%
Bizkaia	2.217	1.152.651	520	112	n.d.	n.d.	n.d.	41	346.843	8.460	30%
Asturias	10.602	1.022.800	96	78	n.d.	n.d.	n.d.	187	219.686	1.177	21%
Málaga	1.432	1.046.552	731	15	75	5%	13.991	395	574.654	1.456	55%
Mallorca ¹	3.623	880.113	243	53	212	6%	4.151	214	409.661	1.918	47%
Bahía de Cádiz	3.312	820.129	248	12	n.d.	n.d.	n.d.	14	116.027	8.171	14%
Zaragoza	3.258	789.779	242	32	258	8%	3.061	938	674.997	720	85%
Gipuzkoa	1.980	723.576	365	89	n.d.	n.d.	n.d.	73	187.415	2.567	26%
C. de Tarragona	2.999	626.277	209	132	189	6%	3.317	65	134.515	2.063	21%
Granada	861	536.771	624	33	94	11%	5.723	88	232.462	2.641	43%
Almería ¹	2.127	522.687	246	18	n.d.	n.d.	n.d.	296	196.851	666	38%
Alicante	354	470.888	1.329	5	74	21%	6.363	201	331.577	1.647	70%
Valladolid	955	404.305	424	25	125	13%	3.234	198	298.412	1.508	74%
Lleida	5.586	361.911	65	149	182	3%	1.992	212	138.956	655	38%
C. de Pamplona	92	351.777	3.838	18	50	55%	6.985	25	201.653	8.037	57%
C. de Gibraltar ²	1.530	272.804	178	8	432	28%	631	88	122.097	1.392	45%
A Coruña	-	-	-	-	-	-	-	38	245.711	6.384	-
Jaén	3.231	223.221	69	15	n.d.	n.d.	n.d.	1.759	112.999	64	51%
León	913	203.461	223	16	21	2%	9.611	39	124.303	3.185	61%
Cáceres ³	n.d.	96.120	n.d.	1	21	1%	4.577	1.760	96.120	55	100%

*Superficie urbanizada/ superficie total del área metropolitana

**Población de la ciudad capital/ población del área metropolitana

1: Datos del Informe de 2018 al n.d. de datos actualizados.

2: Superficie del área metropolitana es dato de 2015, superficie urbanizada es dato de 2007 y superficie de la ciudad capital es dato de 2015.

3: Datos del informe de 2017 al n.d. de datos actualizados.

Fuente: elaboración propia a partir de datos proporcionados por las ATP.

Table 1: General characteristics of the metropolitan areas in Spain. Metropolitan Mobility Observatory. OMM Report 2019-2020 Preview. July 2021.

Metropolitan areas can be divided into three groups:

- **Large metropolitan areas:** These have a population of over one million inhabitants. They generally have high urban densities (except for Asturias), which makes the use of public transportation very efficient. These areas typically have one or more rail modes, such as metro, tram, or commuter trains.
- **Medium-sized metropolitan areas:** These have a population ranging from half a million to one million inhabitants. This group is quite heterogeneous, with areas that are in between small and large. Generally, they exhibit medium population densities, ranging from 200 to 624 (Granada) inhabitants per km². Consequently, some of these areas have rail modes (metro, commuter trains, or tram) in their public transportation systems, while others rely solely on bus services.
- **Small metropolitan areas:** These have a population of less than half a million inhabitants. They typically have lower population densities (except for Comarca de Pamplona, Alicante, and Valladolid), with values below 300 inhabitants per km². This makes public transportation less efficient, but walking or cycling are more suitable options. Small



metropolitan areas usually lack rail modes, except for Alicante which has a tram, and León which offers narrow-gauge commuter train services.

The following table displays the motorization index per 1,000 inhabitants for private vehicles (cars, motorcycles, and mopeds). The evolution of these indices allows us to understand the availability of private vehicles for daily travel, providing an indirect and approximate insight into the trends of using this type of transportation in these areas.

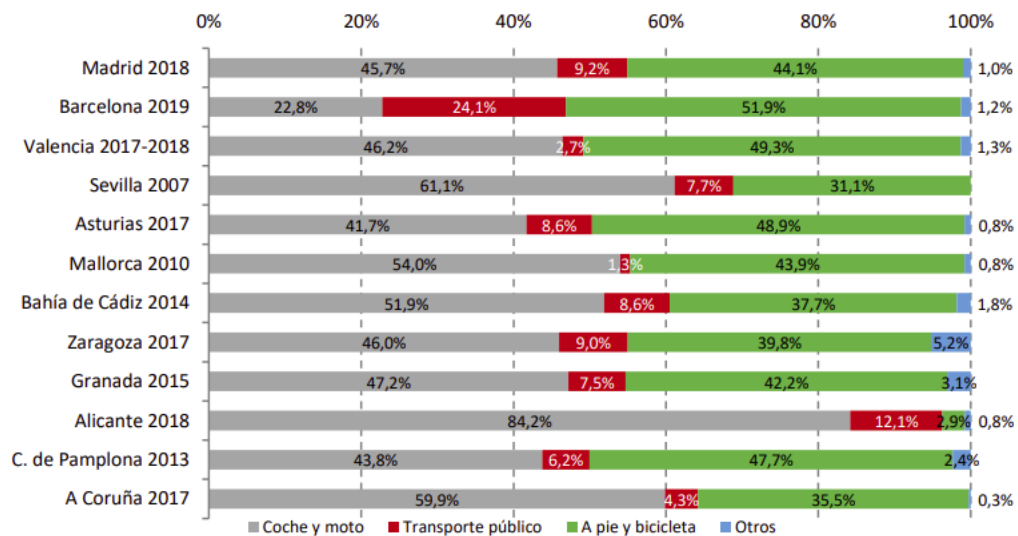
	Área metropolitana		Ciudad capital ¹	
	Turismos	Motos y Ciclomotores	Turismos	Motocicletas
Madrid	580	58	458	65
Barcelona	486	128	338	154
Valencia	406 ¹	101 ¹	442	102
Sevilla	486	145	475	168
Bizkaia¹	439	44	396	59
Asturias	511	81	440	61
Málaga	483	165	449	166
Mallorca¹	649	113	598	111
Bahía de Cádiz	460	91	385	107
Zaragoza	535 ¹	109 ¹	383	73
Gipuzkoa	443	82	409 ¹	162 ¹
Camp de Tarragona	519	98	472	97
Granada	494	183	484	182
Almería¹	230	38	448	149
Alicante	461	75	452	80
Valladolid	666	78	460	51
Lleida	522	70	441	64
Comarca de Pamplona	498	74	482	70
Campo de Gibraltar²	482	141	487	135
A Coruña	-	-	414	50
Jaén	426	134	443	144
León	523	78	480	63
Cáceres¹	540	103	515	106

1: Datos del Informe de 2017 al n.d. de datos actualizados.

2: No existe una ciudad capital, por lo que se considera Algeciras en su lugar.

Table 2: Motorization index (Vehicles/1,000 inhabitants). Year 2019. Metropolitan Mobility Observatory. OMM Report 2019-2020 Preview. July 2021.

In the modal split of mobility in the main cities of metropolitan areas, walking or cycling trips stand out (average of 50.2% of all journeys). In contrast, the use of public transportation is limited (16.1%). These figures contrast with the travel patterns within the metropolitan areas (Table 3), where walking or cycling trips decrease.



Fuente: elaboración propia a partir de datos de las ATP.

Table 3: Modal split of trips taken in the metropolitan periphery. Year 2019. Metropolitan Mobility Observatory. OMM Report 2019-2020 Preview. July 2021.

Regarding demand, Mobility Surveys (Encuestas de Movilidad - EDM) provide the necessary data for public transportation planning. According to this data, the characteristics of mobility in metropolitan areas are reflected in the following table.

	Viajes en día laborable (Millones)	Tiempo medio de viaje (min)	Distancia media de viaje (km)	Nº de viajes por persona al día	Viajes intermodales (%)	Viajeros según sexo (%)		Viajeros por edad (%)		
						Hombre	Mujer	<16 años	16-65 años	>65 años
Madrid 2018 ¹	15,85	25,50	7,10	2,4	8,5%	47,7	52,3	12	74	14
Barcelona 2019	12,03	24,00	6,60	2,4	12,7%	49,1	50,9	20	63,9	16
Valencia 2017-2018	4,88	n.d.	n.d.	2,6	5,2%	52,0	48,0	n.d.	n.d.	n.d.
Sevilla 2007	2,90	28,10	n.d.	2,4	4,3%	50,6	49,4	4	89	7
Bizkaia 2008 ²	3,01	n.d.	3,2-12,7	2,8	1,9%	68-40	32-60	n.d.	n.d.	n.d.
Asturias 2017 ³	2,45	22,00	n.d.	3,1	1,0%	49,4	50,6	n.d.	77	23
Málaga 2011 ⁴	2,78	23,40	8,50	2,2	n.d.	36,4	63,6	2	78,6	19,4
Mallorca 2010	2,28	17,0	n.d.	3,6	1%	50,7	49,3	1	87	11
Bahía de Cádiz 2007-15 ⁵	2,57	21,7	n.d.	3,3	1%	44,0	56,0	91,0		9
Zaragoza 2017	1,73	n.d.	n.d.	2,5	4%	49,1	50,9	n.d.	n.d.	n.d.
Gipuzkoa 2016	2,19	n.d.	n.d.	3,3	0,7%	36,0	64,0	n.d.	n.d.	n.d.
C. de Tarragona 2006 ⁶	1,85	18,00	n.d.	3,2	4%	n.d.	n.d.	n.d.	n.d.	n.d.
Granada 2015 ⁷	1,12	19,20	n.d.	2,3	6,8%	52,0	48,0	19	66	15
Alicante 2018	1,76	21,57	12,52	2,6	9,6%	49,3	50,7	9	84	8
Valladolid 2015	0,66	19,30	n.d.	2,3	n.d.	47,1	52,9	9	n.d.	n.d.
Lleida 2006	1,30	n.d.	n.d.	3,2	10,6%	n.d.	n.d.	n.d.	n.d.	n.d.
C. de Pamplona 2013 ⁸	0,97	17,10	n.d.	3,0	1,8%	48,6	51,4	14	68	18
C. de Gibraltar 2007 ⁹	0,56	12,30	n.d.	2,2	n.d.	40,0	60,0	7	75	18
A Coruña 2017	n.d.	15,00	3,60	1,3	n.d.	31,5	68,5	5	82	13
León 2009	0,34	17,10	n.d.	2,7	6,1%	n.d.	n.d.	n.d.	n.d.	n.d.
Cáceres 2013	0,19	n.d.	n.d.	2,0	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.

Table 4: Characteristics of mobility in metropolitan areas. Year 2019. Metropolitan Mobility Observatory. OMM Report 2019-2020 Preview. July 2021.

Regarding the demand for public transportation, in 2019, a total of 3.848 billion trips using bus and rail modes (metro, tram, and rail) were recorded across all the analyzed metropolitan areas. Out of these trips, 1.876 billion were conducted by bus, while rail modes accounted for 1.972 billion trips. Within the bus trips, 1.250 billion were taken on urban buses, while 626 million trips were made on metropolitan buses:



	Autobús urbano	Otros autobuses urbanos	Autobús metropolitano	Metro	Tranvía/Metro ligero	Cercanías RENFE	FF.CC. autonómicos y de vía estrecha
Madrid	439,8	254,7		684,4	18,8	253,4	-
Barcelona	219,6	143,5	41,5	453,5	29,8	119,3	86
Valencia	96,9	-	10,2	60,3	9,2	16,2	-
Sevilla	79,7	1,1	10,7	20	3	7,5	-
Bizkaia	24,8	1,6	29,3	88,4	3,1	10,6	11,8
Asturias ¹	11,8	18,3	15,6	-	-	4,7	1,7
Málaga	51,9	-	13,5	6,8	-	11,8	-
Mallorca ²	41,7	-	10,2	-	-	-	-
Bahía de Cádiz	-	-	4,7	-	-	2,8	-
Zaragoza	94,2	-	5,4	-	25,8	0,3	-
Gipuzkoa	29,6	2,5	25	-	-	5,9	13
C. de Tarragona	10,4	2,7	8,6	-	-	-	-
Granada ³	26,2	0,1	7,9	-	11,72	-	-
Almería ⁴	-	-	3,2	-	-	-	-
Alicante ⁵	17,7	-	7,4	0,6	11,5	-	-
Valladolid	26	-	-	-	-	-	-
Lleida	6,5	-	2	-	-	-	0,3
C. de Pamplona ⁶		40,6		-	-	-	-
C. de Gibraltar ⁷	1,5	4,1	1,2	-	-	-	-
A Coruña	22,5	-	-	-	-	-	-
Jaén	-	-	1,3	-	-	-	-
León	4	-	-	-	-	-	0,1
Cáceres	4,6	-	-	-	-	-	-

Table 5: Demand for public transportation. Line trips and Network trips. OMM Report 2019-2020 Preview. July 2021.

The following table shows the estimated average distance of trips (km):

	Autobús urbano	Otros autobuses urbanos	Autobús metropolitano	Metro	Tranvía/Metro ligero	Cercanías RENFE	FF.CC. autonómicos y de vía estrecha
Madrid	2,5	13,3		6,3	5,0	17,3	-
Barcelona	2,8	6,3	14,1	5,0	2,7	20,6	16,5
Valencia	-	-	-	7,9	4,7	33,0	-
Sevilla	3,4	3,4	15,4	4,6	1,2	23,5	-
Bizkaia	-	-	-	-	-	9,6	1,3
Asturias	13,5	6,0	-	-	-	18,9	18,4
Málaga	5,6	-	10,0	5,1	-	16,8	-
Mallorca ¹	8,0	-	21,3	-	-	-	-
Bahía de Cádiz	-	-	22,6	-	-	24,0	-
Zaragoza	-	-	-	-	6,5	9,8	-
Gipuzkoa	6,8	-	36,0	-	-	18,2	17,5
Almería ²	-	-	14,4	-	-	-	-
Alicante	-	-	26,1	12,7	11,9	-	-
Lleida	-	-	21,2	-	-	-	33,9
Comarca de Pamplona		3,9		-	-	-	-
Campo de Gibraltar	3,8	-	1,0	-	-	-	-
A Coruña	3,6	-	-	-	-	-	-
León	7,1	-	-	-	-	-	34,6

Table 6: Estimated average distance of trips (km). OMM Report 2019-2020 Preview. July 2021.

Regarding the supply, the following table presents some indicators characterizing the bus network and the rail network (including metro): the number of daytime routes, the total length of the routes, the number of stops, and the average length of the routes. Please note that for the length of routes, the sum of lengths between the end points in both directions is considered, as the distance covered per direction might differ. Furthermore, if multiple routes share the same section, that section is counted as many times as there are routes passing through it. The same principle applies to the number of stops-routes.



	Nº de líneas			Longitud de líneas (km)			Paradas líneas			Longitud media de las líneas (km)		
	Bus Urbano	Otros buses urbanos	Bus Metrop.	Bus Urbano	Otros buses urbanos	Bus Metrop.	Bus Urbano	Otros buses urbanos	Bus Metrop.	Bus Urbano	Otros buses urbanos	Bus Metrop.
Madrid	211	117	341	3.857	1.841	19.462	11.074	4.429	17.530	18	16	57
Barcelona	111	250	397	1.690	3.974	21.221	4.906	8.094	19.119	15	16	53
Valencia	44	-	34	776	-	1.698	2.104	-	n.d.	18	-	50
Sevilla	44	12	63	685	192	2.597	2.067	335	2.808	16	16	41
Bizkaia	35	n.d.	110	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	-	-
Asturias	13	17	380	185	392	31.638	857	1.319	17.759	14	23	83
Málaga ¹	47	-	114	984	-	4.841	2.233	-	4.426	21	-	42
Mallorca ²	34	-	102	804	-	9.603	1.772	-	4.042	24	-	94
Bahía de Cádiz	n.d.	n.d.	75	n.d.	n.d.	5.271	n.d.	n.d.	1.602	n.d.	-	70
Zaragoza	36	-	20	723	-	774	1.538	-	n.d.	20	-	39
Gipuzkoa ³	41	-	171	547	-	4.790	1.478	-	4.507	13	-	28
C. de Tarragona	17	12	78	285	268	2.512	781	498	2.140	17	22	32
Granada	28	n.d.	61	320	n.d.	2.234	1.132	n.d.	2.520	11	-	37
Almería ⁴	16	2	31	n.d.	n.d.	2.372	n.d.	n.d.	1.351	n.d.	-	77
Alicante	25	-	11	405	-	287	1.107	-	395	16	-	26
Valladolid	52	-	n.d.	548	-	n.d.	1.943	-	n.d.	11	-	-
Lleida	13	-	53	170	-	1.984	450	-	755	13	-	37
C. de Pamplona ⁵		24			369			850			15	
C. de Gibraltar	n.d.	n.d.	16	n.d.	n.d.	1.054	n.d.	n.d.	394	n.d.	-	66
A Coruña	24	-	-	353	-	-	1.151	-	-	15	-	-
Jaén	n.d.	n.d.	21	n.d.	n.d.	2.120	n.d.	n.d.	241	n.d.	-	101
León	13	-	n.d.	181	-	n.d.	463	-	n.d.	14	-	-
Cáceres	13	-	-	295	-	-	380	-	-	23	-	-

Table 7: Characteristics of the bus network. OMM Report 2019-2020 Preview. July 2021.

	Nº de líneas				Longitud red (km)				Nº de estaciones de la red			
	Metro	Tranvía/ Metro ligero	Cercanías RENFE*	FF.CC. autonóm. y de vía estrecha	Metro	Tranvía/ Metro ligero	Cercanías RENFE*	FF.CC. autonóm. y de vía estrecha	Metro	Tranvía/ Metro ligero	Cercanías RENFE*	FF.CC. autonóm. y de vía estrecha
Madrid	12	4	9	-	288,5	35,8	357,9	-	242	57	92	-
Barcelona	12	6	8	11	140,3	29,1	456,4	132,7	184	56	123	54
Valencia	6	3	6	-	136,9	21,0	252,0	-	95	43	66	-
Sevilla	1	1	5	-	18,1	2,2	222,1	-	21	5	33	-
Bizkaia ¹	2	1	3	1	52,1	5,6	51,3	33,3	41	14	44	22
Asturias	-	-	3	5	-	-	117,1	668,9	-	-	44	268
Málaga	2	-	2	-	10,4	-	67,1	-	17	-	23	-
Mallorca ²	1	-	-	4	9,0	-	-	76,0	-	-	-	29
Bahía de Cádiz	-	-	2	-	-	-	60,8	-	-	-	14	-
Zaragoza	-	1	1	-	-	12,8	16,6	-	-	33	6	-
Gipuzkoa	-	-	1	2	-	-	82,2	86,1	-	-	30	40
Granada	-	1	-	-	-	15,9	-	-	-	26	-	-
Alicante ³	1	5	-	-	50,8	58,8	-	-	17	53	-	-
Lleida	-	-	-	1	-	-	-	88,3	-	-	-	17
León ⁴	-	-	-	1	-	-	-	115,8	-	-	-	44

Table 8: Characteristics of the rail network. OMM Report 2019-2020 Preview. July 2021.

In the overall analyzed areas and modes, a total of 51.583 billion seat-kilometers were offered on buses and 87.892 billion on railways, representing approximately a 1.9% reduction in bus seat-kilometers and a 0.37% increase for railways. Notable increases in bus seat-kilometers include Valencia's networks (20.6%), Valladolid (2.2%), and Sevilla (1.9%), as well as urban buses in Barcelona (5.5%) and Campo de Tarragona (1.5%). In railways, the Granada metro stands out with a 9% increase in seat-kilometers, along with Valencia (3%) and Barcelona (2.4%).

The fleets of urban and metropolitan buses, classified by vehicle length into minibuses, standard buses, and articulated buses, are included in the following table. The largest bus fleets are found in Madrid and Barcelona, together accounting for 58% of the buses in operation across all the areas under study. Additionally, in urban areas, the standard bus is the most commonly used type,



comprising 77% of the total fleets, followed by articulated buses (18%). In metropolitan fleets, the percentage of standard buses is 93%, and articulated buses make up 3%.

	Autobús urbano capital				Otros autobuses urbanos				Autobús metropolitano				Total buses
	M	E	A	Total	M	E	A	Total	M	E	A	Total	
Madrid	53	1.943	86	2.082	35			1.977	45			2.057	4.139
Barcelona	72	704	364	1.140	90	838	40	968	55	564	20	639	2.747
Valencia	9	398	81	488	-	-	-	-	-	117	-	117	605
Sevilla	4	300	104	408	14	4	-	18	4	137	4	145	571
Asturias	4	27	36	67	-	64	18	82	51	830	28	909	1.058
Málaga	24	148	89	261	-	-	-	-	-	85	15	100	361
Mallorca ¹	13	120	43	176	-	-	-	-	27	156	26	209	385
B. Cádiz	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	61	7	68	68
Zaragoza	11	230	98	339	-	-	-	-	7	51	-	58	397
Gipuzkoa	11	95	30	136	-	-	-	-	n.d.	n.d.	n.d.	n.d.	136
C. Tarragona	4	59	3	66	2	16	-	18	11	152	-	163	247
Granada	26	132	33	191	3	-	-	3	5	110	-	115	309
Almería ²	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	2	67	6	75	75
Alicante	2	84	11	97	-	-	-	-	2	36	9	47	144
Valladolid	0	117	33	150	-	-	-	-	n.d.	n.d.	n.d.	n.d.	150
Lleida	2	42	4	48	-	-	-	-	5	93	-	98	146
C. Pamplona ³	2	91	55	148	-	-	-	-	-	-	-	-	148
C. Gibraltar	n.d.	n.d.	n.d.	n.d.	-	-	-	-	2	22	-	24	24
A Coruña	-	74	19	93	-	-	-	-	-	-	-	-	93
Jaén	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	-	82	-	82	82
León	1	30	0	31	-	-	-	-	n.d.	n.d.	n.d.	n.d.	31
Cáceres	2	29	6	37	-	-	-	-	-	-	-	-	37

LEYENDA: M=Microbús; E: Estándar; A=Articulado

Table 9: Size of bus fleets. OMM Report 2019-2020 Preview. July 2021.

The fleet of rail modes, including cars and trains, is presented in the following table:

	Metro		Tranvía	Cercanías Renfe*		FF.CC. autonómicos y de vía estrecha	
	Coches	Trenes	Trenes	Coches	Trenes	Coches	Trenes
Madrid	2.341	318	37	1.136	280	-	-
Barcelona	906	189	41	719	202	245	70
Valencia	268	62	44	159	50	-	-
Sevilla	n.d.	21	4	105	25	-	-
Bizkaia	n.d.	n.d.	n.d.	60	20	20	9
Asturias	-	-	-	51	17	88	43
Málaga	-	14	-	32	8	-	-
Mallorca ¹	n.d.	6	-	-	-	n.d.	27
B. Cádiz	-	-	-	16	6	-	-
Zaragoza	-	-	21	6	2	-	-
Gipuzkoa	-	-	-	48	14	174	48
Granada	-	-	15	-	-	-	-
Alicante ²	10	5	38	-	-	-	-
Lleida	-	-	-	-	-	4	2
León	-	-	-	-	-	8	5

1: Datos del 2018.

Table 10: Fleet of rail modes. OMM Report 2019-2020 Preview. July 2021.

The following tables display the fare revenues obtained across all public transportation services in the areas for the period 2013-2020, as well as the fare revenues for the Commuter services operated by Renfe, which are presented separately. A widespread increase in fare revenues can be observed in nearly all metropolitan areas between 2013 and 2019, with this increase amounting to 21.1%.



	2013	2014	2015	2016	2017	2018	2019	2020
Madrid	917,3	910,4	880,1	841,3	866,5	898,3	926,5	529,2
Barcelona	564,7	541,4	464,1	402,2	653,9	685,4	683,1	n.d.
Valencia	0	99,5	99,5	103,3	101,6	114,7	118,4	61,2
Sevilla	62,7	63,4	63,6	68	69,9	71,6	74,2	37,2
Asturias	23	23	23,2	22,9	23,2	n.d.	n.d.	n.d.
Málaga	28,5	28,6	28,8	29,3	31,2	47,7	48,7	34,3
Mallorca	25,7	26,3	26,4	29,2	21,3	65,5	n.d.	n.d.
Bahía de Cádiz	8,5	8,6	8,7	8,6	8,7	9,1	9,7	4,3
Zaragoza	n.d.	n.d.	57	41,2	42,5	61,1	61,0	35,2
Gipuzkoa	18,5	18,5	18,4	19	19,6	65,1	67,9	39,5
C. Tarragona	16,7	16,7	15,8	16,5	17,5	17,9	18,2	7,9
Granada	32,4	30,9	29,4	29,6	30,2	18,3	18,3	n.d.
Alicante	0	23,5	22,2	n.d.	29,3	19,5	20,0	n.d.
Valladolid	-	-	-	-	-	14,7	14,8	7,4
Lleida	3,4	3,6	3,4	3,5	3,3	5,8	5,9	4,3
C. Pamplona	17,5	17,6	17,8	17,6	18	18,7	19,1	10,2
A Coruña	14	14,4	14,2	14,5	14,6	14,7	13,4	7,9
León	2,8	2,8	2,9	2,9	2,9	2,8	2,9	1,4

Table 11: Fare revenues (Million Euros). OMM Report 2019-2020 Preview. July 2021.

	2013	2014	2015	2016	2017	2018	2019	2020
Madrid	222,2	233,5	233,9	236,5	249,4	268,8	264,1	143,3
Barcelona	136,4	140,6	138,8	138,9	145,3	150,4	155,2	83,8
Valencia	31,5	31,4	30,8	29,6	30,7	31,6	33,6	17,7
Sevilla	9,6	9,9	9,8	9,6	9,9	10,1	10,3	5,5
Bizkaia	9,2	9,2	9,2	9,1	9,1	9,6	9,8	6,1
Asturias	7,7	7,2	7,5	7	6,8	6,7	6,9	4,3
Málaga	13,3	14,1	14,8	15,9	17,6	17,9	19	8,2
Bahía de Cádiz	4,4	4,5	4,4	4,3	4,3	4,4	4,8	2,9
Zaragoza	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,2
Gipuzkoa	7,5	7,8	7,6	7,9	7,6	7,5	7,3	4,7

Fuente: DG Viajeros RENFE.

Table 12: Fare revenues of RENFE commuter services (Million Euros). OMM Report 2019-2020 Preview. July 2021.

Next, the operating costs in various areas for the period 2013-2019 are presented. There has been an overall increase of 19% in the total operating costs across all analyzed areas. In 2020, there was a reduction of 8.7% compared to 2019.



	2013	2014	2015	2016	2017	2018	2019	2020
Madrid	1.909,8	1.963,7	1.738,0	1.853,3	1.930,0	2.065,2	2.172,6	2.044,3
Barcelona	1.023,6	811,6	817,1	769,2	n.d.	n.d.	n.d.	n.d.
Valencia	n.d.	177,1	177,1	180,4	178,7	215,8	215,5	199,0
Sevilla¹	122,5	124,0	122,4	127,3	130,6	130,8	135,9	127,2
Asturias	41,4	41,2	41,5	41,9	42,0	n.d.	n.d.	n.d.
Málaga	53,7	56,5	56,5	58,9	63,2	65,3	65,4	58,9
Mallorca	46,9	47,8	47,3	50,0	23,7	78,6	n.d.	n.d.
Bahía de Cádiz	11,3	11,7	11,9	11,4	11,9	11,4	11,4	7,5
Zaragoza	n.d.	n.d.	110,8	83,6	77,7	122,4	125,7	110,1
Gipuzkoa	33,8	33,8	33,4	35,7	36,6	38,0	41,4	38,9
C. Tarragona²	16,7	16,7	15,8	16,5	17,5	48,5	51,2	46,8
Granada³	47,8	48,9	49,5	47,4	48,1	45,1	51,5	n.d.
Alicante	43,9	59,4	59,5	30,1	56,0	33,1	33,7	n.d.
Valladolid	-	-	-	-	-	31,0	32,1	30,1
Lleida⁴	11,1	12,5	12,7	13,0	13,6	13,7	13,8	12,7
C. Pamplona	27,2	27,1	26,8	26,8	27,4	29,2	29,9	25,1
A Coruña	18,2	18,2	18,5	18,6	19,1	19,5	19,6	17,8
León	5,6	5,1	5,0	4,9	5,2	5,2	5,3	4,8

Ningún área incluye costes de Cercanías Renfe ni vía estrecha.

Table 13: Operating costs (Million Euros). OMM Report 2019-2020 Preview. July 2021.

From the previous tables, it can be inferred that there is an evolution in the average coverage ratio across all metropolitan areas. The average ratio reaches its highest value in 2015 and then decreases, reaching its lowest value in 2020.

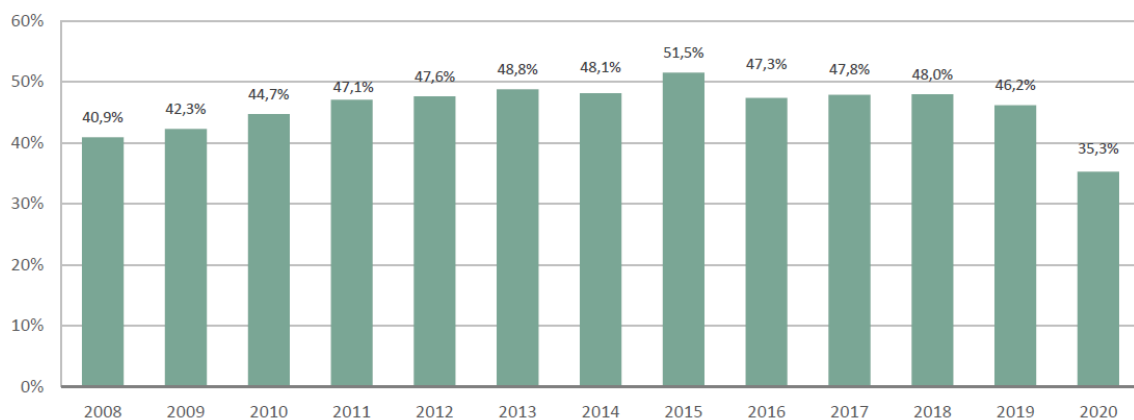


Table 14: Evolution of the average coverage ratio across all metropolitan areas. OMM Report 2019-2020 Preview. July 2021

Regarding the ownership of urban and metropolitan transportation networks, the only public transportation infrastructure owned by the State is the one corresponding to the Iberian gauge (1,668 mm) railway service operated by Renfe Cercanías, a division of Renfe Operadora under the Ministry of Development (Ministerio de Fomento). Also operating as a commuter service, albeit in fewer towns and with fewer passengers, is Renfe Feve, another division of Renfe Operadora, which operates on a meter gauge (1,000 mm) railway.

In the case of Catalonia, on January 1, 2010, the management of commuter rail services was transferred to the Government of Catalonia (Generalitat de Catalunya). However, Renfe Cercanías still operates the lines under the commercial brand "Rodalies de Catalunya." In 2022, the control of funds for managing Rodalies was also transferred from the State to the Generalitat. It is



estimated that the Generalitat will receive between 270 and 320 million euros annually from the State to cover the deficit of this railway network.

Certain commuter rail services were transferred to regional governments (CC. AA.) at some point, as were the metro networks and some tram services in Spain. Additionally, the networks of intermunicipal bus services were also transferred in some cases. In most instances, the management of these infrastructures is handled by regional transportation consortia in which the autonomous community and/or the respective provincial government participate, along with some private companies in some cases. Occasionally, the municipalities receiving the service are also involved.

Municipal authority is typically limited to the urban bus networks of individual municipalities, whether managed directly by a municipal company or through a concession, as well as some tram networks whose management or concession falls under the jurisdiction of the respective municipality.

3. Methodology

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 carried out through a comparative study with other countries in our economic and social environment. It considers the most representative indicators of the sector (both for 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, UITP, etc.). The preference has been to gather starting data that have been collected with comparable and verifiable criteria across different countries, allowing the analysis of indicator trends over a period of time.

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

To facilitate the assessment, the analysis has been grouped into eight criteria that are common to all sectors, albeit with specificities for each sector. These criteria are called "Criteria": Capacity, Performance, Financing, Adaptation to the Future and Sustainable Development, Operation and Maintenance, Safety, 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 specific criterion. Once the eight Criteria indices for each sector are obtained, the Sector index is also derived as a result of a new weighted assessment of these Criteria indices.

To establish an international comparison of Spain's Urban Public Transportation sector, the following countries have been selected: prominent European countries like Germany, France, the United Kingdom, Italy, and Turkey; four countries from the Americas: the United States, Mexico, Brazil, and Peru; three countries from Africa: Egypt, Israel, and Saudi Arabia; and three Asian countries: Japan, China, and India. Not all countries have been evaluated for all indicators due to lack of basic data.

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 various factors such as geographical, territorial, economic, population distribution peculiarities, etc.) and to minimize the effect of occasional extreme data points, it's necessary to bound the data both at the upper and lower ends. After obtaining the ratios, the dispersion of the values achieved in different countries and years considered is analyzed.**

For these purposes, two methods have been considered for each indicator to control dispersion. The first method considers the mean and standard deviation of the data in the historical series, assigning the lower bound value as the mean minus 1.5 times the standard deviation, and the upper bound value as the mean plus 1.5 times the standard deviation. The second method uses percentiles of the data in the historical series, analyzing the 90th or 80th percentile and the 10th percentile. The better-suited method is adopted for each Indicator, based on its appropriateness to limit dispersion. There are exceptions to this general rule in some cases, such as Safety Indicators, where the minimum value is assigned as zero, considering it as the value that should receive the highest score.

Once these values are obtained, they are transformed onto a scale of 0 to 10, where 10 represents the highest value and 0 the lowest. Subsequently, the following grades are 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 15: Rating system for Indicators, Criteria, and Sectors



When calculating all the Indicators for each Criterion, the next step is to weight them 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 most significant challenges. To address this, the input of experts is essential. Based on their experience and knowledge, experts assign these weights.

It's important to consider that when forming the Criterion Indicator as a weighted score of the Indicators, the maximum value that the Criterion Indicator can achieve is the result of summing the weight assigned to each Indicator by the maximum score (10) the Indicator can reach, adjusted by a reducing coefficient (considered as 0.9). Applying this reducing coefficient is considered essential to balance the integration of Indicators (for example, in roads, within the Adaptation to the Future criterion, ratios of investment growth in relation to motorization rate growth, traffic growth, and population growth are analyzed. If the motorization rate decreases due to the extension of shared-use vehicles, the sector's indicator would decrease, even with increased traffic).

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 times the 10% reduction coefficient = 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 (€)
Total:	12	30	120	
% Max score over Max Value		90,0%	108,00	

When forming the Criterion Indicator neither the mean nor the standard deviation is considered, as it would distort the Criterion Indicator by overvaluing the integration of the Indicators. However, a reduction percentage is taken into account.

Furthermore, since data from certain countries and years are not always available, this document has opted to calculate the ratios without considering or estimating data that are not available. In this way, data that is not reliable or incorrect is not considered in either the assessment of the Criterion Indicator or the assessment of the Criterion Indicator. Therefore, the Criterion Index and the "Sector Index" only take into account data for which effective evidence exists. This method is followed to prevent data from distorting the assessment achieved by a particular country.

Continuing with the previous example, if reliable data for Indicator I 5.5 of a specific country is not available, the assessment of the "Operation and Maintenance" criterion for that country would be based on the maximum value of 68 (which is the result of subtracting 40 from 108, which is the total maximum score of all Indicators, minus the maximum score of Indicator I 5.5, once the 10%



reduction coefficient is applied). For the assessment of other countries that have data for all indicators, the value of 108 would be considered as the maximum score.

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



4. Quantitative Indicators of Urban Public Transportation

For the comparative study, 51 quantitative indicators have been utilized, all referenced to the most representative sector data (both from Spain and other countries), obtained from publicly accessible databases 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 opinion of consulted experts and experience. It has also been essential to have the appropriate database to compose the indicator.

To conduct a rigorous evaluation of the indicators for each country and compare the results obtained with other countries, all cities of various sizes and importance should be analyzed, including their metropolitan areas. This thorough analysis goes beyond the scope of this study (it would require an in-depth study of the state of all urban public transportation infrastructures in the cities of each country³).

In order to simplify the evaluation between countries, the choice has been made to represent each country by its three most important cities (whenever data could be located). In this way, **the ratings for each country are the weighted average of the three most important cities, as they are the most populous cities**, have greater public transportation needs, and have the largest and most socioeconomically significant metropolitan areas. However, it should be considered that the evaluation conducted in this manner is used to compare indicators between countries approximately, as not all cities and metropolitan areas of each country have been considered.

Basic population, area, population density, GDP, etc. data refer to the entire metropolitan area of each city. It is necessary to use data for the entire metropolitan area (not exclusively data from the main city) since public transportation serves the entire population residing in both the main city and the population centers of the metropolitan periphery, and it facilitates movement both within urban cores and between different urban centers.

It should also be noted that if the entire metropolitan area were considered, the values of its area (and therefore population density) could be affected by including undeveloped open countryside areas; hence, data from Demographia World Urban Areas⁴ has been used. Regardless of whether the terms "city" or "metropolitan area" are used in the report for the sake of simplicity and comprehensibility, they should be understood with the expressed considerations.

For city classification, a megacity is considered to have more than 10 million inhabitants in its metropolitan area, a large city has more than 5 million inhabitants, and a medium city has more than 1 million inhabitants. This classification provides an idea of each one's size, but for more detailed insight, both population and area should be consulted.

Data sources are indicated in the tables for potential reference. The most recent available data for each city have been used (which are not always from the same period), so it has not been

³ This detailed analysis of cities and their metropolitan areas is, in some cases, found in highly specialized reports. Each country develops its own methodology, and it is not always possible to find comparable data between countries. For example, in Spain, the Metropolitan Mobility Observatory provides very precise and elaborated data; in the USA, this data is analyzed in the report by the American Public Transport Association.

⁴ www.demographia.com/db-worldua.pdf



possible to group data by years and analyze their annual variation, as has been done in other sectors of public works analyzed.

For Spain, the data corresponds to the year 2019 and has been extracted from the Metropolitan Mobility Observatory. Report OMM 2019- Advance 2020. July 2021.

DB TPU CIUDADES 1			Datos Generales TPU (Población del área metropolitana, superficie del área metropolitana y PIB del área metropolitana)						
Ubicación			Área Metropolitana Urbanizada						
Región	País	Ciudad	Población	Superficie urbanizada	Densidad	PIB	PIB per	Peso	Clasificación
			(millns.)	(km ²)	(hab/km ²)	(Millones \$)	capita (\$)	(%)	
Europa	España	Barcelona	5,1	634	8.044	160.617	31.494	37,5%	Ciudad grande
		Madrid	6,7	919	7.291	240.000	35.821	49,3%	Ciudad grande
		Valencia	1,8	306	5.882	55.000	30.556	13,2%	Ciudad mediana
	Italia	Milán	5,5	1.891	2.902	298.335	54.361	53,8%	Ciudad grande
		Roma	3,2	1.114	2.885	376.688	117.202	31,5%	Ciudad mediana
		Turín	1,5	376	3.973	65.766	44.020	14,7%	Ciudad mediana
	Francia	Marsella	1,4	689	2.003	176.256	127.722	10,3%	Ciudad mediana
		Nantes	0,9	1.173	772	58.206	64.316	6,8%	Ciudad mediana
		París	11,1	2.845	3.888	866.588	78.353	82,9%	Megaciudad
	Alemania	Berlín	4,0	1.347	2.978	602.985	150.295	49,7%	Ciudad mediana
		Hamburgo	2,0	777	2.598	358.218	177.423	25,0%	Ciudad mediana
		Múnich	2,0	466	4.373	270.943	132.946	25,3%	Ciudad mediana
	Reino Unido	Glasgow	1,3	368	3.451	178.985	140.933	8,3%	Ciudad mediana
		Londres	11,3	1.738	6.480	937.569	83.251	73,6%	Megaciudad
		Manchester	2,8	630	4.392	62.397	22.550	18,1%	Ciudad mediana
Asia	China	Pekín	18,5	4.144	4.470	583.184	31.486	37,0%	Megaciudad
		Hong Kong (SAR)	7,5	285	26.140	340.618	45.721	14,9%	Ciudad grande
		Shangái	24,1	4.015	5.996	633.935	26.334	48,1%	Megaciudad
	India	Bangalore	15,4	1.166	13.196	93.858	6.100	21,2%	Megaciudad
		Delhi	32,2	2.202	14.635	189.805	5.890	44,4%	Megaciudad
	Mumbai	25,0	881	28.346	388.853	15.571	34,4%	Megaciudad	
	Japón	Tokio	37,7	8.547	4.415	1.790.463	47.452	100%	Megaciudad
Corea Sur	Seúl	23,0	2.745	8.385	915.201	39.764	100%	Megaciudad	
Oceanía	Australia	Melbourne	4,7	2.705	1.745	173.392	36.728	100%	Ciudad mediana
África	Sudáfrica	Johannesburgo	14,6	2.590	5.632	162.320	11.128	100%	Megaciudad
	Egipto	El Cairo	20,3	1.917	10.587	141.096	6.952	100%	Megaciudad
Norteamérica	Canada	Toronto	6,8	2.300	2.944	421.313	62.223	73,4%	Ciudad grande
		Vancouver	2,5	876	2.808	155.297	63.129	26,6%	Ciudad mediana
	EE.UU.	Chicago	9,1	6.856	1.321	656.137	72.445	23,7%	Ciudad grande
		Nueva York	21,5	11.875	1.811	1.732.561	80.551	56,3%	Megaciudad
		Washington DC	7,6	3.424	2.229	597.760	78.333	20,0%	Ciudad grande
Sudamérica	Brasil	Curitiba	3,2	842	3.822	69.963	21.741	12,2%	Ciudad mediana
		São Paulo	23,1	3.043	7.587	531.846	23.038	87,8%	Megaciudad
Colombia	Bogotá	10,1	562	17.945	176.447	17.496	100%	Megaciudad	

Fuente: España: Observatorio de la Movilidad Urbana. Informe 2019 y avance 2020. Resto del mundo: www.demographia.com/db-worldua.pdf

Table 16: General data and weights of urbanized metropolitan areas

It has not been deemed appropriate to go beyond the year 2019 due to the distortion caused by the COVID-19 pandemic, which significantly disrupts the comparison of indicators during the year 2020 and partially in the year 2021.

Once the available databases have been analyzed, the following ones have been considered suitable for use:

- The World Bank (WB)
 - Population
 - Area
 - GDP (USD)
 - Number of daily trips on public transport
 - Average length of public transport trips
 - Average travel time on public transport
 - Percentage of trips using motorized modes



- Percentage of trips on Public Transport
- Costs and revenues of the Public Bus Network
- Costs and revenues of the Urban Rail Transport Network
- Relative cost of fares

- • UN habitat
 - Population growth

- • OECD - International Transport Forum (OCDE)
 - Road investment
 - Road infrastructure maintenance investment
 - Road infrastructure investment (current €)
 - Passenger Transport

- • EUROSTAT and EU
 - National GDP (current €)
 - Congestion hours. Transport in the European Union. Current Trends and Issues. March 2019
 - Statistical Annex. Transport in the EU 2018
 - Road networks for European countries
 - EU. Economic investment report
 - EU. Alternative Fuels Observatory

- • INTERNATIONAL ROAD FEDERATION (IRF)
 - Road networks. World Road Statistics 2019, 2018, 2017, 2016, 2012
 - Accident data. World Road Statistics 2019, 2018, 2017, 2016, 2012
 - Domestic traffic of people and goods. World Road Statistics 2019, 2018, 2017, 2016, 2012

- • NUMBEO
 - Traffic index
 - Time index
 - Dissatisfaction index
 - Inefficiency index

- • MINISTRY OF TRANSPORTATION OF SPAIN
 - Statistical Yearbook 2019
 - Transportation and Infrastructure 2019
 - Mobility and Transportation Observatory 2019

- • MINISTRY OF INTERIOR
 - Accident Statistical Yearbook 2019. DGT

- • OBSERVATORY OF METROPOLITAN MOBILITY. Data from Spain
 - Population
 - Area



- GDP (€)
- Number of daily trips on public transport
- Average length of public transport trips
- Average travel time on public transport
- Percentage of trips using motorized modes
- Percentage of trips on public transport
- Costs and revenues of the Public Bus Network
- Costs and revenues of the Urban Rail Transport Network
- Relative cost of fares



Indicators Urban Public Transport. 2023	
1 CAPACITY	
C.1	Use of public transport. Daily trips / Population
C.2	Use of public transport. Daily trips / Area
C.3	Capacity (Buses + Train cars) / Daily trips
C.4	Capacity (Buses + Train cars) / Population
C.5	Capacity (Buses + Train cars) / Area
2 PERFORMANCE	
P.1	Average travel speed (km/h)
P.2	public transport trips / Motorized trips
P.3	% of population with convenient access to Public Transport (SDG 11.2.1)
P.4	Network length (km) / City Area (KM2)
P.5	Absolute accessibility to public transport within the metropolitan area in 15 minutes
P.6	Absolute bicycle accessibility within the metropolitan area in 15 minutes. OECD
P.7	Absolute walking accessibility within the metropolitan area in 15 minutes. OECD
P.8	Traffic index (Numbeo)
P.9	Time index (Numbeo)
P.10	Dissatisfaction index (Numbeo)
P.11	Inefficiency index (Numbeo)
3 FINANCING	
F.1	Bus network. Revenues / Costs
F.2	Rail network. Revenues / Costs
F.3	Cost (bus network + rail network) / GDP per capita
4 ADAPTATION TO THE FUTURE AND SUSTAINABILITY	
A.1	Mass public transport / Total public transport
A.2	Increase in urban Population
A.3	CO2 emissions index. WB
A.4	Pollution index. WB
A.5	Energy consumption per transported passenger (MJ / (Passenger*km)). WB
A.6	Number of bicycles + scooters / 10,000 inhabitants
A.7	CO2 emissions (t per capita). WB
A.8	Average population exposure to pollutants (micrograms/m3 PM2.5). UN Urban Indicators
A.9	Development of Climate Change Mitigation Technologies related to transport (OECD)
A.10	% of urban population exposed to high noise levels. EUROSTAT
5 OPERATION AND MAINTENANCE	
O.1	Operating expenses / inhabitants
O.2	Operating expenses / GDP
O.3	Operating expenses / Area
6 SAFETY	
S.1	Number of fatalities / 100,000 inhabitants
7 RESILIENCE	
R.1	Network length (km) / City Area (KM2)
R.2	% of population within 1,000 m of a public transport stop (OECD)
R.3	% of population traveling less than 30 minutes on public transport (OECD)
R.4	Hours/year lost in Traffic jams (Tomtom)
R.5	urban core public transport coverage (ITF. Benchmarking accessibility in Cities)
R.6	metropolitan Area public transport coverage (ITF. Benchmarking accessibility in Cities)
R.7	Periurban Area public transport coverage (ITF. Benchmarking accessibility in Cities)
8 ENGINEERING AND INNOVATION	
I.1	Availability of data on Google Maps (Static GTFS + Dynamic GTFS)
I.2	% of GDP allocated to Gross Domestic Expenditure on R&D (OECD R&D)
I.3	Gross Domestic Expenditure on R&D (\$) / Population (OECD R&D)
I.4	Digitalization. Participation in new technologies. Global Competitiveness index score (WEF)
I.5	Digitalization. Index of Information and Communication Technology Infrastructure. (ND Index)
I.6	Digitalization. % of people using the internet
I.7	Engineering. Regulatory transparency. Services Trade Restrictiveness Index (OECD)
I.8	Engineering. Barriers to competition. Services Trade Restrictiveness Index (OECD)
I.9	Engineering. Restrictions on movement. Services Trade Restrictiveness Index (OECD)
I.10	Engineering. Restrictions on the entry of foreign engineers. Services Trade Restrictiveness Index (OECD)
I.11	Innovation index. ND Gain Index



4.1. Capacity

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

To achieve this, the following five sub-indicators have been selected:

1 CAPACITY	
C.1	Use of public transport. Daily trips / Population
C.2	Use of public transport. Daily trips / Area
C.3	Capacity (Buses + Train cars) / Daily trips
C.4	Capacity (Buses + Train cars) / Population
C.5	Capacity (Buses + Train cars) / Area

For the evaluation of this Criterion, five indicators have been used. The first two analyze the usage of public transportation, while the following three assess the capacity of buses and railway cars in relation to daily trips, population, and surface area.

To appropriately evaluate whether urban public transportation infrastructure has the necessary capacity to meet the population's demand, it's important to consider both the available transportation supply and user demand, while establishing a balance between the two. Excessive demand for the available supply indicates a lack of capacity, which would result in inadequate service for all users. Conversely, an excess of supply compared to existing demand would entail undesirable extra costs.

The most appropriate way to measure the capacity of a public transportation system would be based on the number of passengers that can be transported during peak hours. However, due to the complexity of assessing and obtaining this indicator, real demand data such as the average number of trips on working days is often used. Therefore, in this report, this criterion has been adopted based on data availability, even if it may not be entirely precise. To calculate this indicator, both the population of the metropolitan area and the population and surface area have been considered, providing an approximate idea of the demand that urban public transportation systems face. This indicator, apart from giving insight into the system's capacity, can also correlate with the quality of service provided. However, to accurately determine capacity, knowledge of the service level is required, but international data comparison for this aspect is complex.

The difficulty in evaluating the actual capacity of each bus or train has been resolved by estimating the average capacity of buses as 40 passengers and that of train carriages as 130 passengers. In reality, in the case of buses, the various types that are used should be considered. For the sake of simplicity in calculation, the average capacities mentioned have been used for buses and train carriages. This simplification introduces a certain degree of imprecision, given that it's based on average values. It's also important to note that the number of buses in fleets designated for public transportation is being quantified, not the number of registered buses, which would include other services such as tourism, school transport, etc., and wouldn't be representative of the public transportation sector. The basic data for these indicators are presented in the following tables.



DB TPU CIUDADES 3			Viajes diarios en Transporte público (Mills.)						
Viajes diarios en Transporte público / Población									
Región	País	Ciudad	Mill. Viajes/Día Trns. Público				Viajes diarios / Población	Peso (%)	Viajes diarios / Población
Europa	España	Barcelona	2,995				0,587	38,53%	0,60
		Madrid	4,520				0,675	49,85%	
		Valencia	0,528				0,293	11,62%	
	Italia	Milán	2,342				0,427	53,83%	0,59
		Roma	3,596				1,119	31,52%	
		Turín	0,126				0,084	14,65%	
	Francia	Marsella	0,499				0,361	10,34%	0,47
		Nantes	0,321				0,355	6,78%	
		París	5,426				0,491	82,88%	
	Alemania	Berlín	2,847				0,710	49,72%	0,67
		Hamburgo	1,207				0,598	25,02%	
		Múnich	1,343				0,659	25,26%	
Reino Unido	Glasgow	0,343				0,270	8,30%	0,67	
	Londres	9,603				0,853	73,61%		
	Manchester	0,282				0,102	18,09%		
Asia	China	Pekín	19,098				1,031	37,01%	0,79
		Hong Kong (SAR)	7,402				0,994	14,89%	
		Shangái	12,854				0,534	48,10%	
	India	Bangalore	4,940				0,321	21,20%	0,20
		Delhi	4,952				0,154	44,40%	
		Mumbai	4,887				0,196	34,41%	
	Japón	Tokio	9,242				0,245	100,00%	0,24
Corea Sur	Seúl	11,165				0,485	100,00%	0,49	
Oceanía	Australia	Melbourne	1,293				0,274	100,00%	0,27
África	Sudáfrica	Johannesburgo	7,003				0,480	100,00%	0,48
	Egipto	El Cairo	3,751				0,185	100,00%	0,18
Norteamérica	Canada	Toronto	2,675				0,395	73,35%	0,41
		Vancouver	1,110				0,451	26,65%	
	EE.UU.	Chicago	1,610				0,178	23,71%	0,25
		Nueva York	6,863				0,319	56,31%	
		Washington DC	1,128				0,148	19,98%	
Sudamérica	Brasil	Curitiba	4,340				1,349	12,23%	0,83
		São Paulo	17,414				0,754	87,77%	
Colombia	Bogotá	2,739				0,272	100,00%	0,27	

Fuente: España: Observatorio de la Movilidad Urbana. Informe 2019 y avance 2020. Resto del mundo: WB.

Viajes diarios en Transporte público / superficie									
Región	País	Ciudad					Viajes diarios /superficie	Peso (%)	Viajes diarios /superficie
Europa	España	Barcelona					4,724	38,53%	4,47
		Madrid					4,918	49,85%	
		Valencia					1,725	11,62%	
	Italia	Milán					1,239	53,83%	1,73
		Roma					3,228	31,52%	
		Turín					0,334	14,65%	
	Francia	Marsella					0,724	10,34%	1,67
		Nantes					0,274	6,78%	
		París					1,907	82,88%	
	Alemania	Berlín					2,114	49,72%	2,17
		Hamburgo					1,554	25,02%	
		Múnich					2,883	25,26%	
Reino Unido	Glasgow					0,932	8,30%	4,23	
	Londres					5,525	73,61%		
	Manchester					0,448	18,09%		
Asia	China	Pekín					4,609	37,01%	7,11
		Hong Kong (SAR)					25,973	14,89%	
		Shangái					3,201	48,10%	
	India	Bangalore					4,237	21,20%	3,81
		Delhi					2,249	44,40%	
		Mumbai					5,547	34,41%	
	Japón	Tokio					1,081	100,00%	1,08
Corea Sur	Seúl					4,068	100,00%	4,07	
Oceanía	Australia	Melbourne				0,478	100,00%	0,48	
África	Sudáfrica	Johannesburgo					2,704	100,00%	2,70
	Egipto	El Cairo					1,957	100,00%	1,96
Norteamérica	Canada	Toronto					1,163	73,35%	1,19
		Vancouver					1,267	26,65%	
	EE.UU.	Chicago					0,235	23,71%	0,45
		Nueva York					0,578	56,31%	
Washington DC						0,329	19,98%		
Sudamérica	Brasil	Curitiba					5,154	12,23%	5,65
		São Paulo					5,723	87,77%	
	Colombia	Bogotá					4,873	100,00%	4,87

Fuente: España: Observatorio de la Movilidad Urbana. Informe 2019 y avance 2020. Resto del mundo: WB.



DB TPU CIUDADES 4			Nº de buses (Capacidad: 40 pasaj./Bus); Nº de Vagones (Capacidad: 130 pasaj./Vagón)						
Capacidad respecto a los viajes diarios									
Región	País	Ciudad	Nº Buses 40 Pasaj./ Bus	Nº Vagones 130 Pasj./Vagón	Capacidad Total (Oferta) Nº pasajeros	Capacidad/ Viaj. Diar.	Peso Ciudad (%)	Capacidad/ Viaj. Diar.	
Europa	España	Barcelona	2.747	1.911	358.310	0,120	38,53%	0,13	
		Madrid	4.139	3.514	622.380	0,138	49,85%		
		Valencia	605	471	85.430	0,162	11,62%		
	Italia	Milán	1.505	1.451	248.830	0,106	53,83%	0,18	
		Roma	2.092	812	189.240	0,053	31,52%		
		Turín	1.200	346	92.980	0,740	14,65%		
	Francia	Marsella	595	170	45.900	0,092	10,34%	0,21	
		Nantes	319	283	49.530	0,154	6,78%		
		París	4.158	8.445	1.264.170	0,233	82,88%		
	Alemania	Berlín	1.790	3.501	526.710	0,185	49,72%	0,18	
		Hamburgo	723	1.277	194.930	0,161	25,02%		
		Múnich	423	1.614	226.740	0,169	25,26%		
Reino Unido	Glasgow	1.277	400	103.060	0,301	8,30%	0,19		
	Londres	8.360	8.871	1.487.610	0,155	73,61%			
	Manchester	1.794	32	75.900	0,269	18,09%			
Asia	China	Pekín	21.548	2.463	1.182.110	0,062	37,01%	0,07	
		Hong Kong (SAR)	6.000	2.026	503.380	0,068	14,89%		
		Shangái	17.455	2.869	1.071.170	0,083	48,10%		
	India	Bangalore	6.381	80	265.640	0,054	21,20%	0,07	
		Delhi	4.330	966	298.780	0,060	44,40%		
		Mumbai	3.391	2.226	425.020	0,087	34,41%		
Japón	Tokio	1.462	20.223	2.687.470	0,291	100,00%	0,29		
Corea Sur	Seúl	17.608	5.454	1.413.340	0,127	100,00%	0,13		
Oceanía	Australia	Melbourne	1.460	1.705	279.988	0,217	100,00%	0,22	
África	Sudáfrica	Johannesburgo	14.736	1.757	817.850	0,117	100,00%	0,12	
	Egipto	El Cairo	5.136	805	310.090	0,083	100,00%	0,08	
Norteamérica	Canada	Toronto	1.819	1.517	269.970	0,101	73,35%	0,09	
		Vancouver	1.116	295	82.990	0,075	26,65%		
	EE.UU.	Chicago	1.781	2.210	358.540	0,223	23,71%	0,20	
		Nueva York	5.982	8.628	1.360.920	0,198	56,31%		
		Washington DC	1.492	1.301	228.810	0,203	19,98%		
Sudamérica	Brasil	Curitiba	2.755		110.180	0,025	12,23%	0,05	
		São Paulo	16.966	1.541	878.950	0,050	87,77%		
	Colombia	Bogotá	13.454		538.160	0,196	100,00%	0,20	

Fuente: España: Observatorio de la Movilidad Urbana. Informe 2019 y avance 2020. Resto del mundo: WB.

Capacidad respecto a la población								
Región	País	Ciudad				Capacidad/ Poblac.	Peso (%)	Capacidad/ Poblac.
Europa	España	Barcelona				0,070	38,53%	0,08
		Madrid				0,093	49,85%	
		Valencia				0,047	11,62%	
	Italia	Milán				0,045	53,83%	0,05
		Roma				0,059	31,52%	
		Turín				0,062	14,65%	
	Francia	Marsella				0,033	10,34%	0,10
		Nantes				0,055	6,78%	
		París				0,114	82,88%	
	Alemania	Berlín				0,131	49,72%	0,12
		Hamburgo				0,097	25,02%	
		Múnich				0,111	25,26%	
Reino Unido	Glasgow				0,081	8,30%	0,11	
	Londres				0,132	73,61%		
	Manchester				0,027	18,09%		
Asia	China	Pekín				0,064	37,01%	0,06
		Hong Kong (SAR)				0,068	14,89%	
		Shangái				0,044	48,10%	
	India	Bangalore				0,017	21,20%	0,01
		Delhi				0,009	44,40%	
		Mumbai				0,017	34,41%	
Japón	Tokio				0,071	100,00%	0,07	
Corea Sur	Seúl				0,061	100,00%	0,06	
Oceanía	Australia	Melbourne				0,059	100,00%	0,06
África	Sudáfrica	Johannesburgo				0,056	100,00%	0,06
	Egipto	El Cairo				0,015	100,00%	0,02
Norteamérica	Canada	Toronto				0,040	73,35%	0,04
		Vancouver				0,034	26,65%	
	EE.UU.	Chicago				0,040	23,71%	0,05
		Nueva York				0,063	56,31%	
Sudamérica	Brasil	Curitiba				0,034	12,23%	0,04
		São Paulo				0,038	87,77%	
	Colombia	Bogotá				0,053	100,00%	0,05

Fuente: España: Observatorio de la Movilidad Urbana. Informe 2019 y avance 2020. Resto del mundo: WB.



Capacidad del Transp. Público con respecto a la superficie									
Región	País	Ciudad					Capacidad / Superficie	Peso (%)	Capacidad / Superficie
Europa	España	Barcelona					565,158	38,53%	587,79
		Madrid					677,236	49,85%	
		Valencia					279,183	11,62%	
	Italia	Milán					131,586	53,83%	160,61
		Roma					169,874	31,52%	
		Turín					247,287	14,65%	
	Francia	Marsella					66,618	10,34%	378,02
		Nantes					42,225	6,78%	
		París					444,348	82,88%	
	Alemania	Berlín					391,024	49,72%	380,09
		Hamburgo					250,875	25,02%	
		Múnich					486,567	25,26%	
Reino Unido	Glasgow					280,054	8,30%	675,11	
	Londres					855,932	73,61%		
	Manchester					120,476	18,09%		
Asia	China	Pekín				285,258	37,01%	496,84	
		Hong Kong (SAR)				1.766,246	14,89%		
		Shangái				266,792	48,10%		
	India	Bangalore					227,822	21,20%	274,51
		Delhi					135,686	44,40%	
		Mumbai					482,429	34,41%	
Japón	Tokio					314,434	100,00%	314,43	
	Corea Sur	Seúl				514,878	100,00%		
Oceanía	Australia	Melbourne				103,507	100,00%	103,51	
África	Sudáfrica	Johannesburgo				315,772	100,00%	315,77	
	Egipto	El Cairo				161,758	100,00%	161,76	
Norteamérica	Canada	Toronto				117,378	73,35%	111,34	
		Vancouver				94,737	26,65%		
	EE.UU.	Chicago					52,296	23,71%	90,28
		Nueva York					114,604	56,31%	
Sudamérica	Brasil	Curitiba				130,855	12,23%	269,52	
		São Paulo				288,843	87,77%		
	Colombia	Bogotá				957,580	100,00%	957,58	

Fuente: España: Observatorio de la Movilidad Urbana. Informe 2019 y avance 2020. Resto del mundo: WB.



4.1.1. Capacity Indicators

4.1.1.1 Indicator C.1: Use of public transport. Daily trips / Population

TPU C.1	Uso del transporte público. Viajes diarios / Población					
	2010	2015	2016	2017	2018	2019
España						0,60
Alemania						0,67
Francia						0,47
Reino Unido						0,67
Italia						0,59
EEUU						0,25
Brasil						0,83
Colombia						0,27
Canadá						0,41
Egipto						0,18
Sudáfrica						0,48
Japón						0,24
China						0,79
India						0,20
Corea del Sur						0,49
Australia						0,27
Maximo:		0,83	MAX ((Media+Factor max*Desv Est.):		0,78	10
Mínimo:		0,18	MIN ((Media-Factor min *Desv);0):		0,15	1
Media:		0,46		Percentil 90%:	0,73	9
Media+Factor max*Desv Estándar:		0,78		Percentil 10%:	0,22	Unidad: 14,19
Media-Factor min*Desv Estándar:		0,15		Desv. Est.:	0,21	

Table 17: Indicator C.1 Values: Use of public transport. Daily trips / Population

TPU C.1	Uso del transporte público. Viajes diarios / Población					Calificación 2019	
	2010	2015	2016	2017	2018		
España						7,4	BIEN C
Alemania						8,4	MUY BIEN B
Francia						5,6	SUFICIENTE E
Reino Unido						8,4	MUY BIEN B
Italia						7,4	BIEN C
EEUU						2,5	MUY INSUFICIENTE F
Brasil						10,0	EXCELENTE A
Colombia						2,8	MUY INSUFICIENTE F
Canadá						4,7	INSUFICIENTE FX
Egipto						1,5	MUY INSUFICIENTE F
Sudáfrica						5,7	SUFICIENTE E
Japón						2,4	MUY INSUFICIENTE F
China						10,0	EXCELENTE A
India						1,8	MUY INSUFICIENTE F
Corea del Sur						5,8	SUFICIENTE E
Australia						2,8	MUY INSUFICIENTE F

Table 18: Indicator C.1 Rating: Use of public transport. Daily trips / Population



4.1.1.2 *Indicator C.2: Use of public transport. Daily trips / Area*

TPU C.2	Uso del transporte público. Viajes diarios / Superficie					
	2010	2015	2016	2017	2018	2019
España						4,472
Alemania						2,168
Francia						1,674
Reino Unido						4,226
Italia						1,733
EEUU						0,447
Brasil						5,653
Colombia						4,873
Canadá						1,191
Egipto						1,957
Sudáfrica						2,704
Japón						1,081
China						7,112
India						3,805
Corea del Sur						4,068
Australia						0,478
Maximo:		7,11	MAX ((Media+Factor max*Desv Est.):		5,93	10
Mínimo:		0,45	MIN ((Media-Factor min *Desv),0):		0,03	1
Media:		2,98	Percentil 90%:	5,26	5,90	9
Media+Factor max*Desv Estándar:		5,93	Percentil 10%:	0,78	Unidad:	1,53
Media-Factor min*Desv Estándar:		0,03		Desv. Est.:	1,97	

Table 19: Indicator C.2 Values: Use of public transport. Daily trips / Area

TPU C.2	Uso del transporte público. Viajes diarios / Superficie					Calificación 2019		
	2010	2015	2016	2017	2018			
España						7,8	BIEN	C
Alemania						4,3	INSUFICIENTE	FX
Francia						3,5	INSUFICIENTE	FX
Reino Unido						7,4	BIEN	C
Italia						3,6	INSUFICIENTE	FX
EEUU						1,6	MUY INSUFICIENTE	F
Brasil						9,6	EXCELENTE	A
Colombia						8,4	MUY BIEN	B
Canadá						2,8	MUY INSUFICIENTE	F
Egipto						3,9	INSUFICIENTE	FX
Sudáfrica						5,1	SUFICIENTE	E
Japón						2,6	MUY INSUFICIENTE	F
China						10,0	EXCELENTE	A
India						6,8	SUFICIENTE ALTO	D
Corea del Sur						7,2	BIEN	C
Australia						1,7	MUY INSUFICIENTE	F

Table 20: Indicator C.2 Rating: Use of public transport. Daily trips / Area



4.1.1.3 *Indicator C.3: Capacity (Buses + Train cars) / Daily trips*

TPU C.3	Capacidad (Buses+Vagones) / Viajes diarios					
	2010	2015	2016	2017	2018	2019
España						0,134
Alemania						0,175
Francia						0,213
Reino Unido						0,188
Italia						0,182
EEUU						0,205
Brasil						0,047
Colombia						0,196
Canadá						0,094
Egipto						0,083
Sudáfrica						0,117
Japón						0,291
China						0,073
India						0,068
Corea del Sur						0,127
Australia						0,217
Maximo:		0,29	MAX ((Media+Factor max*Desv Est.):		0,25	10
Mínimo:		0,05	MIN ((Media-Factor min *Desv);0):		0,05	1
Media:		0,15	Percentil 90%:	0,21	0,20	9
Media+Factor max*Desv Estándar:		0,25	Percentil 10%:	0,07	Unidad:	44,16
Media-Factor min*Desv Estándar:		0,05		Desv. Est.:	0,07	

Table 21: Indicator C.3 Values: Capacity (Buses + Train cars) / Daily trips

TPU C.3	Capacidad (Buses+Vagones) / Viajes diarios						Calificación 2019	
	2010	2015	2016	2017	2018			
España						4,7	INSUFICIENTE	FX
Alemania						6,6	SUFICIENTE ALTO	D
Francia						8,3	MUY BIEN	B
Reino Unido						7,1	BIEN	C
Italia						6,9	SUFICIENTE ALTO	D
EEUU						7,9	BIEN	C
Brasil						1,0	MUY INSUFICIENTE	F
Colombia						7,5	BIEN	C
Canadá						3,0	INSUFICIENTE	FX
Egipto						2,5	MUY INSUFICIENTE	F
Sudáfrica						4,0	INSUFICIENTE	FX
Japón						10,0	EXCELENTE	A
China						2,1	MUY INSUFICIENTE	F
India						1,9	MUY INSUFICIENTE	F
Corea del Sur						4,4	INSUFICIENTE	FX
Australia						8,4	MUY BIEN	B

Table 22: Indicator C.3 Indicator: Capacity (Buses + Train cars) / Daily trips



4.1.1.4 Indicator C.4: Capacity (Buses + Train cars) / Population

TPU C.4	Capacidad (Buses+Vagones) / Población					
	2010	2015	2016	2017	2018	2019
España						0,079
Alemania						0,118
Francia						0,102
Reino Unido						0,109
Italia						0,052
EEUU						0,051
Brasil						0,038
Colombia						0,053
Canadá						0,038
Egipto						0,015
Sudáfrica						0,056
Japón						0,071
China						0,055
India						0,014
Corea del Sur						0,061
Australia						0,059
Maximo:		0,12	MAX ((Media+Factor max*Desv Est.):		0,11	10
Mínimo:		0,01	MIN ((Media-Factor min *Desv);0):		0,02	1
Media:		0,06	Percentil 90%:	0,11	0,09	9
Media+Factor max*Desv Estándar:		0,11	Percentil 10%:	0,03	Unidad:	100,79
Media-Factor min*Desv Estándar:		0,02		Desv. Est.:	0,03	

Table 23: Indicator C.4 Values: Capacity (Buses + Train cars) / Population

TPU C.4	Capacidad (Buses+Vagones) / Población						Calificación 2019	
	2010	2015	2016	2017	2018			
España						7,3	BIEN	C
Alemania						10,0	EXCELENTE	A
Francia						9,6	EXCELENTE	A
Reino Unido						10,0	EXCELENTE	A
Italia						4,6	INSUFICIENTE	FX
EEUU						4,5	INSUFICIENTE	FX
Brasil						3,2	INSUFICIENTE	FX
Colombia						4,8	INSUFICIENTE	FX
Canadá						3,2	INSUFICIENTE	FX
Egipto						1,0	MUY INSUFICIENTE	F
Sudáfrica						5,0	SUFICIENTE	E
Japón						6,6	SUFICIENTE ALTO	D
China						4,9	INSUFICIENTE	FX
India						1,0	MUY INSUFICIENTE	F
Corea del Sur						5,6	SUFICIENTE	E
Australia						5,4	SUFICIENTE	E

Table 24: Indicator C.4 Rating: Capacity (Buses + Train cars) / Population



4.1.1.5 Indicador C.5: Capacity (Buses + Train cars) / Area

TPU C.5	Capacidad (Buses+Vagones) / superficie					
	2010	2015	2016	2017	2018	2019
España						587,794
Alemania						380,088
Francia						378,017
Reino Unido						675,112
Italia						160,609
EEUU						90,285
Brasil						269,515
Colombia						957,580
Canadá						111,345
Egipto						161,758
Sudáfrica						315,772
Japón						314,434
China						496,844
India						274,514
Corea del Sur						514,878
Australia						103,507
Maximo:		957,58	MAX ((Media+Factor max*Desv Est.):		719,20	10
Mínimo:		90,28	MIN ((Media-Factor min *Desv);0):		4,80	1
Media:		362,00	Percentil 90%:	631,45	714,40	9
Media+Factor max*Desv Estándar:		719,20	Percentil 10%:	107,43	Unidad:	0,01
Media-Factor min*Desv Estándar:		4,80		Desv. Est.:	238,13	

Table 25: Indicator C.5 Values: Capacity (Buses + Train cars) / Area

TPU C.5	Capacidad (Buses+Vagones) / superficie						Calificación 2019	
	2010	2015	2016	2017	2018			
España						8,3	MUY BIEN	B
Alemania						5,7	SUFICIENTE	E
Francia						5,7	SUFICIENTE	E
Reino Unido						9,4	EXCELENTE	A
Italia						3,0	INSUFICIENTE	FX
EEUU						2,1	MUY INSUFICIENTE	F
Brasil						4,3	INSUFICIENTE	FX
Colombia						10,0	EXCELENTE	A
Canadá						2,3	MUY INSUFICIENTE	F
Egipto						3,0	INSUFICIENTE	FX
Sudáfrica						4,9	INSUFICIENTE	FX
Japón						4,9	INSUFICIENTE	FX
China						7,2	BIEN	C
India						4,4	INSUFICIENTE	FX
Corea del Sur						7,4	BIEN	C
Australia						2,2	MUY INSUFICIENTE	F

Table 26: Indicator C.5 Rating: Capacity (Buses + Train cars) / Area



4.1.2. Capacity Indicator

	Índice de Capacidad						Max valor 2019
	2010	2015	2016	2017	2018	2019	
España						35,6	45
Alemania						35,0	45
Francia						32,7	45
Reino Unido						42,4	45
Italia						25,5	45
EEUU						18,6	45
Brasil						28,1	45
Colombia						33,5	45
Canadá						16,1	45
Egipto						12,0	45
Sudáfrica						24,8	45
Japón						26,5	45
China						34,2	45
India						15,8	45
Corea del Sur						30,4	45
Australia						20,5	45
Maximo:		42,397	Máximo Valor:		VER TABLA	10	
Mínimo:		11,966	MIN:		0	0	
Media:		26,972				10,000	

Table 27: Capacity Indicator Values

	Evaluación de Capacidad						Subindicadores considerados		
	2010	2015	2016	2017	2018	Calificación 2019			
España						7,9	BIEN	C	5
Alemania						7,8	BIEN	C	5
Francia						7,3	BIEN	C	5
Reino Unido						9,4	EXCELENTE	A	5
Italia						5,7	SUFICIENTE	E	5
EEUU						4,1	INSUFICIENTE	FX	5
Brasil						6,2	SUFICIENTE ALTO	D	5
Colombia						7,4	BIEN	C	5
Canadá						3,6	INSUFICIENTE	FX	5
Egipto						2,7	MUY INSUFICIENTE	F	5
Sudáfrica						5,5	SUFICIENTE	E	5
Japón						5,9	SUFICIENTE	E	5
China						7,6	BIEN	C	5
India						3,5	INSUFICIENTE	FX	5
Corea del Sur						6,8	SUFICIENTE ALTO	D	5
Australia						4,6	INSUFICIENTE	FX	5

Table 28: Capacity Criterion Rating

Subindicadores de Capacidad		Pesos	Punt. Max.	Total Max puntuación
TPU C.1	Uso del transporte público. Viajes diarios / Población	1	10	10
TPU C.2	Uso del transporte público. Viajes diarios / Superficie	1	10	10
TPU C.3	Capacidad (Buses+Vagones) / Viajes diarios	1	10	10
TPU C.4	Capacidad (Buses+Vagones) / Población	1	10	10
TPU C.5	Capacidad (Buses+Vagones) / superficie	1	10	10
		5		50
		% Valorado de la Max. Puntuación del Criterio	90,0%	45

Table 29: Weights and reduced maximum scores of the Capacity Indicators



The first two indicators evaluate the average number of daily passengers across all modes of public transport in relation to the population and surface area. Two ratios have been considered: daily trips per population, which provides an indicator of the number of trips per inhabitant; and daily trips per urbanized surface area of the metropolitan area.

The data on the number of trips have been obtained from the World Bank database, with older data updated to the current situation and supplemented with missing data through consultation of the websites of service operators and their annual reports. In the case of Spain, data from the Urban Mobility Observatory has been used again.

The "daily trips/population" indicator has an average value of 0.46, with a maximum of 0.83 (Brazil) and a minimum of 0.18 (Egypt). Spain (0.6), above the average, is aligned with other European countries, similar to Italy (0.59), lower than Germany and the United Kingdom (0.67), and higher than France (0.47). The "daily trips/surface area (km²)" indicator has an average value of 2.98. Spain, along with the United Kingdom, has the highest value in the EU (4.47).

The following indicators refer to the existing supply of transport and its relative capacity to meet this demand. The selected indicators are related to the average capacity of public transport services in relation to trips, population, and surface area.

The capacity ratio (buses and train carriages) per daily trips has an average value of 0.15. In European countries, it is higher: between 0.13 (Spain) and 0.21 (France). A lower value of this indicator indicates that there may be excess capacity or that the provision of public transport vehicles is sized to accommodate more passengers (which can be due to a concentration of trips during peak hours).

The next two ratios: "Capacity/population" and "capacity/surface area" also show favorable ratios for Spain.

The final rating of the Capacity criterion indicator rates the United Kingdom as Excellent; Spain, Germany, France, Colombia, and China as Good; High Sufficient for Brazil and South Korea; Insufficient for the USA, Canada, India, and Australia; and Very Insufficient for Egypt.



4.2. Performance

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

The selected indicators for this criterion are as follows:

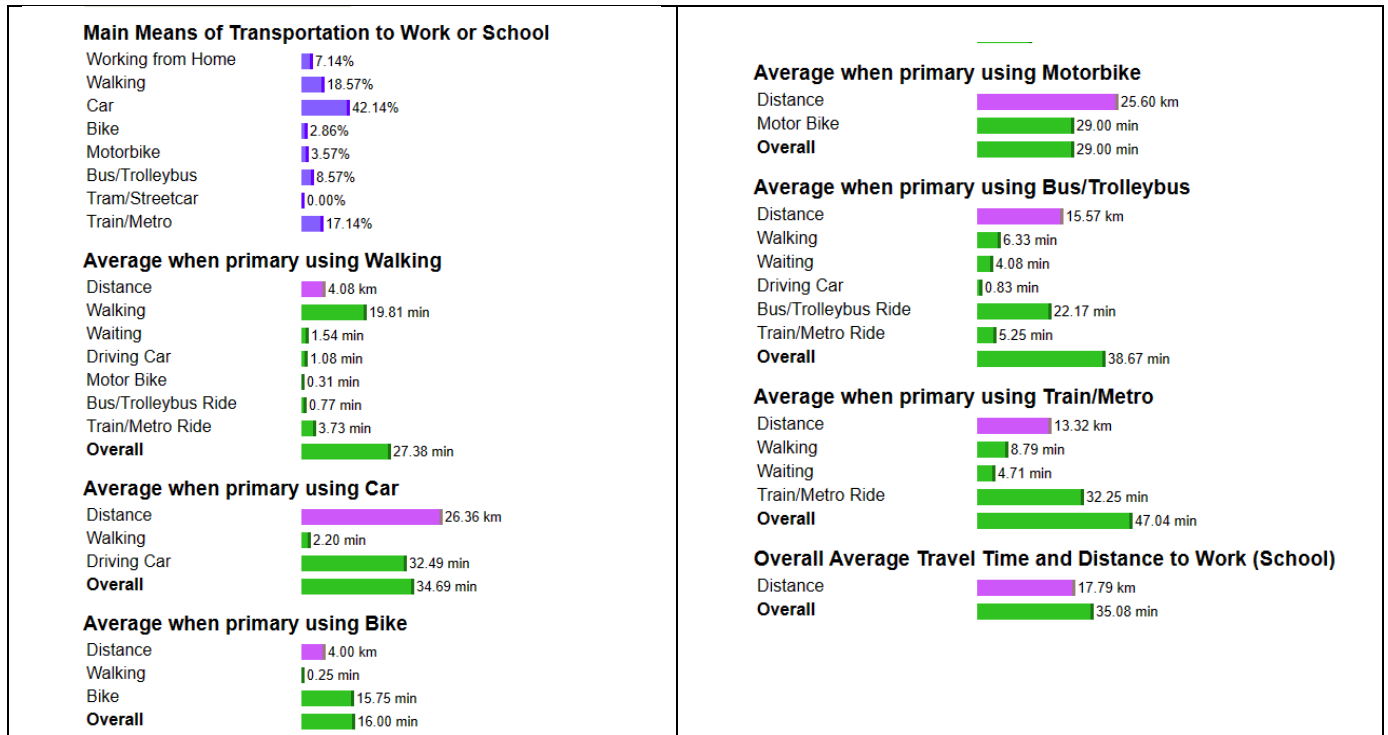
2 PERFORMANCE	
P.1	Average travel speed (km/h)
P.2	public transport trips / Motorized trips
P.3	% of population with convenient access to Public Transport (SDG 11.2.1)
P.4	Network length (km) / City Area (KM2)
P.5	Absolute accessibility to public transport within the metropolitan area in 15 minutes
P.6	Absolute bicycle accessibility within the metropolitan area in 15 minutes. OECD
P.7	Absolute walking accessibility within the metropolitan area in 15 minutes. OECD
P.8	Traffic index (Numbeo)
P.9	Time index (Numbeo)
P.10	Dissatisfaction index (Numbeo)
P.11	Inefficiency index (Numbeo)

The average length of trips in public transportation and their duration is a good indicator to analyze the use of public transport.

The indicator "Public transport trips/motorized transport trips" shows the percentage of journeys made by public transport compared to those made by private transport. The indicator "Length of network/city area" indicates the density of the public transport network. The accessibility indicators for public transport, cycling, and walking show the ease with which citizens can access different places in the city.

The NUMBEO indicators: average trip length, average travel time, traffic index, time index, dissatisfaction index, and inefficiency index also demonstrate the effectiveness of public transport provision. This organization provides disaggregated data on various aspects of quality of life in major cities in each country, including aspects related to traffic, public transport, pollution, etc.





In the following tables, the basic data of the indicators and their calculation are presented.

DB TPU CIUDADES 6		Longitud de viaje (media en km) y Tiempo de viaje (medio en km/h)						
		Velocidad de viaje media (km / h)						
Región	País	Ciudad	Longitud media de viaje (km)	Tiempo medio de viaje (min)		Velocidad de km / h	Peso (%)	Velocidad de viaje km / h
Europa	España	Barcelona	9,5	30		19	38,53%	25,82
		Madrid	17,8	35		31	49,85%	
		Valencia	11,2	25		27	11,62%	
	Italia	Milán	9,2	27		21	53,83%	21,57
		Roma	13,2	32		25	31,52%	
		Turín	7,1	24		18	14,65%	
	Francia	Marsella	7,5	16		28	10,34%	21,83
		Nantes	10,2	19		33	6,78%	
		París	11,3	34		20	82,88%	
	Alemania	Berlín	16,0	30		32	49,72%	32,93
		Hamburgo	15,6	28		34	25,02%	
		Múnich	15,4	27		35	25,26%	
Reino Unido	Glasgow	13,7	26		32	8,30%	12,18	
	Londres	5,0	37		8	73,61%		
	Manchester	8,6	26		20	18,09%		
Asia	China	Pekín	13,0	52		15	37,01%	13,42
		Hong Kong (SAR)	7,8	20		24	14,89%	
		Shangái	7,0	47		9	48,10%	
	India	Bangalore	9,6	32		18	21,20%	20,80
		Delhi	10,2	30		20	44,40%	
		Mumbai	14,2	37		23	34,41%	
Japón	Tokio	12,2	33		22	100,00%	22,18	
Corea Sur	Seúl	11,4	27		25	100,00%	25,33	
Oceanía	Australia	Melbourne	8,7	27		19	100,00%	19,33
África	Sudáfrica	Johannesburgo	18,9	51		22	100,00%	22,24
	Egipto	El Cairo	6,3	47		8	100,00%	8,13
Norteamérica	Canada	Toronto	12,0	40		18	73,35%	16,78
		Vancouver	7,5	34		13	26,65%	
	EE.UU.	Chicago	12,6	34		23	23,71%	24,73
		Nueva York Washington DC	14,1 17,7	39 29		22 36	56,31% 19,98%	
Sudamérica	Brasil	Curitiba	12,2	31		24	12,23%	23,60
		São Paulo	17,7	45		24	87,77%	
	Colombia	Bogotá	9,1	69		8	100,00%	7,91

Fuente: NUMBEO. <https://www.numbeo.com/traffic/>



DB TPU CIUDADES 7		% de viajes en modos motorizados; % de viajes en transporte público motorizado						
% Viajes en Trans. Público / Viajes en modos motorizados								
Región	País	Ciudad	Viajes en usos motorizados (%)	Viajes en TP (%)		Viajes en Trans. / Viajes	Peso (%)	Viajes en Trans. / Viajes motorizados
Europa	España	Barcelona	74,2%	43,1%		58,1%	38,53%	51,5%
		Madrid	83,2%	42,7%		51,3%	49,85%	
		Valencia	79,1%	24,0%		30,3%	11,62%	
	Italia	Milán	86,7%	19,9%		22,9%	53,83%	22,0%
		Roma	91,8%	20,6%		22,5%	31,52%	
		Turín	87,8%	15,3%		17,4%	14,65%	
	Francia	Marsella	85,6%	10,8%		12,6%	10,34%	58,7%
		Nantes	90,0%	9,4%		10,4%	6,78%	
		París	83,2%	56,9%		68,4%	82,88%	
	Alemania	Berlín	82,3%	32,0%		38,9%	49,72%	37,7%
		Hamburgo	83,3%	28,1%		33,7%	25,02%	
		Múnich	83,4%	32,9%		39,4%	25,26%	
Reino Unido	Glasgow	97,0%	38,0%		39,2%	8,30%	38,7%	
	Londres	67,6%	28,0%		41,4%	73,61%		
	Manchester	97,4%	26,8%		27,5%	18,09%		
Asia	China	Pekín	47,0%	23,0%		48,9%	37,01%	60,6%
		Hong Kong (SAR)	88,9%	75,1%		84,5%	14,89%	
		Shangái	53,0%	33,0%		62,3%	48,10%	
	India	Bangalore	67,0%	35,0%		52,2%	21,20%	52,2%
		Delhi	79,0%	32,0%		40,5%	44,40%	
		Mumbai	67,0%	45,0%		67,2%	34,41%	
Japón	Tokio	63,0%	51,0%		81,0%	100,00%	81,0%	
Corea Sur	Seúl	70,0%	63,0%		90,0%	100,00%	90,0%	
Oceania	Australia	Melbourne	85,0%	7,0%		8,2%	100,00%	8,2%
África	Sudáfrica	Johannesburgo	88,0%	14,0%		15,9%	100,00%	15,9%
	Egipto	El Cairo	95,0%	40,0%		42,1%	100,00%	42,1%
Norteamérica	Canada	Toronto	92,0%	24,0%		26,1%	73,35%	24,1%
		Vancouver	92,0%	17,0%		18,5%	26,65%	
	EE.UU.	Chicago	96,3%	11,2%		11,6%	23,71%	24,1%
		Nueva York Washington DC	93,6% 96,0%	30,6% 14,0%		32,7% 14,6%	56,31% 19,98%	
Sudamérica	Brasil	Curitiba	58,2%	27,9%		47,9%	12,23%	50,8%
		São Paulo	64,6%	33,1%		51,2%	87,77%	
	Colombia	Bogotá	81,9%	57,0%		69,6%	100,00%	69,6%

Fuente: España: Observatorio de la Movilidad Urbana. Informe 2019 y avance 2020. Resto del mundo: WB.

DB TPU CIUDADES 2		% de la población que tiene acceso conveniente al Trans. Público (SDG 11.2.1)						
% de la población que tiene acceso conveniente al Trans. Público (SDG 11.2.1)								
Región	País	Ciudad				% Población	Peso (%)	% Población
Europa	España	Barcelona				99,7	38,5%	97,70
		Madrid				98,4	49,9%	
		Valencia				88,0	11,6%	
	Italia	Milán				77,7	53,8%	86,49
		Roma				96,1	31,5%	
		Turín				98,0	14,7%	
	Francia	Marsella				94,4	10,3%	97,30
		Nantes				97,3	6,8%	
		París				97,7	82,9%	
	Alemania	Berlín				92,9	49,7%	92,47
		Hamburgo				90,5	25,0%	
		Múnich				93,6	25,3%	
Reino Unido	Glasgow				94,8	8,3%	95,44	
	Londres				94,8	73,6%		
	Manchester				98,4	18,1%		
Asia	China	Pekín				47,4	37,0%	59,56
		Hong Kong (SAR)				98,8	14,9%	
		Shangái				56,8	48,1%	
	India	Bangalore				73,9	21,2%	74,58
		Delhi				70,0	44,4%	
		Mumbai				80,9	34,4%	
Japón	Tokio				74,0	100%	74,03	
Corea Sur	Seúl				80,0	100%	80,00	
Oceania	Australia	Melbourne				88,9	100%	88,91
África	Sudáfrica	Johannesburgo				20,8	100%	20,78
	Egipto	El Cairo				21,2	100%	21,24
Norteamérica	Canada	Toronto				93,6	73,4%	94,00
		Vancouver				95,1	26,6%	
	EE.UU.	Chicago				39,1	23,7%	60,59
		Nueva York Washington DC				69,8 60,0	56,3% 20,0%	
Sudamérica	Brasil	Curitiba				70,9	12,2%	70,11
		São Paulo				70,0	87,8%	
	Colombia	Bogotá				91,4	100%	91,41

Fuente: UN SDG <https://data.unhabitat.org/pages/urban-transport>



DB TPU CIUDADES 22		Accesibilidad absoluta en transp. Púlic. dentro del área metropolitana en 15 minutos (2018). OCDE							
Accesibilidad absoluta en transp. Púlic. dentro del área metropolitana en 15 minutos. OCDE									
Región	País	Ciudad	Accesib. en Transp.				Accesib. en Transp.	Peso (%)	Accesib. Absoluta en Transp. Público
Europa	España	Barcelona						0,00%	72.525
		Madrid	74.558				74.558	81,09%	
		Valencia	63.803				63.803	18,91%	
	Italia	Milán	16.404				16.404	53,83%	28.533
		Roma	50.891				50.891	31,52%	
		Turín	24.992				24.992	14,65%	
	Francia	Marsella	28.124				28.124	10,34%	73.771
		Nantes	18.099				18.099	6,78%	
		París	84.021				84.021	82,88%	
	Alemania	Berlín	50.298				50.298	66,52%	39.143
		Hamburgo	16.977				16.977	33,48%	
		Múnich						0,00%	
Reino Unido	Glasgow	10.363				10.363	8,30%	37.217	
	Londres	46.525				46.525	73,61%		
	Manchester	11.655				11.655	18,09%		
Asia	China	Pekín					37,01%	0	
		Hong Kong (SAR)					14,89%		
		Shangái					48,10%		
	India	Bangalore					21,20%	0,00	
		Delhi					44,40%		
		Mumbai					34,41%		
Japón	Tokio					100,00%	0,00		
Corea Sur	Seúl					100,00%	0,00		
Oceanía	Australia	Melbourne					100,00%	0,00	
África	Sudáfrica	Johannesburgo					100,00%	0,00	
	Egipto	El Cairo					100,00%	0,00	
Norteamérica	Canada	Toronto					73,35%	0,00	
		Vancouver					26,65%		
	EE.UU.	Chicago					23,71%	0,00	
		Nueva York Washington DC					56,31% 19,98%		
Sudamérica	Brasil	Curitiba					12,23%	0,00	
		São Paulo					87,77%		
	Colombia	Bogotá					100,00%	0,00	

Fuente: OCDE https://stats.oecd.org/BrandedView.aspx?oeed_bv_id=trsprt-data-en&doi=0ae92b30-en

DB TPU CIUDADES 23		Accesibilidad absoluta en bicicleta dentro del área metropolitana en 15 minutos (2018). OCDE							
Accesibilidad absoluta en bicicleta dentro del área metropolitana en 15 minutos. OCDE									
Región	País	Ciudad	Accesib. en bicicleta				Accesib. en bicicleta	Peso (%)	Accesib. Absoluta en bicicleta
Europa	España	Barcelona	258.137,000				258.137	38,53%	215.614
		Madrid	182.635				182.635	49,85%	
		Valencia	216.116				216.116	11,62%	
	Italia	Milán	110.229				110.229	53,83%	106.997
		Roma	78.615				78.615	31,52%	
		Turín	156.182				156.182	14,65%	
	Francia	Marsella	75.467				75.467	10,34%	190.442
		Nantes	50.826				50.826	6,78%	
		París	216.212				216.212	82,88%	
	Alemania	Berlín	125.539				125.539	49,72%	106.689
		Hamburgo	79.645				79.645	25,02%	
		Múnich	96.371,970				96.372	25,26%	
Reino Unido	Glasgow	46.623				46.623	8,30%	117.289	
	Londres	140.574				140.574	73,61%		
	Manchester	54.951				54.951	18,09%		
Asia	China	Pekín					37,01%	0	
		Hong Kong (SAR)					14,89%		
		Shangái					48,10%		
	India	Bangalore					21,20%	0,00	
		Delhi					44,40%		
		Mumbai					34,41%		
Japón	Tokio					100,00%	0,00		
Corea Sur	Seúl					100,00%	0,00		
Oceanía	Australia	Melbourne					100,00%	0,00	
África	Sudáfrica	Johannesburgo					100,00%	0,00	
	Egipto	El Cairo					100,00%	0,00	
Norteamérica	Canada	Toronto					73,35%	0,00	
		Vancouver					26,65%		
	EE.UU.	Chicago					23,71%	0,00	
		Nueva York Washington DC					56,31% 19,98%		
Sudamérica	Brasil	Curitiba					12,23%	0,00	
		São Paulo					87,77%		
	Colombia	Bogotá					100,00%	0,00	

Fuente: OCDE https://stats.oecd.org/BrandedView.aspx?oeed_bv_id=trsprt-data-en&doi=0ae92b30-en



DB TPU CIUDADES 24		Accesibilidad absoluta caminando dentro del área metropolitana en 15 minutos (2018). OCDE							
Accesibilidad absoluta caminando dentro del área metropolitana en 15 minutos. OCDE									
Región	País	Ciudad	Accesib. caminando				Accesib. caminando	Peso (%)	Accesib. Absoluta caminando
Europa	España	Barcelona	47.090,000				47.090	38,53%	41.258
		Madrid	37.862				37.862	49,85%	
		Valencia	36.489				36.489	11,62%	
	Italia	Milán	13.525				13.525	53,83%	15.213
		Roma	15.819				15.819	31,52%	
		Turín	20.107				20.107	14,65%	
	Francia	Marsella	13.845				13.845	10,34%	24.695
		Nantes	7.297				7.297	6,78%	
		París	27.472				27.472	82,88%	
	Alemania	Berlín	15.045				15.045	49,72%	13.027
		Hamburgo	9.895				9.895	25,02%	
		Múnich	12.157,000				12.157	25,26%	
Reino Unido	Glasgow	7.388				7.388	8,30%	12.880	
	Londres	14.741				14.741	73,61%		
	Manchester	7.826				7.826	18,09%		
Asia	China	Pekín					37,01%	0	
		Hong Kong (SAR)					14,89%		
		Shangái					48,10%		
	India	Bangalore					21,20%	0,00	
		Delhi					44,40%		
Mumbai						34,41%			
Japón	Tokio					100,00%			
Corea Sur	Seúl					100,00%			
Oceanía	Australia	Melbourne					100,00%		
África	Sudáfrica	Johannesburgo					100,00%		
	Egipto	El Cairo					100,00%		
Norteamérica	Canada	Toronto					73,35%	0,00	
		Vancouver					26,65%		
	EE.UU.	Chicago					23,71%	0,00	
		Nueva York					56,31%		
Washington DC						19,98%			
Sudamérica	Brasil	Curitiba					12,23%	0,00	
		São Paulo					87,77%		
	Colombia	Bogotá					100,00%		

Fuente: OCDE https://stats.oecd.org/BrandedView.aspx?oeed_bv_id=trsprt-data-en&doi=0ae92b30-en

DB TPU CIUDADES 30		Índice de insatisfacción (Numbeo)							
Índice de insatisfacción (Numbeo)									
Región	País	Ciudad	Índice de (Numbeo)				Índice de (Numbeo)	Peso (%)	Índice de (Numbeo)
Europa	España	Barcelona						38,53%	78,58
		Madrid					49,85%		
		Valencia					11,62%		
	Italia	Milán					53,83%	381,95	
		Roma					31,52%		
		Turín					14,65%		
	Francia	Marsella					10,34%	511,31	
		Nantes					6,78%		
		París					82,88%		
	Alemania	Berlín					49,72%	169,90	
		Hamburgo					25,02%		
		Múnich					25,26%		
Reino Unido	Glasgow					8,30%	480,32		
	Londres					73,61%			
	Manchester					18,09%			
Asia	China	Pekín					37,01%	1477,53	
		Hong Kong (SAR)					14,89%		
		Shangái					48,10%		
	India	Bangalore					21,20%	4180,15	
		Delhi					44,40%		
Mumbai						34,41%			
Japón	Tokio					100,00%	1807,84		
Corea Sur	Seúl					100,00%	1515,23		
Oceanía	Australia	Melbourne					100,00%	513,42	
África	Sudáfrica	Johannesburgo					100,00%	1389,66	
	Egipto	El Cairo					100,00%	5251,39	
Norteamérica	Canada	Toronto					73,35%	376,55	
		Vancouver					26,65%		
	EE.UU.	Chicago					23,71%	305,94	
		Nueva York					56,31%		
Washington DC						19,98%			
Sudamérica	Brasil	Curitiba					12,23%	1953,56	
		São Paulo					87,77%		
	Colombia	Bogotá					100,00%	5015,68	

Fuente: https://www.numbeo.com/traffic/rankings_by_country.jsp



DB TPU CIUDADES 28			Índice de tráfico (Numbeo)						
Región	País	Ciudad	Índice de tráfico (Numbeo)				Índice de tráfico (Numbeo)	Peso (%)	Índice de tráfico (Numbeo)
Europa	España	Barcelona						38,53%	106,28
		Madrid					49,85%		
		Valencia					11,62%		
	Italia	Milán						53,83%	130,90
		Roma						31,52%	
		Turín						14,65%	
	Francia	Marsella						10,34%	126,69
		Nantes						6,78%	
		París						82,88%	
	Alemania	Berlín						49,72%	104,76
		Hamburgo						25,02%	
		Múnich						25,26%	
Reino Unido	Glasgow						8,30%	132,74	
	Londres						73,61%		
	Manchester						18,09%		
Asia	China	Pekín						37,01%	148,94
		Hong Kong (SAR)					14,89%		
		Shangái						48,10%	
	India	Bangalore						21,20%	203,01
		Delhi						44,40%	
		Mumbai						34,41%	
Japón	Tokio						100,00%	137,27	
Corea Sur	Seúl						100,00%	143,04	
Oceanía	Australia	Melbourne					100,00%	147,00	
África	Sudáfrica	Johannesburgo					100,00%	190,39	
	Egipto	El Cairo					100,00%	230,67	
Norteamérica	Canada	Toronto						73,35%	139,22
		Vancouver						26,65%	
	EE.UU.	Chicago						23,71%	151,46
		Washington DC						56,31%	
Sudamérica	Brasil	Curitiba						12,23%	173,99
		São Paulo						87,77%	
	Colombia	Bogotá						100,00%	203,01

Fuente: https://www.numbeo.com/traffic/rankings_by_country.jsp

DB TPU CIUDADES 29			Índice de tiempo de viaje (Numbeo)						
Región	País	Ciudad	Índice de tiempo (Numbeo)				Índice de tiempo (Numbeo)	Peso (%)	Índice de tiempo (Numbeo)
Europa	España	Barcelona						38,53%	29,20
		Madrid					49,85%		
		Valencia					11,62%		
	Italia	Milán						53,83%	33,61
		Roma						31,52%	
		Turín						14,65%	
	Francia	Marsella						10,34%	34,67
		Nantes						6,78%	
		París						82,88%	
	Alemania	Berlín						49,72%	31,14
		Hamburgo						25,02%	
		Múnich						25,26%	
Reino Unido	Glasgow						8,30%	34,43	
	Londres						73,61%		
	Manchester						18,09%		
Asia	China	Pekín						37,01%	39,51
		Hong Kong (SAR)					14,89%		
		Shangái						48,10%	
	India	Bangalore						21,20%	46,40
		Delhi						44,40%	
		Mumbai						34,41%	
Japón	Tokio						100,00%	40,65	
Corea Sur	Seúl						100,00%	39,65	
Oceanía	Australia	Melbourne					100,00%	34,68	
África	Sudáfrica	Johannesburgo					100,00%	39,18	
	Egipto	El Cairo					100,00%	48,29	
Norteamérica	Canada	Toronto						73,35%	33,56
		Vancouver						26,65%	
	EE.UU.	Chicago						23,71%	32,88
		Washington DC						56,31%	
Sudamérica	Brasil	Curitiba						12,23%	41,11
		São Paulo						87,77%	
	Colombia	Bogotá						100,00%	47,90

Fuente: https://www.numbeo.com/traffic/rankings_by_country.jsp



4.2.1. Performance Indicators

4.2.1.1 Indicator P.1: Average travel speed (km/h)

TPU P.1	Velocidad media de viaje (km/h)					
	2010	2015	2016	2017	2018	2019
España						25,819
Alemania						32,930
Francia						21,826
Reino Unido						12,182
Italia						21,568
EEUU						24,729
Brasil						23,602
Colombia						7,913
Canadá						16,783
Egipto						8,129
Sudáfrica						22,235
Japón						22,182
China						13,423
India						20,795
Corea del Sur						25,333
Australia						19,333
Maximo:		32,93	MAX ((Media+Factor max*Desv Est.):		30,05	10
Mínimo:		7,91	MIN ((Media-Factor min *Desv),0):		9,80	1
Media:		19,92	Percentil 90%:	25,58	20,24	9
Media+Factor max*Desv Estándar:		30,05	Percentil 10%:	10,16	Unidad:	0,44
Media-Factor min*Desv Estándar:		9,80		Desv. Est.:	6,75	

Table 30: Indicator P.1 Values: Average travel speed (km/h)

TPU P.1	Velocidad media de viaje (km/h)						Calificación 2019	
	2010	2015	2016	2017	2018			
España						8,1	MUY BIEN	B
Alemania						10,0	EXCELENTE	A
Francia						6,3	SUFICIENTE ALTO	D
Reino Unido						2,1	MUY INSUFICIENTE	F
Italia						6,2	SUFICIENTE ALTO	D
EEUU						7,6	BIEN	C
Brasil						7,1	BIEN	C
Colombia						1,0	MUY INSUFICIENTE	F
Canadá						4,1	INSUFICIENTE	FX
Egipto						1,0	MUY INSUFICIENTE	F
Sudáfrica						6,5	SUFICIENTE ALTO	D
Japón						6,5	SUFICIENTE ALTO	D
China						2,6	MUY INSUFICIENTE	F
India						5,9	SUFICIENTE	E
Corea del Sur						7,9	BIEN	C
Australia						5,2	SUFICIENTE	E

Table 31: Indicator P.1 Rating: Average travel speed (km/h)



4.2.1.2 Indicador P.2: Public transport trips / Motorized trips

TPU P.2	Viajes en transporte público / Viajes en usos motorizados					
	2010	2015	2016	2017	2018	2019
España						0,515
Alemania						0,377
Francia						0,587
Reino Unido						0,387
Italia						0,220
EEUU						0,241
Brasil						0,508
Colombia						0,696
Canadá						0,241
Egipto						0,421
Sudáfrica						0,159
Japón						0,810
China						0,606
India						0,522
Corea del Sur						0,900
Australia						0,082
Maximo:		0,90	MAX ((Media+Factor max*Desv Est.):		0,80	10
Mínimo:		0,08	MIN ((Media-Factor min *Desv),0):		0,10	1
Media:		0,45	Percentil 90%:	0,75	0,70	9
Media+Factor max*Desv Estándar:		0,80	Percentil 10%:	0,19	Unidad:	12,84
Media-Factor min*Desv Estándar:		0,10		Desv. Est.:	0,23	

Table 32: Indicator P.2 Values: Public transport trips / Motorized trips

TPU P.2	Viajes en transporte público / Viajes en usos motorizados					Calificación 2019		
	2010	2015	2016	2017	2018			
España						6,3	SUFICIENTE ALTO	D
Alemania						4,5	INSUFICIENTE	FX
Francia						7,2	BIEN	C
Reino Unido						4,6	INSUFICIENTE	FX
Italia						2,5	MUY INSUFICIENTE	F
EEUU						2,8	MUY INSUFICIENTE	F
Brasil						6,2	SUFICIENTE ALTO	D
Colombia						8,6	MUY BIEN	B
Canadá						2,8	MUY INSUFICIENTE	F
Egipto						5,1	SUFICIENTE	E
Sudáfrica						1,7	MUY INSUFICIENTE	F
Japón						10,0	EXCELENTE	A
China						7,5	BIEN	C
India						6,4	SUFICIENTE ALTO	D
Corea del Sur						10,0	EXCELENTE	A
Australia						1,0	MUY INSUFICIENTE	F

Table 33: Indicator P.2 Rating: Public transport trips / Motorized trips



4.2.1.3 *Indicator P.3: % of population with convenient access to Public Transport (SDG 11.2.1)*

TPU P.3	% de la población que tiene acceso conveniente al Trans. Público (SDG 11.2.1)					
	2010	2015	2016	2017	2018	2019
España						97,699
Alemania						92,471
Francia						97,295
Reino Unido						95,439
Italia						86,494
EEUU						60,589
Brasil						70,105
Colombia						91,410
Canadá						94,000
Egipto						21,240
Sudáfrica						20,780
Japón						74,030
China						59,559
India						74,576
Corea del Sur						80,000
Australia						88,910
Maximo:		97,70	MAX :		100,00	10
Mínimo:		20,78	MIN ((Media-Factor min *Desv);0):		38,51	1
Media:		75,29	Percentil 90%:	96,37	61,49	9
Media+Factor max*Desv Estándar:		112,06	Percentil 10%:	40,40	Unidad:	0,15
Media-Factor min*Desv Estándar:		38,51		Desv. Est.:	24,52	

Table 34: Indicator P.3 Values: % of population with convenient access to Public Transport (SDG 11.2.1)

TPU P.3	% de la población que tiene acceso conveniente al Trans. Público (SDG 11.2.1)						Calificación 2019		
	2010	2015	2016	2017	2018				
España						9,7	EXCELENTE	A	
Alemania						8,9	MUY BIEN	B	
Francia						9,6	EXCELENTE	A	
Reino Unido						9,3	EXCELENTE	A	
Italia						8,0	MUY BIEN	B	
EEUU						4,2	INSUFICIENTE	FX	
Brasil						5,6	SUFICIENTE	E	
Colombia						8,7	MUY BIEN	B	
Canadá						9,1	EXCELENTE	A	
Egipto						1,0	MUY INSUFICIENTE	F	
Sudáfrica						1,0	MUY INSUFICIENTE	F	
Japón						6,2	SUFICIENTE ALTO	D	
China						4,1	INSUFICIENTE	FX	
India						6,3	SUFICIENTE ALTO	D	
Corea del Sur						7,1	BIEN	C	
Australia						8,4	MUY BIEN	B	

Table 35: Indicator P.3 Rating: % of population with convenient access to Public Transport (SDG 11.2.1)



4.2.1.4 Indicator P.4: Network length (km) / City Area (KM2)

TPU P.4	Longitud de red (km) / Área ciudad (km2)					
	2010	2015	2016	2017	2018	2019
España						0,978
Alemania						0,264
Francia						2,314
Reino Unido						0,241
Italia						1,032
EEUU						0,647
Brasil						0,136
Colombia						0,049
Canadá						0,712
Egipto						0,148
Sudáfrica						0,018
Japón						0,143
China						0,151
India						0,078
Corea del Sur						0,649
Australia						0,036
Maximo:		2,31	MAX ((Media+Factor max*Desv Est.):		1,37	10
Mínimo:		0,02	MIN ((Media-Factor min *Desv);0):		0,00	1
Media:		0,47	Percentil 90%:	1,00	1,37	9
Media+Factor max*Desv Estándar:		1,37	Percentil 10%:	0,04	Unidad:	6,57
Media-Factor min*Desv Estándar:		-0,42		Desv. Est.:	0,60	

Table 36: Indicator P.4 Values: Network length (km) / City Area (KM2)

TPU P.4	Longitud de red (km) / Área ciudad (km2)						Calificación 2019	
	2010	2015	2016	2017	2018			
España						7,4	BIEN	C
Alemania						2,7	MUY INSUFICIENTE	F
Francia						10,0	EXCELENTE	A
Reino Unido						2,6	MUY INSUFICIENTE	F
Italia						7,8	BIEN	C
EEUU						5,3	SUFICIENTE	E
Brasil						1,9	MUY INSUFICIENTE	F
Colombia						1,3	MUY INSUFICIENTE	F
Canadá						5,7	SUFICIENTE	E
Egipto						2,0	MUY INSUFICIENTE	F
Sudáfrica						1,1	MUY INSUFICIENTE	F
Japón						1,9	MUY INSUFICIENTE	F
China						2,0	MUY INSUFICIENTE	F
India						1,5	MUY INSUFICIENTE	F
Corea del Sur						5,3	SUFICIENTE	E
Australia						1,2	MUY INSUFICIENTE	F

Table 37: Indicator P.4 Rating: Network length (km) / City Area (KM2)



4.2.1.5 *Indicator P.5: Absolute accessibility to public transport within the metropolitan area in 15 minutes*

TPU P.5	Accesibilidad absoluta en transp. Púbic. dentro del área metropolitana en 15 minutos. OCDE					
	2010	2015	2016	2017	2018	2019
España						72.525
Alemania						39.143
Francia						73.771
Reino Unido						37.217
Italia						28.533
EEUU						
Brasil						
Colombia						
Canadá						
Egipto						
Sudáfrica						
Japón						
China						
India						
Corea del Sur						
Australia						
Maximo:		73.770,60		Percentil 90%:	73.272,36	10
Mínimo:		28.533,23	MIN ((Media-Factor min *Desv),0):		18.292,38	1
Media:		50.237,78	Percentil 90%:	73.272,36	54.979,98	9
Media+Factor max*Desv Estándar:		82.183,17	Percentil 10%:	32.006,58	Unidad:	0,0002
Media-Factor min*Desv Estándar:		18.292,38		Desv. Est.:	21.296,93	

Table 38: Indicator P.5 Values: Absolute accessibility to public transport within the metropolitan area in 15 minutes

TPU P.5	Accesibilidad absoluta en transp. Púbic. dentro del área metropolitana en 15 minutos. OCDE						Calificación 2019		
	2010	2015	2016	2017	2018				
España						9,9	EXCELENTE	A	
Alemania						4,4	INSUFICIENTE	FX	
Francia						10,0	EXCELENTE	A	
Reino Unido						4,1	INSUFICIENTE	FX	
Italia						2,7	MUY INSUFICIENTE	F	
EEUU									
Brasil									
Colombia									
Canadá									
Egipto									
Sudáfrica									
Japón									
China									
India									
Corea del Sur									
Australia									

Table 39: Indicator P.5 Rating: Absolute accessibility to public transport within the metropolitan area in 15 minutes



4.2.1.6 *Indicator P.6: Absolute bicycle accessibility within the metropolitan area in 15 minutes. OECD*

TPU P.6	Accesibilidad absoluta en bicicleta dentro del área metropolitana en 15 minutos. OCDE					
	2010	2015	2016	2017	2018	2019
España						215.614
Alemania						106.689
Francia						190.442
Reino Unido						117.289
Italia						106.997
EEUU						
Brasil						
Colombia						
Canadá						
Egipto						
Sudáfrica						
Japón						
China						
India						
Corea del Sur						
Australia						
Maximo:		215.614,38	MAX ((Media+Factor max*Desv Est.):		224.995,10	10
Mínimo:		106.688,57	MIN ((Media-Factor min *Desv);0):		69.817,24	1
Media:		147.406,17	Percentil 90%:	205.545,37	155.177,86	9
Media+Factor max*Desv Estándar:		224.995,10	Percentil 10%:	106.811,94	Unidad:	0,0001
Media-Factor min*Desv Estándar:		69.817,24		Desv. Est.:	51.725,95	

Table 40: P.6 Values: Absolute bicycle accessibility within the metropolitan area in 15 minutes. OECD

TPU P.6	Accesibilidad absoluta en bicicleta dentro del área metropolitana en 15 minutos. OCDE					
	2010	2015	2016	2017	2018	Calificación 2019
España						9,5 EXCELENTE A
Alemania						3,1 INSUFICIENTE FX
Francia						8,0 MUY BIEN B
Reino Unido						3,8 INSUFICIENTE FX
Italia						3,2 INSUFICIENTE FX
EEUU						
Brasil						
Colombia						
Canadá						
Egipto						
Sudáfrica						
Japón						
China						
India						
Corea del Sur						
Australia						

Table 41: P.6 Rating: Absolute bicycle accessibility within the metropolitan area in 15 minutes. OECD



4.2.1.7 *Indicator P.7: Absolute walking accessibility within the metropolitan area in 15 minutes. OECD*

TPU P.7	Accesibilidad absoluta caminando dentro del área metropolitana en 15 minutos. OCDE					
	2010	2015	2016	2017	2018	2019
España						41.258
Alemania						13.027
Francia						24.695
Reino Unido						12.880
Italia						15.213
EEUU						
Brasil						
Colombia						
Canadá						
Egipto						
Sudáfrica						
Japón						
China						
India						
Corea del Sur						
Australia						
Maximo:		41.257,64	MAX ((Media+Factor max*Desv Est.):		39.572,46	10
Mínimo:		12.879,96	MIN ((Media-Factor min *Desv);0):		3.256,25	1
Media:		21.414,36	Percentil 90%:	34.632,45	36.316,21	9
Media+Factor max*Desv Estándar:		39.572,46	Percentil 10%:	12.938,76	Unidad:	0,0002
Media-Factor min*Desv Estándar:		3.256,25		Desv. Est.:	12.105,40	

Table 42: Indicator P.7 Values: Absolute walking accessibility within the metropolitan area in 15 minutes. OECD

TPU P.7	Accesibilidad absoluta caminando dentro del área metropolitana en 15 minutos. OCDE					
	2010	2015	2016	2017	2018	Calificación 2019
España						10,0 EXCELENTE A
Alemania						3,4 INSUFICIENTE FX
Francia						6,3 SUFICIENTE ALTO D
Reino Unido						3,4 INSUFICIENTE FX
Italia						4,0 INSUFICIENTE FX
EEUU						
Brasil						
Colombia						
Canadá						
Egipto						
Sudáfrica						
Japón						
China						
India						
Corea del Sur						
Australia						

Table 43: Indicator P.7 Rating: Absolute walking accessibility within the metropolitan area in 15 minutes. OECD



4.2.1.8 Indicator P.8: Traffic index (Numbeo)

TPU P.8	Índice de tráfico (Numbeo)					
	2010	2015	2016	2017	2018	2019
España						106,3
Alemania						104,8
Francia						126,7
Reino Unido						132,7
Italia						130,9
EEUU						151,5
Brasil						174,0
Colombia						203,0
Canadá						139,2
Egipto						230,7
Sudáfrica						190,4
Japón						137,3
China						148,9
India						203,0
Corea del Sur						143,0
Australia						147,0
Maximo:		230,67	MAX ((Media+Factor max*Desv Est.):		208,47	1
Mínimo:		104,76	MIN ((Media-Factor min *Desv);0):		100,20	10
Media:		154,34	Percentil 90%:	203,01	108,27	-9
Media+Factor max*Desv Estándar:		208,47	Percentil 10%:	116,49	Unidad:	-0,0831
Media-Factor min*Desv Estándar:		100,20		Desv. Est.:	36,09	

Table 44: Indicator P.8 Values: Traffic index (Numbeo)

TPU P.8	Índice de tráfico (Numbeo)						Calificación 2019	
	2010	2015	2016	2017	2018			
España						9,5	EXCELENTE	A
Alemania						9,6	EXCELENTE	A
Francia						7,8	BIEN	C
Reino Unido						7,3	BIEN	C
Italia						7,4	BIEN	C
EEUU						5,7	SUFICIENTE	E
Brasil						3,9	INSUFICIENTE	FX
Colombia						1,5	MUY INSUFICIENTE	F
Canadá						6,8	SUFICIENTE ALTO	D
Egipto						1,0	MUY INSUFICIENTE	F
Sudáfrica						2,5	MUY INSUFICIENTE	F
Japón						6,9	SUFICIENTE ALTO	D
China						5,9	SUFICIENTE	E
India						1,5	MUY INSUFICIENTE	F
Corea del Sur						6,4	SUFICIENTE ALTO	D
Australia						6,1	SUFICIENTE ALTO	D

Table 45: Indicator P.8 Rating: Traffic index (Numbeo)



4.2.1.9 Indicator P.9: Time index (Numbeo). Average Travel Time for a Journey (minutes)

TPU P.9	Índice de tiempo (Numbeo)					
	2010	2015	2016	2017	2018	2019
España						29,2
Alemania						31,1
Francia						34,7
Reino Unido						34,4
Italia						33,6
EEUU						32,9
Brasil						41,1
Colombia						47,9
Canadá						33,6
Egipto						48,3
Sudáfrica						39,2
Japón						40,7
China						39,5
India						46,4
Corea del Sur						39,7
Australia						34,7
Maximo:		48,29	MAX ((Media+Factor max*Desv Est.):		46,78	1
Mínimo:		29,20	MIN ((Media-Factor min *Desv);0):		29,08	10
Media:		37,93	Percentil 90%:	47,15	17,70	-9
Media+Factor max*Desv Estándar:		46,78	Percentil 10%:	32,01	Unidad:	-0,5085
Media-Factor min*Desv Estándar:		29,08		Desv. Est.:	5,90	

Table 46: Indicator P.9 Values: Time index (Numbeo)

TPU P.9	Índice de tiempo (Numbeo)						Calificación 2019	
	2010	2015	2016	2017	2018			
España						9,9	EXCELENTE	A
Alemania						9,0	MUY BIEN	B
Francia						7,2	BIEN	C
Reino Unido						7,3	BIEN	C
Italia						7,7	BIEN	C
EEUU						8,1	MUY BIEN	B
Brasil						3,9	INSUFICIENTE	FX
Colombia						1,0	MUY INSUFICIENTE	F
Canadá						7,7	BIEN	C
Egipto						1,0	MUY INSUFICIENTE	F
Sudáfrica						4,9	INSUFICIENTE	FX
Japón						4,1	INSUFICIENTE	FX
China						4,7	INSUFICIENTE	FX
India						1,2	MUY INSUFICIENTE	F
Corea del Sur						4,6	INSUFICIENTE	FX
Australia						7,2	BIEN	C

Table 47: Indicator P.9 Rating: Time index (Numbeo)



4.2.1.10 Indicator P.10: Dissatisfaction index (Numbeo)

TPU P.10	Índice de insatisfacción (Numbeo)					
	2010	2015	2016	2017	2018	2019
España						78,6
Alemania						169,9
Francia						511,3
Reino Unido						480,3
Italia						382,0
EEUU						305,9
Brasil						1.953,6
Colombia						5.015,7
Canadá						376,6
Egipto						5.251,4
Sudáfrica						1.389,7
Japón						1.807,8
China						1.477,5
India						4.180,2
Corea del Sur						1.515,2
Australia						513,4
Maximo:		5.251,39	MAX ((Media+Factor max*Desv Est.):		4.172,35	1
Mínimo:		78,58	MIN ((Media-Factor min *Desv);0):		0,00	10
Media:		1.588,06	Percentil 90%:	4.597,92	4.172,35	-9
Media+Factor max*Desv Estándar:		4.172,35	Percentil 10%:	237,92	Unidad:	-0,0022
Media-Factor min*Desv Estándar:		-996,22		Desv. Est.:	1.722,86	

Table 48: Indicator P.10 Values: Dissatisfaction index (Numbeo)

TPU P.10	Índice de insatisfacción (Numbeo)						Calificación 2019	
	2010	2015	2016	2017	2018			
España						9,8	EXCELENTE	A
Alemania						9,6	EXCELENTE	A
Francia						8,9	MUY BIEN	B
Reino Unido						9,0	EXCELENTE	A
Italia						9,2	EXCELENTE	A
EEUU						9,3	EXCELENTE	A
Brasil						5,8	SUFICIENTE	E
Colombia						1,0	MUY INSUFICIENTE	F
Canadá						9,2	EXCELENTE	A
Egipto						1,0	MUY INSUFICIENTE	F
Sudáfrica						7,0	BIEN	C
Japón						6,1	SUFICIENTE ALTO	D
China						6,8	SUFICIENTE ALTO	D
India						1,0	MUY INSUFICIENTE	F
Corea del Sur						6,7	SUFICIENTE ALTO	D
Australia						8,9	MUY BIEN	B

Table 49: Indicator P.10 Rating: Dissatisfaction index (Numbeo)



4.2.1.11 Indicator P.11: Inefficiency index (Numbeo)

TPU P.11	Índice de ineficiencia (Numbeo)					
	2010	2015	2016	2017	2018	2019
España						126,8
Alemania						125,6
Francia						138,6
Reino Unido						157,8
Italia						157,4
EEUU						241,6
Brasil						205,9
Colombia						216,6
Canadá						176,4
Egipto						284,3
Sudáfrica						242,8
Japón						153,7
China						166,9
India						240,9
Corea del Sur						149,9
Australia						206,8
Maximo:		284,25	MAX ((Media+Factor max*Desv Est.):		258,99	1
Mínimo:		125,56	MIN ((Media-Factor min *Desv);0):		115,01	10
Media:		187,00	Percentil 90%:	242,19	143,99	-9
Media+Factor max*Desv Estándar:		258,99	Percentil 10%:	132,73	Unidad:	-0,0625
Media-Factor min*Desv Estándar:		115,01		Desv. Est.:	48,00	

Table 50: Indicator P.11 Values: Inefficiency index (Numbeo)

TPU P.11	Índice de ineficiencia (Numbeo)						Calificación 2019	
	2010	2015	2016	2017	2018			
España						9,3	EXCELENTE	A
Alemania						9,3	EXCELENTE	A
Francia						8,5	MUY BIEN	B
Reino Unido						7,3	BIEN	C
Italia						7,4	BIEN	C
EEUU						2,1	MUY INSUFICIENTE	F
Brasil						4,3	INSUFICIENTE	FX
Colombia						3,6	INSUFICIENTE	FX
Canadá						6,2	SUFICIENTE ALTO	D
Egipto						1,0	MUY INSUFICIENTE	F
Sudáfrica						2,0	MUY INSUFICIENTE	F
Japón						7,6	BIEN	C
China						6,8	SUFICIENTE ALTO	D
India						2,1	MUY INSUFICIENTE	F
Corea del Sur						7,8	BIEN	C
Australia						4,3	INSUFICIENTE	FX

Table 51: Indicator P.11 Rating: Inefficiency index (Numbeo)



4.2.2. Performance Indicator

	Índice de Prestaciones						Max valor 2019
	2010	2015	2016	2017	2018	2019	
España						99,3	99
Alemania						74,7	99
Francia						89,8	99
Reino Unido						60,7	99
Italia						66,0	99
EEUU						45,1	72
Brasil						38,7	72
Colombia						26,8	72
Canadá						51,5	72
Egipto						13,0	72
Sudáfrica						26,7	72
Japón						49,4	72
China						40,3	72
India						25,8	72
Corea del Sur						55,9	72
Australia						42,3	72
Maximo:		99,343		Máximo Valor:	VER TABLA	10	
Mínimo:		13,041		MIN:	0	0	
Media:		50,376				10,000	

Table 52: Performance Indicator Values

	Evaluación de Prestaciones						Subindicadores considerados	
	2010	2015	2016	2017	2018	Calificación 2019		
España					10,0	EXCELENTE	A	11
Alemania					7,5	BIEN	C	11
Francia					9,1	EXCELENTE	A	11
Reino Unido					6,1	SUFICIENTE ALTO	D	11
Italia					6,7	SUFICIENTE ALTO	D	11
EEUU					6,3	SUFICIENTE ALTO	D	8
Brasil					5,4	SUFICIENTE	E	8
Colombia					3,7	INSUFICIENTE	FX	8
Canadá					7,2	BIEN	C	8
Egipto					1,8	MUY INSUFICIENTE	F	8
Sudáfrica					3,7	INSUFICIENTE	FX	8
Japón					6,9	SUFICIENTE ALTO	D	8
China					5,6	SUFICIENTE	E	8
India					3,6	INSUFICIENTE	FX	8
Corea del Sur					7,8	BIEN	C	8
Australia					5,9	SUFICIENTE	E	8

Table 53: Performance Criterion Rating

Subindicadores de Prestaciones		Pesos	Punt. Max.	Total Max puntuación
TPU P.1	Velocidad media de viaje (km/h)	1	10	10
TPU P.2	Viajes en transporte público / Viajes en usos motorizados	1	10	10
TPU P.3	% de la población que tiene acceso conveniente al Trans. Público (SDG 11.2.1)	1	10	10
TPU P.4	Longitud de red (km) / Área ciudad (km2)	1	10	10
TPU P.5	Accesibilidad absoluta en transp. Públic. dentro del área metropolitana en 15 minutos. OCDE	1	10	10
TPU P.6	Accesibilidad absoluta en bicicleta dentro del área metropolitana en 15 minutos. OCDE	1	10	10
TPU P.7	Accesibilidad absoluta caminando dentro del área metropolitana en 15 minutos. OCDE	1	10	10
TPU P.8	Índice de tráfico (Numbeo)	1	10	10
TPU P.9	Índice de tiempo (Numbeo)	1	10	10
TPU P.10	Índice de insatisfacción (Numbeo)	1	10	10
TPU P.11	Índice de ineficiencia (Numbeo)	1	10	10
		11		110
		% Valorado de la Max. Puntuación del Criterio	90,0%	99

Table 54: Weights and reduced maximum score of Performance Indicators



The average travel speed in the analyzed countries is 20 km/h, ranging from a minimum of 8 in Colombia and Egypt to a maximum of 33 km/h in Germany. Spain presents a very good ratio (25.9 km/h). The data has been collected from NUMBEO and reflects the entire journey (from home to workplace or school), including walking distances, waiting times for public transport, and the transport journey itself.

The Indicator "public transport trips / motorized mode trips" shows an average value of 0.45; that is, half of the motorized mode trips are done using public transport. Japan and South Korea stand out with very high values (0.81 and 0.9, respectively). Spain is in the average range (0.515).

The indicator "% of the population with convenient access to public transport" is the SDG 11.2.11 indicator from the United Nations' 2030 Agenda for Sustainable Development. Spain, the United Kingdom, and France present the best values (above 96%).

The OECD's indicators of absolute accessibility, both for public transport and for biking and walking, are ratios that demonstrate the level of performance. Spain stands out with excellent values in all three indicators.

Regarding the four NUMBEO indicators, Spain also receives an excellent rating.

In the set of eleven evaluated indicators, Spain achieves the highest rating (Excellent), with similar values to France. Germany, Canada, and South Korea also have good ratings.



4.3. Financing

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

For the purposes of this report, the following three Indicators have been considered:

3 FINANCING	
F.1	Bus network. Revenues / Costs
F.2	Rail network. Revenues / Costs
F.3	Cost (bus network + rail network) / GDP per capita

To assess the financing in the urban public transportation sector, both investment in new infrastructure creation and operation, maintenance, and improvement must be studied. One of the peculiarities of this sector is the significant variation in service management: in some municipalities, public administrations are responsible for operating the services, while in others, it's done through private concessionaire companies.

The management approach significantly affects financing. Revenues are obtained from various sources, including user fares, public subsidies received by some concessionaire companies, and other sources like advertising income.

Due to the different operational and financing methods, conducting a rigorous international comparative study is complex. In this report, the analysis has focused on examining fare revenues from users and the percentage of coverage of operating expenses of the service. Additionally, another indicator related to the ticket price adjusted to citizens' purchasing power has been used. The financing of public transportation networks varies among different modes, such as buses or railways. Therefore, these modes have been considered separately.

The basic data used for calculating the Indicators are presented in the following tables. The data originates from the World Bank. In Spain, the data has been replaced with values provided by the Urban Mobility Observatory. Report 2019 and Advance 2020. The costs of the railway and bus networks in Barcelona are not available, so an estimate of their value has been made (the exchange rate from € to \$ has been estimated at 1.1 €/€).



DB TPU CIUDADES 8			Coste de la red de buses (millns. \$); Ingresos de la red de buses (millns. \$)					
% Ingresos / Costes (Red de Buses) (\$)								
Región	País	Ciudad	Coste red Bus (millns. \$)	Ingresos red (millns. \$)		Ingresos/Costes Red Buses	Peso (%)	Ingresos/Costes Red Buses
Europa	España	Barcelona	700,000	318,770		0,455	38,53%	0,41
		Madrid	1.104,120	460,370		0,417	49,85%	
		Valencia	139,900	29,300		0,209	11,62%	
	Italia	Milán	373,197	160,008		0,429	100,00%	0,43
		Roma					0,00%	
		Turín					0,00%	
	Francia	Marsella					0,00%	0,95
		Nantes					0,00%	
		París	636,085	602,725		0,948	100,00%	
	Alemania	Berlín					0,00%	0,65
		Hamburgo	275,471	179,025		0,650	100,00%	
		Múnich					0,00%	
Reino Unido	Glasgow					0,00%	0,46	
	Londres	4.166,049	1.916,108		0,460	100,00%		
	Manchester					0,00%		
Asia	China	Pekín					0,00%	1,11
		Hong Kong (SAR)	1.640,414	1.823,952		1,112	100,00%	
		Shangái					0,00%	
	India	Bangalore	570,756	540,518		0,947	21,20%	0,59
		Delhi	758,256	307,684		0,406	44,40%	
		Mumbai	701,663	434,113		0,619	34,41%	
Japón	Tokio					100,00%		
Corea Sur	Seúl					100,00%		
Oceania	Australia	Melbourne					100,00%	
África	Sudáfrica	Johannesburgo					100,00%	
	Egipto	El Cairo					100,00%	
Norteamérica	Canada	Toronto	433,219	330,887		0,764	73,35%	0,69
		Vancouver	445,226	222,387		0,499	26,65%	
	EE.UU.	Chicago	913,937	291,701		0,319	23,71%	0,35
		Nueva York	3.939,333	1.421,619		0,361	56,31%	
		Washington DC	582,492	213,938		0,367	19,98%	
Sudamérica	Brasil	Curitiba	564,220	544,580		0,965	12,23%	1,00
		São Paulo	4.803,860	4.852,320		1,010	87,77%	
	Colombia	Bogotá	5.504,098	4.068,650		0,739	100,00%	0,74

Fuente: España: Observatorio de la Movilidad Urbana. Informe 2019 y avance 2020. Resto del mundo: WB.

DB TPU CIUDADES 9			Coste de la red de FFCC (millns. \$); Ingresos de la red de FFCC (millns. \$)					
% Ingresos / Costes (Red de Buses) (\$)								
Región	País	Ciudad	Coste red FC (millns. \$)	Ingresos red FC (millns. \$)		Ingresos/Costes Red FC	Peso (%)	Ingresos/Costes Red FC
Europa	España	Barcelona	880,000	571,549		0,649	38,53%	0,65
		Madrid	1.175,361	803,253		0,683	49,85%	
		Valencia	198,440	101,937		0,514	11,62%	
	Italia	Milán	567,109	243,148		0,429	100,00%	0,43
		Roma					0,00%	
		Turín					0,00%	
	Francia	Marsella					0,00%	1,22
		Nantes					0,00%	
		París	2.950,663	3.588,403		1,216	100,00%	
	Alemania	Berlín					0,00%	0,72
		Hamburgo	250,246	179,025		0,715	100,00%	
		Múnich					0,00%	
Reino Unido	Glasgow					0,00%	0,93	
	Londres	3.173,683	2.951,142		0,930	100,00%		
	Manchester					0,00%		
Asia	China	Pekín					0,00%	1,30
		Hong Kong (SAR)	1.015,886	1.318,933		1,298	100,00%	
		Shangái					0,00%	
	India	Bangalore					21,20%	0,31
		Delhi	516,483	362,678		0,702	44,40%	
		Mumbai					34,41%	
Japón	Tokio	2.124,395	2.829,511		1,332	100,00%	1,33	
Corea Sur	Seúl	980,766	596,934		0,609	100,00%	0,61	
Oceania	Australia	Melbourne					100,00%	
África	Sudáfrica	Johannesburgo					100,00%	
	Egipto	El Cairo					100,00%	
Norteamérica	Canada	Toronto	611,948	410,563		0,671	73,35%	0,71
		Vancouver	147,656	122,224		0,828	26,65%	
	EE.UU.	Chicago	603,010	420,101		0,697	23,71%	0,46
		Nueva York	7.396,018	2.939,451		0,397	56,31%	
		Washington DC	1.334,682	490,203		0,367	19,98%	
Sudamérica	Brasil	Curitiba					12,23%	
		São Paulo					87,77%	
Colombia	Bogotá					100,00%		

Fuente: España: Observatorio de la Movilidad Urbana. Informe 2019 y avance 2020. Resto del mundo: WB.



DB TPU CIUDADES 10		Coste relativo de las tarifas (PIB per cápita)							
% Coste relativo de las tarifas (PIB per cápita)									
Región	País	Ciudad	Coste relativo PIB per cápita				Coste relativo PIB per cápita	Peso (%)	Coste relativo PIB per cápita
Europa	España	Barcelona	0,025				0,025	38,53%	0,019
		Madrid	0,014				0,014	49,85%	
		Valencia	0,022				0,022	11,62%	
	Italia	Milán	0,013				0,013	53,83%	0,014
		Roma	0,011				0,011	31,52%	
		Turín	0,020				0,020	14,65%	
	Francia	Marsella	0,010				0,010	10,34%	0,009
		Nantes	0,022				0,022	6,78%	
		París	0,008				0,008	82,88%	
	Alemania	Berlín	0,035				0,035	49,72%	0,026
		Hamburgo	0,012				0,012	25,02%	
		Múnich	0,022				0,022	25,26%	
	Reino Unido	Glasgow	0,018				0,018	8,30%	0,021
Londres		0,020				0,020	73,61%		
Manchester		0,029				0,029	18,09%		
Asia	China	Pekín	0,007				0,007	37,01%	0,009
		Hong Kong (SAR)	0,008				0,008	14,89%	
		Shangái	0,011				0,011	48,10%	
	India	Bangalore	0,032				0,032	21,20%	0,036
		Delhi	0,037				0,037	44,40%	
		Mumbai	0,035				0,035	34,41%	
Japón	Tokio	0,014				0,014	100,00%	0,014	
Corea Sur	Seúl	0,018				0,018	100,00%	0,018	
Oceanía	Australia	Melbourne	0,031				0,031	100,00%	0,031
África	Sudáfrica	Johannesburgo						100,00%	
	Egipto	El Cairo						100,00%	
Norteamérica	Canada	Toronto	0,031				0,031	73,35%	0,031
		Vancouver	0,032				0,032	26,65%	
	EE.UU.	Chicago	0,018				0,018	23,71%	0,022
		Nueva York	0,027				0,027	56,31%	
		Washington DC	0,012				0,012	19,98%	
Sudamérica	Brasil	Curitiba						12,23%	0,034
		São Paulo	0,039				0,039	87,77%	
	Colombia	Bogotá	0,047				0,047	100,00%	0,047

Fuente: España: Observatorio de la Movilidad Urbana. Informe 2019 y avance 2020. Resto del mundo: WB.



4.3.1. Financing Indicators

4.3.1.1 Indicator F.1: Bus network. Revenues / Costs

TPU F.1	Red de autobuses. Ingresos / Costes					
	2010	2015	2016	2017	2018	2019
España						0,405
Alemania						0,650
Francia						0,948
Reino Unido						0,460
Italia						0,429
EEUU						0,352
Brasil						1,005
Colombia						0,739
Canadá						0,693
Egipto						
Sudáfrica						
Japón						
China						1,112
India						0,594
Corea del Sur						
Australia						
Maximo:		1,11	MAX ((Media+Factor max*Desv Est.):		1,06	10
Mínimo:		0,35	MIN ((Media-Factor min *Desv);0):		0,28	1
Media:		0,67	Percentil 90%:	1,00	0,78	9
Media+Factor max*Desv Estándar:		1,06	Percentil 10%:	0,41	Unidad:	11,5982
Media-Factor min*Desv Estándar:		0,28		Desv. Est.:	0,26	

Table 55: Indicator F.1 Values: Bus network. Revenues / Costs

TPU F.1	Red de autobuses. Ingresos / Costes						Calificación 2019	
	2010	2015	2016	2017	2018			
España						2,4	MUY INSUFICIENTE	F
Alemania						5,2	SUFICIENTE	E
Francia						8,7	MUY BIEN	B
Reino Unido						3,0	INSUFICIENTE	FX
Italia						2,7	MUY INSUFICIENTE	F
EEUU						1,8	MUY INSUFICIENTE	F
Brasil						9,4	EXCELENTE	A
Colombia						6,3	SUFICIENTE ALTO	D
Canadá						5,8	SUFICIENTE	E
Egipto								
Sudáfrica								
Japón								
China						10,0	EXCELENTE	A
India						4,6	INSUFICIENTE	FX
Corea del Sur								
Australia								

Table 56: Indicator F.1 Rating: Bus network. Revenues / Costs



4.3.1.2 Indicador F.2: Rail network. Revenues / Costs

TPU F.2	Red ferroviaria. Ingresos / Costes					
	2010	2015	2016	2017	2018	2019
España						0,651
Alemania						0,715
Francia						1,216
Reino Unido						0,930
Italia						0,429
EEUU						0,462
Brasil						
Colombia						
Canadá						0,713
Egipto						
Sudáfrica						
Japón						1,332
China						1,298
India						0,312
Corea del Sur						0,609
Australia						
Maximo:		1,33	MAX ((Media+Factor max*Desv Est.):		1,33	10
Mínimo:		0,31	MIN ((Media-Factor min *Desv),0):		0,25	1
Media:		0,79	Percentil 90%:	1,30	1,07	9
Media+Factor max*Desv Estándar:		1,33	Percentil 10%:	0,43	Unidad:	8,3736
Media-Factor min*Desv Estándar:		0,25		Desv. Est.:	0,36	

Table 57: Indicator F.2 Values: Rail network. Revenues / Costs

TPU F.2	Red ferroviaria. Ingresos / Costes					Calificación 2019		
	2010	2015	2016	2017	2018			
España						4,4	INSUFICIENTE	FX
Alemania						4,9	INSUFICIENTE	FX
Francia						9,1	EXCELENTE	A
Reino Unido						6,7	SUFICIENTE ALTO	D
Italia						2,5	MUY INSUFICIENTE	F
EEUU						2,8	MUY INSUFICIENTE	F
Brasil								
Colombia								
Canadá						4,9	INSUFICIENTE	FX
Egipto								
Sudáfrica								
Japón						10,0	EXCELENTE	A
China						9,8	EXCELENTE	A
India						1,5	MUY INSUFICIENTE	F
Corea del Sur						4,0	INSUFICIENTE	FX
Australia								

Table 58: Indicator F.2 Rating: Rail network. Revenues / Costs



4.3.1.3 *Indicator F.3: Cost (bus network + rail network) / GDP per capita*

TPU F.3	Coste (red buses + red FFCC) / PIB per cápita					
	2010	2015	2016	2017	2018	2019
España						0,019
Alemania						0,026
Francia						0,009
Reino Unido						0,021
Italia						0,014
EEUU						0,022
Brasil						0,034
Colombia						0,047
Canadá						0,031
Egipto						
Sudáfrica						
Japón						0,014
China						0,009
India						0,036
Corea del Sur						0,018
Australia						0,031
Maximo:		0,05	MAX ((Media+Factor max*Desv Est.):		0,04	1
Mínimo:		0,01	MIN ((Media-Factor min *Desv);0):		0,01	10
Media:		0,02	Percentil 90%:	0,04	0,03	-9
Media+Factor max*Desv Estándar:		0,04	Percentil 10%:	0,01	Unidad:	-271,2418
Media-Factor min*Desv Estándar:		0,01		Desv. Est.:	0,01	
			Percent. 90<Media+Factor*Desv. Est.		Percent. 10>Media-Factor*Desv. Est.	

Table 59: Indicator F.3 Values: Cost (bus network + rail network) / GDP per capita

TPU F.3	Coste (red buses + red FFCC) / PIB per cápita						Calificación 2019		
	2010	2015	2016	2017	2018				
España						6,7	SUFICIENTE ALTO	D	
Alemania						4,8	INSUFICIENTE	FX	
Francia						9,4	EXCELENTE	A	
Reino Unido						6,1	SUFICIENTE ALTO	D	
Italia						8,2	MUY BIEN	B	
EEUU						6,0	SUFICIENTE ALTO	D	
Brasil						2,7	MUY INSUFICIENTE	F	
Colombia						1,0	MUY INSUFICIENTE	F	
Canadá						3,5	INSUFICIENTE	FX	
Egipto									
Sudáfrica									
Japón						8,0	MUY BIEN	B	
China						9,5	EXCELENTE	A	
India						2,3	MUY INSUFICIENTE	F	
Corea del Sur						7,0	BIEN	C	
Australia						3,5	INSUFICIENTE	FX	

Table 60: Indicator F.3 Rating: Cost (bus network + rail network) / GDP per capita



4.3.2. Financing Indicator

	Índice de Financiación						Max valor 2019
	2010	2015	2016	2017	2018	2019	
España						13,4	27
Alemania						15,0	27
Francia						27,2	27
Reino Unido						15,9	27
Italia						13,4	27
EEUU						10,6	27
Brasil						12,1	18
Colombia						7,3	18
Canadá						14,1	27
Egipto							0
Sudáfrica							0
Japón						18,0	18
China						29,3	27
India						8,4	27
Corea del Sur						11,0	18
Australia						3,5	9
Maximo:		29,306		Máximo Valor:	VER TABLA	10	
Mínimo:		3,501		MIN:	0	0	
Media:		14,227				10,000	

Table 61: Financing Indicator Values

Subindicadores de Financiación		Pesos	Punt. Max.	Total Max puntuación
TPU F.1	Red de autobuses. Ingresos / Costes	1	10	10
TPU F.2	Red ferroviaria. Ingresos / Costes	1	10	10
TPU F.3	Coste (red buses + red FFCC) / PIB per cápita	1	10	10
		3		30
		% Valorado de la Max. Puntuación del Criterio	90,0%	27

Table 62: Financing Indicator Weights

	Evaluación de Financiación						Subindicadores considerados		
	2010	2015	2016	2017	2018	Calificación 2019			
España						5,0	SUFICIENTE	E	3
Alemania						5,6	SUFICIENTE	E	3
Francia						10,0	EXCELENTE	A	3
Reino Unido						5,9	SUFICIENTE	E	3
Italia						5,0	SUFICIENTE	E	3
EEUU						3,9	INSUFICIENTE	FX	3
Brasil						6,7	SUFICIENTE ALTO	D	2
Colombia						4,0	INSUFICIENTE	FX	2
Canadá						5,2	SUFICIENTE	E	3
Egipto									0
Sudáfrica									0
Japón						10,0	EXCELENTE	A	2
China						10,0	EXCELENTE	A	3
India						3,1	INSUFICIENTE	FX	3
Corea del Sur						6,1	SUFICIENTE ALTO	D	2
Australia						3,9	INSUFICIENTE	FX	1

Table 63: Financing Criterion Rating



In these Indicators, the highest rating has been given to maximum revenue coverage (revenues from fares covering all operating expenses). However, it's important to mention that they are not directly related to the quality of the service provided: different local or national administrations may subsidize all or part of the costs based on purely political decisions. Similarly, there may be other sources of revenue not directly linked to fares (such as advertising income, as mentioned before).

Data related to the ticket price comes from the World Bank's database, showing the average annual cost as a percentage of the population's GDP spent on public transportation fares. The highest rating has been given to lower costs, although again, it shouldn't be directly related to the quality of service provision. For instance, in the case of China, transportation systems are often operated by state-owned enterprises, leading to more subsidies and lower fare costs, which in turn encourages more people to use these modes due to affordability. However, in Bogotá, the use of different operators for various lines and locations results in higher fare costs for the population as they rely more on this source of financing.

In the final evaluation of the Financing criterion, cities receiving the highest ratings are Hong Kong, Paris, and Tokyo. On the other hand, there is uncertainty in the ratings of cities with lower scores, which might lead to an incorrect evaluation. This could be the case with Berlin, where using real revenue and operating cost values could potentially yield a higher rating.



4.4. Adaptation to the future and Sustainability

The questions addressed by 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 sufficient to meet the future needs of the sector? How are actions promoting environmental sustainability being implemented? Are active measures being taken to achieve the established goals for decarbonizing public works and transportation?

The selected Indicators are as follows:

4 ADAPTATION TO THE FUTURE AND SUSTAINABILITY	
A.1	Mass public transport / Total public transport
A.2	Increase in urban Population
A.3	CO2 emissions index. WB
A.4	Pollution index. WB
A.5	Energy consumption per transported passenger (MJ / (Passenger*km)). WB
A.6	Number of bicycles + scooters / 10,000 inhabitants
A.7	CO2 emissions (t per capita). WB
A.8	Average population exposure to pollutants (micrograms/m3 PM2.5). UN Urban Indicators
A.9	Development of Climate Change Mitigation Technologies related to transport (OECD)
A.10	% of urban population exposed to high noise levels. EUROSTAT

The first indicator "Mass Transit / Total Public Transit" estimates the use of mass transit, which is considered more efficient and better suited for the future as urban population grows at high rates.

The increase in urban population indicates the need for adaptation to future demand in metropolitan areas: with high growth rates, efforts are required to meet future demand.

The CO₂ emissions index informs about the sustainability of public transportation systems, just like the pollution index, energy consumption per transported passenger, CO₂ emissions (t/capita), and population exposure to pollutants.

The number of bicycles and scooters per 10,000 inhabitants is another indicator that demonstrates the sustainability of the city.

The indicator "Development of Climate Change Mitigation Technologies in Transportation (OECD)" shows the research being conducted to promote future sustainability.

Finally, the "% of the urban population exposed to high noise levels. EUROSTAT" assesses the sound sustainability of the metropolitan area.

The tables below present the basic values of the indicators used.



DB TPU CIUDADES 11			% Viajes diarios en Transporte masivo (Mills.)						
			% Transp. Público masivo / trans. Público Total						
Región	País	Ciudad	Viaj / día Trap. P. Masivo				Transp. P. Transp. P. Total	Peso (%)	Transp. P. Masivo / Transp. P. Total
Europa	España	Barcelona	1,066				35,58%	38,53%	37,25%
		Madrid	1,765				39,06%	49,85%	
		Valencia	0,185				34,98%	11,62%	
	Italia	Milán	1,535				65,52%	53,83%	55,67%
		Roma	1,130				31,43%	31,52%	
		Turín	0,090				71,65%	14,65%	
	Francia	Marsella	0,265				53,08%	10,34%	78,14%
		Nantes	0,203				63,30%	6,78%	
		París	4,475				82,48%	82,88%	
	Alemania	Berlín	1,739				61,06%	49,72%	66,51%
		Hamburgo	0,606				50,21%	25,02%	
		Múnich	1,255				93,41%	25,26%	
Reino Unido	Glasgow	0,038				11,18%	8,30%	30,16%	
	Londres	3,332				34,70%	73,61%		
	Manchester	0,058				20,39%	18,09%		
Asia	China	Pekín	5,259				27,54%	37,01%	38,82%
		Hong Kong (SAR)	4,632				62,57%	14,89%	
		Shangái	5,162				40,16%	48,10%	
	India	Bangalore	0,440				8,91%	21,20%	21,97%
		Delhi	1,922				38,81%	44,40%	
		Mumbai	0,405				8,29%	34,41%	
	Japón	Tokio	8,690				94,03%	100,00%	94,03%
Corea Sur	Seúl	6,064				54,31%	100,00%	54,31%	
Oceanía	Australia	Melbourne	1,077				83,26%	100,00%	83,26%
África	Sudáfrica	Johannesburgo	0,038				0,54%	100,00%	0,54%
	Egipto	El Cairo	2,145				57,20%	100,00%	57,20%
Norteamérica	Canada	Toronto	1,969				73,61%	73,35%	70,94%
		Vancouver	0,706				63,60%	26,65%	
	EE.UU.	Chicago	0,640				39,75%	23,71%	60,38%
		Nueva York Washington DC	4,515 0,785				65,79% 69,62%	56,31% 19,98%	
Sudamérica	Brasil	Curitiba São Paulo	2,300 6,914				53,00% 39,70%	12,23% 87,77%	41,33%
	Colombia	Bogotá	2,090				76,31%	100,00%	76,31%

Fuente: [WB](#)

DB TPU CIUDADES 12			% Incremento de la población						
			% Incremento de la población						
Región	País	Ciudad	Increment. Pob. %				Increment. Pob. %	Peso (%)	Increment. Pob. %
Europa	España	Barcelona	11,36%				11,36%	38,53%	11,16%
		Madrid	12,26%				12,26%	49,85%	
		Valencia	5,76%				5,76%	11,62%	
	Italia	Milán	2,49%				2,49%	53,83%	3,77%
		Roma	6,38%				6,38%	31,52%	
		Turín	2,85%				2,85%	14,65%	
	Francia	Marsella	1,99%				1,99%	10,34%	4,40%
		Nantes	10,42%				10,42%	6,78%	
		París	4,21%				4,21%	82,88%	
	Alemania	Berlín	2,71%				2,71%	49,72%	5,98%
		Hamburgo	12,46%				12,46%	25,02%	
		Múnich	6,02%				6,02%	25,26%	
Reino Unido	Glasgow	2,71%				2,71%	8,30%	10,48%	
	Londres	12,46%				12,46%	73,61%		
	Manchester	6,02%				6,02%	18,09%		
Asia	China	Pekín	19,32%				19,32%	37,01%	20,48%
		Hong Kong (SAR)	5,75%				5,75%	14,89%	
		Shangái	25,93%				25,93%	48,10%	
	India	Bangalore	37,91%				37,91%	21,20%	24,46%
		Delhi	29,68%				29,68%	44,40%	
		Mumbai	9,43%				9,43%	34,41%	
	Japón	Tokio	1,65%				1,65%	100,00%	1,65%
Corea Sur	Seúl	1,71%				1,71%	100,00%	1,71%	
Oceanía	Australia	Melbourne	21,33%				21,33%	100,00%	21,33%
África	Sudáfrica	Johannesburgo	29,10%				29,10%	100,00%	29,10%
	Egipto	El Cairo	18,80%				18,80%	100,00%	18,80%
Norteamérica	Canada	Toronto	10,60%				10,60%	73,35%	10,73%
		Vancouver	11,08%				11,08%	26,65%	
	EE.UU.	Chicago	2,88%				2,88%	23,71%	4,69%
		Nueva York Washington DC	2,47% 13,08%				2,47% 13,08%	56,31% 19,98%	
Sudamérica	Brasil	Curitiba São Paulo	14,78% 10,12%				14,78% 10,12%	12,23% 87,77%	10,69%
	Colombia	Bogotá	25,62%				25,62%	100,00%	25,62%

Fuente: [WB](#)



DB TPU CIUDADES 17			Índice de CO2						
Región	País	Ciudad	Índice de CO2				Índice de CO2	Peso (%)	Índice de CO2
Europa	España	Barcelona	3.134				3.134	38,53%	3.806
		Madrid	4.660				4.660	49,85%	
		Valencia	2.375				2.375	11,62%	
	Italia	Milán	2.457				2.457	53,83%	3.824
		Roma	6.059				6.059	31,52%	
		Turín	4.036				4.036	14,65%	
	Francia	Marsella					0	0,00%	3.102
		Nantes					0	0,00%	
		París	3.102				3.102	100,00%	
	Alemania	Berlín	1.927				1.927	49,72%	2.002
		Hamburgo	2.813				2.813	25,02%	
		Múnich	1.346				1.346	25,26%	
Reino Unido	Glasgow	5.156				5.156	8,30%	3.217	
	Londres	2.457				2.457	73,61%		
	Manchester	5.417				5.417	18,09%		
Asia	China	Pekín	6.034				6.034	37,01%	4.424
		Hong Kong (SAR)	1.861				1.861	14,89%	
		Shangái	3.978				3.978	48,10%	
	India	Bangalore	7.483				7.483	21,20%	8.427
		Delhi	10.102				10.102	44,40%	
		Mumbai	6.847				6.847	34,41%	
	Japón	Tokio	973				973	100,00%	973
Corea Sur	Seúl	2.088				2.088	100,00%	2.088	
Oceanía	Australia	Melbourne	5.787				5.787	100,00%	5.787
África	Sudáfrica	Johannesburgo	10.798				10.798	100,00%	10.798
	Egipto	El Cairo	9.434				9.434	100,00%	9.434
Norteamérica	Canada	Toronto	6.461				6.461	73,35%	6.368
		Vancouver	6.112				6.112	26,65%	
	EE.UU.	Chicago	7.635				7.635	23,71%	5.579
		Nueva York Washington DC	3.694 8.451				3.694 8.451	56,31% 19,98%	
Sudamérica	Brasil	Curitiba	6.088				6.088	12,23%	6.385
		São Paulo	6.427				6.427	87,77%	
	Colombia	Bogotá	3.251				3.251	100,00%	3.251

Fuente: WB

DB TPU CIUDADES 14			Consumo de energía en Transporte público (MJ / Pasajero-km)						
Región	País	Ciudad	Consumo (MJ/(Pasajero*k)				Consumo (MJ/(Pasajero*k)	Peso (%)	Consumo energía TP (MJ/(Pasajero*k))
Europa	España	Barcelona	0,370				0,370	43,59%	0,56
		Madrid	0,710				0,710	56,41%	
		Valencia	0,500					0,00%	
	Italia	Milán	0,590				0,590	63,07%	0,53
		Roma	0,430				0,430	36,93%	
		Turín	0,500					0,00%	
	Francia	Marsella	1,220				1,220	10,34%	0,64
		Nantes	0,580				0,580	6,78%	
		París	0,570				0,570	82,88%	
	Alemania	Berlín	0,590				0,590	49,72%	0,60
		Hamburgo	0,640				0,640	25,02%	
		Múnich	0,580				0,580	25,26%	
Reino Unido	Glasgow	2,410				2,410	8,30%	0,86	
	Londres	0,590				0,590	73,61%		
	Manchester	1,240				1,240	18,09%		
Asia	China	Pekín	0,130				0,130	37,01%	0,22
		Hong Kong (SAR)	0,640				0,640	14,89%	
		Shangái	0,150				0,150	48,10%	
	India	Bangalore						0,00%	0,08
		Delhi						0,00%	
		Mumbai	0,080				0,080	100,00%	
	Japón	Tokio	0,190				0,190	100,00%	0,19
Corea Sur	Seúl	0,470				0,470	100,00%	0,47	
Oceanía	Australia	Melbourne	0,720				0,720	100,00%	0,72
África	Sudáfrica	Johannesburgo	0,460				0,460	100,00%	0,46
	Egipto	El Cairo	0,730				0,730	100,00%	0,73
Norteamérica	Canada	Toronto	0,980				0,980	73,35%	1,00
		Vancouver	1,050				1,050	26,65%	
	EE.UU.	Chicago	1,740				1,740	23,71%	1,31
		Nueva York Washington DC	1,090 1,440				1,090 1,440	56,31% 19,98%	
Sudamérica	Brasil	Curitiba	0,590				0,590	12,23%	0,40
		São Paulo	0,370				0,370	87,77%	
	Colombia	Bogotá	1,310				1,310	100,00%	1,31

Fuente: España: Observatorio de la Movilidad Urbana. Informe 2019 y avance 2020. Resto del mundo: WB.



DB TPU CIUDADES 20			Nº Bicicletas y patinetes						
			Nº Bicicletas y patinetes / 10.000 Habit.						
Región	País	Ciudad	Nº Bicis y patinetes				Nº Bicis y 10.000 Habit.	Peso (%)	Nº Bicis y patinetes / 10.000 Habit.
Europa	España	Barcelona	7.216				14	38,53%	10,12
		Madrid	3.136				5	49,85%	
		Valencia	3.613				20	11,62%	
	Italia	Milán	12.929				24	78,60%	24,58
		Roma						0,00%	
		Turín	4.234				28	21,40%	
	Francia	Marsella	1.000				7	10,34%	16,58
		Nantes	1.230				14	6,78%	
		París	19.890				18	82,88%	
	Alemania	Berlín	12.700				32	49,72%	32,81
		Hamburgo	2.974				15	25,02%	
		Múnich	10.800				53	25,26%	
Reino Unido	Glasgow	435				3	8,30%	13,88	
	Londres	19.300				17	73,61%		
	Manchester	1.500				5	18,09%		
Asia	China	Pekín	137.100				74	37,01%	56,39
		Hong Kong (SAR)	1.150				2	14,89%	
		Shangái	143.975				60	48,10%	
	India	Bangalore	3.500				2	21,20%	0,68
		Delhi	941				0	44,40%	
		Mumbai	500				0	34,41%	
	Japón	Tokio	6.831				2	100,00%	1,81
Corea Sur	Seúl	16.355				7	100,00%	7,11	
Oceanía	Australia	Melbourne	1.800				4	100,00%	3,81
África	Sudáfrica	Johannesburgo						100,00%	
	Egipto	El Cairo						100,00%	
Norteamérica	Canada	Toronto	3.115				5	73,35%	5,78
		Vancouver	2.225				9	26,65%	
	EE.UU.	Chicago	6.656				7	23,71%	6,41
		Nueva York	11.120				5	56,31%	
		Washington DC	6.715				9	19,98%	
Sudamérica	Brasil	Curitiba	480				1	12,23%	1,19
		São Paulo	2.650				1	87,77%	
	Colombia	Bogotá						100,00%	

Fuente: [WB](#)

DB TPU CIUDADES 18			Emisiones de CO2 (t per cápita)						
			Emisiones de CO2 (t per cápita). WB						
Región	País	Ciudad	Emisiones de (t per cápita)				Emisiones de (t per cápita)	Peso (%)	Emisiones de CO2 (t per cápita)
Europa	España	Barcelona	5,034				5,034	38,53%	5,03
		Madrid	5,034				5,034	49,85%	
		Valencia	5,034				5,034	11,62%	
	Italia	Milán	5,271				5,271	53,83%	5,27
		Roma	5,271				5,271	31,52%	
		Turín	5,271				5,271	14,65%	
	Francia	Marsella	4,573				4,573	10,34%	4,57
		Nantes	4,573				4,573	6,78%	
		París	4,573				4,573	82,88%	
	Alemania	Berlín	8,890				8,890	49,72%	8,89
		Hamburgo	8,890				8,890	25,02%	
		Múnich	8,890				8,890	25,26%	
Reino Unido	Glasgow	6,497				6,497	8,30%	6,50	
	Londres	6,497				6,497	73,61%		
	Manchester	6,497				6,497	18,09%		
Asia	China	Pekín	7,544				7,544	37,01%	7,54
		Hong Kong (SAR)	7,544				7,544	14,89%	
		Shangái	7,544				7,544	48,10%	
	India	Bangalore	1,730				1,730	21,20%	1,73
		Delhi	1,730				1,730	44,40%	
		Mumbai	1,730				1,730	34,41%	
	Japón	Tokio	9,539				9,539	100,00%	9,54
Corea Sur	Seúl	11,570				11,570	100,00%	11,57	
Oceanía	Australia	Melbourne	15,370				15,370	100,00%	15,37
África	Sudáfrica	Johannesburgo	8,980				8,980	100,00%	8,98
	Egipto	El Cairo	2,200				2,200	100,00%	2,20
Norteamérica	Canada	Toronto	15,117				15,117	73,35%	15,12
		Vancouver	15,117				15,117	26,65%	
	EE.UU.	Chicago	16,491				16,491	23,71%	16,49
		Nueva York	16,491				16,491	56,31%	
Sudamérica	Brasil	Curitiba	2,594				2,594	12,23%	2,59
		São Paulo	2,594				2,594	87,77%	
	Colombia	Bogotá	1,760				1,760	100,00%	1,76

Fuente: [WB](#)



DB TPU CIUDADES 5		Exposición media de la población a contaminantes (microgramos/m3)						
Exposición media de la población a contaminantes (microgramos/m3)								
Región	País	Ciudad	Exposición a contaminantes			Exposición a contaminantes	Peso (%)	Exposición a contaminantes
Europa	España	Barcelona	11,300			11,300	38,53%	10,37
		Madrid	9,800			9,800	49,85%	
		Valencia	9,700			9,700	11,62%	
	Italia	Milán	21,800			21,800	53,83%	19,49
		Roma	15,500			15,500	31,52%	
		Turín	19,600			19,600	14,65%	
	Francia	Marsella	12,800			12,800	10,34%	12,95
		Nantes	10,100			10,100	6,78%	
		París	13,200			13,200	82,88%	
	Alemania	Berlín	15,700			15,700	49,72%	13,74
		Hamburgo	12,200			12,200	25,02%	
		Múnich	11,400			11,400	25,26%	
Reino Unido	Glasgow	6,700			6,700	8,30%	11,64	
	Londres	12,700			12,700	73,61%		
	Manchester	9,600			9,600	18,09%		
Asia	China	Pekín	68,200			68,200	37,01%	53,99
		Hong Kong (SAR)	47,700			47,700	14,89%	
		Shangái	45,000			45,000	48,10%	
	India	Bangalore	160,000			160,000	21,20%	178,76
		Delhi	163,500			163,500	44,40%	
		Mumbai	210,000			210,000	34,41%	
Japón	Tokio	13,100			13,100	100,00%	13,10	
Corea Sur	Seúl	27,600			27,600	100,00%	27,60	
Oceanía	Australia	Melbourne	10,000			10,000	100,00%	10,00
África	Sudáfrica	Johannesburgo	33,600			33,600	100,00%	33,60
	Egipto	El Cairo	81,300			81,300	100,00%	81,30
Norteamérica	Canada	Toronto	7,500			7,500	73,35%	7,39
		Vancouver	7,100			7,100	26,65%	
	EE.UU.	Chicago	9,600			9,600	23,71%	7,57
		Nueva York	7,200			7,200	56,31%	
		Washington DC	6,200			6,200	19,98%	
Sudamérica	Brasil	Curitiba	0,000			0,000	0,00%	13,90
		São Paulo	13,900			13,900	100,00%	
	Colombia	Bogotá	30,000			30,000	100,00%	30,00

Fuente: <https://data.unhabitat.org/pages/urban-environment-and-quality-of-life>



4.4.1. Adaptation to the future and Sustainability Indicators

4.4.1.1 Indicator A.1: Mass public transport / Total public transport

TPU A.1	Transporte público masivo / Transporte público total					
	2010	2015	2016	2017	2018	2019
España						37,25%
Alemania						66,51%
Francia						78,14%
Reino Unido						30,16%
Italia						55,67%
EEUU						60,38%
Brasil						41,33%
Colombia						76,31%
Canadá						70,94%
Egipto						57,20%
Sudáfrica						0,54%
Japón						94,03%
China						38,82%
India						21,97%
Corea del Sur						54,31%
Australia						83,26%
Maximo:		94,03%	MAX ((Media+Factor max*Desv Est.):		91,24%	10
Mínimo:		0,54%	MIN ((Media-Factor min *Desv);0):		17,11%	1
Media:		54,18%	Percentil 90%:	80,70%	74,14%	9
Media+Factor max*Desv Estándar:		91,24%	Percentil 10%:	26,06%	Unidad:	12,14
Media-Factor min*Desv Estándar:		17,11%		Desv. Est.:	24,71%	

Table 64: Indicator A.1 Values: Mass public transport / Total public transport

TPU A.1	Transporte público masivo / Transporte público total					
	2010	2015	2016	2017	2018	Calificación 2019
España						3,4 INSUFICIENTE FX
Alemania						7,0 BIEN C
Francia						8,4 MUY BIEN B
Reino Unido						2,6 MUY INSUFICIENTE F
Italia						5,7 SUFICIENTE E
EEUU						6,3 SUFICIENTE ALTO D
Brasil						3,9 INSUFICIENTE FX
Colombia						8,2 MUY BIEN B
Canadá						7,5 BIEN C
Egipto						5,9 SUFICIENTE E
Sudáfrica						1,0 MUY INSUFICIENTE F
Japón						10,0 EXCELENTE A
China						3,6 INSUFICIENTE FX
India						1,6 MUY INSUFICIENTE F
Corea del Sur						5,5 SUFICIENTE E
Australia						9,0 EXCELENTE A

Table 65: Indicator A.1 Rating: Mass public transport / Total public transport



4.4.1.2 *Indicator A.2: Increase in urban Population*

TPU A.2	Incremento de la población urbana					
	2010	2015	2016	2017	2018	2019
España						11,16%
Alemania						5,98%
Francia						4,40%
Reino Unido						10,48%
Italia						3,77%
EEUU						4,69%
Brasil						10,69%
Colombia						25,62%
Canadá						10,73%
Egipto						18,80%
Sudáfrica						29,10%
Japón						1,65%
China						20,48%
India						24,46%
Corea del Sur						1,71%
Australia						21,33%
Maximo:		29,10%		Percentil 80%:	21,33%	1
Mínimo:		1,65%	MIN ((Media-Factor min *Desv),0):		0,00%	10
Media:		12,82%	Percentil 80%:	21,33%	21,33%	-9
Media+Factor max*Desv Estándar:		26,58%	Percentil 10%:	2,74%	Unidad:	-42,20
Media-Factor min*Desv Estándar:		-0,94%		Desv. Est.:	9,17%	

Table 66: Indicator A.2 Values: Increase in urban Population

TPU A.2	Incremento de la población urbana					Calificación 2019		
	2010	2015	2016	2017	2018			
España						5,3	SUFICIENTE	E
Alemania						7,5	BIEN	C
Francia						8,1	MUY BIEN	B
Reino Unido						5,6	SUFICIENTE	E
Italia						8,4	MUY BIEN	B
EEUU						8,0	MUY BIEN	B
Brasil						5,5	SUFICIENTE	E
Colombia						1,0	MUY INSUFICIENTE	F
Canadá						5,5	SUFICIENTE	E
Egipto						2,1	MUY INSUFICIENTE	F
Sudáfrica						1,0	MUY INSUFICIENTE	F
Japón						9,3	EXCELENTE	A
China						1,4	MUY INSUFICIENTE	F
India						1,0	MUY INSUFICIENTE	F
Corea del Sur						9,3	EXCELENTE	A
Australia						1,0	MUY INSUFICIENTE	F

Table 67: Indicator A.2 Rating: Increase in urban Population



4.4.1.3 *Indicator A.3: CO₂ emissions index. WB*

TPU A.3	Índice de emisiones de CO ₂ . WB					
	2010	2015	2016	2017	2018	2019
España						3.806
Alemania						2.002
Francia						3.102
Reino Unido						3.217
Italia						3.824
EEUU						5.579
Brasil						6.385
Colombia						3.251
Canadá						6.368
Egipto						9.434
Sudáfrica						10.798
Japón						973
China						4.424
India						8.427
Corea del Sur						2.088
Australia						5.787
Maximo:		10.798,09	MAX ((Media+Factor max*Desv Est.):		9.145,24	1
Mínimo:		972,70	MIN ((Media-Factor min *Desv);0):		787,63	10
Media:		4.966,43	Percentil 90%:	8.930,12	8.357,61	-9
Media+Factor max*Desv Estándar:		9.145,24	Percentil 10%:	2.044,95	Unidad:	-0,00108
Media-Factor min*Desv Estándar:		787,63		Desv. Est.:	2.785,87	

Table 68: Indicator A.3 Values: CO₂ emissions index. WB

TPU A.3	Índice de emisiones de CO ₂ . WB						Calificación 2019		
	2010	2015	2016	2017	2018				
España						6,7	SUFICIENTE ALTO	D	
Alemania						8,7	MUY BIEN	B	
Francia						7,5	BIEN	C	
Reino Unido						7,4	BIEN	C	
Italia						6,7	SUFICIENTE ALTO	D	
EEUU						4,8	INSUFICIENTE	FX	
Brasil						4,0	INSUFICIENTE	FX	
Colombia						7,3	BIEN	C	
Canadá						4,0	INSUFICIENTE	FX	
Egipto						1,0	MUY INSUFICIENTE	F	
Sudáfrica						1,0	MUY INSUFICIENTE	F	
Japón						9,8	EXCELENTE	A	
China						6,1	SUFICIENTE ALTO	D	
India						1,8	MUY INSUFICIENTE	F	
Corea del Sur						8,6	MUY BIEN	B	
Australia						4,6	INSUFICIENTE	FX	

Table 69: Indicator A.3 Rating: CO₂ emissions index. WB



4.4.1.4 Indicator A.4: Pollution index. WB

TPU A.4	Índice de polución. WB					
	2010	2015	2016	2017	2018	2019
España						59,140
Alemania						33,120
Francia						66,025
Reino Unido						56,169
Italia						66,560
EEUU						48,217
Brasil						79,189
Colombia						72,270
Canadá						34,343
Egipto						94,740
Sudáfrica						65,580
Japón						46,870
China						84,882
India						88,353
Corea del Sur						40,320
Australia						27,790
Maximo:		94,74	MAX ((Media+Factor max*Desv Est.):		91,18	1
Mínimo:		27,79	MIN ((Media-Factor min *Desv);0):		29,26	10
Media:		60,22	Percentil 90%:	86,62	61,92	-9
Media+Factor max*Desv Estándar:		91,18	Percentil 10%:	33,73	Unidad:	-0,14534
Media-Factor min*Desv Estándar:		29,26		Desv. Est.:	20,64	

Table 70: Indicator A.4 Values: Pollution index. WB

TPU A.4	Índice de polución. WB						Calificación 2019	
	2010	2015	2016	2017	2018			
España						5,7	SUFICIENTE	E
Alemania						9,4	EXCELENTE	A
Francia						4,7	INSUFICIENTE	FX
Reino Unido						6,1	SUFICIENTE ALTO	D
Italia						4,6	INSUFICIENTE	FX
EEUU						7,2	BIEN	C
Brasil						2,7	MUY INSUFICIENTE	F
Colombia						3,7	INSUFICIENTE	FX
Canadá						9,3	EXCELENTE	A
Egipto						1,0	MUY INSUFICIENTE	F
Sudáfrica						4,7	INSUFICIENTE	FX
Japón						7,4	BIEN	C
China						1,9	MUY INSUFICIENTE	F
India						1,4	MUY INSUFICIENTE	F
Corea del Sur						8,4	MUY BIEN	B
Australia						10,0	EXCELENTE	A

Table 71: Indicator A.4 Rating: Pollution index. WB



4.4.1.5 *Indicator A.5: Energy consumption per transported passenger (MJ / (Passenger*km)). WB*

TPU A.5	Consumo energía por pasajero transportado (MJ / (Pasajero*km)). WB					
	2010	2015	2016	2017	2018	2019
España						0,562
Alemania						0,600
Francia						0,638
Reino Unido						0,859
Italia						0,531
EEUU						1,314
Brasil						0,397
Colombia						1,310
Canadá						0,999
Egipto						0,730
Sudáfrica						0,460
Japón						0,190
China						0,216
India						0,080
Corea del Sur						0,470
Australia						0,720
Maximo:		1,31	MAX ((Media+Factor max*Desv Est.):		1,17	1
Mínimo:		0,08	MIN ((Media-Factor min *Desv);0):		0,09	10
Media:		0,63	Percentil 90%:	1,15	1,08	-9
Media+Factor max*Desv Estándar:		1,17	Percentil 10%:	0,20	Unidad:	-8,36623
Media-Factor min*Desv Estándar:		0,09		Desv. Est.:	0,36	

Table 72: Indicator A.5 Values: Energy consumption per transported passenger (MJ / (Passenger*km)). WB

TPU A.5	Consumo energía por pasajero transportado (MJ / (Pasajero*km)). WB						Calificación 2019	
	2010	2015	2016	2017	2018			
España						6,1	SUFICIENTE ALTO	D
Alemania						5,7	SUFICIENTE	E
Francia						5,4	SUFICIENTE	E
Reino Unido						3,6	INSUFICIENTE	FX
Italia						6,3	SUFICIENTE ALTO	D
EEUU						1,0	MUY INSUFICIENTE	F
Brasil						7,4	BIEN	C
Colombia						1,0	MUY INSUFICIENTE	F
Canadá						2,4	MUY INSUFICIENTE	F
Egipto						4,7	INSUFICIENTE	FX
Sudáfrica						6,9	SUFICIENTE ALTO	D
Japón						9,2	EXCELENTE	A
China						9,0	EXCELENTE	A
India						10,0	EXCELENTE	A
Corea del Sur						6,8	SUFICIENTE ALTO	D
Australia						4,7	INSUFICIENTE	FX

Table 73: Indicator A.5 Rating: Energy consumption per transported passenger (MJ / (Passenger*km)). WB



4.4.1.6 Indicator A.6: Number of bicycles + scooters / 10,000 inhabitants

TPU A.6	Nº Bicicletas + patinetes / 10.000 Habitantes					
	2010	2015	2016	2017	2018	2019
España						11,209
Alemania						32,810
Francia						16,575
Reino Unido						13,880
Italia						24,582
EEUU						6,412
Brasil						1,190
Colombia						
Canadá						5,785
Egipto						
Sudáfrica						
Japón						1,810
China						56,394
India						0,681
Corea del Sur						7,106
Australia						3,813
Maximo:		56,39	MAX ((Media+Factor max*Desv Est.):		37,91	10
Mínimo:		0,68	MIN ((Media-Factor min *Desv);0):		0,00	1
Media:		14,02	Percentil 90%:	31,16	37,91	9
Media+Factor max*Desv Estándar:		37,91	Percentil 10%:	1,31	Unidad:	0,23741
Media-Factor min*Desv Estándar:		-9,87		Desv. Est.:	15,93	

Table 74: Indicator A.6 Values: Number of bicycles + scooters / 10,000 inhabitants

TPU A.6	Nº Bicicletas + patinetes / 10.000 Habitantes						Calificación 2019	
	2010	2015	2016	2017	2018			
España						3,7	INSUFICIENTE	FX
Alemania						8,8	MUY BIEN	B
Francia						4,9	INSUFICIENTE	FX
Reino Unido						4,3	INSUFICIENTE	FX
Italia						6,8	SUFICIENTE ALTO	D
EEUU						2,5	MUY INSUFICIENTE	F
Brasil						1,3	MUY INSUFICIENTE	F
Colombia								
Canadá						2,4	MUY INSUFICIENTE	F
Egipto								
Sudáfrica								
Japón						1,4	MUY INSUFICIENTE	F
China						10,0	EXCELENTE	A
India						1,2	MUY INSUFICIENTE	F
Corea del Sur						2,7	MUY INSUFICIENTE	F
Australia						1,9	MUY INSUFICIENTE	F

Table 75: Indicator A.6 Rating: Number of bicycles + scooters / 10,000 inhabitants



4.4.1.7 *Indicator A.7: CO₂ emissions (t per capita). WB*

TPU A.7	Emisiones de CO2 (t per cápita). WB					
	2010	2015	2016	2017	2018	2019
España						5,034
Alemania						8,890
Francia						4,573
Reino Unido						6,497
Italia						5,271
EEUU						16,491
Brasil						2,594
Colombia						1,760
Canadá						15,117
Egipto						2,200
Sudáfrica						8,980
Japón						9,539
China						7,544
India						1,730
Corea del Sur						11,570
Australia						15,370
Maximo:		16,49	MAX ((Media+Factor max*Desv Est.):		15,09	1
Mínimo:		1,73	MIN ((Media-Factor min *Desv),0):		0,31	10
Media:		7,70	Percentil 90%:	15,24	14,78	-9
Media+Factor max*Desv Estándar:		15,09	Percentil 10%:	1,98	Unidad:	-0,60897
Media-Factor min*Desv Estándar:		0,31		Desv. Est.:	4,93	

Table 76: Indicator A.7 Values: CO₂ emissions (t per capita). WB

TPU A.7	Emisiones de CO2 (t per cápita). WB					Calificación 2019		
	2010	2015	2016	2017	2018			
España						7,1	BIEN	C
Alemania						4,8	INSUFICIENTE	FX
Francia						7,4	BIEN	C
Reino Unido						6,2	SUFICIENTE ALTO	D
Italia						7,0	BIEN	C
EEUU						1,0	MUY INSUFICIENTE	F
Brasil						8,6	MUY BIEN	B
Colombia						9,1	EXCELENTE	A
Canadá						1,0	MUY INSUFICIENTE	F
Egipto						8,8	MUY BIEN	B
Sudáfrica						4,7	INSUFICIENTE	FX
Japón						4,4	INSUFICIENTE	FX
China						5,6	SUFICIENTE	E
India						9,1	EXCELENTE	A
Corea del Sur						3,1	INSUFICIENTE	FX
Australia						1,0	MUY INSUFICIENTE	F

Table 77: Indicator A.7 Rating: CO₂ emissions (t per capita). WB



4.4.1.8 Indicator A.8: Average population exposure to pollutants (micrograms/m³ PM2.5). UN Urban Indicators

TPU A.8	Exposición media de la población a contaminantes (microgramos/m ³ PM2.5). UN Urban Indicators					
	2010	2015	2016	2017	2018	2019
España						10,366
Alemania						13,738
Francia						12,948
Reino Unido						11,641
Italia						19,492
EEUU						7,569
Brasil						13,900
Colombia						30,000
Canadá						7,393
Egipto						81,300
Sudáfrica						33,600
Japón						13,100
China						53,988
India						178,757
Corea del Sur						27,600
Australia						10,000
Maximo:		178,76	MAX ((Media+Factor max*Desv Est.):		98,30	1
Mínimo:		7,39	MIN ((Media-Factor min *Desv);0):		0,00	10
Media:		32,84	Percentil 90%:	67,64	98,30	-9
Media+Factor max*Desv Estándar:		98,30	Percentil 10%:	8,78	Unidad:	-0,09155
Media-Factor min*Desv Estándar:		-32,63		Desv. Est.:	43,64	

Table 78: Indicator A.8 Values: Average population exposure to pollutants (micrograms/m³ PM2.5). UN Urban Indicators

TPU A.8	Exposición media de la población a contaminantes (microgramos/m ³ PM2.5). UN Urban Indicators					
	2010	2015	2016	2017	2018	Calificación 2019
España						9,1 EXCELENTE A
Alemania						8,7 MUY BIEN B
Francia						8,8 MUY BIEN B
Reino Unido						8,9 MUY BIEN B
Italia						8,2 MUY BIEN B
EEUU						9,3 EXCELENTE A
Brasil						8,7 MUY BIEN B
Colombia						7,3 BIEN C
Canadá						9,3 EXCELENTE A
Egipto						2,6 MUY INSUFICIENTE F
Sudáfrica						6,9 SUFICIENTE ALTO D
Japón						8,8 MUY BIEN B
China						5,1 SUFICIENTE E
India						1,0 MUY INSUFICIENTE F
Corea del Sur						7,5 BIEN C
Australia						9,1 EXCELENTE A

Table 79: Indicator A.8 Rating: Average population exposure to pollutants (micrograms/m³ PM2.5). UN Urban Indicators



4.4.1.9 Indicator A.9: Development of Climate Change Mitigation Technologies related to transport (OECD)

TPU A.9	Desarrollo de Tecnologías de mitigación del cambio climático relacionado con el transporte (OCDE)					
	2010	2015	2016	2017	2018	2019
España						0,840
Alemania						4,770
Francia						4,930
Reino Unido						3,880
Italia						2,120
EEUU						2,070
Brasil						1,260
Colombia						0,370
Canadá						2,600
Egipto						
Sudáfrica						0,520
Japón						2,400
China						0,900
India						1,330
Corea del Sur						2,000
Australia						1,230
Maximo:		4,93	MAX ((Media+Factor max*Desv Est.):		4,25	10
Mínimo:		0,37	MIN ((Media-Factor min *Desv);0):		0,00	1
Media:		2,08	Percentil 90%:	4,41	4,25	9
Media+Factor max*Desv Estándar:		4,25	Percentil 10%:	0,65	Unidad:	2,11837
Media-Factor min*Desv Estándar:		-0,09		Desv. Est.:	1,44	

Table 80: Indicator A.9 Values: Development of Climate Change Mitigation Technologies related to transport (OECD)

TPU A.9	Desarrollo de Tecnologías de mitigación del cambio climático relacionado con el transporte (OCDE)						Calificación 2019	
	2010	2015	2016	2017	2018			
España						2,8	MUY INSUFICIENTE	F
Alemania						10,0	EXCELENTE	A
Francia						10,0	EXCELENTE	A
Reino Unido						9,2	EXCELENTE	A
Italia						5,5	SUFICIENTE	E
EEUU						5,4	SUFICIENTE	E
Brasil						3,7	INSUFICIENTE	FX
Colombia						1,8	MUY INSUFICIENTE	F
Canadá						6,5	SUFICIENTE ALTO	D
Egipto								
Sudáfrica						2,1	MUY INSUFICIENTE	F
Japón						6,1	SUFICIENTE ALTO	D
China						2,9	MUY INSUFICIENTE	F
India						3,8	INSUFICIENTE	FX
Corea del Sur						5,2	SUFICIENTE	E
Australia						3,6	INSUFICIENTE	FX

Table 81: Indicator A.9 Rating: Development of Climate Change Mitigation Technologies related to transport (OECD)



4.4.1.10 Indicator A.10: % of urban population exposed to high noise levels. EUROSTAT

TPU A.10	% de la población de áreas urbanas expuesto a niveles altos de ruido. EUROSTAT					
	2010	2015	2016	2017	2018	2019
España						60
Alemania						23
Francia						52
Reino Unido						27
Italia						61
EEUU						
Brasil						
Colombia						
Canadá						
Egipto						
Sudáfrica						
Japón						
China						
India						
Corea del Sur						
Australia						
Maximo:		61,00	MAX ((Media+Factor max*Desv Est.):		72,03	1
Mínimo:		23,00	MIN ((Media-Factor min *Desv);0):		17,17	10
Media:		44,60	Percentil 90%:	60,60	54,85	-9
Media+Factor max*Desv Estándar:		72,03	Percentil 10%:	24,60	Unidad:	-0,16408
Media-Factor min*Desv Estándar:		17,17		Desv. Est.:	18,28	

Table 82: Indicator A.10 Values: % of urban population exposed to high noise levels. EUROSTAT

TPU A.10	% de la población de áreas urbanas expuesto a niveles altos de ruido. EUROSTAT					
	2010	2015	2016	2017	2018	Calificación 2019
España						3,0 INSUFICIENTE FX
Alemania						9,0 EXCELENTE A
Francia						4,3 INSUFICIENTE FX
Reino Unido						8,4 MUY BIEN B
Italia						2,8 MUY INSUFICIENTE F
EEUU						
Brasil						
Colombia						
Canadá						
Egipto						
Sudáfrica						
Japón						
China						
India						
Corea del Sur						
Australia						

Table 83: Indicator A.10 Rating: % of urban population exposed to high noise levels. EUROSTAT



4.4.2. Adaptation to the future and Sustainability Indicator

	Índice de Adaptación al futuro y Desarrollo Sost.						Max valor 2019
	2010	2015	2016	2017	2018	2019	
España						52,5	90
Alemania						79,7	90
Francia						69,6	90
Reino Unido						62,3	90
Italia						62,1	90
EEUU						45,6	81
Brasil						45,9	81
Colombia						39,4	72
Canadá						47,9	81
Egipto						26,0	63
Sudáfrica						28,4	72
Japón						66,4	81
China						45,5	81
India						30,9	81
Corea del Sur						57,2	81
Australia						45,0	81
Maximo:		79,714		Máximo Valor:	VER TABLA	10	
Mínimo:		25,998		MIN:	0	0	
Media:		50,270				10,000	

Table 84: Adaptation to the future and Sustainability Indicator

	Evaluación de Adaptación al futuro y Desarrollo Sost.						Subindicadores considerados	
	2010	2015	2016	2017	2018	Calificación 2019		
España					5,8	SUFICIENTE	E	10
Alemania					8,9	MUY BIEN	B	10
Francia					7,7	BIEN	C	10
Reino Unido					6,9	SUFICIENTE ALTO	D	10
Italia					6,9	SUFICIENTE ALTO	D	10
EEUU					5,6	SUFICIENTE	E	9
Brasil					5,7	SUFICIENTE	E	9
Colombia					5,5	SUFICIENTE	E	8
Canadá					5,9	SUFICIENTE	E	9
Egipto					4,1	INSUFICIENTE	FX	7
Sudáfrica					3,9	INSUFICIENTE	FX	8
Japón					8,2	MUY BIEN	B	9
China					5,6	SUFICIENTE	E	9
India					3,8	INSUFICIENTE	FX	9
Corea del Sur					7,1	BIEN	C	9
Australia					5,6	SUFICIENTE	E	9

Table 85: Adaptation to the future and Sustainability Criterion Rating

Subindicadores de Adaptación al futuro y Desarrollo Sost.		Pesos	Punt. Max.	Total Max puntuación
TPU A.1	Transporte público masivo / Transporte público total	1	10	10
TPU A.2	Incremento de la población urbana	1	10	10
TPU A.3	Índice de emisiones de CO2. WB	1	10	10
TPU A.4	Índice de polución. WB	1	10	10
TPU A.5	Consumo energía por pasajero transportado (MJ / (Pasajero*km)). WB	1	10	10
TPU A.6	Nº Bicicletas + patinetes / 10.000 Habitantes	1	10	10
TPU A.7	Emisiones de CO2 (t per cápita). WB	1	10	10
TPU A.8	Exposición media de la población a contaminantes (microgramos/m3 PM2.5). UN Urban Indicators	1	10	10
TPU A.9	Desarrollo de Tecnologías de mitigación del cambio climático relacionado con el transporte (OCDE)	1	10	10
TPU A.10	% de la población de áreas urbanas expuesto a niveles altos de ruido. EUROSTAT	1	10	10
		10		100

Table 86: Weights and maximum reduced scores for the Indicators of Future Adaptation and Sustainability



The "Mass Transit / Total Public Transport" indicator has an average of 54%, ranging from a maximum of 94% (Japan) to a minimum of 0.54% (South Africa). Spain has a value of 37%, considerably lower compared to Germany (66%) and France (78%).

The urban population growth in Spain (11.1%) is the highest among the analyzed European countries. In Colombia, South Africa, China, India, and Australia, the increase is above 20%.

In the indicators: CO₂ emissions index, pollution index, energy consumption per transported passenger, and CO₂ emissions (t/capita), Spain's values are of the same magnitude as European countries.

The number of bicycles and scooters per 10,000 inhabitants in Spain (10,117) is much lower compared to European countries (Germany has a value of 32.8%, and China has 56.4%).

In the "Development of Technologies for Climate Change Mitigation related to Transport (OECD)" indicator, Spain has the worst result among all European countries.

Lastly, in the "% of urban population exposed to high noise levels (EUROSTAT)", Spain, France, and Italy present very similar values (between 50% and 60%).

The countries with the highest ratings are Germany (8.9) and Japan (8.2), followed by France (7.7), South Korea (7.1), and the United Kingdom and Italy (6.9). Spain receives a rating of sufficient (5.8), the lowest among European countries.



4.5. Operation and maintenance

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

The selected indicators for this criterion are as follows:

5 OPERATION AND MAINTENANCE	
O.1	Operating expenses / inhabitants
O.2	Operating expenses / GDP
O.3	Operating expenses / Area

It should be noted that separating investment in operation and maintenance from investment in infrastructure creation is often challenging. Budget items are not always well-defined, and in some cases, the national accounting of certain countries does not differentiate this separation, leading to potentially unreliable data.

Investment needs for operation, conservation, and maintenance are related to the condition of the infrastructure and the requirements for adapting to new technical, functional, and technological advancements. Experts have debated extensively about the necessary investment for proper conservation. While there is no widespread consensus on an exact percentage, it is generally considered that the required conservation investment should range 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 closely reflect reality. Some attempts have been made to determine asset value, although they are not standardized, and verifiable and comparable data are often lacking.

Regarding urban public transportation, maintenance expenses, which include repairs and rehabilitations in the urban public transportation network, should not be confused with the total operating expenses of the network. However, in the majority of cases, authorities do not provide separate data for these categories, instead giving the total operating costs of the network for the entire year. Consequently, it is not possible to internationally compare specific data such as maintenance workshop expenses, infrastructure maintenance expenses, or exclusive operating costs. Instead, even though it provides less granularity, these categories will be grouped together, and the total cost of operating and maintaining the network will be evaluated for international comparison.

Similarly to what was discussed regarding the Financing Criterion, the percentage of GDP allocated to operating expenses represents an indicator that can provide insight into the adequacy of investment for conservation and operation. To further specify and support this indicator, investment per capita and per area have also been considered.

The following tables present the basic data of the indicators used.



DB TPU CIUDADES 13			Gastos de operación (millns. \$)					
Gastos de operación (\$) / Habitantes								
Región	País	Ciudad	Gastos Oper. (millns. \$)			Gastos Opr. / Habitantes	Peso (%)	Gastos Opr. / Habitantes
Europa	España	Barcelona	1.650,000			323,529	38,53%	325,21
		Madrid	2.389,893			356,700	49,85%	
		Valencia	352,330			195,739	11,62%	
	Italia	Milán	940,306			171,339	100,00%	171,34
		Roma					0,00%	
		Turín					0,00%	
	Francia	Marsella					0,00%	324,30
		Nantes					0,00%	
		París	3.586,748			324,299	100,00%	
	Alemania	Berlín					0,00%	260,38
		Hamburgo	525,717			260,385	100,00%	
		Múnich					0,00%	
Reino Unido	Glasgow					0,00%	651,73	
	Londres	7.339,732			651,725	100,00%		
	Manchester					0,00%		
Asia	China	Pekín					0,00%	356,55
		Hong Kong (SAR)	2.656,300			356,550	100,00%	
		Shangái					0,00%	
	India	Bangalore	570,756			37,096	21,20%	35,09
		Delhi	1.274,739			39,556	44,40%	
		Mumbai	701,663			28,097	34,41%	
Japón	Tokio	2.124,395			56,302	100,00%	56,30	
Corea Sur	Seúl	980,766			42,612	100,00%	42,61	
Oceanía	Australia	Melbourne					100,00%	
África	Sudáfrica	Johannesburgo					100,00%	
	Egipto	El Cairo					100,00%	
Norteamérica	Canada	Toronto	1.045,167			154,359	73,35%	177,45
		Vancouver	592,882			241,009	26,65%	
	EE.UU.	Chicago	1.516,948			167,489	23,71%	386,67
		Nueva York	11.335,351			527,005	56,31%	
		Washington DC	1.917,174			251,235	19,98%	
Sudamérica	Brasil	Curitiba	564,220			175,333	12,23%	204,08
		São Paulo	4.803,860			208,085	87,77%	
	Colombia	Bogotá	5.504,098			545,771	100,00%	545,77

Fuente: España: Observatorio de la Movilidad Urbana. Informe 2019 y avance 2020. Resto del mundo: WB.

0			0					
Gastos de operación (\$) / PIB								
Región	País	Ciudad				Gastos Opr. / PIB	Peso (%)	Gastos Opr. / PIB
Europa	España	Barcelona				1,03%	38,53%	0,97%
		Madrid				1,00%	49,85%	
		Valencia				0,64%	11,62%	
	Italia	Milán				0,32%	100,00%	0,32%
		Roma					0,00%	
		Turín					0,00%	
	Francia	Marsella					0,00%	0,41%
		Nantes					0,00%	
		París				0,41%	100,00%	
	Alemania	Berlín					0,00%	0,15%
		Hamburgo				0,15%	100,00%	
		Múnich					0,00%	
Reino Unido	Glasgow					0,00%	0,78%	
	Londres				0,78%	100,00%		
	Manchester					0,00%		
Asia	China	Pekín					0,00%	0,78%
		Hong Kong (SAR)				0,78%	100,00%	
		Shangái					0,00%	
	India	Bangalore				0,61%	21,20%	0,49%
		Delhi				0,67%	44,40%	
		Mumbai				0,18%	34,41%	
Japón	Tokio				0,12%	100,00%	0,12%	
Corea Sur	Seúl				0,11%	100,00%	0,11%	
Oceanía	Australia	Melbourne					100,00%	
África	Sudáfrica	Johannesburgo					100,00%	
	Egipto	El Cairo					100,00%	
Norteamérica	Canada	Toronto				0,25%	73,35%	0,28%
		Vancouver				0,38%	26,65%	
	EE.UU.	Chicago				0,23%	23,71%	0,49%
		Nueva York				0,65%	56,31%	
		Washington DC				0,32%	19,98%	
Sudamérica	Brasil	Curitiba				0,81%	12,23%	0,89%
		São Paulo				0,90%	87,77%	
	Colombia	Bogotá				3,12%	100,00%	3,12%

Fuente: España: Observatorio de la Movilidad Urbana. Informe 2019 y avance 2020. Resto del mundo: WB.



Gastos de operación (\$) / superficie								
Región	País	Ciudad				Gastos Superficie	Peso (%)	Gastos operación / Superficie
Europa	España	Barcelona				2,603	38,53%	2,43
		Madrid				2,601	49,85%	
		Valencia				1,151	11,62%	
	Italia	Milán				0,497	100,00%	0,50
		Roma					0,00%	
		Turín					0,00%	
	Francia	Marsella					0,00%	1,26
		Nantes					0,00%	
		París				1,261	100,00%	
	Alemania	Berlín					0,00%	0,68
		Hamburgo				0,677	100,00%	
		Múnich					0,00%	
Reino Unido	Glasgow					0,00%	4,22	
	Londres				4,223	100,00%		
	Manchester					0,00%		
Asia	China	Pekín					0,00%	9,32
		Hong Kong (SAR)				9,320	100,00%	
		Shangái					0,00%	
	India	Bangalore				0,489	21,20%	0,63
		Delhi				0,579	44,40%	
		Mumbai				0,796	34,41%	
Japón	Tokio				0,249	100,00%	0,25	
Corea Sur	Seúl				0,357	100,00%	0,36	
Oceanía	Australia	Melbourne					100,00%	
África	Sudáfrica	Johannesburgo					100,00%	
	Egipto	El Cairo					100,00%	
Norteamérica	Canada	Toronto				0,454	73,35%	0,51
		Vancouver				0,677	26,65%	
	EE.UU.	Chicago				0,221	23,71%	0,70
		Nueva York				0,955	56,31%	
		Washington DC				0,560	19,98%	
Sudamérica	Brasil	Curitiba				0,670	12,23%	1,47
		São Paulo				1,579	87,77%	
	Colombia	Bogotá				9,794	100,00%	9,79

Fuente: [WB](#)



4.5.1. Operation and maintenance Indicators

4.5.1.1 Indicator O.1: Operating expenses / inhabitants

TPU O.1	Gastos operativos / Habitantes					
	2010	2015	2016	2017	2018	2019
España						325
Alemania						260
Francia						324
Reino Unido						652
Italia						171
EEUU						387
Brasil						204
Colombia						546
Canadá						177
Egipto						
Sudáfrica						
Japón						56
China						357
India						35
Corea del Sur						43
Australia						
Maximo:		651,73	MAX ((Media+Factor max*Desv Est.):		554,10	10
Mínimo:		35,09	MIN ((Media-Factor min *Desv);0):		0,00	1
Media:		272,11	Percentil 90%:	513,95	554,10	9
Media+Factor max*Desv Estándar:		554,10	Percentil 10%:	45,35	Unidad:	0,01624
Media-Factor min*Desv Estándar:		-9,88		Desv. Est.:	187,99	

Table 87: Indicator O.1 Values: Operating expenses / inhabitants

TPU O.1	Gastos operativos / Habitantes						Calificación 2019		
	2010	2015	2016	2017	2018				
España						6,3	SUFICIENTE ALTO	D	
Alemania						5,2	SUFICIENTE	E	
Francia						6,3	SUFICIENTE ALTO	D	
Reino Unido						10,0	EXCELENTE	A	
Italia						3,8	INSUFICIENTE	FX	
EEUU						7,3	BIEN	C	
Brasil						4,3	INSUFICIENTE	FX	
Colombia						9,9	EXCELENTE	A	
Canadá						3,9	INSUFICIENTE	FX	
Egipto									
Sudáfrica									
Japón						1,9	MUY INSUFICIENTE	F	
China						6,8	SUFICIENTE ALTO	D	
India						1,6	MUY INSUFICIENTE	F	
Corea del Sur						1,7	MUY INSUFICIENTE	F	
Australia									

Table 88: Indicator O.1 Rating: Operating expenses / inhabitants



4.5.1.2 *Indicator O.2: Operating expenses / GDP*

TPU O.2	Gastos operativos / PIB					
	2010	2015	2016	2017	2018	2019
España						0,010
Alemania						0,001
Francia						0,004
Reino Unido						0,008
Italia						0,003
EEUU						0,005
Brasil						0,009
Colombia						0,031
Canadá						0,003
Egipto						
Sudáfrica						
Japón						0,001
China						0,008
India						0,005
Corea del Sur						0,001
Australia						
Maximo:		0,03	MAX ((Media+Factor max*Desv Est.):		0,02	10
Mínimo:		0,00	MIN ((Media-Factor min *Desv),0):		0,00	1
Media:		0,01	Percentil 90%:	0,01	0,02	9
Media+Factor max*Desv Estándar:		0,02	Percentil 10%:	0,00	Unidad:	481,94125
Media-Factor min*Desv Estándar:		0,00		Desv. Est.:	0,01	

Table 89: Indicator O.2 Values: Operating expenses / GDP

TPU O.2	Gastos operativos / PIB					Calificación 2019		
	2010	2015	2016	2017	2018			
España						5,7	SUFICIENTE	E
Alemania						1,7	MUY INSUFICIENTE	F
Francia						3,0	INSUFICIENTE	FX
Reino Unido						4,8	INSUFICIENTE	FX
Italia						2,5	MUY INSUFICIENTE	F
EEUU						3,3	INSUFICIENTE	FX
Brasil						5,3	SUFICIENTE	E
Colombia						10,0	EXCELENTE	A
Canadá						2,4	MUY INSUFICIENTE	F
Egipto								
Sudáfrica								
Japón						1,6	MUY INSUFICIENTE	F
China						4,8	INSUFICIENTE	FX
India						3,4	INSUFICIENTE	FX
Corea del Sur						1,5	MUY INSUFICIENTE	F
Australia								

Table 90: Indicator O.2 Rating: Operating expenses / GDP



4.5.1.3 Indicator O.3: Operating expenses / Area

TPU O.3	Gastos operativos / Superficie					
	2010	2015	2016	2017	2018	2019
España						2,433
Alemania						0,677
Francia						1,261
Reino Unido						4,223
Italia						0,497
EEUU						0,702
Brasil						1,468
Colombia						9,794
Canadá						0,514
Egipto						
Sudáfrica						
Japón						0,249
China						9,320
India						0,635
Corea del Sur						0,357
Australia						
Maximo:		9,79	MAX ((Media+Factor max*Desv Est.):		7,46	10
Mínimo:		0,25	MIN ((Media-Factor min *Desv);0):		0,00	1
Media:		2,47	Percentil 90%:	8,30	7,46	9
Media+Factor max*Desv Estándar:		7,46	Percentil 10%:	0,39	Unidad:	1,20580
Media-Factor min*Desv Estándar:		-2,52		Desv. Est.:	3,33	

Table 91: Indicator O.3 Values: Operating expenses / Area

TPU O.3	Gastos operativos / Superficie					Calificación 2019		
	2010	2015	2016	2017	2018			
España						3,9	INSUFICIENTE	FX
Alemania						1,8	MUY INSUFICIENTE	F
Francia						2,5	MUY INSUFICIENTE	F
Reino Unido						6,1	SUFICIENTE ALTO	D
Italia						1,6	MUY INSUFICIENTE	F
EEUU						1,8	MUY INSUFICIENTE	F
Brasil						2,8	MUY INSUFICIENTE	F
Colombia						10,0	EXCELENTE	A
Canadá						1,6	MUY INSUFICIENTE	F
Egipto								
Sudáfrica								
Japón						1,3	MUY INSUFICIENTE	F
China						10,0	EXCELENTE	A
India						1,8	MUY INSUFICIENTE	F
Corea del Sur						1,4	MUY INSUFICIENTE	F
Australia								

Table 92: Indicator O.3 Rating: Operating expenses / Area



4.5.2. Operation and maintenance Indicator

	Índice de Operación y mantenimiento						Max valor 2019
	2010	2015	2016	2017	2018	2019	
España						15,9	27
Alemania						8,8	27
Francia						11,8	27
Reino Unido						20,9	27
Italia						7,9	27
EEUU						12,5	27
Brasil						12,4	27
Colombia						29,9	27
Canadá						7,9	27
Egipto							0
Sudáfrica							0
Japón						4,8	27
China						21,5	27
India						6,7	27
Corea del Sur						4,6	27
Australia							0
Maximo:		29,865		Máximo Valor:	VER TABLA	10	
Mínimo:		4,639		MIN:	0	0	
Media:		12,726				10,000	

Table 93: Operation and maintenance Indicator Values

Subindicadores de Operación y mantenimiento		Pesos	Punt. Max.	Total Max puntuación
TPU O.1	Gastos operativos / Habitantes	1	10	10
TPU O.2	Gastos operativos / PIB	1	10	10
TPU O.3	Gastos operativos / Superficie	1	10	10
		3		30
		% Valorado de la Max. Puntuación del Criterio	90,0%	27

Table 94: Operation and maintenance Indicators Weights

	Evaluación de Operación y mantenimiento						Subindicadores considerados	
	2010	2015	2016	2017	2018	Calificación 2019		
España					5,9	SUFICIENTE	E	3
Alemania					3,2	INSUFICIENTE	FX	3
Francia					4,4	INSUFICIENTE	FX	3
Reino Unido					7,7	BIEN	C	3
Italia					2,9	MUY INSUFICIENTE	F	3
EEUU					4,6	INSUFICIENTE	FX	3
Brasil					4,6	INSUFICIENTE	FX	3
Colombia					10,0	EXCELENTE	A	3
Canadá					2,9	MUY INSUFICIENTE	F	3
Egipto								0
Sudáfrica								0
Japón					1,8	MUY INSUFICIENTE	F	3
China					8,0	MUY BIEN	B	3
India					2,5	MUY INSUFICIENTE	F	3
Corea del Sur					1,7	MUY INSUFICIENTE	F	3
Australia								0

Table 95: Operation and maintenance Criterion Rating



As previously discussed, the most significant ratio for evaluating the Operation and Maintenance Criterion is the percentage of investment in operating expenses over asset value. However, obtaining this value for urban public transportation is not feasible. Therefore, the investment in operating expenses relative to GDP has been used instead. The average value of the "Operating Expenses / Real GDP" ratio is 0.01%, with a maximum of 0.03% and a minimum of 0.001%, corresponding to Germany, Japan, and South Korea. Spain's percentage is 0.01%, which is in line with the average.

Another indicative ratio is the percentage of operating expenses relative to the population. The resulting average value is 272, with the maximum being 651 and the minimum 35. Spain's value is 325.

In the overall Operation and Maintenance Criterion, Spain is rated as "Sufficient" (5.9). Countries with the highest rating are Colombia and China, while countries with lower ratings include Italy, Canada, Japan, and Australia.



4.6. Safety

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

The chosen Indicators are:

6 SAFETY	
S.1	Number of fatalities / 100,000 inhabitants

To assess the safety of urban public transportation infrastructure, the most accurate indicator would be the accident and casualty index in public transportation. However, it is very difficult to obtain this data as, generally, these statistics are not commonly recorded, and in many cases, attempts are made to conceal them.

The ASCE report indicates that in the United States, there were a total of 255 fatalities in accidents related to public transportation, but only 5% of this figure were passengers of public transportation; the remaining 95% were due to other circumstances unrelated to the transportation users. This is because most accidents are pedestrian collisions involving buses, which also do not represent a relative safety figure for the infrastructure, as these accidents are usually caused by pedestrians' or drivers' actions. However, particularly in older railway systems, incidents like smoke, fires, derailments, or collisions can occur, making it essential to maintain the infrastructure's good condition to ensure public safety.

One way to assess vehicle safety would be to measure their safety features, such as automatic blocking and braking systems in railway modes. However, since networks generally consist of homogeneous vehicles and these systems are challenging to quantify due to international variations from vehicle manufacturers, they have not been used as indicators in this report. Nevertheless, their implementation and enhancement should always be considered, particularly in older systems lacking such features.

Instead, the number of fatalities in traffic accidents on urban roads in the studied cities has been quantified. A higher value for this indicator may signify poorer safety on urban roads due to excessive use owing to the lack of adequate public transportation infrastructure. The following tables show the results obtained for this Safety Indicator, which is the only component of the Safety Indicator.

The most recent year for which data is available has been used in all cases, with a zero rating given if the urban traffic fatality rate is equal to or greater than 10 per 100,000 inhabitants. As evident, generally, poorer results are obtained in less developed countries. In Europe, the best indicator values are obtained. In the United States, the high number of fatalities in Chicago stands out compared to other cities.



4.6.1. Safety Indicators

4.6.1.1 Indicator S.1: Number of fatalities / 100,000 inhabitants

TPU S.1	Nº Víctimas / 100.000 Habitantes					
	2010	2015	2016	2017	2018	2019
España						2,6
Alemania						2,0
Francia						2,5
Reino Unido						2,8
Italia						6,0
EEUU						5,4
Brasil						13,0
Colombia						6,9
Canadá						6,2
Egipto						11,4
Sudáfrica						15,4
Japón						5,3
China						7,7
India						13,2
Corea del Sur						17,0
Australia						4,0
Maximo:		17,00	MAX ((Media+Factor max*Desv Est.):		14,92	1
Mínimo:		2,00	MIN :		0,00	10
Media:		7,60	Percentil 90%:	14,30	14,92	-9
Media+Factor max*Desv Estándar:		14,92	Percentil 10%:	2,55	Unidad:	-0,60333
Media-Factor min*Desv Estándar:		0,28		Desv. Est.:	4,88	

Table 96: Indicator S.1 Values: Number of fatalities / 100,000 inhabitants

TPU S.1	Nº Víctimas / 100.000 Habitantes						Calificación 2019	
	2010	2015	2016	2017	2018			
España						8,4	MUY BIEN	B
Alemania						8,8	MUY BIEN	B
Francia						8,5	MUY BIEN	B
Reino Unido						8,3	MUY BIEN	B
Italia						6,4	SUFICIENTE ALTO	D
EEUU						6,7	SUFICIENTE ALTO	D
Brasil						2,2	MUY INSUFICIENTE	F
Colombia						5,8	SUFICIENTE	E
Canadá						6,2	SUFICIENTE ALTO	D
Egipto						3,1	INSUFICIENTE	FX
Sudáfrica						1,0	MUY INSUFICIENTE	F
Japón						6,8	SUFICIENTE ALTO	D
China						5,3	SUFICIENTE	E
India						2,0	MUY INSUFICIENTE	F
Corea del Sur						1,0	MUY INSUFICIENTE	F
Australia						7,6	BIEN	C

Table 97: Indicator S.1 Rating: Number of fatalities / 100,000 inhabitants



4.6.2. Safety Indicator

	Índice de Seguridad						Max valor 2019
	2010	2015	2016	2017	2018	2019	
España						8,4	10
Alemania						8,8	10
Francia						8,5	10
Reino Unido						8,3	10
Italia						6,4	10
EEUU						6,7	10
Brasil						2,2	10
Colombia						5,8	10
Canadá						6,2	10
Egipto						3,1	10
Sudáfrica						1,0	10
Japón						6,8	10
China						5,3	10
India						2,0	10
Corea del Sur						1,0	10
Australia						7,6	10
Maximo:		8,793	Máximo Valor:		VER TABLA	10	
Mínimo:		1,000	MIN:		0	0	
Media:		5,513				10,000	

Table 98: Safety Indicator Values

Subindicadores de Seguridad		Pesos	Punt. Max.	Total Max puntuación
TPU S.1	Nº Víctimas / 100.000 Habitantes	1	10	10
		1		10
		% Valorado de la Max. Puntuación del Criterio	100,0%	10

Table 99: Safety Indicators Weights

	Evaluación de Seguridad						Subindicadores considerados	
	2010	2015	2016	2017	2018	Calificación 2019		
España					8,4	MUY BIEN	B	1
Alemania					8,8	MUY BIEN	B	1
Francia					8,5	MUY BIEN	B	1
Reino Unido					8,3	MUY BIEN	B	1
Italia					6,4	SUFICIENTE ALTO	D	1
EEUU					6,7	SUFICIENTE ALTO	D	1
Brasil					2,2	MUY INSUFICIENTE	F	1
Colombia					5,8	SUFICIENTE	E	1
Canadá					6,2	SUFICIENTE ALTO	D	1
Egipto					3,1	INSUFICIENTE	FX	1
Sudáfrica					1,0	MUY INSUFICIENTE	F	1
Japón					6,8	SUFICIENTE ALTO	D	1
China					5,3	SUFICIENTE	E	1
India					2,0	MUY INSUFICIENTE	F	1
Corea del Sur					1,0	MUY INSUFICIENTE	F	1
Australia					7,6	BIEN	C	1

Table 100: Safety Criterion Rating

Overall, the better-rated countries are European ones (with the exception of Italy). The United States, Japan, and Australia receive a rating of "HIGH SATISFACTORY," with slight variations among them. The least favorable countries are South Africa, South Korea, and India.



4.7. Resilience

Resilience is the ability of a system to restore its initial state once 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 consequences for users, the environment, the economy, and national security? Is public infrastructure prepared to recover its initial state within a reasonable time once the threat or adverse incident has ceased? Are there alternatives to maintain the services it provides?

The chosen indicators are:

7 RESILIENCE	
R.1	Network length (km) / City Area (KM2)
R.2	% of population within 1,000 m of a public transport stop (OECD)
R.3	% of population traveling less than 30 minutes on public transport (OECD)
R.4	Hours/year lost in Traffic jams (Tomtom)
R.5	urban core public transport coverage (ITF. Benchmarking accessibility in Cities)
R.6	metropolitan Area public transport coverage (ITF. Benchmarking accessibility in Cities)
R.7	Periurban Area public transport coverage (ITF. Benchmarking accessibility in Cities)

The resilience of public infrastructure is put to the test following the impacts of extreme natural phenomena, such as earthquakes or floods, or intentionally or inadvertently caused actions by citizens that severely affect the infrastructure and can temporarily disrupt its services. Resilience is challenging to quantify, primarily relying on the capacity of the infrastructure to respond and adapt to a specific incident. One possible way to assess the resilience of public infrastructure is through the redundancy of its elements.

In the case of urban public transportation networks, one of the most significant indicators to understand the adaptive capacity of a transport network in the face of any accident would be the number of transfer stations divided by the length of the network. This would evaluate the network's ability to provide its services through various modes of transportation in case any one is affected, as well as the proportion of interchange stations in the network. However, this indicator is often unavailable. Alternatively, indicators that are also representative for assessing resilience have been employed, such as evaluating the network length divided by the city's area. This provides a quantification of the proportion of the city's area covered by the urban public transportation network and its citizens' capacity to access it in the event that certain services are temporarily unavailable.

The coverage of public transportation is also a good indicator of the system's resilience capacity. In this report, the coverage of public transportation for the main urban core, metropolitan area, and peri-urban area has been considered. The data originates from the International Transport Forum (ITF).

Additionally, the following indicators are considered: the percentage of the population located within 1,000 meters of a public transportation stop, the percentage of the population traveling less than 30 minutes via public transportation, and the annual hours lost due to congestion (in this case, information has been collected from Tomtom). The following tables present the basic data of the cities under consideration.



DB TPU CIUDADES 16			Longitud red (km); Superficie Ciudad (km2)					
Longitud de red (km) / Área ciudad (km2)								
Región	País	Ciudad	Longitud red (km)	Área ciudad (km ²)		Longitud de red Área ciudad	Peso (%)	Longitud de red (km) Área ciudad (km2)
Europa	España	Barcelona	152,400	102		1,50	38,53%	0,98
		Madrid	322,770	604		0,53	49,85%	
		Valencia	156,400	135		1,16	11,62%	
	Italia	Milán	258,800	182		1,42	53,83%	1,03
		Roma	104,270	1.285		0,08	31,52%	
		Turín	213,200	130		1,64	14,65%	
	Francia	Marsella	33,000	241		0,14	10,34%	2,31
		Nantes	49,000	65		0,75	6,78%	
		París	286,000	105		2,71	82,88%	
	Alemania	Berlín	151,700	892		0,17	49,72%	0,26
		Hamburgo	115,500	755		0,15	25,02%	
		Múnich	174,000	310		0,56	25,26%	
Reino Unido	Glasgow	10,400	175		0,06	8,30%	0,24	
	Londres	483,000	1.572		0,31	73,61%		
	Manchester	6,400	116		0,06	18,09%		
Asia	China	Pekín	390,950	16.808		0,02	37,01%	0,15
		Hong Kong (SAR)	205,000	285		0,72	14,89%	
		Shangái	463,000	6.340		0,07	48,10%	
	India	Bangalore	42,300	709		0,06	21,20%	0,08
		Delhi	195,470	1.484		0,13	44,40%	
		Mumbai	11,400	603		0,02	34,41%	
	Japón	Tokio	313,200	2.188		0,14	100,00%	0,14
Corea Sur	Seúl	393,000	605		0,65	100,00%	0,65	
Oceanía	Australia	Melbourne	357,500	9.990		0,04	100,00%	0,04
África	Sudáfrica	Johannesburgo	30,000	1.645		0,02	100,00%	0,02
	Egipto	El Cairo	78,000	528		0,15	100,00%	0,15
Norteamérica	Canada	Toronto	420,800	630		0,67	73,35%	0,71
		Vancouver	95,700	115		0,83	26,65%	
	EE.UU.	Chicago	389,780	606		0,64	23,71%	0,65
		Nueva York	419,720	784		0,54	56,31%	
		Washington DC	170,750	177		0,96	19,98%	
Sudamérica	Brasil	Curitiba	81,400	435		0,19	12,23%	0,14
		São Paulo	196,750	1.521		0,13	87,77%	
	Colombia	Bogotá	87,000	1.775		0,05	100,00%	0,05

Fuente: [WB](#)

DB TPU CIUDADES 33			% de la población a menos de 1.000 m de una parada de transporte público (OCDE)					
% de la población a menos de 1.000 m de una parada de transporte público (OCDE)								
Región	País	Ciudad	% de la a menos de 1			% de la a menos de 1	Peso (%)	% de la población a menos de 1 km de
Europa	España	Barcelona					0,00%	90,00
		Madrid	90			90,000	100,00%	
		Valencia					0,00%	
	Italia	Milán					0,00%	87,00
		Roma	87			87,000	100,00%	
		Turín					0,00%	
	Francia	Marsella					0,00%	95,00
		Nantes	95			95,000	7,56%	
		París	95			95,000	92,44%	
	Alemania	Berlín	100			100,000	100,00%	100,00
		Hamburgo					0,00%	
		Múnich					0,00%	
Reino Unido	Glasgow					8,30%	0,00	
	Londres					73,61%		
	Manchester					18,09%		
Asia	China	Pekín					37,01%	0,00
		Hong Kong (SAR)					14,89%	
		Shangái					48,10%	
	India	Bangalore					21,20%	0,00
		Delhi					44,40%	
		Mumbai					34,41%	
	Japón	Tokio					100,00%	
Corea Sur	Seúl					100,00%		
Oceanía	Australia	Melbourne				100,00%		
África	Sudáfrica	Johannesburgo				100,00%		
	Egipto	El Cairo	40			40,000	100,00%	40,00
Norteamérica	Canada	Toronto	90			90,000	100,00%	90,00
		Vancouver					0,00%	
	EE.UU.	Chicago					0,00%	100,00
		Nueva York					0,00%	
		Washington DC	100			100,000	100,00%	
Sudamérica	Brasil	Curitiba					0,00%	50,00
		São Paulo	50			50,000	100,00%	
Colombia	Bogotá					100,00%		

Fuente: [ITF \(OCDE. linking-people-places-spatial-access.pdf\). Pag. 39](#)



DB TPU CIUDADES 34		% de la población que viaja menos de 30 minutos en transporte público (OCDE)						
% de la población que viaja menos de 30 minutos en transporte público (OCDE)								
Región	País	Ciudad	% de la que viaja < 30			% de la que viaja < 30	Peso (%)	% de la población que viaja < 30 min en
Europa	España	Barcelona	14,0			14,000	0,00%	14,00
		Madrid					100,00%	
		Valencia					0,00%	
	Italia	Milán	6,5			6,500	0,00%	6,50
		Roma					100,00%	
		Turín					0,00%	
	Francia	Marsella	30,0			30,000	0,00%	11,98
		Nantes					6,78%	
		París					82,88%	
	Alemania	Berlín	22,0			22,000	100,00%	22,00
Hamburgo					0,00%			
Reino Unido	Glasgow					8,30%	0,00	
		Londres				73,61%		
	Manchester					18,09%		
Asia	China	Pekín				37,01%	0,00	
		Hong Kong (SAR)				14,89%		
		Shangái				48,10%		
	India	Bangalore					21,20%	0,00
		Delhi					44,40%	
		Mumbai					34,41%	
Japón	Tokio					100,00%		
Corea Sur	Seúl					100,00%		
Oceanía	Australia	Melbourne					100,00%	
África	Sudáfrica	Johannesburgo					100,00%	
	Egipto	El Cairo	4,0			4,000	100,00%	4,00
Norteamérica	Canada	Toronto	3,5			3,500	100,00%	3,50
		Vancouver					0,00%	
	EE.UU.	Chicago					0,00%	1,50
		Nueva York					0,00%	
Washington DC		1,5			1,500	100,00%		
Sudamérica	Brasil	Curitiba	2,5			2,500	0,00%	2,50
		São Paulo					100,00%	
Colombia	Bogotá					100,00%		

Fuente: [ITF \(OCDE. linking-people-places-spatial-access.pdf\)](https://www.itf-ocde.org/en/linking-people-places-spatial-access/pdf), Pag. 39

DB TPU CIUDADES 35		h / año perdidas en atascos (Tomtom)							
h / año perdidas en atascos (Tomtom)									
Región	País	Ciudad	h / año perdidas en			h / año perdidas en	Peso (%)	h / año perdidas en atascos	
Europa	España	Barcelona	59			59	38,53%	48,17	
		Madrid	41			41	49,85%		
		Valencia	43			43	11,62%		
	Italia	Milán	64			64	53,83%	65,42	
		Roma	75			75	31,52%		
		Turín	50			50	14,65%		
	Francia	Marsella	80			80	10,34%	80,10	
		Nantes	57			57	6,78%		
		París	82			82	82,88%		
	Alemania	Berlín	69			69	49,72%	66,97	
Hamburgo		71			71	25,02%			
Múnich		59			59	25,26%			
Reino Unido	Glasgow		50			50	8,30%	69,31	
		Londres	75			75	73,61%		
	Manchester		55			55	18,09%		
Asia	China	Pekín	78			78	0,00%	78,00	
		Hong Kong (SAR)							100,00%
		Shangái							0,00%
	India	Bangalore	110			110	21,20%	113,78	
		Delhi	110			110	44,40%		
		Mumbai	121			121	34,41%		
Japón	Tokio	98			98	100,00%			
Corea Sur	Seúl					100,00%			
Oceanía	Australia	Melbourne	57			57	100,00%	57,00	
África	Sudáfrica	Johannesburgo	43			43	100,00%	43,00	
	Egipto	El Cairo	80			80	100,00%	80,00	
Norteamérica	Canada	Toronto	55			55	73,35%	60,33	
		Vancouver	75			75	26,65%		
	EE.UU.	Chicago	55			55	23,71%	67,68	
		Nueva York	80			80	56,31%		
Washington DC		48			48	19,98%			
Sudamérica	Brasil	Curitiba	55			55	12,23%	69,04	
		São Paulo	71			71	87,77%		
	Colombia	Bogotá	126			126	100,00%	126,00	

Fuente: <https://www.tomtom.com/traffic-index/ranking/>



DB TPU CIUDADES 25		Cobertura de transporte público del núcleo urbano (ITF. Benchmarking Accessibility in Cities)							
Cobertura de transporte público del núcleo urbano (ITF. Benchmarking Accessibility in Cities)									
Región	País	Ciudad	Cobertura del Núcleo urbano				Cobertura del Núcleo urbano	Peso (%)	Cobertura del Trans. Núcleo urbano
Europa	España	Barcelona						0,00%	93,39
		Madrid	96,7				96,700	81,09%	
		Valencia	79,2				79,200	18,91%	
	Italia	Milán	63,2				63,200	53,83%	69,43
		Roma	67,1				67,100	31,52%	
		Turín	97,3				97,300	14,65%	
	Francia	Marsella	83,9				83,900	10,34%	94,67
		Nantes	67,9				67,900	6,78%	
		París	98,2				98,200	82,88%	
	Alemania	Berlín	99,5				99,500	66,52%	99,50
		Hamburgo	99,5				99,500	33,48%	
Múnich							0,00%		
Reino Unido	Glasgow	99,4				99,400	8,30%	99,33	
	Londres	99,3				99,300	73,61%		
	Manchester	99,4				99,400	18,09%		
Asia	China	Pekín						37,01%	0,00
		Hong Kong (SAR)						14,89%	
		Shangái						48,10%	
	India	Bangalore						21,20%	0,00
		Delhi						44,40%	
		Mumbai						34,41%	
	Japón	Tokio						100,00%	
Corea Sur	Seúl						100,00%		
Oceanía	Australia	Melbourne						100,00%	
África	Sudáfrica	Johannesburgo						100,00%	
	Egipto	El Cairo						100,00%	
Norteamérica	Canada	Toronto						73,35%	0,00
		Vancouver						26,65%	
	EE.UU.	Chicago						23,71%	0,00
		Nueva York Washington DC						56,31% 19,98%	
Sudamérica	Brasil	Curitiba						12,23%	0,00
		São Paulo						87,77%	
	Colombia	Bogotá						100,00%	

Fuente: [ITF. Benchmarking Accessibility in Cities](#)

DB TPU CIUDADES 26		Cobertura de transporte público del área metropolitana (ITF. Benchmarking Accessibility in Cities)							
Cobertura de transporte público del área metropolitana (ITF. Benchmarking Accessibility in Cities)									
Región	País	Ciudad	Cobertura del Área				Cobertura del Área	Peso (%)	Cobertura del Trans. Área metropolitana
Europa	España	Barcelona						0,00%	97,71
		Madrid	99,9				99,900	81,09%	
		Valencia	88,3				88,300	18,91%	
	Italia	Milán	71,0				71,000	53,83%	83,67
		Roma	97,7				97,700	31,52%	
		Turín	100,0				100,000	14,65%	
	Francia	Marsella	91,2				91,200	10,34%	98,93
		Nantes	97,6				97,600	6,78%	
		París	100,0				100,000	82,88%	
	Alemania	Berlín	100,0				100,000	66,52%	99,97
		Hamburgo	99,9				99,900	33,48%	
Múnich							0,00%		
Reino Unido	Glasgow	99,8				99,800	8,30%	99,82	
	Londres	99,8				99,800	73,61%		
	Manchester	99,9				99,900	18,09%		
Asia	China	Pekín						37,01%	0,00
		Hong Kong (SAR)						14,89%	
		Shangái						48,10%	
	India	Bangalore						21,20%	0,00
		Delhi						44,40%	
		Mumbai						34,41%	
	Japón	Tokio						100,00%	
Corea Sur	Seúl						100,00%		
Oceanía	Australia	Melbourne						100,00%	
África	Sudáfrica	Johannesburgo						100,00%	
	Egipto	El Cairo						100,00%	
Norteamérica	Canada	Toronto						73,35%	0,00
		Vancouver						26,65%	
	EE.UU.	Chicago						23,71%	0,00
		Nueva York Washington DC						56,31% 19,98%	
Sudamérica	Brasil	Curitiba						12,23%	0,00
		São Paulo						87,77%	
	Colombia	Bogotá						100,00%	

Fuente: [ITF. Benchmarking Accessibility in Cities](#)



DB TPU CIUDADES 27		Cobertura de transporte público del área periurbana (ITF. Benchmarking Accessibility in Cities)						
Cobertura de transporte público del área periurbana (ITF. Benchmarking Accessibility in Cities)								
Región	País	Ciudad	Cobertura del Área periurbana			Cobertura del Área periurbana	Peso (%)	Cobertura del Trans. Área periurbana
Europa	España	Barcelona	83,0			83,000	0,00%	75,12
		Madrid	41,3			41,300	81,09%	
		Valencia					18,91%	
	Italia	Milán	28,7			28,700	53,83%	32,13
		Roma	8,9			8,900	31,52%	
		Turín	94,7			94,700	14,65%	
	Francia	Marsella	35,5			35,500	10,34%	79,62
		Nantes	6,6			6,600	6,78%	
		París	91,1			91,100	82,88%	
	Alemania	Berlín	98,5			98,500	66,52%	98,63
		Hamburgo	98,9			98,900	33,48%	
		Múnich					0,00%	
Reino Unido	Glasgow	98,1			98,100	8,30%	97,35	
	Londres	97,5			97,500	73,61%		
	Manchester	96,4			96,400	18,09%		
Asia	China	Pekín				37,01%	0,00	
		Hong Kong (SAR)				14,89%		
		Shangái				48,10%		
	India	Bangalore				21,20%	0,00	
		Delhi				44,40%		
		Mumbai				34,41%		
Japón	Tokio				100,00%			
Corea Sur	Seúl				100,00%			
Oceanía	Australia	Melbourne				100,00%		
África	Sudáfrica	Johannesburgo				100,00%		
	Egipto	El Cairo				100,00%		
Norteamérica	Canada	Toronto				73,35%	0,00	
		Vancouver				26,65%		
	EE.UU.	Chicago				23,71%	0,00	
		Nueva York Washington DC				56,31% 19,98%		
Sudamérica	Brasil	Curitiba				12,23%	0,00	
		São Paulo				87,77%		
	Colombia	Bogotá				100,00%		

Fuente: [ITF. Benchmarking Accessibility in Cities](#)



4.7.1. Resilience Indicators

4.7.1.1 Indicator R.1: Network length (km) / City Area (KM2)

TPU R.1	Longitud de red (km) / Área ciudad (km2)					
	2010	2015	2016	2017	2018	2019
España						0,978
Alemania						0,264
Francia						2,314
Reino Unido						0,241
Italia						1,032
EEUU						0,647
Brasil						0,136
Colombia						0,049
Canadá						0,712
Egipto						0,148
Sudáfrica						0,018
Japón						0,143
China						0,151
India						0,078
Corea del Sur						0,649
Australia						0,036
Maximo:		2,31	MAX ((Media+Factor max*Desv Est.):		1,37	10
Mínimo:		0,02	MIN ((Media-Factor min *Desv);0):		0,00	1
Media:		0,47	Percentil 90%:	1,00	1,37	9
Media+Factor max*Desv Estándar:		1,37	Percentil 10%:	0,04	Unidad:	6,57195
Media-Factor min*Desv Estándar:		-0,42		Desv. Est.:	0,60	

Table 101: Indicator R.1 Values: Network length (km) / City Area (KM2)

TPU R.1	Longitud de red (km) / Área ciudad (km2)						Calificación 2019	
	2010	2015	2016	2017	2018			
España						7,4	BIEN	C
Alemania						2,7	MUY INSUFICIENTE	F
Francia						10,0	EXCELENTE	A
Reino Unido						2,6	MUY INSUFICIENTE	F
Italia						7,8	BIEN	C
EEUU						5,3	SUFICIENTE	E
Brasil						1,9	MUY INSUFICIENTE	F
Colombia						1,3	MUY INSUFICIENTE	F
Canadá						5,7	SUFICIENTE	E
Egipto						2,0	MUY INSUFICIENTE	F
Sudáfrica						1,1	MUY INSUFICIENTE	F
Japón						1,9	MUY INSUFICIENTE	F
China						2,0	MUY INSUFICIENTE	F
India						1,5	MUY INSUFICIENTE	F
Corea del Sur						5,3	SUFICIENTE	E
Australia						1,2	MUY INSUFICIENTE	F

Table 102: Indicator R.1 Rating: Network length (km) / City Area (KM2)



4.7.1.2 Indicator R.2: % of population within 1,000 m of a public transport stop (OECD)

TPU R.2	% de la población a menos de 1.000 m de una parada de transporte público (OCDE)					
	2010	2015	2016	2017	2018	2019
España						90,0
Alemania						100,0
Francia						95,0
Reino Unido						
Italia						87,0
EEUU						100,0
Brasil						50,0
Colombia						
Canadá						90,0
Egipto						40,0
Sudáfrica						
Japón						
China						
India						
Corea del Sur						
Australia						
Maximo:		100,00	MAX ((Media+Factor max*Desv Est.):		100,00	10
Mínimo:		40,00	MIN ((Media-Factor min *Desv),0):		46,75	1
Media:		81,50	Percentil 90%:	100,00	53,25	9
Media+Factor max*Desv Estándar:		116,25	Percentil 10%:	47,00	Unidad:	0,16903
Media-Factor min*Desv Estándar:		46,75		Desv. Est.:	23,16	

Table 103: Indicator R.2 Values: % of population within 1,000 m of a public transport stop (OECD)

TPU R.2	% de la población a menos de 1.000 m de una parada de transporte público (OCDE)					
	2010	2015	2016	2017	2018	Calificación 2019
España						8,3 MUY BIEN B
Alemania						10,0 EXCELENTE A
Francia						9,2 EXCELENTE A
Reino Unido						
Italia						7,8 BIEN C
EEUU						10,0 EXCELENTE A
Brasil						1,5 MUY INSUFICIENTE F
Colombia						
Canadá						8,3 MUY BIEN B
Egipto						1,0 MUY INSUFICIENTE F
Sudáfrica						
Japón						
China						
India						
Corea del Sur						
Australia						

Table 104: Indicator R.2 Rating: % of population within 1,000 m of a public transport stop (OECD)



4.7.1.3 *Indicator R.3: % of population traveling less than 30 minutes on public transport (OECD)*

TPU R.3	% de la población que viaja menos de 30 minutos en transporte público (OCDE)					
	2010	2015	2016	2017	2018	2019
España						14,0
Alemania						22,0
Francia						12,0
Reino Unido						
Italia						6,5
EEUU						1,5
Brasil						2,5
Colombia						
Canadá						3,5
Egipto						4,0
Sudáfrica						
Japón						
China						
India						
Corea del Sur						
Australia						
Maximo:		22,00	MAX ((Media+Factor max*Desv Est.):		18,98	1
Mínimo:		1,50	MIN ((Media-Factor min *Desv.);0):		0,00	10
Media:		8,25	Percentil 90%:	16,40	18,98	-9
Media+Factor max*Desv Estándar:		18,98	Percentil 10%:	2,20	Unidad:	-0,47419
Media-Factor min*Desv Estándar:		-2,48		Desv. Est.:	7,15	

Table 105: Indicator R.3 Values: % of population traveling less than 30 minutes on public transport (OECD)

TPU R.3	% de la población que viaja menos de 30 minutos en transporte público (OCDE)						Calificación 2019	
	2010	2015	2016	2017	2018			
España						3,4	INSUFICIENTE	FX
Alemania						1,0	MUY INSUFICIENTE	F
Francia						4,3	INSUFICIENTE	FX
Reino Unido								
Italia						6,9	SUFICIENTE ALTO	D
EEUU						9,3	EXCELENTE	A
Brasil						8,8	MUY BIEN	B
Colombia								
Canadá						8,3	MUY BIEN	B
Egipto						8,1	MUY BIEN	B
Sudáfrica								
Japón								
China								
India								
Corea del Sur								
Australia								

Table 106: Indicator R.3 Rating: % of population traveling less than 30 minutes on public transport (OECD)



4.7.1.4 Indicator R.4: Hours/year lost in Traffic jams (Tomtom)

TPU R.4	h / año perdidas en atascos (Tomtom)					
	2010	2015	2016	2017	2018	2019
España						48,2
Alemania						67,0
Francia						80,1
Reino Unido						69,3
Italia						65,4
EEUU						67,7
Brasil						69,0
Colombia						126,0
Canadá						60,3
Egipto						80,0
Sudáfrica						43,0
Japón						98,0
China						78,0
India						113,8
Corea del Sur						
Australia						57,0
Maximo:		126,00	MAX ((Media+Factor max*Desv Est.):		109,00	1
Mínimo:		43,00	MIN ((Media-Factor min *Desv);0):		40,71	10
Media:		74,85	Percentil 90%:	107,47	68,29	-9
Media+Factor max*Desv Estándar:		109,00	Percentil 10%:	51,70	Unidad:	-0,13179
Media-Factor min*Desv Estándar:		40,71		Desv. Est.:	22,76	

Table 107: Indicator R.4 Values: Hours/year lost in Traffic jams (Tomtom)

TPU R.4	h / año perdidas en atascos (Tomtom)						Calificación 2019	
	2010	2015	2016	2017	2018			
España						9,0	EXCELENTE	A
Alemania						6,5	SUFICIENTE ALTO	D
Francia						4,8	INSUFICIENTE	FX
Reino Unido						6,2	SUFICIENTE ALTO	D
Italia						6,7	SUFICIENTE ALTO	D
EEUU						6,4	SUFICIENTE ALTO	D
Brasil						6,3	SUFICIENTE ALTO	D
Colombia						1,0	MUY INSUFICIENTE	F
Canadá						7,4	BIEN	C
Egipto						4,8	INSUFICIENTE	FX
Sudáfrica						9,7	EXCELENTE	A
Japón						2,4	MUY INSUFICIENTE	F
China						5,1	SUFICIENTE	E
India						1,0	MUY INSUFICIENTE	F
Corea del Sur								
Australia						7,9	BIEN	C

Table 108: Indicator R.4 Rating: Hours/year lost in Traffic jams (Tomtom)



4.7.1.5 *Indicator R.5: Urban core public transport coverage (ITF. Benchmarking accessibility in Cities)*

TPU R.5	Cobertura de transporte público del núcleo urbano (ITF. Benchmarking Accessibility in Cities)					
	2010	2015	2016	2017	2018	2019
España						93,4
Alemania						99,5
Francia						94,7
Reino Unido						99,3
Italia						69,4
EEUU						
Brasil						
Colombia						
Canadá						
Egipto						
Sudáfrica						
Japón						
China						
India						
Corea del Sur						
Australia						
Maximo:		99,50		Percentil 90%:	99,43	10
Mínimo:		69,43	MIN ((Media-Factor min *Desv),0):		72,50	1
Media:		91,26		Percentil 90%:	99,43	26,93
Media+Factor max*Desv Estándar:		110,02		Percentil 10%:	79,01	Unidad: 0,33419
Media-Factor min*Desv Estándar:		72,50		Desv. Est.:	12,51	

Table 109: Indicator R.5 Values: Urban core public transport coverage (ITF. Benchmarking accessibility in Cities)

TPU R.5	Cobertura de transporte público del núcleo urbano (ITF. Benchmarking Accessibility in Cities)					
	2010	2015	2016	2017	2018	Calificación 2019
España						8,0 MUY BIEN B
Alemania						10,0 EXCELENTE A
Francia						8,4 MUY BIEN B
Reino Unido						10,0 EXCELENTE A
Italia						1,0 MUY INSUFICIENTE F
EEUU						
Brasil						
Colombia						
Canadá						
Egipto						
Sudáfrica						
Japón						
China						
India						
Corea del Sur						
Australia						

Table 110: Indicator R.5 Rating: Urban core public transport coverage (ITF. Benchmarking accessibility in Cities)



4.7.1.6 *Indicator R.6: metropolitan Area public transport coverage (ITF. Benchmarking accessibility in Cities)*

TPU R.6	Cobertura de transporte público del área metropolitana (ITF. Benchmarking Accessibility in Cities)					
	2010	2015	2016	2017	2018	2019
España						97,7
Alemania						100,0
Francia						98,9
Reino Unido						99,8
Italia						83,7
EEUU						
Brasil						
Colombia						
Canadá						
Egipto						
Sudáfrica						
Japón						
China						
India						
Corea del Sur						
Australia						
Maximo:		99,97		Percentil 90%:	99,91	10
Mínimo:		83,67	MIN ((Media-Factor min *Desv),0):		85,57	1
Media:		96,02	Percentil 90%:	99,91	14,33	9
Media+Factor max*Desv Estándar:		106,46	Percentil 10%:	89,28	Unidad:	0,62785
Media-Factor min*Desv Estándar:		85,57		Desv. Est.:	6,96	

Table 111: *Indicator R.6 Values: metropolitan Area public transport coverage (ITF. Benchmarking accessibility in Cities)*

TPU R.6	Cobertura de transporte público del área metropolitana (ITF. Benchmarking Accessibility in Cities)					
	2010	2015	2016	2017	2018	Calificación 2019
España						8,6 MUY BIEN B
Alemania						10,0 EXCELENTE A
Francia						9,4 EXCELENTE A
Reino Unido						9,9 EXCELENTE A
Italia						1,0 MUY INSUFICIENTE F
EEUU						
Brasil						
Colombia						
Canadá						
Egipto						
Sudáfrica						
Japón						
China						
India						
Corea del Sur						
Australia						

Table 112: *Indicator R.6 Rating: Metropolitan Area public transport coverage (ITF. Benchmarking accessibility in Cities)*



4.7.1.7 *Indicator R.7: Periurban Area public transport coverage (ITF. Benchmarking accessibility in Cities)*

TPU R.7	Cobertura de transporte público del área periurbana (ITF. Benchmarking Accessibility in Cities)					
	2010	2015	2016	2017	2018	2019
España						75,1
Alemania						98,6
Francia						79,6
Reino Unido						97,4
Italia						32,1
EEUU						
Brasil						
Colombia						
Canadá						
Egipto						
Sudáfrica						
Japón						
China						
India						
Corea del Sur						
Australia						
Maximo:		98,63		Percentil 90%:	98,12	10
Mínimo:		32,13	MIN ((Media-Factor min *Desv),0):		36,15	1
Media:		76,57		Percentil 90%:	98,12	61,97
Media+Factor max*Desv Estándar:		116,99		Percentil 10%:	49,32	Unidad: 0,14522
Media-Factor min*Desv Estándar:		36,15		Desv. Est.:	26,95	

Table 113: Indicator R.7 Values: Periurban Area public transport coverage (ITF. Benchmarking accessibility in Cities)

TPU R.7	Cobertura de transporte público del área periurbana (ITF. Benchmarking Accessibility in Cities)					
	2010	2015	2016	2017	2018	Calificación 2019
España						6,7 SUFICIENTE ALTO D
Alemania						10,0 EXCELENTE A
Francia						7,3 BIEN C
Reino Unido						9,9 EXCELENTE A
Italia						1,0 MUY INSUFICIENTE F
EEUU						
Brasil						
Colombia						
Canadá						
Egipto						
Sudáfrica						
Japón						
China						
India						
Corea del Sur						
Australia						

Table 114: Indicator R.7 Rating: Periurban Area public transport coverage (ITF. Benchmarking accessibility in Cities)



4.7.2. Resilience Indicator

	Índice de Resiliencia						Max valor 2019
	2010	2015	2016	2017	2018	2019	
España						51,4	70
Alemania						50,3	70
Francia						53,4	70
Reino Unido						38,6	50
Italia						32,2	70
EEUU						31,0	40
Brasil						18,5	40
Colombia						2,3	20
Canadá						29,7	40
Egipto						15,9	40
Sudáfrica						10,8	20
Japón						4,4	20
China						7,1	20
India						2,5	20
Corea del Sur						5,3	10
Australia						9,1	20
Maximo:		53,389		Máximo Valor:	VER TABLA	10	
Mínimo:		2,322		MIN:	0	0	
Media:		22,657				10,000	

Table 115: Resilience Indicator Values

Subindicadores de Resiliencia		Pesos	Punt. Max.	Total Max puntuación
TPU R.1	Longitud de red (km) / Área ciudad (km2)	1	10	10
TPU R.2	% de la población a menos de 1.000 m de una parada de transporte público (OCDE)	1	10	10
TPU R.3	% de la población que viaja menos de 30 minutos en transporte público (OCDE)	1	10	10
TPU R.4	h / año perdidas en atascos (Tomtom)	1	10	10
TPU R.5	Cobertura de transporte público del núcleo urbano (ITF. Benchmarking Accessibility in Cities)	1	10	10
TPU R.6	Cobertura de transporte público del área metropolitana (ITF. Benchmarking Accessibility in Cities)	1	10	10
TPU R.7	Cobertura de transporte público del área periurbana (ITF. Benchmarking Accessibility in Cities)	1	10	10
		7		70
		% Valorado de la Max. Puntuación del Criterio	100,0%	70

Table 116: Resilience Indicators Weights

	Evaluación de Resiliencia						Subindicadores considerados
	2010	2015	2016	2017	2018	Calificación 2019	
España						7,3 BIEN C	7
Alemania						7,2 BIEN C	7
Francia						7,6 BIEN C	7
Reino Unido						7,7 BIEN C	5
Italia						4,6 INSUFICIENTE FX	7
EEUU						7,7 BIEN C	4
Brasil						4,6 INSUFICIENTE FX	4
Colombia						1,2 MUY INSUFICIENTE F	2
Canadá						7,4 BIEN C	4
Egipto						4,0 INSUFICIENTE FX	4
Sudáfrica						5,4 SUFICIENTE E	2
Japón						2,2 MUY INSUFICIENTE F	2
China						3,5 INSUFICIENTE FX	2
India						1,3 MUY INSUFICIENTE F	2
Corea del Sur						5,3 SUFICIENTE E	1
Australia						4,5 INSUFICIENTE FX	2

Table 117: Resilience Criterion Rating



In the "Network Length (km) / City Area (km²)" indicator, the top-performing countries are France, Italy, and Spain (with values of 2.6, 1, and 0.97, respectively).

In the "Percentage of Population within 1,000 m of a Public Transportation Stop" indicator, European countries, the US, and Canada stand out.

The annual hours lost in traffic congestion reflect the city's traffic behavior effectively and thus the performance of public transportation. Spain achieves an excellent result (48 hours annually lost in traffic congestion), surpassing all European countries and ranking as the second-best among all the countries analyzed.

The indicators related to public transportation coverage, which have only been evaluated for European countries, show similar results, except for Italy.

The highest overall ratings in this indicator are achieved by European countries (except for Italy), the US, Canada, and Japan (9.9), with France and the US also performing well (9.5). Egypt, South Korea, and Australia receive a satisfactory rating. The least favorable countries are India, Japan, and Colombia.



4.8. Engineering and Innovation

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

The chosen indicators are:

8 ENGINEERING AND INNOVATION	
I.1	Availability of data on Google Maps (Static GTFS + Dynamic GTFS)
I.2	% of GDP allocated to Gross Domestic Expenditure on R&D (OECD R&D)
I.3	Gross Domestic Expenditure on R&D (\$) / Population (OECD R&D)
I.4	Digitalization. Participation in new technologies. Global Competitiveness index score (WEF)
I.5	Digitalization. Index of Information and Communication Technology Infrastructure. (ND Index)
I.6	Digitalization. % of people using the internet
I.7	Engineering. Regulatory transparency. Services Trade Restrictiveness Index (OECD)
I.8	Engineering. Barriers to competition. Services Trade Restrictiveness Index (OECD)
I.9	Engineering. Restrictions on movement. Services Trade Restrictiveness Index (OECD)
I.10	Engineering. Restrictions on the entry of foreign engineers. Services Trade Restrictiveness Index (OECD)
I.11	Innovation index. ND Gain Index

In recent years, numerous innovations have been introduced in the urban public transportation sector. One of the most notable innovations is the implementation of public bicycle systems, established as a new mode of public transportation. These systems not only reduce polluting emissions and energy consumption but also serve as an optimal means for short-distance travel compared to traditional modes like trams, metros, or buses. Additionally, they enhance citizens' mobility and accessibility by providing quicker access to public transportation stops. These bicycles typically have dedicated parking facilities and are regulated by authorities, although in some cases, they may be operated by private companies.

Another innovative system involves shared vehicles located through GPS and a mobile application. In recent years, this system has gained popularity and expanded to include shared electric scooters. However, despite the versatility advantages offered by this system, it also presents certain drawbacks such as the potential to obstruct pedestrian pathways if there's an excess of vehicles or improper parking.

Furthermore, the incorporation of new technologies into the urban public transportation sector has significantly improved citizens' ability to plan their journeys and arrive at their destinations on time. Any device with internet access can utilize applications like Google Maps, which have collaborated with urban public transportation authorities to provide routes and schedules. In some cities, a more modern version of this system has been introduced, offering real-time updates on vehicle status, location, delays, and any disruptions due to breakdowns or other issues.



The most comprehensive report that evaluates urban mobility innovation is the Urban Mobility Innovation Index (UMii)⁵, developed by the International Association of Public Transport (UITP). In its latest version from 2021, the report assesses 40 cities from various parts of the world. This report provides a wealth of valuable information. The Urban Mobility Innovation Index (UMii) is a framework of indicators that assesses a city's innovation ecosystem maturity in urban mobility. It utilizes a collection of qualitative and quantitative indicators that capture multiple aspects of the innovation value chain. The index is based on 9 composite indicators that cover 3 dimensions: preparedness, deployment, and livability.

Preparedness refers to forward-looking innovation drivers: the city's ambition and scope of its strategy, concrete objectives, institutional capacity and capabilities to work towards those objectives, and the robustness of its data collection, accessibility, and usability. Deployment deals with key enablers of the strategy: the ability to address regulatory barriers to innovation, attract investments from a wide range of stakeholders, incentivize innovation, and the level of citizen and stakeholder engagement in co-design and testing of innovative mobility solutions. Livability assesses the final impacts of the resulting transportation system in terms of connectivity (mobility options and integration), well-being (health, equity, accessibility), and the environment (air quality, energy consumption, noise, and natural areas).

To analyze engineering and innovation in public transportation, a deep understanding of new techniques, materials, technologies, implemented innovations, engineering status, progress in digitalization, and resources allocated to engineering and innovation is required.

Despite efforts to obtain more specific data for the urban public transportation sector, reliable and verifiable data have not been found. In the absence of such data, the analysis of R&D and innovation across different countries on a global scale has been pursued as a proxy for assessing the state of urban transportation. To achieve this, the Main Science and Technology Indicators, Volume 2021, published in 2022 by the OECD⁶, have been selected. This comprehensive report offers a collection of indicators reflecting the level and structure of efforts undertaken by OECD member countries and other non-member countries (Argentina, People's Republic of China, Romania, Russian Federation, 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 R&D-intensive industries.

The ND Gain Index, the University of Notre Dame's innovation index, has also been considered.

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

To analyze the state of engineering in the urban public transportation sector, it would have been valuable to have precise information about the training of engineers working in the sector, the number of engineers engaged in design, construction, preservation, and management of urban public transportation per economic unit invested. Particularly insightful would have been economic data related to engineering investment in relation to investment in construction, preservation, operation, and management of transportation networks. Unfortunately, obtaining

⁵ [UMii-report-2021_NEW.pdf \(uitp.org\)](#)

⁶ [Main Science and Technology Indicators, Volume 2021 Issue 2 | READ online \(oecd-ilibrary.org\)](#)



such data has not been possible. As a result, four OECD indicators related to engineering as a whole have been considered: regulatory transparency, barriers to competition, restrictions on the movement of engineers, and restrictions on the entry of foreign engineers. All of these are included in the OECD's⁷ periodic Index of Restrictiveness of Trade in Services.

⁷ [Services Trade Restrictiveness Index \(oecd.org\)](https://www.oecd.org/)



4.8.1. Engineering and Innovation Indicators

4.8.1.1 Indicator I.1: Availability of data on Google Maps (Static GTFS + Dynamic GTFS)

TPU I.1	Disponibilidad de datos en Google Maps (GTFS Estático + GTFS Dinámico)					
	2010	2015	2016	2017	2018	2019
España						1,00
Alemania						1,50
Francia						1,00
Reino Unido						1,74
Italia						1,15
EEUU						1,80
Brasil						1,00
Colombia						1,00
Canadá						2,00
Egipto						0,00
Sudáfrica						0,00
Japón						2,00
China						0,15
India						1,00
Corea del Sur						1,00
Australia						1,00
Maximo:		2,00	MAX ((Media+Factor max*Desv Est.):		2,00	10
Mínimo:		0,00	MIN ((Media-Factor min *Desv);0):		0,13	1
Media:		1,08	Percentil 90%:	1,90	1,87	9
Media+Factor max*Desv Estándar:		2,04	Percentil 10%:	0,07	Unidad:	4,81103
Media-Factor min*Desv Estándar:		0,13		Desv. Est.:	0,64	

Table 118: Indicator I.1 Values: Availability of data on Google Maps (Static GTFS + Dynamic GTFS)

TPU I.1	Disponibilidad de datos en Google Maps (GTFS Estático + GTFS Dinámico)						Calificación 2019		
	2010	2015	2016	2017	2018				
España						5,2	SUFICIENTE	E	
Alemania						7,6	BIEN	C	
Francia						5,2	SUFICIENTE	E	
Reino Unido						8,7	MUY BIEN	B	
Italia						5,9	SUFICIENTE	E	
EEUU						9,0	EXCELENTE	A	
Brasil						5,2	SUFICIENTE	E	
Colombia						5,2	SUFICIENTE	E	
Canadá						10,0	EXCELENTE	A	
Egipto						1,0	MUY INSUFICIENTE	F	
Sudáfrica						1,0	MUY INSUFICIENTE	F	
Japón						10,0	EXCELENTE	A	
China						1,1	MUY INSUFICIENTE	F	
India						5,2	SUFICIENTE	E	
Corea del Sur						5,2	SUFICIENTE	E	
Australia						5,2	SUFICIENTE	E	

Table 119: Indicator I.1 Rating: Availability of data on Google Maps (Static GTFS + Dynamic GTFS)



4.8.1.2 Indicator I.2: % of GDP allocated to Gross Domestic Expenditure on R&D (OECD R&D)

TPU I.2	% del PIB destinado al Gasto interior bruto en I+D (OCDE R&D)					
	2010	2015	2016	2017	2018	2019
España						1,25%
Alemania						3,17%
Francia						2,19%
Reino Unido						1,71%
Italia						1,46%
EEUU						3,18%
Brasil						
Colombia						0,32%
Canadá						1,59%
Egipto						
Sudáfrica						0,83%
Japón						3,21%
China						2,23%
India						
Corea del Sur						4,63%
Australia						1,80%
Maximo:		4,63%	MAX ((Media+Factor max*Desv Est.):		3,87%	10,00
Mínimo:		0,32%	MIN ((Media-Factor min *Desv),0):		0,37%	1
Media:		2,12%	Percentil 90%:	3,20%	3,50%	9,000
Media+Factor max*Desv Estándar:		3,87%	Percentil 10%:	0,91%	Unidad:	256,782
Media-Factor min*Desv Estándar:		0,37%		Desv. Est.:	0,012	

Table 120: Indicator I.2 Values: % of GDP allocated to Gross Domestic Expenditure on R&D (OECD R&D)

TPU I.2	% del PIB destinado al Gasto interior bruto en I+D (OCDE R&D)						Calificación 2019	
	2010	2015	2016	2017	2018			
España						3,3	INSUFICIENTE	FX
Alemania						8,2	MUY BIEN	B
Francia						5,7	SUFICIENTE	E
Reino Unido						4,4	INSUFICIENTE	FX
Italia						3,8	INSUFICIENTE	FX
EEUU						8,2	MUY BIEN	B
Brasil								
Colombia						1,0	MUY INSUFICIENTE	F
Canadá						4,1	INSUFICIENTE	FX
Egipto								
Sudáfrica						2,2	MUY INSUFICIENTE	F
Japón						8,3	MUY BIEN	B
China						5,8	SUFICIENTE	E
India								
Corea del Sur						10,0	EXCELENTE	A
Australia						4,7	INSUFICIENTE	FX

Table 121: Indicator I.2 Rating: % of GDP allocated to Gross Domestic Expenditure on R&D (OECD R&D)



4.8.1.3 Indicator I.3: Gross Domestic Expenditure on R&D (\$) / Population (OECD R&D)

TPU I.3	Gasto interior bruto en I+D (\$)/Población (OCDE R&D)					
	2010	2015	2016	2017	2018	2019
España						522
Alemania						1.763
Francia						1.070
Reino Unido						838
Italia						649
EEUU						2.066
Brasil						0
Colombia						52
Canadá						785
Egipto						0
Sudáfrica						108
Japón						1.364
China						376
India						0
Corea del Sur						1.992
Australia						947
Maximo:		2066,00	MAX ((Media+Factor max*Desv Est.):		2031,64	10,00
Mínimo:		52,000	MIN ((Media-Factor min *Desv);0):		0	1
Media:		964,000	Percentil 90%:	1.877,500	2031,638	9,000
Media+Factor max*Desv Estándar:		2.031,638	Percentil 10%:	0,000	Unidad:	0,004
Media-Factor min*Desv Estándar:		-103,638		Desv. Est.:	711,759	

Table 122: Indicator I.13 Values: Gross Domestic Expenditure on R&D (\$) / Population (OECD R&D)

TPU I.3	Gasto interior bruto en I+D (\$)/Población (OCDE R&D)						Calificación 2019	
	2010	2015	2016	2017	2018			
España						3,3	INSUFICIENTE	FX
Alemania						8,8	MUY BIEN	B
Francia						5,7	SUFICIENTE	E
Reino Unido						4,7	INSUFICIENTE	FX
Italia						3,9	INSUFICIENTE	FX
EEUU						10,0	EXCELENTE	A
Brasil								
Colombia						1,2	MUY INSUFICIENTE	F
Canadá						4,5	INSUFICIENTE	FX
Egipto								
Sudáfrica						1,5	MUY INSUFICIENTE	F
Japón						7,0	BIEN	C
China						2,7	MUY INSUFICIENTE	F
India								
Corea del Sur						9,8	EXCELENTE	A
Australia						5,2	SUFICIENTE	E

Table 123: Indicator I.3 Rating: Gross Domestic Expenditure on R&D (\$) / Population (OECD R&D)



4.8.1.4 Indicator I.4: Digitalization. Participation in new technologies. Global Competitiveness index score (WEF)

TPU I.4	Digitalización. Participación en la nuevas tecnologías. Puntuación GCI (WEF)						
	2010	2015	2016	2017	2018	2019	
España						98,30%	
Alemania						92,10%	
Francia						96,60%	
Reino Unido						98,30%	
Italia						95,50%	
EEUU						98,30%	
Brasil						97,20%	
Colombia						92,10%	
Canadá						91,00%	
Egipto						53,90%	
Sudáfrica						84,80%	
Japón						98,30%	
China						90,50%	
India						95,50%	
Corea del Sur						100,00%	
Australia						98,30%	
Maximo:		100,00%		MAX		100,00%	10
Mínimo:		53,90%		MIN ((Media-(F min *Desv));>0):		75,94%	0
Media:		92,54%		Percentil 90%:	98,30%	24,06%	10,000
Media+Factor max*Desv Estándar:		109,14%		Percentil 10%:	87,65%	Unidad:	41,569
Media-Factor min*Desv Estándar:		75,94%			Desv. Est.:	0,111	

Table 124: Indicator I.4 Values: Digitalization. Participation in new technologies. Global Competitiveness index score (WEF)

TPU I.4	Digitalización. Participación en la nuevas tecnologías. Puntuación GCI (WEF)							
	2010	2015	2016	2017	2018	Calificación 2019		
España						9,3	EXCELENTE	A
Alemania						6,7	SUFICIENTE ALTO	D
Francia						8,6	MUY BIEN	B
Reino Unido						9,3	EXCELENTE	A
Italia						8,1	MUY BIEN	B
EEUU						9,3	EXCELENTE	A
Brasil						8,8	MUY BIEN	B
Colombia						6,7	SUFICIENTE ALTO	D
Canadá						6,3	SUFICIENTE ALTO	D
Egipto							MUY INSUFICIENTE	F
Sudáfrica						3,7	INSUFICIENTE	FX
Japón						9,3	EXCELENTE	A
China						6,1	SUFICIENTE ALTO	D
India						8,1	MUY BIEN	B
Corea del Sur						10,0	EXCELENTE	A
Australia						9,3	EXCELENTE	A

Table 125: Indicator I.4 Rating: Digitalization. Participation in new technologies. Global Competitiveness index score (WEF)



4.8.1.5 *Indicator I.5: Digitalization. Index of Information and Communication Technology Infrastructure. (ND Index)*

TPU I.5	Digitalización. Índice de las Infraestructuras de tecnologías de información y comunicación. (ND Index)					
	2010	2015	2016	2017	2018	2019
España						0,671
Alemania						0,710
Francia						0,725
Reino Unido						0,710
Italia						0,603
EEUU						0,661
Brasil						0,521
Colombia						0,488
Canadá						0,708
Egipto						0,436
Sudáfrica						0,434
Japón						0,687
China						0,558
India						0,331
Corea del Sur						0,732
Australia						0,649
Maximo:		0,73	MAX		1	10
Mínimo:		0,331	MIN ((Media-Factor min *Desv),0):		0,413967009	1
Media:		0,602	Percentil 90%:	0,718	0,375	9,000
Media+Factor max*Desv Estándar:		0,789	Percentil 10%:	0,435	Unidad:	23,990
Media-Factor min*Desv Estándar:		0,414		Desv. Est.:	0,125	

Table 126: Indicator I.5 Values: Digitalization. Index of Information and Communication Technology Infrastructure. (ND Index)

TPU I.5	Digitalización. Índice de las Infraestructuras de tecnologías de información y comunicación. (ND Index)					
	2010	2015	2016	2017	2018	Calificación 2019
España						7,2 BIEN C
Alemania						8,1 MUY BIEN B
Francia						8,5 MUY BIEN B
Reino Unido						8,1 MUY BIEN B
Italia						5,5 SUFICIENTE E
EEUU						6,9 SUFICIENTE ALTO D
Brasil						3,6 INSUFICIENTE FX
Colombia						2,8 MUY INSUFICIENTE F
Canadá						8,0 MUY BIEN B
Egipto						1,5 MUY INSUFICIENTE F
Sudáfrica						1,5 MUY INSUFICIENTE F
Japón						7,5 BIEN C
China						4,5 INSUFICIENTE FX
India						1,0 MUY INSUFICIENTE F
Corea del Sur						8,6 MUY BIEN B
Australia						6,6 SUFICIENTE ALTO D

Table 127: Indicator I.5 Rating: Digitalization. Index of Information and Communication Technology Infrastructure. (ND Index)



4.8.1.6 *Indicator I.6: Digitalization. % of people using the internet*

TPU I.6	Digitalización. % de personas que usan internet					
	2010	2015	2016	2017	2018	2019
España						90,70%
Alemania						88,10%
Francia						83,30%
Reino Unido						92,50%
Italia						78,00%
EEUU						90,00%
Brasil						73,90%
Colombia						65,00%
Canadá						
Egipto						57,30%
Sudáfrica						95,70%
Japón						92,70%
China						
India						21,00%
Corea del Sur						96,20%
Australia						89,00%
Maximo:		96,20%		MAX	100,00%	10
Mínimo:		21,00%		MIN ((Media-Factor min *Desv);0):	48,79%	1
Media:		79,53%		Percentil 90%:	94,80%	51,21%
Media+Factor max*Desv Estándar:		110,26%		Percentil 10%:	59,61%	Unidad:
Media-Factor min*Desv Estándar:		48,79%			Desv. Est.:	0,205

Table 128: Indicator I.6 Values: Digitalization. % of people using the internet

TPU I.6	Digitalización. % de personas que usan internet						Calificación 2019		
	2010	2015	2016	2017	2018				
España						8,4	MUY BIEN	B	
Alemania						7,9	BIEN	C	
Francia						7,1	BIEN	C	
Reino Unido						8,7	MUY BIEN	B	
Italia						6,1	SUFICIENTE ALTO	D	
EEUU						8,2	MUY BIEN	B	
Brasil						5,4	SUFICIENTE	E	
Colombia						3,8	INSUFICIENTE	FX	
Canadá									
Egipto						2,5	MUY INSUFICIENTE	F	
Sudáfrica						9,2	EXCELENTE	A	
Japón						8,7	MUY BIEN	B	
China									
India						1,0	MUY INSUFICIENTE	F	
Corea del Sur						9,3	EXCELENTE	A	
Australia						8,1	MUY BIEN	B	

Table 129: Indicator I.6 Rating: Digitalization. % of people using the internet



4.8.1.7 *Indicator I.7: Engineering. Regulatory transparency. Services Trade Restrictiveness Index (OECD)*

TPU I.7	Ingeniería. Transparencia regulatoria. Índice de restricción del comercio de servicios (OCDE)					
	2010	2015	2016	2017	2018	2019
España						0,028
Alemania						0,028
Francia						0,014
Reino Unido						0,028
Italia						0,028
EEUU						0,014
Brasil						0,001
Colombia						0,014
Canadá						0,028
Egipto						
Sudáfrica						0,014
Japón						0,001
China						0,001
India						0,042
Corea del Sur						0,001
Australia						0,042
Maximo:		0,04	MAX ((Media+Factor max*Desv Est.):		0,04	1
Mínimo:		0,00	MIN ((Media-Factor min *Desv);0):		0,00	10
Media:		0,02	Percentil 90%:	0,04	0,04	-9
Media+Factor max*Desv Estándar:		0,04	Percentil 10%:	0,00	Unidad:	-222,94546
Media-Factor min*Desv Estándar:		0,00		Desv. Est.:	0,01	

Table 130: Indicator I.7 Values: Engineering. Regulatory transparency. Services Trade Restrictiveness Index (OECD)

TPU I.7	Ingeniería. Transparencia regulatoria. Índice de restricción del comercio de servicios (OCDE)					
	2010	2015	2016	2017	2018	Calificación 2019
España						3,8 INSUFICIENTE FX
Alemania						3,8 INSUFICIENTE FX
Francia						6,9 SUFICIENTE ALTO D
Reino Unido						3,8 INSUFICIENTE FX
Italia						3,8 INSUFICIENTE FX
EEUU						6,9 SUFICIENTE ALTO D
Brasil						9,8 EXCELENTE A
Colombia						6,9 SUFICIENTE ALTO D
Canadá						3,8 INSUFICIENTE FX
Egipto						
Sudáfrica						6,9 SUFICIENTE ALTO D
Japón						9,8 EXCELENTE A
China						9,8 EXCELENTE A
India						1,0 MUY INSUFICIENTE F
Corea del Sur						9,8 EXCELENTE A
Australia						1,0 MUY INSUFICIENTE F

Table 131: Indicator I.7 Rating: Engineering. Regulatory transparency. Services Trade Restrictiveness Index (OECD)



4.8.1.8 Indicator I.8: Engineering. Barriers to competition. Services Trade Restrictiveness Index (OECD)

TPU I.8	Ingeniería. Barreras a la competencia. Índice de restricción del comercio de servicios (OCDE)					
	2010	2015	2016	2017	2018	2019
España						0,009
Alemania						0,019
Francia						0,009
Reino Unido						0,001
Italia						0,009
EEUU						0,001
Brasil						0,009
Colombia						0,001
Canadá						0,009
Egipto						
Sudáfrica						0,009
Japón						0,001
China						0,001
India						0,001
Corea del Sur						0,009
Australia						0,001
Maximo:		0,02	MAX ((Media+Factor max*Desv Est.):		0,01	1
Mínimo:		0,00	MIN ((Media-Factor min *Desv);0):		0,00	10
Media:		0,01	Percentil 90%:	0,01	0,01	-9
Media+Factor max*Desv Estándar:		0,01	Percentil 10%:	0,00	Unidad:	-641,92360
Media-Factor min*Desv Estándar:		0,00		Desv. Est.:	0,01	

Table 132: Indicator I.8 Values: Engineering. Barriers to competition. Services Trade Restrictiveness Index (OECD)

TPU I.8	Ingeniería. Barreras a la competencia. Índice de restricción del comercio de servicios (OCDE)					
	2010	2015	2016	2017	2018	Calificación 2019
España						4,2 INSUFICIENTE FX
Alemania						1,0 MUY INSUFICIENTE F
Francia						4,2 INSUFICIENTE FX
Reino Unido						9,4 EXCELENTE A
Italia						4,2 INSUFICIENTE FX
EEUU						9,4 EXCELENTE A
Brasil						4,2 INSUFICIENTE FX
Colombia						9,4 EXCELENTE A
Canadá						4,2 INSUFICIENTE FX
Egipto						
Sudáfrica						4,2 INSUFICIENTE FX
Japón						9,4 EXCELENTE A
China						9,4 EXCELENTE A
India						9,4 EXCELENTE A
Corea del Sur						4,2 INSUFICIENTE FX
Australia						9,4 EXCELENTE A

Table 133: Indicator I.8 Rating: Engineering. Barriers to competition. Services Trade Restrictiveness Index (OECD)



4.8.1.9 *Indicator I.9: Engineering. Restrictions on movement. Services Trade Restrictiveness Index (OECD)*

TPU I.10	Ingeniería. Restricciones a la entrada de ingenieros del extranjero. Índice de restricción del comercio de servicios (OCDE)					
	2010	2015	2016	2017	2018	2019
España						0,047
Alemania						0,047
Francia						0,024
Reino Unido						0,024
Italia						0,071
EEUU						0,024
Brasil						0,118
Colombia						0,047
Canadá						0,036
Egipto						
Sudáfrica						0,095
Japón						0,024
China						0,118
India						0,083
Corea del Sur						0,047
Australia						0,071
Maximo:		0,12	MAX ((Media+Factor max*Desv Est.):		0,11	1
Mínimo:		0,02	MIN ((Media-Factor min *Desv);0):		0,01	10
Media:		0,06	Percentil 90%:	0,11	0,10	-9
Media+Factor max*Desv Estándar:		0,11	Percentil 10%:	0,02	Unidad:	-91,28226
Media-Factor min*Desv Estándar:		0,01		Desv. Est.:	0,03	

Table 134: Indicator I.9 Values: Engineering. Restrictions on movement. Services Trade Restrictiveness Index (OECD)

TPU I.10	Ingeniería. Restricciones a la entrada de ingenieros del extranjero. Índice de restricción del comercio de servicios (OCDE)						Calificación 2019		
	2010	2015	2016	2017	2018				
España						6,5	SUFICIENTE ALTO	D	
Alemania						6,5	SUFICIENTE ALTO	D	
Francia						8,6	MUY BIEN	B	
Reino Unido						8,6	MUY BIEN	B	
Italia						4,3	INSUFICIENTE	FX	
EEUU						8,6	MUY BIEN	B	
Brasil						1,0	MUY INSUFICIENTE	F	
Colombia						6,5	SUFICIENTE ALTO	D	
Canadá						7,5	BIEN	C	
Egipto									
Sudáfrica						2,2	MUY INSUFICIENTE	F	
Japón						8,6	MUY BIEN	B	
China						1,0	MUY INSUFICIENTE	F	
India						3,3	INSUFICIENTE	FX	
Corea del Sur						6,5	SUFICIENTE ALTO	D	
Australia						4,3	INSUFICIENTE	FX	

Table 135: Indicator I.9 Rating: Engineering. Restrictions on movement. Services Trade Restrictiveness Index (OECD)



4.8.1.10 Indicator I.10: Engineering. Restrictions on the entry of foreign engineers. Services Trade Restrictiveness Index (OECD)

TPU I.10	Ingeniería. Restricciones a la entrada de ingenieros del extranjero. Índice de restricción del comercio de servicios (OCDE)					
	2010	2015	2016	2017	2018	2019
España						0,047
Alemania						0,047
Francia						0,024
Reino Unido						0,024
Italia						0,071
EEUU						0,024
Brasil						0,118
Colombia						0,047
Canadá						0,036
Egipto						
Sudáfrica						0,095
Japón						0,024
China						0,118
India						0,083
Corea del Sur						0,047
Australia						0,071
Maximo:		0,12	MAX ((Media+Factor max*Desv Est.):		0,11	1
Mínimo:		0,02	MIN ((Media-Factor min *Desv);0):		0,01	10
Media:		0,06	Percentil 90%:	0,11	0,10	-9
Media+Factor max*Desv Estándar:		0,11	Percentil 10%:	0,02	Unidad:	-91,28226
Media-Factor min*Desv Estándar:		0,01		Desv. Est.:	0,03	

Table 136: Indicator I.10 Values: Engineering. Restrictions on the entry of foreign engineers. Services Trade Restrictiveness Index (OECD)

TPU I.10	Ingeniería. Restricciones a la entrada de ingenieros del extranjero. Índice de restricción del comercio de servicios (OCDE)						Calificación 2019		
	2010	2015	2016	2017	2018				
España						6,5	SUFICIENTE ALTO	D	
Alemania						6,5	SUFICIENTE ALTO	D	
Francia						8,6	MUY BIEN	B	
Reino Unido						8,6	MUY BIEN	B	
Italia						4,3	INSUFICIENTE	FX	
EEUU						8,6	MUY BIEN	B	
Brasil						1,0	MUY INSUFICIENTE	F	
Colombia						6,5	SUFICIENTE ALTO	D	
Canadá						7,5	BIEN	C	
Egipto									
Sudáfrica						2,2	MUY INSUFICIENTE	F	
Japón						8,6	MUY BIEN	B	
China						1,0	MUY INSUFICIENTE	F	
India						3,3	INSUFICIENTE	FX	
Corea del Sur						6,5	SUFICIENTE ALTO	D	
Australia						4,3	INSUFICIENTE	FX	

Table 137: Indicator I.10 Rating: Engineering. Restrictions on the entry of foreign engineers. Services Trade Restrictiveness Index (OECD)



4.8.1.11 Indicator I.11: Innovation index. ND Gain Index

TPU I.11	Índice de innovación. ND Gain Index					
	2010	2015	2016	2017	2018	2019
España						0,128
Alemania						1,000
Francia						0,980
Reino Unido						0,843
Italia						0,722
EEUU						1,000
Brasil						0,121
Colombia						0,039
Canadá						0,527
Egipto						0,048
Sudáfrica						0,045
Japón						1,000
China						1,000
India						0,066
Corea del Sur						1,000
Australia						0,486
Maximo:		1,00	MAX:		1,00	10
Mínimo:		0,04	MIN ((Media-Factor min *Desv);0):		0,00	1
Media:		0,56	Percentil 90%:	1,00	1,00	9
Media+Factor max*Desv Estándar:		1,20	Percentil 10%:	0,05	Unidad:	9,00000
Media-Factor min*Desv Estándar:		-0,07		Desv. Est.:	0,42	

Table 138: Indicator I.11 Values: Innovation index. ND Gain Index

TPU I.11	Índice de innovación. ND Gain Index						Calificación 2019	
	2010	2015	2016	2017	2018			
España						2,1	MUY INSUFICIENTE	F
Alemania						10,0	EXCELENTE	A
Francia						9,8	EXCELENTE	A
Reino Unido						8,6	MUY BIEN	B
Italia						7,5	BIEN	C
EEUU						10,0	EXCELENTE	A
Brasil						2,1	MUY INSUFICIENTE	F
Colombia						1,4	MUY INSUFICIENTE	F
Canadá						5,7	SUFICIENTE	E
Egipto						1,4	MUY INSUFICIENTE	F
Sudáfrica						1,4	MUY INSUFICIENTE	F
Japón						10,0	EXCELENTE	A
China						10,0	EXCELENTE	A
India						1,6	MUY INSUFICIENTE	F
Corea del Sur						10,0	EXCELENTE	A
Australia						5,4	SUFICIENTE	E

Table 139: Indicator I.11 Rating: Innovation index. ND Gain Index



4.8.2. Engineering and Innovation Indicator

	Índice de Ingeniería e Innovación						Max valor 2019
	2010	2015	2016	2017	2018	2019	
España						61,1	99
Alemania						74,2	99
Francia						76,6	99
Reino Unido						79,2	99
Italia						54,2	99
EEUU						90,7	99
Brasil						45,0	81
Colombia						51,9	99
Canadá						61,2	90
Egipto						6,5	45
Sudáfrica						40,1	99
Japón						96,5	99
China						58,0	90
India						36,1	81
Corea del Sur						89,8	99
Australia						67,0	99
Maximo:		96,481		Máximo Valor:	VER TABLA	10	
Mínimo:		6,459		MIN:	0	0	
Media:		61,753				10,000	

Table 140: Engineering and Innovation Indicator Values

Subindicadores de Ingeniería e Innovación		Pesos	Punt. Max.	Total Max puntuación
TPU I.1	Disponibilidad de datos en Google Maps (GTFS Estático + GTFS Dinámico)	1	10	10
TPU I.2	% del PIB destinado al Gasto interior bruto en I+D (OCDE R&D)	1	10	10
TPU I.3	Gasto interior bruto en I+D (\$)/Población (OCDE R&D)	1	10	10
TPU I.4	Digitalización. Participación en la nuevas tecnologías. Puntuación GCI (WEF)	1	10	10
TPU I.5	Digitalización. Índice de las Infraestructuras de tecnologías de información y comunicación. (ND Index)	1	10	10
TPU I.6	Digitalización. % de personas que usan internet	1	10	10
TPU I.7	Ingeniería. Transparencia regulatoria. Índice de restricción del comercio de servicios (OCDE)	1	10	10
TPU I.8	Ingeniería. Barreras a la competencia. Índice de restricción del comercio de servicios (OCDE)	1	10	10
TPU I.9	Ingeniería. Restricciones al movimiento. Índice de restricción del comercio de servicios (OCDE)	1	10	10
TPU I.10	Ingeniería. Restricciones a la entrada de ingenieros del extranjero. Índice de restricción del comercio de servicios (OCDE)	1	10	10
TPU I.11	Índice de innovación. ND Gain Index	1	10	10
		11		110
		% Valorado de la Max. Puntuación del Criterio	90,0%	99

Table 141: Engineering and Innovation Indicators Weights

	Evaluación de Ingeniería e Innovación						Subindicadores considerados		
	2010	2015	2016	2017	2018	Calificación 2019			
España						6,2	SUFICIENTE ALTO	D	11
Alemania						7,5	BIEN	C	11
Francia						7,7	BIEN	C	11
Reino Unido						8,0	MUY BIEN	B	11
Italia						5,5	SUFICIENTE	E	11
EEUU						9,2	EXCELENTE	A	11
Brasil						5,5	SUFICIENTE	E	9
Colombia						5,2	SUFICIENTE	E	11
Canadá						6,8	SUFICIENTE ALTO	D	10
Egipto						1,4	MUY INSUFICIENTE	F	5
Sudáfrica						4,0	INSUFICIENTE	FX	11
Japón						9,7	EXCELENTE	A	11
China						6,4	SUFICIENTE ALTO	D	10
India						4,5	INSUFICIENTE	FX	9
Corea del Sur						9,1	EXCELENTE	A	11
Australia						6,8	SUFICIENTE ALTO	D	11

Table 142: Engineering and Innovation Criterion Rating



The indicator "Availability of data in Google Maps (Static GTFS + Dynamic GTFS)" has an average of 1.08, with a maximum of 2.00 and a minimum of 0.00. Spain has a value of 1.00, the same as France and lower than Germany (1.5) and the United Kingdom (1.74).

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

For instance, the indicator "% of GDP allocated to gross domestic expenditure on R&D" among the analyzed countries presents a wide spectrum: ranging from a maximum of 3.21% (Japan) to a minimum of 0.32% (Canada). Spain falls within the lower band (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%) fall in an intermediate position. Over the five years analyzed (2015 to 2019), these percentages remain relatively constant, highlighting the growing technological gap.

If we look at gross investment in R&D per capita, the results display differences: Spain - \$522 per capita; USA - \$2,066 per capita; Germany - \$1,763 per capita.

The three selected indicators for evaluating digitization show very similar results among the analyzed countries. Nevertheless, Spain ranks among the top countries: 90.7% of the population uses the internet (surpassed only by the UK, Japan, and South Korea); the score given by the World Economic Forum in the indicator "participation in new technologies" is 98.3% (exceeded only by South Korea); however, the University of Notre Dame's index "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 related to engineering in the analyzed sector, and the number of engineers and their training in relation to engineering, four OECD indicators have been employed 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 of these are related to the OECD's periodic Index of Restrictiveness of Trade in Services. In these indicators, Spain falls in an intermediate position among the analyzed countries: very good in restrictions on the movement of engineers, sufficient in barriers to competition, and insufficient in restrictions on the entry of foreign engineers and regulatory transparency.

The global innovation index of the University of Notre Dame has also been analyzed. The best results are achieved by Germany, the USA, China, and Japan (with the highest score of "1"). Following are France (0.98), the UK (0.84), and Italy (0.722). Spain ranks among the lower-performing analyzed countries (0.128).

The overall assessment of the Engineering and Innovation criterion awards the highest scores to the USA (9.2), Japan (9.7), followed by Germany (7.5), and France (7.7). Spain receives a score of 6.2, below that of China (6.4).



4.9. Global Assessment of Urban Public Transport Based on Objective Indicators

The assessment based on the established criteria is as follows::

TPU I C	Capacidad					Calificación 2019		
	2010	2015	2016	2017	2018			
España						7,9	BIEN	C
Alemania						7,8	BIEN	C
Francia						7,3	BIEN	C
Reino Unido						9,4	EXCELENTE	A
Italia						5,7	SUFICIENTE	E
EEUU						4,1	INSUFICIENTE	FX
Brasil						6,2	SUFICIENTE ALTO	D
Colombia						7,4	BIEN	C
Canadá						3,6	INSUFICIENTE	FX
Egipto						2,7	MUY INSUFICIENTE	F
Sudáfrica						5,5	SUFICIENTE	E
Japón						5,9	SUFICIENTE	E
China						7,6	BIEN	C
India						3,5	INSUFICIENTE	FX
Corea del Sur						6,8	SUFICIENTE ALTO	D
Australia						4,6	INSUFICIENTE	FX

Table 143: Capacity Criterion Rating

TPU I P	Prestaciones					Calificación 2019		
	2010	2015	2016	2017	2018			
España						10,0	EXCELENTE	A
Alemania						7,5	BIEN	C
Francia						9,1	EXCELENTE	A
Reino Unido						6,1	SUFICIENTE ALTO	D
Italia						6,7	SUFICIENTE ALTO	D
EEUU						6,3	SUFICIENTE ALTO	D
Brasil						5,4	SUFICIENTE	E
Colombia						3,7	INSUFICIENTE	FX
Canadá						7,2	BIEN	C
Egipto						1,8	MUY INSUFICIENTE	F
Sudáfrica						3,7	INSUFICIENTE	FX
Japón						6,9	SUFICIENTE ALTO	D
China						5,6	SUFICIENTE	E
India						3,6	INSUFICIENTE	FX
Corea del Sur						7,8	BIEN	C
Australia						5,9	SUFICIENTE	E

Table 144: Performane Criterion Rating

TPU I F	Financiación					Calificación 2019		
	2010	2015	2016	2017	2018			
España						5,0	SUFICIENTE	E
Alemania						5,6	SUFICIENTE	E
Francia						10,0	EXCELENTE	A
Reino Unido						5,9	SUFICIENTE	E
Italia						5,0	SUFICIENTE	E
EEUU						3,9	INSUFICIENTE	FX
Brasil						6,7	SUFICIENTE ALTO	D
Colombia						4,0	INSUFICIENTE	FX
Canadá						5,2	SUFICIENTE	E
Egipto								
Sudáfrica								
Japón						10,0	EXCELENTE	A
China						10,0	EXCELENTE	A
India						3,1	INSUFICIENTE	FX
Corea del Sur						6,1	SUFICIENTE ALTO	D
Australia						3,9	INSUFICIENTE	FX

Table 145: Financing Criterion Rating



TPU I A	Adaptación al futuro y desarrollo sostenible							
	2010	2015	2016	2017	2018	Calificación 2019		
España						5,8	SUFICIENTE	E
Alemania						8,9	MUY BIEN	B
Francia						7,7	BIEN	C
Reino Unido						6,9	SUFICIENTE ALTO	D
Italia						6,9	SUFICIENTE ALTO	D
EEUU						5,6	SUFICIENTE	E
Brasil						5,7	SUFICIENTE	E
Colombia						5,5	SUFICIENTE	E
Canadá						5,9	SUFICIENTE	E
Egipto						4,1	INSUFICIENTE	FX
Sudáfrica						3,9	INSUFICIENTE	FX
Japón						8,2	MUY BIEN	B
China						5,6	SUFICIENTE	E
India						3,8	INSUFICIENTE	FX
Corea del Sur						7,1	BIEN	C
Australia						5,6	SUFICIENTE	E

Table 146: Adaptation to the future and Sustainability Criterion Rating

TPU I O	Operación y mantenimiento							
	2010	2015	2016	2017	2018	Calificación 2019		
España						5,9	SUFICIENTE	E
Alemania						3,2	INSUFICIENTE	FX
Francia						4,4	INSUFICIENTE	FX
Reino Unido						7,7	BIEN	C
Italia						2,9	MUY INSUFICIENTE	F
EEUU						4,6	INSUFICIENTE	FX
Brasil						4,6	INSUFICIENTE	FX
Colombia						10,0	EXCELENTE	A
Canadá						2,9	MUY INSUFICIENTE	F
Egipto								
Sudáfrica								
Japón						1,8	MUY INSUFICIENTE	F
China						8,0	MUY BIEN	B
India						2,5	MUY INSUFICIENTE	F
Corea del Sur						1,7	MUY INSUFICIENTE	F
Australia								

Table 147: Operation and Maintenance Criterion Rating

TPU I S	Seguridad							
	2010	2015	2016	2017	2018	Calificación 2019		
España						8,4	MUY BIEN	B
Alemania						8,8	MUY BIEN	B
Francia						8,5	MUY BIEN	B
Reino Unido						8,3	MUY BIEN	B
Italia						6,4	SUFICIENTE ALTO	D
EEUU						6,7	SUFICIENTE ALTO	D
Brasil						2,2	MUY INSUFICIENTE	F
Colombia						5,8	SUFICIENTE	E
Canadá						6,2	SUFICIENTE ALTO	D
Egipto						3,1	INSUFICIENTE	FX
Sudáfrica						1,0	MUY INSUFICIENTE	F
Japón						6,8	SUFICIENTE ALTO	D
China						5,3	SUFICIENTE	E
India						2,0	MUY INSUFICIENTE	F
Corea del Sur						1,0	MUY INSUFICIENTE	F
Australia						7,6	BIEN	C

Table 148: Safety Criterion Rating



TPU I R	Resiliencia							
	2010	2015	2016	2017	2018	Calificación 2019		
España						7,3	BIEN	C
Alemania						7,2	BIEN	C
Francia						7,6	BIEN	C
Reino Unido						7,7	BIEN	C
Italia						4,6	INSUFICIENTE	FX
EEUU						7,7	BIEN	C
Brasil						4,6	INSUFICIENTE	FX
Colombia						1,2	MUY INSUFICIENTE	F
Canadá						7,4	BIEN	C
Egipto						4,0	INSUFICIENTE	FX
Sudáfrica						5,4	SUFICIENTE	E
Japón						2,2	MUY INSUFICIENTE	F
China						3,5	INSUFICIENTE	FX
India						1,3	MUY INSUFICIENTE	F
Corea del Sur						5,3	SUFICIENTE	E
Australia						4,5	INSUFICIENTE	FX

Table 149: Resilience Criterion Rating

TPU I I	Ingeniería e Innovación							
	2010	2015	2016	2017	2018	Calificación 2019		
España						6,2	SUFICIENTE ALTO	D
Alemania						7,5	BIEN	C
Francia						7,7	BIEN	C
Reino Unido						8,0	MUY BIEN	B
Italia						5,5	SUFICIENTE	E
EEUU						9,2	EXCELENTE	A
Brasil						5,5	SUFICIENTE	E
Colombia						5,2	SUFICIENTE	E
Canadá						6,8	SUFICIENTE ALTO	D
Egipto						1,4	MUY INSUFICIENTE	F
Sudáfrica						4,0	INSUFICIENTE	FX
Japón						9,7	EXCELENTE	A
China						6,4	SUFICIENTE ALTO	D
India						4,5	INSUFICIENTE	FX
Corea del Sur						9,1	EXCELENTE	A
Australia						6,8	SUFICIENTE ALTO	D

Table 150: Engineering and Innovation Criterion Rating

The overall assessment of the urban public transportation sector is formed by considering the evaluations of the various criteria, applying weights to each criterion. The assigned weights are as follows:

Criterios de TPU		Pesos	Punt. Max.	Total Max puntuación
TPU I C	Capacidad	1	10	10
TPU I P	Prestaciones	1	10	10
TPU I F	Financiación	1	10	10
TPU I A	Adaptación al futuro y desarrollo sostenible	1	10	10
TPU I O	Operación y mantenimiento	1	10	10
TPU I S	Seguridad	1	10	10
TPU I R	Resiliencia	1	10	10
TPU I I	Ingeniería e Innovación	1	10	10
		8		80
		% Valorado de la Max. Puntuación de los Criterios	100,0%	80

Table 151: Weights assigned to the Criteria for the composition of the Evaluation of the urban public transportation sector



	Evaluación de TPU					Calificación 2019			Subindicadores considerados
	2010	2015	2016	2017	2018				
España						7,1	BIEN	C	51
Alemania						7,1	BIEN	C	51
Francia						7,8	BIEN	C	51
Reino Unido						7,5	BIEN	C	49
Italia						5,4	SUFICIENTE	E	51
EEUU						6,0	SUFICIENTE ALTO	D	44
Brasil						5,1	SUFICIENTE	E	41
Colombia						5,4	SUFICIENTE	E	40
Canadá						5,7	SUFICIENTE	E	43
Egipto						2,9	MUY INSUFICIENTE	F	30
Sudáfrica						3,9	INSUFICIENTE	FX	35
Japón						6,4	SUFICIENTE ALTO	D	41
China						6,5	SUFICIENTE ALTO	D	41
India						3,0	INSUFICIENTE	FX	40
Corea del Sur						5,6	SUFICIENTE	E	40
Australia						5,5	SUFICIENTE	E	37

Table 152: Evaluation of the urban public transportation sector based on objective indicators

The evaluation of each country in each year in the overall assessment has been conducted using the maximum rating of the country and the corresponding year as a reference (without making any adjustments or limiting the maximum and minimum), in order to avoid distorting the evaluation if data for any criterion are not available. It's important to consider this aspect, as the overall evaluation only considers the criteria for which verified data is available.

In countries where data for a specific criterion is missing, since those criteria are not evaluated, the overall sector rating could either increase or decrease depending on the result that would have been achieved by the criterion or criteria that are not evaluated.

The countries with the highest overall ratings, taking into account the established indicators, are European countries (except for Italy): France (7.8), the United Kingdom (7.5), Germany, and Spain (7.1). Following them are China (6.5), Japan (6.4), and the United States (6.0); Italy, with a score of 5.4, only achieves a passing grade.

Spain receives a good rating in Capacity (7.9), Performance (10.0), and Safety (8.4). In Financing, it receives a passing grade (5.0).



4.10. Sensitivity Analysis based on Objective Indicators

A sensitivity analysis has been conducted by varying the weights assigned to each criterion. In general terms, when the criterion weights are modified, the evaluation of countries slightly fluctuates without substantially altering the overall assessment. Below are the results achieved by varying the weights of the criteria. Specifically, Spain's overall evaluation is "good" in all three cases.

4.10.1. Highlighted weights in Capacity, Performance, and Safety (3); in Financing; medium weights in Future Adaptation and Sustainable Development; and Operation and Maintenance (2); low weights in Resilience and Innovation (1)

Criterios de TPU		Pesos	Punt. Max.	Total Max puntuación
TPU I C	Capacidad	3	10	30
TPU I P	Prestaciones	3	10	30
TPU I F	Financiación	2	10	20
TPU I A	Adaptación al futuro y desarrollo sostenible	2	10	20
TPU I O	Operación y mantenimiento	2	10	20
TPU I S	Seguridad	3	10	30
TPU I R	Resiliencia	1	10	10
TPU I I	Ingeniería e Innovación	1	10	10
		17		170
		% Valorado de la Max. Puntuación de los Criterios	100,0%	170

Table 153: Sensitivity Analysis: Emphasis on Criteria: Capacity, Performance, and Safety (3)

	Evaluación de TPU					Calificación 2019		
	2010	2015	2016	2017	2018			
España						7,4	BIEN	C
Alemania						7,2	BIEN	C
Francia						7,9	BIEN	C
Reino Unido						7,5	BIEN	C
Italia						5,6	SUFICIENTE	E
EEUU						5,7	SUFICIENTE	E
Brasil						5,0	SUFICIENTE	E
Colombia						5,7	SUFICIENTE	E
Canadá						5,5	SUFICIENTE	E
Egipto						2,8	MUY INSUFICIENTE	F
Sudáfrica						3,7	INSUFICIENTE	FX
Japón						6,5	SUFICIENTE ALTO	D
China						6,6	SUFICIENTE ALTO	D
India						3,1	INSUFICIENTE	FX
Corea del Sur						5,3	SUFICIENTE	E
Australia						5,6	SUFICIENTE	E

Table 154: Sensitivity Analysis: Emphasis on Criteria - Capacity, Performance, and Safety (Weight: 3). Evaluation of Urban Public Transportation



4.10.2. Sensitivity Analysis: Emphasis on Capacity, Performance, and Safety (Weight: 2); Moderate Weights on Other Criteria (1)

Criterios de TPU		Pesos	Punt. Max.	Total Max puntuación
TPU I C	Capacidad	2	10	20
TPU I P	Prestaciones	2	10	20
TPU I F	Financiación	1	10	10
TPU I A	Adaptación al futuro y desarrollo sostenible	1	10	10
TPU I O	Operación y mantenimiento	1	10	10
TPU I S	Seguridad	2	10	20
TPU I R	Resiliencia	1	10	10
TPU I I	Ingeniería e Innovación	1	10	10
		11		110

Table 155: Sensitivity Analysis: Emphasis on Capacity, Performance, and Safety (Weight: 2); Equal Weights on Other Criteria (Weight: 1)

	Evaluación de TPU					Calificación 2019			Subindicadores considerados
	2010	2015	2016	2017	2018				
España						7,5	BIEN	C	51
Alemania						7,3	BIEN	C	51
Francia						7,9	BIEN	C	51
Reino Unido						7,6	BIEN	C	49
Italia						5,7	SUFICIENTE	E	51
EEUU						5,9	SUFICIENTE	E	44
Brasil						5,0	SUFICIENTE	E	41
Colombia						5,4	SUFICIENTE	E	40
Canadá						5,7	SUFICIENTE	E	43
Egipto						2,7	MUY INSUFICIENTE	F	30
Sudáfrica						3,8	INSUFICIENTE	FX	35
Japón						6,5	SUFICIENTE ALTO	D	41
China						6,4	SUFICIENTE ALTO	D	41
India						3,0	INSUFICIENTE	FX	40
Corea del Sur						5,5	SUFICIENTE	E	40
Australia						5,7	SUFICIENTE	E	37

Table 156: Sensitivity Analysis: Emphasis on Capacity, Performance, and Safety (Weight: 2); Equal Weights on Other Criteria (Weight: 1). Evaluation of Urban Public Transportation



4.11. Conclusions from the Evaluation based on Objective Indicators

As mentioned earlier, in urban public transportation:

The countries with the highest global ratings considering the established indicators are European countries (excluding Italy): France (7.8), United Kingdom (7.5), Germany, and Spain (7.1). Following them are China (6.5), Japan (6.4), and the United States (6.0). Italy, with a score of 5.4, only reaches a sufficient rating.

Spain receives a strong rating in Capacity (7.9), an excellent rating in Performance (10.0), and a very good rating in Safety (8.4). In terms of Financing, Spain receives a sufficient rating (5.0).

4.11.1. Capacity Criterion

In order to accurately assess whether urban public transportation infrastructures possess the necessary capacity to meet the population's demand, both the available transportation supply and user demand must be considered, along with their relationship, which should ideally be balanced. Excessive demand compared to the available supply implies a lack of capacity, leading to inadequate service for all users, while an oversupply in relation to the existing demand would result in undesirable cost overruns.

The most appropriate method for measuring the capacity of a public transportation system would be in terms of the number of passengers that can be transported during peak hours. However, due to the complexity of assessing and obtaining this indicator, real demand data, such as the average number of daily trips on working days, are commonly used. Therefore, this report has adopted this criterion linked to data availability, even if it might not be entirely rigorous. To calculate this indicator, both the number of inhabitants in the metropolitan area and the population and area size are considered, providing an approximate idea of the demand that urban public transportation systems face. This indicator, in addition to offering insight into the system's capacity, can correlate with the quality of service provided. However, to precisely determine capacity, knowledge of its level of service would also be necessary, although obtaining and comparing this data internationally is more complex.

The challenge of evaluating the actual capacity of each bus or train has been resolved by estimating the average capacity of buses at 40 passengers and train carriages at 130 passengers. In reality, when considering different types of buses, the calculation should take those distinctions into account. To simplify the calculation, the average capacities mentioned for buses have been used for train carriages. This simplification introduces a certain level of imprecision by considering these average values. It's also important to note that the number of buses in fleets intended for public transportation is being quantified, not the number of registered buses, which might include other services like tourism, school buses, etc., and would not be representative of the public transportation sector.

For the evaluation of this Criterion, five indicators have been utilized. The first two assess the average number of daily passengers using all modes of public transportation in relation to population and area size. Two ratios have been considered: daily trips per population, providing



an indicator of the number of trips per inhabitant; and daily trips per urbanized area size of the metropolitan area.

Trip number data has been acquired from the World Bank database, with older data updated to the current situation and supplemented with some missing data gathered from the websites of service operators and their annual reports. In the case of Spain, data from the Urban Mobility Observatory has been employed.

The Indicator "daily trips/population" has an average value of 0.46, with a maximum of 0.83 (Brazil) and a minimum of 0.18 (Egypt). Spain (0.6), above the average, aligns with other European countries, closely resembling Italy (0.59), falling below Germany and the UK (0.67), and surpassing France (0.47). The Indicator "daily trips/area (km²)" has the highest value in the EU, shared by Spain and the UK (4.47).

The subsequent Indicators pertain to the existing public transportation supply and its relative capacity to meet this demand. The selected Indicators are related to the average capacity of public transportation services in relation to trips, population, and area.

The ratio "capacity (buses and carriages) per daily trips" has an average value of 0.15. In European countries, this ratio is higher, ranging between 0.13 (Spain) and 0.21 (France). A lower value of this Indicator suggests potential excess capacity or that the allocation of public transportation vehicles might be sized to accommodate more passengers, which could result from a concentration of trips during peak hours.

The following two ratios, "Capacity/population" and "Capacity/area," also present favorable figures for Spain.

The final rating for the Capacity criterion evaluates the United Kingdom as excellent; Spain, Germany, France, Colombia, and China as good; Brazil and South Korea as sufficiently high; the United States, Canada, India, and Australia as insufficient; and Egypt as very insufficient.

4.11.2. Performance Criterion

The average travel speed in urban transportation across the analyzed countries is 20 km/h, ranging from a minimum of 8 in Colombia and Egypt to a maximum of 33 km/h in Germany. Spain presents a very good ratio (25.9 km/h). The data has been collected from NUMBEO and reflects the entire journey (from home to work or school activities), including walking distances, waiting times for public transportation, and the transportation leg of the journey.

The "Public Transport Trips/Motorized Mode Trips" Indicator shows the percentage of trips made using public transportation compared to private transportation. The length of the network/area of the city reflects the density of the public transportation network. The Accessibility Indicators for public transportation, cycling, and walking demonstrate citizens' ease of accessing different places in the city. This Indicator has an average value of 0.45, meaning half of motorized trips are taken using public transportation. Japan and South Korea stand out with very high values (0.81 and 0.9, respectively). Spain falls within the average (0.515).



The "% of Population with Convenient Access to Public Transport" Indicator is the UN SDG 11.2.11 Indicator of the Sustainable Development Goals from the United Nations' 2030 Agenda. Spain, the UK, and France exhibit the best values (above 96%).

The OECD's Accessibility Indicators, both for public transportation and for cycling and walking, are ratios that showcase the level of performance. Spain stands out with excellent values in all three Accessibility Indicators.

NUMBEO's Traffic in Spain Indicators, including average trip length, average travel time, traffic index, time dissatisfaction, and inefficiency, also demonstrate the effectiveness of public transportation provision. This organization supplies disaggregated data on various aspects of quality of life in major cities of each country, covering aspects related to traffic, public transportation, pollution, etc. The four NUMBEO Indicators rate Spain as excellent.

Across the eleven evaluated Indicators, Spain achieves the highest rating (Excellent), with values similar to France. Germany, Canada, and South Korea receive a good rating.

4.11.3. Financing Criterion

To evaluate the financing in the urban public transportation sector, it is necessary to study the investment in both new infrastructure creation and the operation, conservation, maintenance, and improvement of existing systems. One of the peculiarities of this sector is the significant variation in service management: in some municipalities, public administrations operate the services, while in others, they are managed by private concessionaire companies.

The management approach significantly affects the financing. Revenues are obtained from various sources, including user fares, public subsidies received by some concessionaire companies, and other sources such as advertising income. Due to the different operating and financing methods, conducting a rigorous international comparative study is complex. In this report, the analysis focuses on examining revenue from user fares and the percentage of coverage of service operating costs.

The highest rating has been given to the maximum coverage of revenues (user fare revenues covering all operating expenses). However, it's important to note that this is not directly related to the quality of service provided. Different local or national administrations may subsidize all or part of the costs based on political decisions, and there can also be other revenues not directly linked to fares (such as advertising income).

Additionally, another indicator related to the ticket price adjusted to citizens' purchasing power has been used. The funding of public transportation networks varies among different modes like buses or railways, so these modes have been considered separately.

The basic data used for calculating the indicators are presented in the following tables. The data originates from the World Bank. In Spain, data has been replaced with values provided by the Metropolitan Mobility Observatory. Report 2019 and advance 2020. The costs of the railway network and the bus network in Barcelona are not available, so an estimation has been made (the exchange rate from € to \$ has been estimated at 1.1 €/(\$)).



In the final evaluation of the Financing criterion, the cities that receive the highest rating are Hong Kong, Paris, and Tokyo. However, there is uncertainty about the data for cities that receive the lowest rating, which means the evaluation might not be accurate. This could be the case for Berlin, where with real values of income and operating costs, a higher rating would likely be obtained. Spain, along with Italy, receives a mediocre rating (5.0), which is the lowest among European countries.

4.11.4. Adaptation to the future and Sustainability Criterion

The first indicator, "Mass Transit Share / Total Public Transport Share," estimates the usage of mass transit, which is considered more efficient and better suited for future adaptation as urban populations grow rapidly. This indicator has an average of 54%, ranging from a maximum of 94% (Japan) to a minimum of 0.54% (South Africa). Spain has a value of 37%, which is very low compared to Germany (66%) and France (78%).

The increase in urban population highlights the need for future demand adaptation in metropolitan areas: higher rates necessitate efforts to address future demand. Spain, with a rate of 11.1%, has the highest rate among the analyzed European countries. In Colombia, South Africa, China, India, and Australia, the increase is above 20%.

The CO₂ emissions index informs about the sustainability of public transportation systems, similar to the pollution index, energy consumption per transported passenger, CO₂ emissions (t/capita), and population exposure to pollutants. Spain's values are of the same order of magnitude as European countries.

The number of bicycles and scooters per 10,000 inhabitants in Spain (10,117) is very low compared to European countries (Germany has a value of 32.8% and China 56.4%).

The "Development of Climate Change Mitigation Technologies related to Transport (OECD)" indicator reflects research conducted to promote future sustainability. Spain has the worst result among all European countries.

Finally, the "% of the urban population exposed to high levels of noise. EUROSTAT" assesses the sound sustainability of the metropolitan area. Spain, France, and Italy present very similar values (between 50% and 60%).

The best-rated countries are Germany (8.9) and Japan (8.2), followed by France (7.7), South Korea (7.1), and the United Kingdom and Italy (6.9). Spain receives a sufficient rating (5.8), the lowest among European countries.

4.11.5. Operation and maintenance Criterion

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



Investment needs for operation, conservation, and maintenance are related to the state of the infrastructure and the requirements for adaptation to new technical, functional, and technological demands. There has been much debate among experts about the necessary investment for proper conservation. While there's no widespread consensus on an exact percentage, the necessary investment for conservation is considered to be 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 the asset value, although they are not widespread and verifiable and comparable data are lacking.

Maintenance expenses, which include repairs and rehabilitations in the urban public transportation network, should not be confused with the total operating expenses. However, even though they should be quantified separately, in most cases, authorities do not provide these data separately, instead giving the total operating costs of the network over the year. Therefore, it's not possible to internationally compare specific data such as workshop maintenance expenses, infrastructure maintenance expenses, or exclusive operating costs. Instead, even if it provides less detail, these categories will be grouped together and the total cost of operating and maintaining the network will be evaluated to compare indicators internationally.

Similarly to what has been mentioned regarding the Financing Criterion, the percentage of GDP allocated to operating expenses represents an indicator that can guide the appropriateness of investment for conservation and operation needs. The average value of the "Operating Expenses % / Real GDP" ratio is 0.01%, with a maximum of 0.03% and a minimum of 0.001%, which corresponds to Germany, Japan, and South Korea. Spain has a percentage of 0.01%.

To provide further clarity and context to this indicator, investment per capita and per area have also been considered. The resulting average investment per capita is 272, with a maximum of 651 and a minimum of 35. Spain's value is 325.

In the overall Operation and Maintenance Criterion, Spain is rated as sufficient (5.9). The countries with the highest rating are Colombia and China, and the countries with the lowest rating are Italy, Canada, Japan, and Australia.

4.11.6. Safety Criterion

Para evaluate the safety of urban public transportation, the most accurate indicator would be the index of accidents and casualties in public transportation. However, obtaining this data is very difficult as statistics on these matters are generally not collected, and in many cases, they are even attempted to be hidden.

The ASCE report indicates that in the United States, there were a total of 255 fatalities in accidents related to public transportation, but only 5% of this number were passengers of public transportation, while the remaining 95% were due to other circumstances unrelated to the transportation users themselves. This is because the majority of accidents that occur involve pedestrians being hit by buses, which also doesn't represent a figure relative to the safety of the infrastructure, as these accidents are generally caused by the actions of pedestrians or drivers.



However, especially in older rail systems, incidents such as smoke, fires, derailments, or collisions can occur, emphasizing the need for maintaining good infrastructure to ensure public safety.

One potential approach to evaluating vehicle safety would be to measure safety features such as automatic blocking and braking systems in rail modes. However, since networks typically consist of homogeneous vehicles and these systems are not quantifiable internationally due to variations introduced by vehicle manufacturers, they could not be utilized as indicators for this report. Nonetheless, their implementation and improvement should always be considered, especially in older systems lacking these features.

Instead, the number of fatalities in traffic accidents on urban roads within the studied cities has been quantified. A higher proportion of this indicator might indicate poorer road safety due to excessive use of roads caused by inadequate public transportation infrastructure. The results for this indicator, which is the sole component of the Safety Indicator, are shown in the following tables.

The most recent year for which data is available has been used in all cases, considering a zero score if the urban traffic fatality rate is equal to or higher than 10 per 100,000 population. As can be observed, generally, less developed countries tend to yield worse results in this indicator. Europe reports the best indicator values. In the United States, it's worth noting the high number of victims in Chicago compared to other cities.

Overall, the best-rated countries are European countries (except Italy). The United States, Japan, and Australia receive a high sufficient rating, with slight variations between them. The worst-performing countries are South Africa, South Korea, and India.

4.11.7. Resilience Criterion

The coverage of public transportation is a good indicator of the resilience capacity of the system. In this report, the coverage of public transportation in the main urban core, metropolitan area, and peri-urban area has been considered. The data is sourced from the International Transport Forum (ITF). In the "Network Length (km) / City Area (km²)" indicator, the best countries are France, Italy, and Spain (with values of 2.6, 1, and 0.97, respectively).

Additionally, the following indicators are considered: the percentage of the population within 1,000 meters of a public transportation stop, the percentage of the population with travel times less than 30 minutes on public transportation, and annual hours lost in traffic congestion (data collected from TomTom in this case).

In the "Percentage of the Population within 1,000 Meters of a Public Transportation Stop" indicator, European countries, the United States, and Canada stand out.

The annual hours lost in traffic congestion reflect how city traffic is performing and, consequently, the functioning of public transportation. Spain performs exceptionally well in this aspect (48 hours lost in traffic congestion annually).

The indicators related to public transportation coverage, which were only evaluated for European countries, show similar results, except for Italy.



The highest overall ratings for this indicator are obtained by European countries (except Italy), the United States, Canada, and Japan (9.9), France and the United States (9.5). Egypt, South Korea, and Australia receive a sufficient rating. The worst-performing countries are India, Japan, and Colombia.

4.11.8. Engineering and Innovation Criterion

The Urban Mobility Innovation Index (UMii)⁸, developed by Advancing Public Transport (UITP), is the most comprehensive report that exclusively evaluates innovation in urban mobility. In its latest version from 2021, it assesses 40 cities from different parts of the world. This report provides valuable information and contains the Urban Mobility Innovation (UMii) index, which is a framework of indicators that assess the maturity of a city's innovation ecosystem in urban mobility. It utilizes a collection of qualitative and quantitative indicators that capture multiple characteristics of the innovation value chain. The index is based on 9 composite indicators that cover 3 dimensions: preparedness, deployment, and habitability.

Preparedness refers to forward-looking innovation levers: the city's ambition and scope of its strategy, concrete objectives, institutional capacity and skills to work towards those goals, and the robustness of its data collection, accessibility, and usability. **Deployment** deals with key enablers of the strategy: the ability to address regulatory barriers to innovation, attract investments from various stakeholders, incentivize innovation, and the level of citizen and stakeholder engagement in co-designing and testing innovative mobility solutions. **Habitability** assesses the final impacts of the resulting transportation system in terms of connectivity (mobility options and integration), well-being (health, equity, accessibility), and environment (air quality, energy consumption, noise, and natural areas).

The "Availability of data in Google Maps (Static GTFS + Dynamic GTFS)" indicator has an average of 1.08, with a maximum of 2.00 and a minimum of 0.00. Spain has a value of 1.00, similar to France and lower than Germany (1.5) and the United Kingdom (1.74).

Despite efforts to obtain more specific data on the urban public transportation sector, reliable and verifiable data hasn't been found. As a result, the report analyzes the state of R&D and innovation in different countries on a global level and assumes these data points to assess the state of public transportation. For this purpose, the database and indicators contained in the "Main Science and Technology Indicators, Volume 2021," published in 2022 by the OECD⁹, were selected. This comprehensive report provides a set of indicators that reflect the level and structure of efforts made by OECD member countries and other non-member countries (Argentina, People's Republic of China, Romania, Russian Federation, 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 R&D-intensive industries.

OECD indicators related to research and development show the global strategic position of countries in relation to research across all sectors of the economy. The "% of GDP allocated to

⁸ [UMii-report-2021_NEW.pdf \(uitp.org\)](#)

⁹ [Main Science and Technology Indicators, Volume 2021 Issue 2 | READ online \(oecd-ilibrary.org\)](#)



gross domestic spending on R&D" of the analyzed countries presents a wide range: from a maximum of 3.21% (Japan) to a minimum of 0.32% (Canada). Spain is positioned on the lower end (1.25%), surpassed by all EU countries. It's logical for the world's technologically advanced countries to 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 relatively constant over the five years analyzed (2015 to 2019), highlighting the growing technological gap.

In terms of gross investment in R&D per capita, there are differences: 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 very similar results among the analyzed countries. Nonetheless, Spain ranks among the top countries: 90.7% of people use the internet (surpassed only by the United Kingdom, Japan, and South Korea); the score given by the World Economic Forum in the "participation in new technologies" indicator is 98.3% (only surpassed by South Korea); however, the University of Notre Dame's "ICT infrastructure index" assigns Spain a value of 0.671, surpassed by Germany (0.710), France (0.725), the United Kingdom (0.710), and South Korea (0.732).

As mentioned, due to the impossibility of obtaining economic investment specifically allocated to the engineering of the analyzed sector, as well as the number of engineers and their engineering-related education, four OECD indicators related to regulatory transparency, competition barriers, movement restrictions of engineers, and entry restrictions for foreign engineers have been used to assess the state of engineering. All of these indicators are related to the trade in services restriction index periodically prepared by the OECD. In these indicators, Spain falls in an intermediate position among the analyzed countries, performing well in movement restrictions of engineers, sufficient in competition barriers, and insufficient in entry restrictions for foreign engineers and regulatory transparency.

The overall evaluation of the Engineering and Innovation criterion gives the highest ratings to the United States (9.2), Japan (9.7), followed by Germany (7.5), and France (7.7). Spain receives a rating of 6.2, below China (6.4).

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



5. Qualitative assessment. 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 Urban Public Transportation 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 157: Sistema de calificación de la evaluación cualitativa por los expertos

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 158: Numerical assignment of qualitative evaluation by experts

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

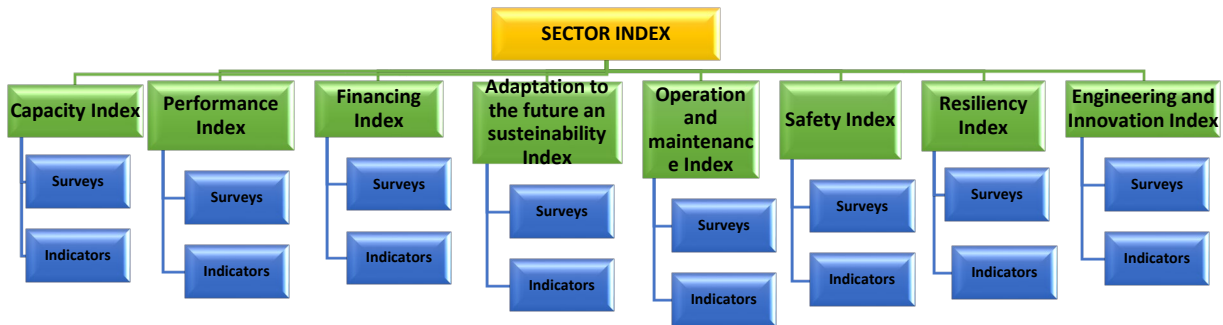


Figure 1: Scheme of the evaluation system for public works sectors

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

In general¹⁰, 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%**

¹⁰ 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. Survey for expert evaluation

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 del sector del transporte público urbano en España en ciudades de población superior a 50.000 habitantes?	7,6	BIEN	C
1	1.1. ¿Cómo valora la cobertura del territorio y la infraestructura del sector del transporte público urbano en España en ciudades de población superior a 50.000 habitantes?	5,4	SUFICIENTE	E
1	1.3. ¿Cómo valora la capacidad del sector del transporte público urbano en España para absorber la demanda actual?	7,1	BIEN	C
1	1.4. ¿Cómo valora la capacidad del sector del transporte público urbano en España para absorber a la previsible demanda futura en los próximos 10 años?	6,5	SUFICIENTE ALTO	D
4	TOTAL EVALUACIÓN CAPACIDAD POR LOS EXPERTOS:	6,6	SUFICIENTE ALTO	D

Table 159: Expert assessment of capacity

Comments, suggestions, and recommendations from the experts

- The overall assessment of Spanish urban transportation, without detailing each city individually, results in an incomplete evaluation; I believe more specifics are necessary to obtain valid results.
- My evaluations are in relative terms. That is, comparing the state of public transportation in Spain with that of other EU countries.
- There is no efficient planning.
- Lack of coordination among responsibilities and transportation policies among different Public Administrations.
- Investment in the public transportation sector has decreased in recent years, but especially the calls and aid from the PRTR (Recovery, Transformation, and Resilience Plan) will significantly reduce this gap in the coming years.
- Urban public transportation currently meets the existing demand, largely captive, but it is not designed or realized as an effective option to attract demand from other modes. It is an expensive system to maintain, serving a demand dependent on the system itself, especially in medium and small-sized cities. In large cities and metropolitan areas, some actions have been taken to make public transportation an alternative to private transportation, such as exclusive lanes, priority at intersections, high frequency, etc.
- Spain's strong point is the existence of a complete and integrated road network that allows "door-to-door" transportation for any form of goods and passengers. Public



transportation services should leverage this network to increase their comprehensive coverage in many municipalities.

- Within the sample of cities with a population over 50,000 inhabitants, there is a significant coverage difference in public transportation. For instance, between Madrid/Barcelona and the rest, to answer that question accurately.
- The supply varies greatly from one city to another.
- There are many differences among municipalities with more than 50,000 inhabitants, as well as those with fewer than 50,000 inhabitants. It's not possible to provide a global answer, as it depends on each specific case.
- I'm not sure if I understand the concepts of coverage and capacity of the sector correctly. I believe they are generally good, but quality is another matter in many cases.
- There is a lack of dedicated infrastructure for public transportation.
- Legislation is needed to provide economic stability through sufficient mixed financing.
- Comprehensive analyses with efficient resource planning.
- Regulate municipal, metropolitan, regional, and national mobility and transportation plans with sufficient normative standards, similar to what has been done in urban planning.
- Embrace a public-private policy that allows for combining traditional mass transportation means (buses, metro, tram, etc.) with other modes like VMPs (not just bicycles or electric scooters) or carsharing (especially), where the private sector is leading, to encourage a shift away from private cars. Also, invest in digitally integrating major operators into open mobility platforms like MaaS (Mobility as a Service), whether public or private, which are becoming more prevalent.
- Design and implement strategies that genuinely create a competitive and efficient mode of urban transportation through proximity-based policies (close to destination), availability (scheduling and frequency), and speed (commercial high speed).
- The survey could have been conducted with more disaggregation: cities > 1 million inhabitants; cities 250,000 - 1 million inhabitants, etc.
- I believe that in many places, Demand-Responsive Transportation will be necessary. In Sevilla, compared to similar cities, there is a huge deficit in high-performance transportation. I also think that reserved bus lane systems could be crucial in many cities or corridors where rail systems cannot or should not be implemented.
- Reserved lanes, traffic light priority, intermodal integration, real-time information, etc.
- The problem often lies not in quantity but in quality: quality of access, quality of waiting areas, etc.



5.1.2. Performance

Peso	EVALUACIÓN DE PRESTACIONES (Encuestas a expertos) (Max 10)			
1	2.1. ¿Cómo valora las prestaciones que aporta el sector del transporte público urbano en España a los usuarios?	7,7	BIEN	C
1	2.2. ¿Cómo valora el equipamiento y los servicios prestados en el sector del transporte público urbano en España a los usuarios?	7,6	BIEN	C
1	2.3. ¿Cómo valora la gestión de las frecuencias en los servicios de transporte público urbano?	6,8	SUFICIENTE ALTO	D
1	2.4. ¿Cómo valora la información a los usuarios del transporte público?	6,4	SUFICIENTE ALTO	D
4	TOTAL EVALUACIÓN PRESTACIONES POR LOS EXPERTOS:	7,1	BIEN	C

Table 160: Expert Assessment of Performance

Comments, suggestions, and recommendations from the experts

- Coordinated digitization for real and shared information.
- It's increasingly rare in major urban centers for a transport authority not to provide real-time service information.
- The question seems to poorly structure the responses because it refers to public transportation as a whole, whereas it depends on the city, operator, line, etc.
- Equipment is different from service provision; they can't be lumped together. There can be excellent equipment but poor service provision.
- Frequencies and the information provided to users vary greatly depending on each city.
- I think the question about information isn't well-formulated, and certainly, the concept of MaaS isn't implemented at all. It should integrate all modes, including personal mobility. The key is the alliance between personal mobility and high-quality public transportation.
- Cities are doing little to improve public transportation operation, like traffic light prioritization, stricter parking policies, etc.
- For urban transportation analysis, it's necessary to delve into the knowledge of what other cities are doing; the data from the Metropolitan Mobility Observatory should be emphasized and improved.
- Give greater value to technical urban mobility studies without political implications.
- Encourage smaller municipalities to provide their own consultancy and engineering, facilitated by the government, to develop or modernize user information systems.
- The specific performance aspects should be detailed.
- Improve real-time information, develop low-emission zones that restrict the indiscriminate use of cars.



5.1.3. Financing

Peso	EVALUACIÓN DE FINANCIACIÓN (Encuestas a expertos) (Max 10)			
1	3.1. ¿ cómo considera suficiente la inversión actual en el sector del transporte público en España?	5,4	SUFICIENTE	E
1	3.2. ¿Cómo valora la robustez de las actuales fuentes de financiación en el sector del transporte público en España?	4,6	INSUFICIENTE	FX
1	3.3. ¿Cómo considera que se está gestionando la inversión en el sector de transporte público en España?	4,9	INSUFICIENTE	FX
1	3.4. ¿Cómo considera la actual participación de la inversión privada en el sector del transporte público en España?	5,0	SUFICIENTE	E
4	TOTAL EVALUACIÓN FINANCIACIÓN POR LOS EXPERTOS:	4,9	INSUFICIENTE	FX

Table 161: Expert Assessment of Financing

Comments, suggestions, and recommendations from the experts

- I believe that the results of private transport companies, with program contracts that require dedicating part of the profits to investment and improvement, should be known, and this would lead to an improvement process.
- Sometimes regulatory competencies and management and operation responsibilities get confused.
- It's clearly a pending issue since public transportation has traditionally been associated with being solely "owned" by the public management.
- As I mentioned in the previous question, you can't ask a macroscopic question: Is the response the same for Madrid and Barcelona as for Alcázar de San Juan or Ayamonte?
- The funding for public transportation in small municipalities is small compared to larger ones, and they have fewer resources for new investments. Thus, even though they have fewer public transportation passengers, it's difficult to improve the service to encourage a shift from private vehicles to public transportation.
- The subsidies provided by the central government for a 30% reduction in public transportation passes for Autonomous Communities and local entities that increase the discount to 50%, at least through the first half of 2023, and the subsidies received from September to December 2022, have been very positive for the recovery of public transportation usage after the pandemic. And what happens after that?
- There's a lot of money, but it needs to be rationalized and optimized. It's a priority within the framework of European sustainability policies. Also, establish a reasonable private sector participation framework and fair competition based on quality, not just price.
- There's no law regarding public transportation funding. Each year, the State's contribution to public transportation is a lottery, only known by the end of December of the previous year.
- The importance of financing in maintaining existing infrastructures.



- Public Administrations should focus more on regulation with social and environmental aims, creating the appropriate scenario for suitable financing and responsible management and operation by public and/or private companies.
- The future Sustainable Mobility Law was also supposed to include Public Transportation Financing, but it hasn't been the case, so a Public Transportation Financing Law would be necessary.



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. ¿Cómo considera los planes de redes de transporte público que conoce con relación a la adaptación a las demandas futuras de los usuarios?	5,9	SUFICIENTE	E
1	4.2. ¿Cómo valora la adaptación de las redes de transporte público a los nuevos sistemas de gestión del tráfico?	5,6	SUFICIENTE	E
1	4.3. ¿Cómo considera la adaptación de las redes de transporte público a la protección del medioambiente?	6,8	SUFICIENTE ALTO	D
1	4.4. ¿Cómo valora las acciones que se están tomando para reducir el consumo de CO2 en la construcción de las redes de transporte público urbano que conoce?	6,4	SUFICIENTE ALTO	D
1	4.5. ¿Cómo valora las acciones que se están tomando para reducir el consumo de CO2 en la conservación, mantenimiento y operación de las redes de transporte público urbano que conoce?	6,4	SUFICIENTE ALTO	D
1	4.6. ¿Cómo valora las medidas que se adoptan para reducir la descarbonización en el material rodante del transporte público urbano y metropolitano?	6,6	SUFICIENTE ALTO	D
1	4.7. ¿Cómo valora los programas de adaptación del transporte público urbano a las nuevas tecnologías, como la conducción automática?	5,8	SUFICIENTE	E
1	4.8. ¿Considera adecuadas las medidas que se adoptan para reducir el impacto ambiental y el tratamiento de los residuos en el transporte público urbano?	6,2	SUFICIENTE ALTO	D
8	TOTAL EVALUACIÓN ADAPTACIÓN AL FUTURO Y DESARROLLO SOSTENIBLE POR LOS EXPERTOS:	6,2	SUFICIENTE ALTO	D

Table 162: Expert Assessment of Adaptation to the future and Sustainability

Comments, suggestions, and recommendations from the experts

- I believe that more investment is being made in aspects of Atmospheric environmental respect than in the actual provision of collective transportation, and this might be a mistake.
- Services should be sustainable in terms of costs, time, environmental impact, quality, with satisfied customers.
- It's true that currently, mobility planning already integrates many best practices for emissions reduction, waste reduction, as well as investments in rolling stock, with specific programs such as PRTR favoring clean and electric systems. However, there's room for improvement in the current network management.
- In general terms, I can state that the investment per passenger to modernize public transportation (energy, CO₂, information, connectivity, intermodality, etc.) is disproportionate and therefore not justified. Think, for example, of the high cost involved in electrifying a regional railway line (locomotives, pantographs, substations, etc.) in proportion to the low demand for these services.



- There are many aspects to consider; waste seems negative due to the battery issue, which needs to be resolved. The key is for public transportation to be faster than cars and for cities to be walkable.
- There is a lack of medium and long-term mobility planning.
- Prioritize providing sufficient services to citizens: network density, frequency, punctuality, for example, over the details of using theoretically cleaner energy sources that sometimes result in less overall attraction for using collective transportation services.
- Environmental adaptations shouldn't lead to service deterioration.
- Focus on the sustainability and conversion of the existing network, not just the new planned investments.
- It should be a normative requirement for cities and Autonomous Communities to have 20-year Strategic Plans for sustainable transportation and mobility, revisable every four years, with their compliance supported by funding laws.



5.1.5. Operation and maintenance

Peso	EVALUACIÓN DE OPERACIÓN Y MANTENIMIENTO (Encuestas a expertos) (Max 10)			
1	5.1. ¿Cómo valora la inversión en la operación, conservación y mantenimiento de las redes de transporte público urbano en España?	5,6	SUFICIENTE	E
1	5.2. ¿Considera que los medios aplicados a la operación, conservación y mantenimiento de las redes de transporte público son los adecuados para atender las demandas de los usuarios?	5,9	SUFICIENTE	E
1	5.3. ¿Cómo valora el estado de operación, conservación y mantenimiento de las redes de transporte público urbano?	6,3	SUFICIENTE ALTO	D
1	5.4. ¿Cómo valora la atención a la vialidad invernal, a la siniestralidad y a las incidencias que se producen en el servicio en cuanto a la gestión del transporte público?	6,6	SUFICIENTE ALTO	D
4	TOTAL EVALUACIÓN OPERACIÓN Y MANTENIMIENTO POR LOS EXPERTOS:	6,1	SUFICIENTE ALTO	D

Table 163: Expert Assessment of Operation and Maintenance

Comments, suggestions, and recommendations from the experts

- I believe that currently, operation and maintenance are provided under budget constraints, as it's not as visible to citizens as new investments that tend to receive more attention. The consequences of this lack are even more noticeable in smaller municipalities, where it might not exist at all or meet standards from the last century.
- Overall, both public and private companies manage the operation and maintenance of the services well.
- Increased investment in the maintenance and operation of transportation infrastructure.
- Active state policies to provide consultancy and engineering resources to smaller transport authorities for their technical preparedness.
- There's a significant lack of renewal and modernization of bus stops; it would be beneficial to create renewal programs.
- Greater oversight by administrations of these services; there is an absolute lack of resources, and administrations have few technical experts.



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 los servicios de transporte público urbano?	7,7	BIEN	C
1	6.2. ¿Cómo valora el nivel de siniestralidad que se produce en el sector del transporte público urbano?	8,1	MUY BIEN	B
1	6.3. ¿Cómo valora el equipamiento de los servicios de transporte público urbano para prevenir o reducir los efectos de los accidentes?	7,6	BIEN	C
1	6.4. ¿Considera que se están tomando medidas para reducir en el futuro la siniestralidad en el sector del transporte público urbano?	7,3	BIEN	C
4	TOTAL EVALUACIÓN SEGURIDAD POR LOS EXPERTOS:	7,7		C

Table 164: Expert Assessment of Safety

Comments, suggestions, and recommendations from the experts

- Safety is always the most important aspect; problems often arise from the increasing conflicts with cyclists, scooters, etc., which significantly hinder the operation of public transportation.
- Safety is something that is unquestioned in the planning, management, and operation of mobility or transportation. These are matters that various public managers are highly aware of.
- There's a lack of controls on drivers, strong opposition to undergo medical checks (health and drug-related), or the knowledge of penalty points on driving licenses.
- Addressing road risks seriously and reducing the number of conflict points between different vehicles and modes of transportation.
- Buses should have systems to detect alcohol, drug consumption, or fatigue, and these devices should be operational.



5.1.7. Resilience

Peso	EVALUACIÓN DE RESILIENCIA (Encuestas a expertos) (Max 10)			
1	7.1. ¿Cómo valora la capacidad de los servicios de transporte público urbano para recuperar, en un tiempo razonable, el estado de servicio inicial cuando se producen situaciones adversas?	6,8	SUFICIENTE ALTO	D
1	7.2. ¿Cómo valora las medidas adoptadas para prevenir la infraestructura transporte público urbano ante incidentes naturales o provocados?	6,8	SUFICIENTE ALTO	D
1	7.3. ¿Cómo valora la capacidad del sector del transporte público para proteger y minimizar los efectos sobre los usuarios y el entorno ante situaciones de riesgo?	6,5	SUFICIENTE ALTO	D
1	7.4. ¿Cómo valora las alternativas entre los distintos modos de transporte público urbano cuando por causas naturales o provocadas se producen paradas en el servicio?	5,9	SUFICIENTE	E
1	7.5. ¿Cómo valora los planes de contingencia que se aplican en el transporte público urbano para prevenir la infraestructura ante incidentes naturales o provocados?	6,3	SUFICIENTE ALTO	D
5	TOTAL EVALUACIÓN RESILIENCIA POR LOS EXPERTOS:	6,5	SUFICIENTE ALTO	D

Table 165: Expert Assessment of Resilience

Comments, suggestions, and recommendations from the experts

- The pandemic has shown us that in adverse situations, the population shifts towards private transportation, particularly cars. Achieving pre-pandemic usage levels has proven difficult, despite reduced prices and fares.
- The responses are biased towards public transportation service in large cities.
- In general, the development of contingency plans is insufficient. Natural incidents are only controlled in cases of snow.
- Developing contingency plans that are well-known to drivers and other staff members of the company. This requires training and more training. But the training should be paid and stipulated in the agreement.

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 y operación del transporte público urbano es adecuada?	5,8	SUFICIENTE	E
1	8.2. ¿Cómo valora los conocimientos y la actitud técnica de los ingenieros actuales del transporte público urbano?	7,4	BIEN	C
1	8.3. ¿Considera adecuados y ajustados a las nuevas tecnologías los conocimientos impartidos en las universidades a los ingenieros?	5,5	SUFICIENTE	E
1	8.4. ¿Cómo valora la utilización de nuevas técnicas y materiales en la construcción, conservación, mantenimiento y gestión de las redes de transporte público urbano?	6,8	SUFICIENTE ALTO	D
1	8.5. ¿Cómo valora las medidas adoptadas en la licitación pública para favorecer la innovación en el sector del transporte público urbano?	5,6	SUFICIENTE	E
1	8.6. ¿Cómo valora la investigación, desarrollo e innovación que se está desarrollando en España con relación al transporte público urbano?	6,3	SUFICIENTE ALTO	D
1	8.7. ¿Cómo valora la tecnología actual que se está aplicando en el transporte público urbano?	7,1	BIEN	C
1	8.8. ¿Cómo considera el avance en la digitalización, monitorización e información del comportamiento de los elementos del transporte público urbano?	6,6	SUFICIENTE ALTO	D
8	TOTAL EVALUACIÓN INGENIERÍA E INNOVACIÓN POR LOS EXPERTOS:	6,4	SUFICIENTE ALTO	D

Table 166: Expert Assessment of Engineering and Innovation

Comments, suggestions, and recommendations from the experts

- The specialization of transportation within civil engineering is excellent. Moreover, the typical profile of a planner, consultant, or manager is usually an innovative individual well-versed in the technical aspects.
- Schools are significantly below average in terms of qualification in this regard. For instance, regarding cycling infrastructure, graduates often lack knowledge. While one leaves school with extensive knowledge in designing roads or railways, nothing is known about designing shared platforms for vehicles and bicycles/VMs or bike lanes. There are even cases where people believe a bike lane is always the only solution, and then you see technicians from small municipalities simply painting bike lanes on any sidewalk or road without evaluating safety or best practices that promote bicycle use as a mobility solution in society, which still generates fear in Spain.
- Training for technicians in small municipalities is sometimes insufficient and less specific in terms of sustainable mobility than in larger ones, which have numerous well-trained staff.



- There's a lack of specialized Master's programs in public transportation. Administrations often fail to adequately value obtaining such qualifications.
- Develop specific training programs on key aspects for the sector. Simultaneously, improve salaries to retain technicians within the field and prevent them from moving to other sectors.
- Nevertheless, this strong innovation profile sometimes leads to poorly thought-out public transportation infrastructure.



5.2. Supplementary Questionnaire

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

CP.1 **What infrastructure needs do you consider necessary for the Urban Public Transportation sector in Spain in the next 10 years?**

CP.2 **Approximately how much investment do you estimate is needed to fulfill the infrastructure needs in the Urban Public Transportation sector in Spain in the next 10 years?**

CP.1 What infrastructure needs do you consider necessary for the Urban Public Transportation sector in Spain in the next 10 years?

- It's necessary to care for and improve the freight and parcel transportation system within cities.
- Enhancements in intermodality; integrating new modes of transportation (such as carsharing, carpooling) with public transportation networks.
- An intermodality study across various modes, aiming for efficiency without compromising service quality and environmental sustainability.
- For Low Emission Zones (LEZs) to be a reality compatible with the economic and social development of cities, infrastructure must be better coordinated to promote sustainable mobility and urban planning.
- A comprehensive approach to make public transportation competitive, shifting away from the perception as the "transportation of the less affluent," with increased offerings, broad investment, and a global marketing campaign showcasing the benefits of public transportation.
- There are diverse needs to address.
- Intermodal stations and dedicated lanes.
- Integrated bus and train stations; bus stops with sheltered structures.
- Advancing the integration of modes and Mobility as a Service (MaaS).
- Digitalization and automation.
- Traffic light priority, autonomous driving, and dynamic stops/offers tailored to demand.
- Renovation and decarbonization of urban and intercity bus fleets (urban buses are currently more advanced). Priority buses (BRT-type). Alternative fuels: electric, green hydrogen, hydrogen refueling stations; segregated priority lanes for public transportation within cities and along main roads. Modal interchange stations, mobility as a service, complete mode integration in fare systems, universal accessibility at all stations (subway, etc.). On-demand transportation in low-density or more dispersed areas, even in industrial and economic zones. Autonomous collective transportation?



- Speaking about urban and metropolitan public transportation, it varies significantly based on each city or metropolitan area. I believe such broad questions don't have a universally applicable answer.
- More cycling infrastructure, additional transport interchange stations.
- Bus dedicated lanes, MaaS integrating all modes.
- Digital infrastructure enabling integrated payment systems.
- Infrastructure: Dedicated bus or tram lanes and additional metro and suburban rail networks; Technology: Real-time information; Developing transportation Big Data; Network digitalization and operation; Training.
- Terminals (stations, stops, etc.) and access points (pedestrian, bicycle, etc.).
(Fast) charging points for electric-powered mobile assets.

CP.2.- Approximately how much investment do you estimate is needed to fulfill the infrastructure needs in the Urban Public Transportation sector in Spain in the next 10 years?

- I'm not entirely sure, but considerably more than the current amount.
- In my opinion, investments in public transportation in Spain are slightly lagging behind urban developments and population growth. However, overall, investments are reasonably aligned with urban growth, and I believe the level of service is generally good, especially in larger population centers. The challenge lies in providing service to smaller populations.
- Assuming the compatibility of expenditure with other essential services and based on public funds, I think allocating €90-110 per capita per year could potentially fund all necessary investments, including maintenance and operation of an adequate urban public transportation system. It's a wide range, but it's important to consider factors like population dispersion, urban typology, and topography, as they significantly influence infrastructure sizing and service provision.
- €10 billion.
- €5 billion annually.
- 10% of the annual operating cost.
- Ten billion euros.
- €30 billion, in addition to operational subsidies, another €30 billion above the current budget.



5.3. Global Evaluation of Urban and Metropolitan Public Transportation by Experts

Integrating the evaluation provided by experts across different criteria, the overall result of the evaluation for urban and metropolitan public transportation is as follows:

Evaluación del sector Transporte Público Urbano y Metropolitano por los expertos (Max: 10)				27
Pesos del criterio	CRITERIOS	CALIFICACIÓN AICCP		
1	CAPACIDAD	6,6	SUFICIENTE ALTO	D
1	PRESTACIONES	7,1	BIEN	C
1	FINANCIACIÓN	4,9	INSUFICIENTE	FX
1	ADAPTACIÓN AL FUTURO Y DESARROLLO SOSTENIBLE	6,2	SUFICIENTE ALTO	D
1	OPERACIÓN Y MANTENIMIENTO	6,1	SUFICIENTE ALTO	D
1	SEGURIDAD	7,7	BIEN	C
1	RESILIENCIA	6,5	SUFICIENTE ALTO	D
1	INGENIERÍA E INNOVACIÓN	6,4	SUFICIENTE ALTO	D
Sector Transporte público urbano y metropolitano. Evaluación ponderada por los expertos		6,4	SUFICIENTE ALTO	D
Respuestas recibidas:		27		

Table 167: Overall Evaluation of Urban and Metropolitan Public Transportation by Experts



6. Global Assessment based on Objective Indicators and Expert Evaluation

Evaluación del sector Transporte Público Urbano y Metropolitano por los expertos (Max: 10)				27	
Pesos del criterio	CRITERIOS	CALIFICACIÓN AICCP			
1	CAPACIDAD	6,6	SUFICIENTE ALTO	D	
1	PRESTACIONES	7,1	BIEN	C	
1	FINANCIACIÓN	4,9	INSUFICIENTE	FX	
1	ADAPTACIÓN AL FUTURO Y DESARROLLO SOSTENIBLE	6,2	SUFICIENTE ALTO	D	
1	OPERACIÓN Y MANTENIMIENTO	6,1	SUFICIENTE ALTO	D	
1	SEGURIDAD	7,7	BIEN	C	
1	RESILIENCIA	6,5	SUFICIENTE ALTO	D	
1	INGENIERÍA E INNOVACIÓN	6,4	SUFICIENTE ALTO	D	
Sector Transporte público urbano y metropolitano. Evaluación ponderada por los expertos		6,4	SUFICIENTE ALTO	D	
Respuestas recibidas:		27			

Table 168: Overall Rating by Experts

Evaluación del sector Transporte Público Urbano y Metropolitano por indicadores objetivos (Max: 10)				
Pesos del criterio	CRITERIOS	CALIFICACIÓN AICCP		
1	CAPACIDAD	7,9	BIEN	C
1	PRESTACIONES	10,0	EXCELENTE	A
1	FINANCIACIÓN	5,0	SUFICIENTE	E
1	ADAPTACIÓN AL FUTURO Y DESARROLLO SOSTENIBLE	5,8	SUFICIENTE	E
1	OPERACIÓN Y MANTENIMIENTO	5,9	SUFICIENTE	E
1	SEGURIDAD	8,4	MUY BIEN	B
1	RESILIENCIA	7,3	BIEN	C
1	INGENIERÍA E INNOVACIÓN	6,2	SUFICIENTE ALTO	D
Transporte público urbano y metropolitano. Evaluación ponderada por indicadores objetivos		7,1	BIEN	C

Table 169: Overall Rating based on Objective Indicators



Evaluación final del sector Transporte Público Urbano y Metropolitano (Max: 10)				
Pesos del criterio	CRITERIOS	CALIFICACIÓN FINAL AICCP (50% evaluación por indicadores; 50% evaluación por expertos)		
1	CAPACIDAD	7,3	BIEN	C
1	PRESTACIONES	8,6	MUY BIEN	B
1	FINANCIACIÓN	5,0	SUFICIENTE	E
1	ADAPTACIÓN AL FUTURO Y DESARROLLO SOSTENIBLE	6,0	SUFICIENTE ALTO	D
1	OPERACIÓN Y MANTENIMIENTO	6,0	SUFICIENTE ALTO	D
1	SEGURIDAD	8,1	MUY BIEN	B
1	RESILIENCIA	6,9	SUFICIENTE ALTO	D
1	INGENIERÍA E INNOVACIÓN	6,3	SUFICIENTE ALTO	D
Sector Transporte público urbano y metropolitano. Evaluación ponderada final		6,8	SUFICIENTE ALTO	D

Table 170: Final Rating based on Objective Indicators and Expert Assessment

Evaluación del sector Transporte Público Urbano y Metropolitano por los expertos (Max: 10)	
CRITERIOS	Diferencias (Indicadores- expertos)
CAPACIDAD	1,3
PRESTACIONES	2,9
FINANCIACIÓN	0,0
ADAPTACIÓN AL FUTURO Y DESARROLLO SOSTENIBLE	-0,4
OPERACIÓN Y MANTENIMIENTO	-0,2
SEGURIDAD	0,7
RESILIENCIA	0,9
INGENIERÍA E INNOVACIÓN	-0,2
Sector Transporte público urbano y metropolitano. Diferencias (indicadores-expertos)	0,6

Table 171: Differences Between Objective Evaluation and Expert Assessment



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- 1. "Report Card for America's Infrastructure." American Society of Civil Engineers (ASCE)**
- 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)
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)
UITP	Unión Internacional del Transporte Público



ANNEXE 4

Bibliography and references

- AEAS. Asociación Española de Abastecimientos de Agua y Saneamiento, <https://www.aeas.es>
- American Society Of Civil Engineers (ASCE). *Report Card for America's Infrastructure*. <https://www.infrastructurereportcard.org/>
- Comisión Europea. *Transport in the European Union. Current Trends and Issues. March 2019*. https://transport.ec.europa.eu/news-events/news/transport-european-union-current-trends-and-issues-2019-03-13_en
- Comisión Europea. *Putting European transport on track for the future*. <https://transport.ec.europa.eu/system/files/2021-04/2021-mobility-strategy-and-action-plan.pdf>
- Comisiones Obreras. <https://observatoriomovilidad.es/>.
- Eurostat- Report "Energy, transport and environment statistics" 2020 Edition <https://ec.europa.eu/eurostat/documents/3217494/11478276/KS-DK-20-001-EN-N.pdf/06ddaf8d-1745-76b5-838e-013524781340>
- Eurostat- Report "Energy balance sheets 2015 DATA" - 2019 edition, <http://ec.europa.eu/eurostat/>
- International Energy Agency - Report "Energy efficiency indicators, Highlights" 2019. <https://www.iea.org/data-and-statistics>
- European Commission "Statistical pocketbook". Years 2010-2022. <https://ec.europa.eu/transport/>
- International Transport Forum (ITF). <https://www.itf-oecd.org/ecmt-road-transport-platform>
- Observatorio de la Movilidad Metropolitana. Informe OMM 2019-Avance 2020. Julio 2021. <https://observatoriomovilidad.es/>
- OECD-International Transport Forum-Report "Transport Infrastructure Investment - Options for Efficiency" (Ed 2022)



- OECD-International Transport Forum-Report "Key Transport Statistics 2019 Data"
https://www.itf-oecd.org/sites/default/files/docs/key-transport-statistics-2019_0.pdf
- OECD. Main Science and Technology Indicators, Volume 2021, https://www.oecd-ilibrary.org/science-and-technology/main-science-and-technology-indicators/volume-2021/issue-2_a4cf3cb8-en
- Ministerio del interior de España. Anuario estadístico de accidentes 2019. DGT
<https://www.dgt.es/export/sites/web-DGT/.galleries/downloads/dgt-en-cifras/publicaciones/Anuario-Estadistico-de-Accidentes/Anuario-estadistico-de-accidentes-2019.pdf>
- Ministerio para la transición Ecológica y el reto Demográfico – “Guía para la elaboración de estudios del medio físico. Contenido y metodología”. Year 2004
- Ministerio de Transportes, Movilidad y Agenda Urbana de España- Los transportes y las infraestructuras - informe anual 2019 y 2020.
<https://observatoriotransporte.mitma.es/>
- Ministerio de Transportes, Movilidad y Agenda Urbana de España - Anuario Estadístico 2019 y 2020. <https://www.mitma.gob.es/informacion-para-el-ciudadano/informacion-estadistica/anuario-estadisticas-de-sintesis-y-boletin/anuario-estadistico>
- Ministerio de Transportes, Movilidad y Agenda Urbana - Evolución de los Indicadores económicos y sociales del transporte terrestre. Nov 2016.
- Ministerio de Transportes, Movilidad y Agenda Urbana de España. Observatorio del transporte y la logística 2019. <https://observatoriotransporte.mitma.es/>
- NUMBEO, Traffic in Spain.
https://www.numbeo.com/traffic/country_result.jsp?country=Spain
- TomTom. <https://www.tomtom.com/traffic-index/ranking/>
- Union International des Transports Publics (UITP).
<https://www.uitp.org/projects/umii-urban-mobility-innovation-index/>
- United Nations, UN Water, Annual report 2020.
[Annual-Report-2020.pdf \(unwater.org\)](https://www.unwater.org/Annual-Report-2020.pdf)



- World Bank. Logistic Performance Index (LPI). <http://www.worldbank.org/>
- World Bank “Connecting to Compete. Trade Logistics in the Global Economy” Years 2010-2018”.
<http://documents.worldbank.org/curated/en/576061531492034646/Connecting-to-compete-2018-trade-logistics-in-the-global-economy-the-logistics-performance-index-and-its-indicators>
- World Economic Forum “The Global Competitiveness Report”. Years 2010-2022”.
- World Economic Forum. *Global Competitiveness Index (GCI)*
<https://www.weforum.org/>

ANNEXE 5

Urban Public Transportation Indicators from Key International Organizations

For the Urban Public Transportation 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
- World Bank. <https://worldroadstatistics.org/>
- World Economic Forum <https://www.weforum.org/>
- Comisión Europea https://ec.europa.eu/commission/index_es
- International Energy Agency <https://www.iea.org/>
- American Society of Civil Engineers. <https://www.fhwa.dot.gov/>
- Global Indicators for the Sustainable Development Goals and Targets of the 2030 Agenda for Sustainable Development (*Sustainable Development Goals* -SDG-.UN). [UNSDG](#).
- World Bank – Urban Transport Data Analysis Tool
- The International Association of Public Transportation (UITP)

These international organizations, which have been used as references, also possess a complementary database enabling the development of new quantitative indices. These fundamental data, thoughtfully selected, along with information sourced from databases in different countries, have constituted the primary source of information for configuring indicators for urban public transportation.

Hereafter, detailed information is included regarding the assessments, indices, and indicators from the major organizations that evaluate Urban Public Transportation (the information is partially in English):

- "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
- "World Bank – Urban Transport Data Analysis Tool"
- "International Association of Public Transport (UITP)"

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"¹¹ from 2021, analyzes eight criteria: capacity, physical condition, financing, future needs, operation and maintenance, public safety, resilience, and innovation.



Figure 2: 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 ASCE¹² 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 172: 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

¹¹ [National_IRC_2021-report-2.pdf \(infrastructurereportcard.org\)](https://infrastructurereportcard.org/wp-content/uploads/2020/12/National_IRC_2021-report-2.pdf)

¹² 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.

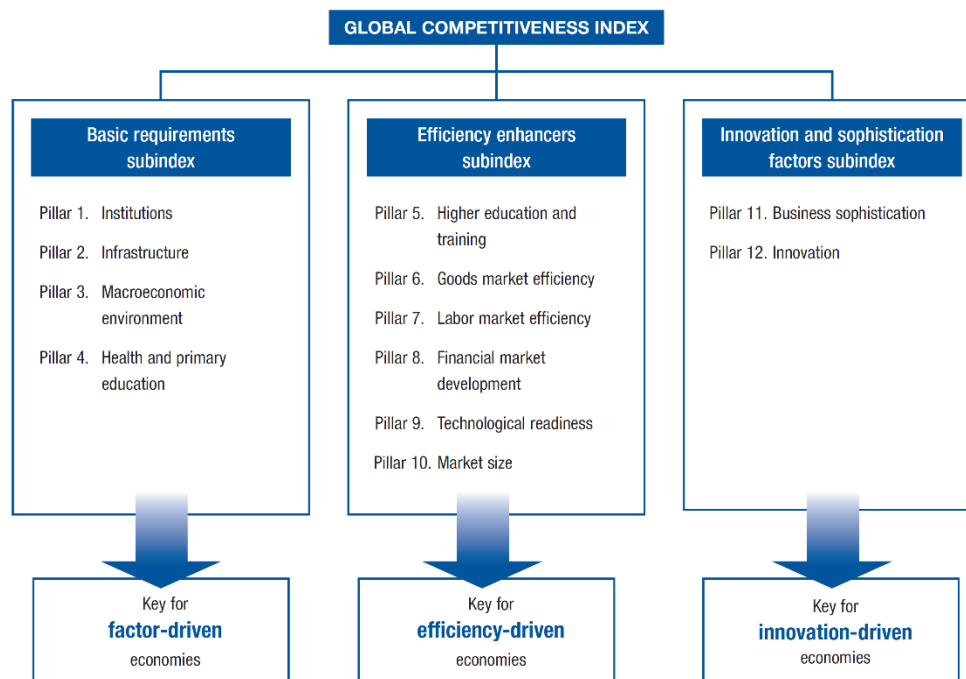
2.- “The Global Competitiveness Report”. World Economic Forum

The World Economic Forum (WEF) produces a series of annual economic reports. Among them, the "Global Competitiveness Report (2019)"¹³ 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 3: 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.

¹³ [WEF_TheGlobalCompetitivenessReport2019.pdf \(weforum.org\)](https://www.weforum.org/reports/the-global-competitiveness-report-2019)



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:

Pillar 2: Infrastructure	8.3%
A. Transport infrastructure	50%²
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 ³	
2.08 Efficiency of seaport services	
B. Utility infrastructure	50%
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 4: Weighting of the Infrastructure Indicator in the 2019 GCI (Global Competitiveness Index) by the WEF (World Economic Forum)

The UPT (Urban Public Transportation) represents 50% of the total rating for public service infrastructure, with the remaining 50% attributed to electricity.

Spain's assessment in the infrastructure pillar is 90.3 out of 100, positioning it as seventh among the 141 countries globally:



2nd pillar: Infrastructure 0–100	-	90.3 ↑	7
Transport infrastructure 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 ²	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
Utility infrastructure 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 5: Infrastructure indicators from the Global Competitiveness Index (GCI) of the World Economic Forum (WEF). (2019)

Spain's overall rating in the GCI indicator is 75%, placing it 23rd out of 141 countries:

Spain

23rd /141

Global Competitiveness Index 4.0 2019 edition

Rank in 2018 edition: 26th/140

Performance Overview 2019

Key ◊ Previous edition ▲ High-income group average □ Europe and North America average

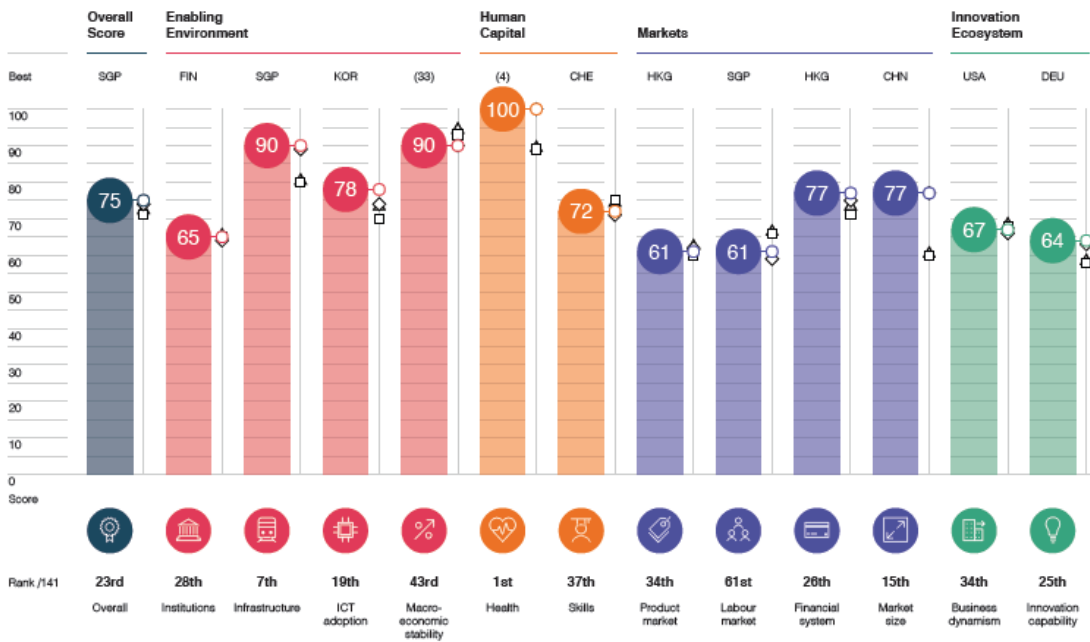


Figure 6: Spain's overall assessment in the GCI indicator of the World Economic Forum (2019)

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

The Global Adaptation Index (ND-GAIN)¹⁴ by the University of Notre Dame is an open-source index that assesses a country's **vulnerability**¹⁵ to climate change and its **readiness**¹⁶ 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.

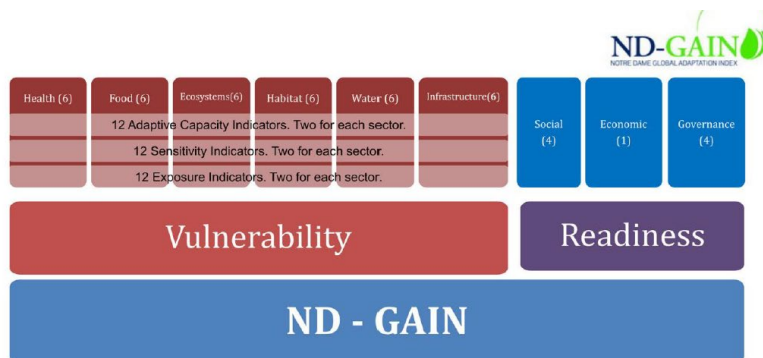


Figure 7: Summary of the vulnerability and readiness indicators from ND-GAIN

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.

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

¹⁴ [Rankings // Notre Dame Global Adaptation Initiative // University of Notre Dame \(nd.edu\)](#)

¹⁵ ND-GAIN defines the concept of Vulnerability as: The propensity or predisposition of human societies to be negatively affected by climate threats.

¹⁶ 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.



Figure 8: 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 countries by ND-GAIN Country Index, Vulnerability and Readiness.

Scores for 2020

ND-GAIN INDEX VULNERABILITY READINESS

Rank	Country	Income group	Score
1	Norway	Upper	75.4
2	Finland	Upper	72.0
3	Switzerland	Upper	71.9
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
8	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 9: Ranking global del índice ND Gain de 2020

En el índice global ND Gain, España ocupa la posición 28, con una puntuación de 61,8 (el mejor país, Noruega, tiene una puntuación de 75,4).

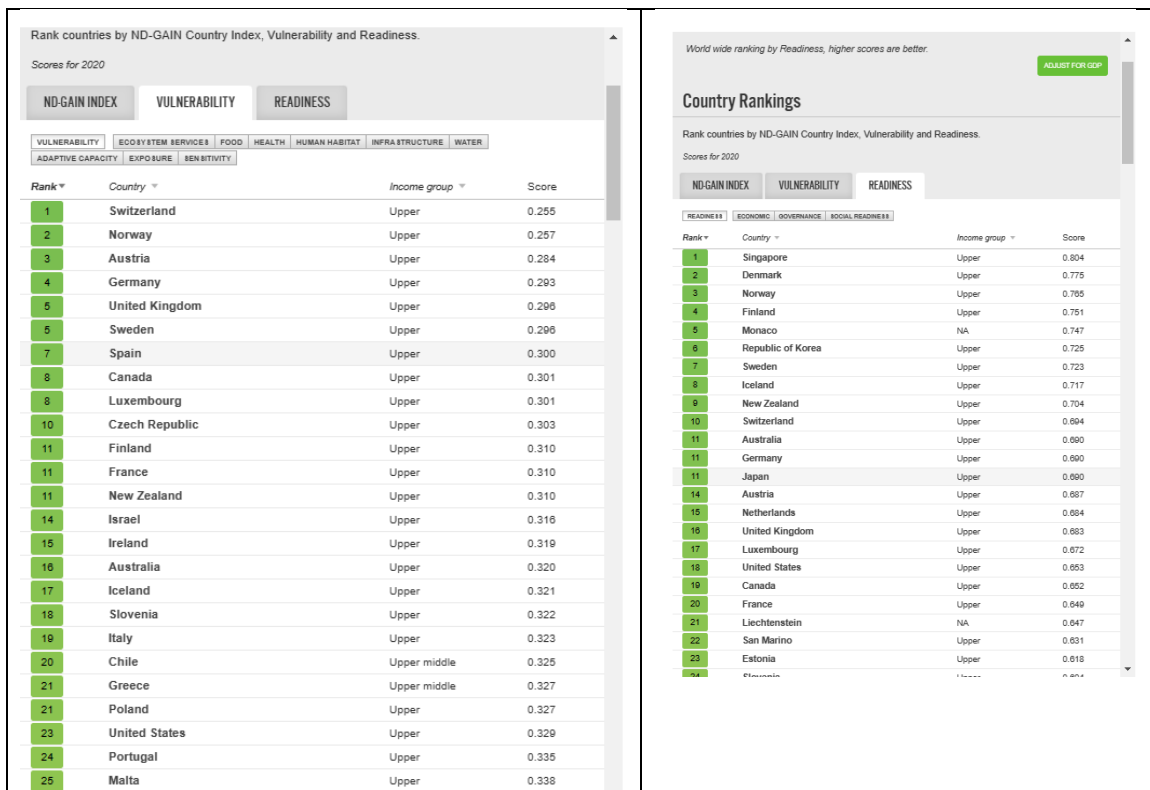


Figure 10: Ranking of Vulnerability and Preparedness in the 2020 ND Gain Index

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 Spain¹⁷ breaks down the results of all the indicators:

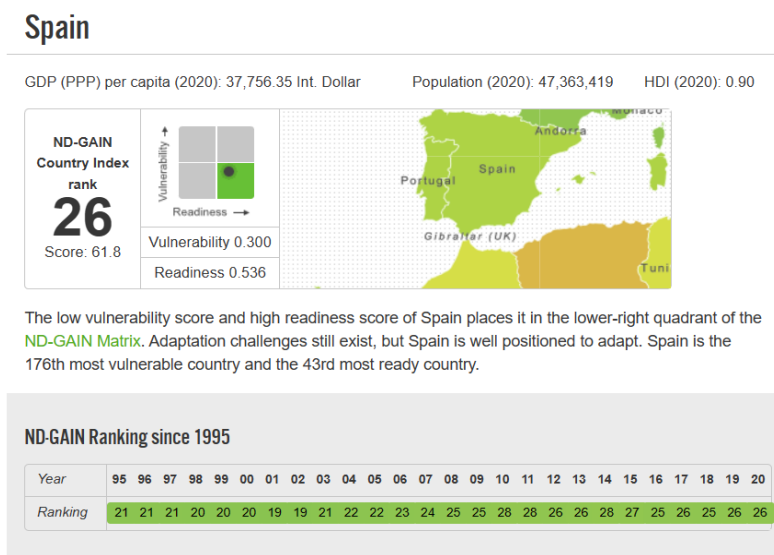


Figure 11: Position of Spain in the scatterplot and annual assessment of ND Gain

¹⁷ [Matrix // Notre Dame Global Adaptation Initiative // University of Notre Dame \(nd.edu\)](https://matrix.nd.edu/)



The relevant indicators for Spain are as follows:

VULNERABILITY		READINESS
SECTOR	COMPONENT	
		● Denotes worst scores
Indicator	2001 to 2020	Score
Vulnerability		0.300
Food		0.313
Projected change of cereal yields		0.801 ●
Projected population change		0.086
Food import dependency		0.185
Rural population		0.207
Agriculture capacity		0.601
Child malnutrition		0
Water		0.266
Projected change of annual runoff		0.453
Projected change of annual groundwater recharge		0.186
Fresh water withdrawal rate		0.237
Water dependency ratio		0.003
Dam capacity		0.715
Access to reliable drinking water		0.004

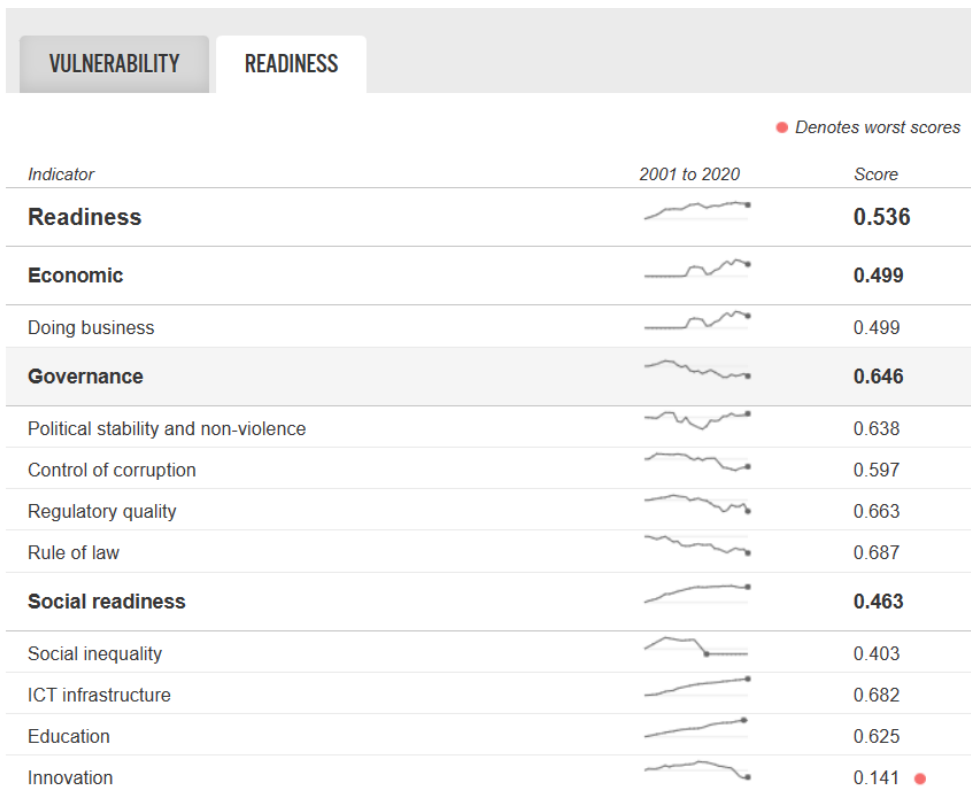
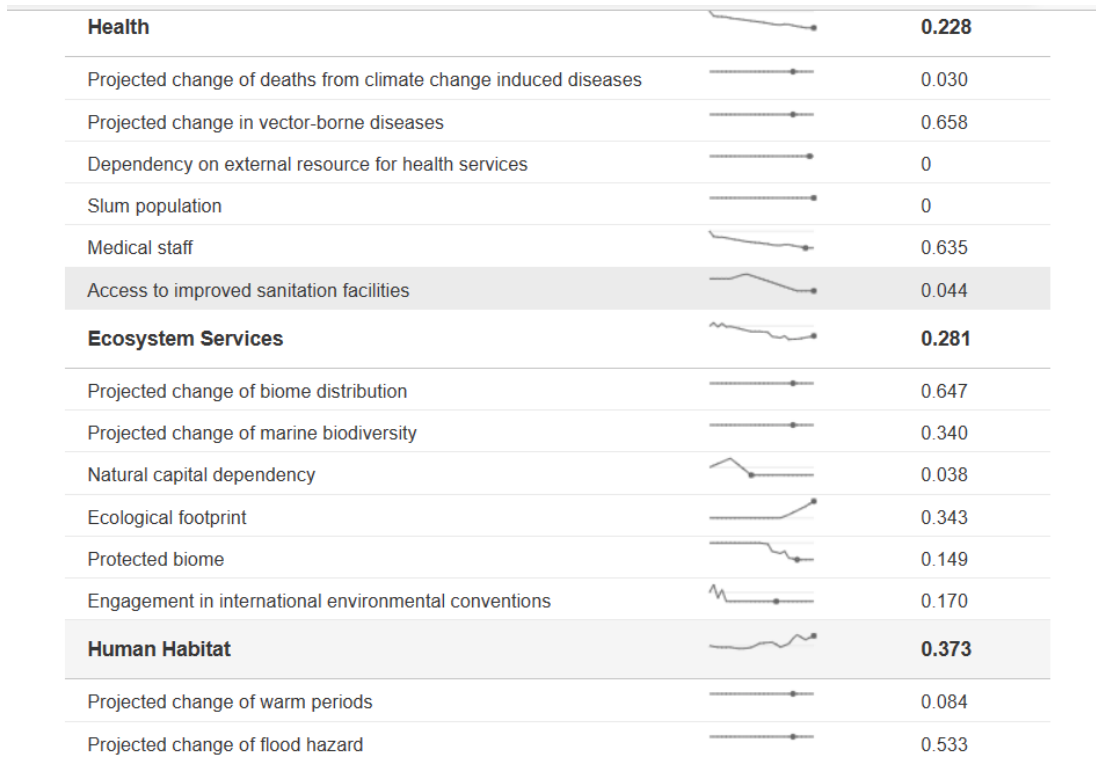


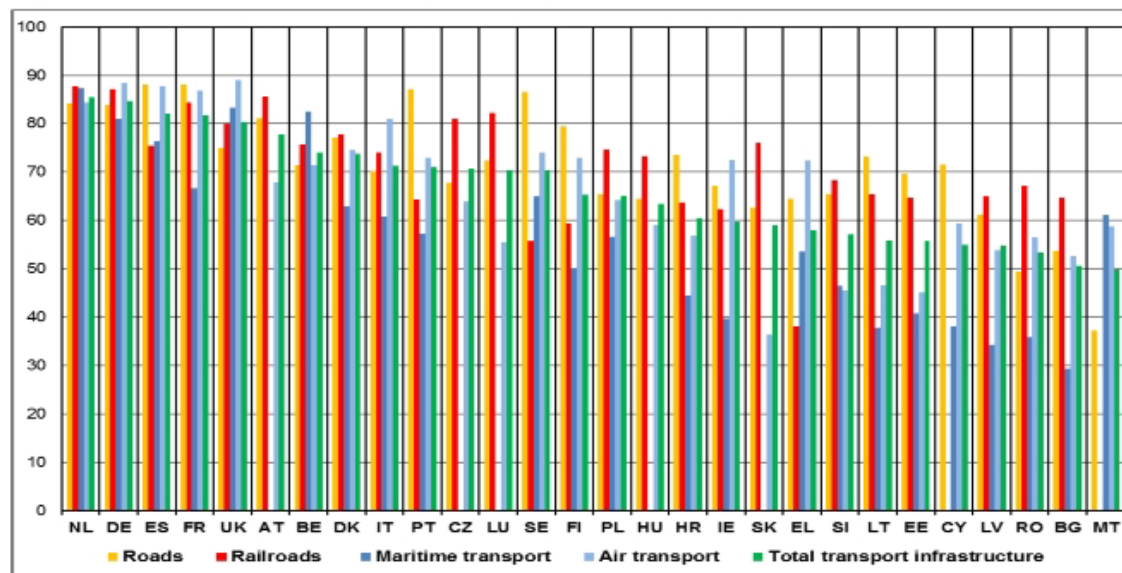
Figure 12: Indicators for Spain. ND Gain

4.- “Transport in the European Union. Current Trends and Issues”. European Commission¹⁸

In this report, published by the European Commission in March 2019 and led by the Directorate-General for Mobility and Transport, issues of mobility within 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 ranking it provides for EU countries regarding citizen satisfaction with the quality of major infrastructures, including roads, the complete water cycle, maritime transportation, and air transportation. The report also includes an overall assessment of the entirety of the infrastructures of 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 13: Satisfaction with the quality of 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.

¹⁸ <https://ec.europa.eu/transport/sites/transport/files/2018-transport-in-the-eu-current-trends-and-issues.pdf>



5.- World Bank – Urban Transport Data Analysis Tool

The World Bank provides public information on its latest studies, reports, and projects covering various priority development topics, including transportation and urban development. As stated in its reports and data, concerning urban development, currently, 55% of the global population resides in urban areas, and it is projected that by 2045, the urban population will increase by 50% from its current value, reaching 6 billion inhabitants in urban areas. As a result, cities must plan their growth and provide essential services for their populations, including urban transportation infrastructure, which enhances residents' productivity and helps reduce emissions.

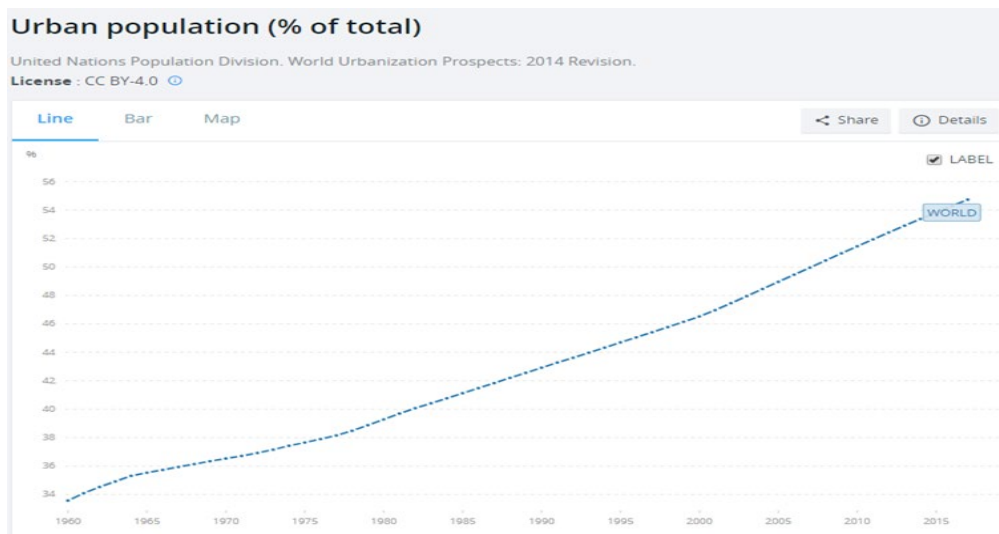


Figure 14: Evolution of the Percentage of the Global Population in Urban Areas (Source: World Bank)

Regarding transportation, projects are being developed to provide safe, clean, efficient, and inclusive mobility. These initiatives contribute to greater growth, access to essential services, and the fight against climate change. Numerous publications address these topics, with particular relevance to the subsector of urban transportation for this report. Within this subsector, there are various initiatives, reports, and training programs aimed at promoting the necessity and significance of sustainable development, given the trends in urban growth.

Many urban growth-related issues arise when transportation demand increases at a pace higher than the existing infrastructure is designed for. This leads to a higher reliance on private vehicles, which in turn results in increased use of fossil fuels, emissions, and pollution. Consequently, the World Bank is dedicated to developing projects that enhance urban mobility efficiently, by increasing transportation capacity and reducing energy consumption to address the growing demand.

The World Bank has a dedicated transportation portal on its website¹⁹ that provides resources and information related to these efforts.

¹⁹ www.worldbank.org/en/topic/transport

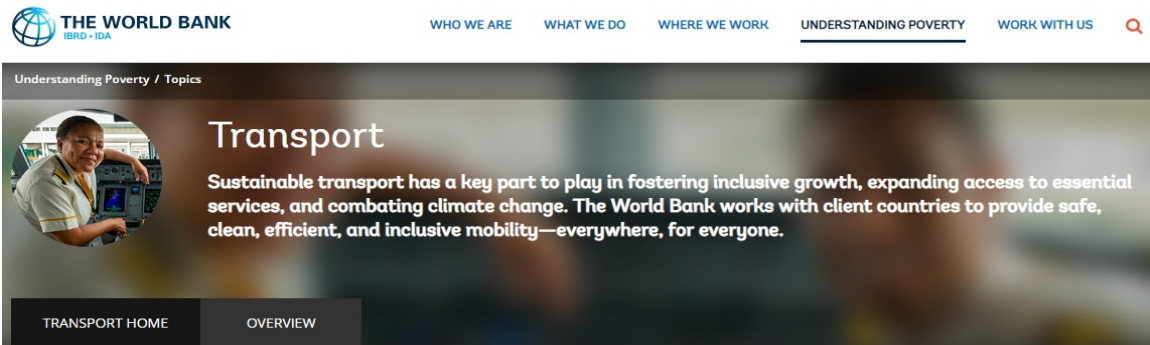


Figure 15: Transportation Portal of the World Bank (Source: World Bank)

Within this same portal, one of its subcategories is urban public transportation²⁰, the subject of this study. In this subcategory, you can find a range of reports, publications, and tools related to the urban public transportation sector.

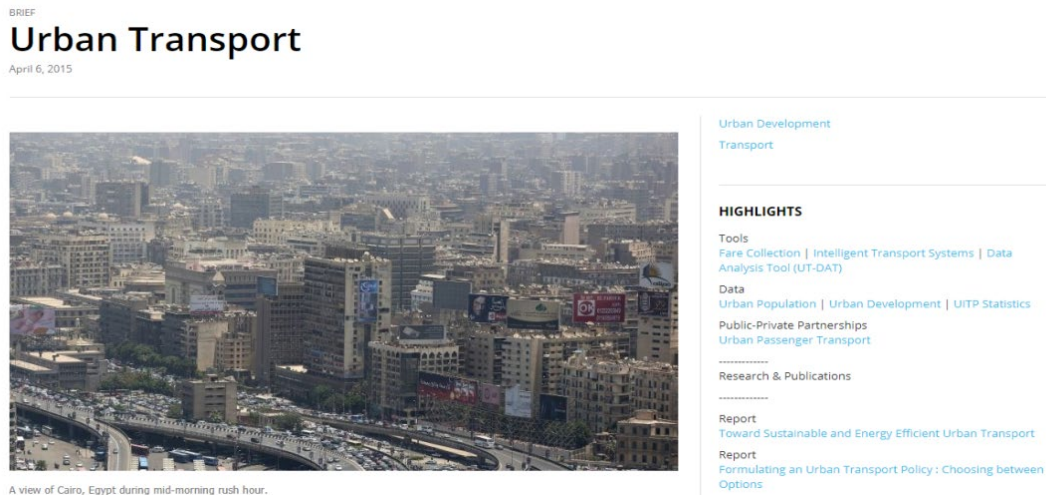


Figure 16: Urban Transportation Portal of the World Bank (Source: World Bank)

Particularly, for the preparation of this report, data from the Urban Transport Data Analysis Tool²¹ (UT-DAT) has been utilized. This tool was developed by the World Bank to facilitate proactive analysis of urban transportation issues in a city and to formulate solutions based on the results. Urban and transportation planners can use this tool as a valuable resource to enhance mobility in their cities. The tool incorporates a set of transportation-related indicators for a total of 93 cities from various parts of the world. These cities can be filtered based on parameters such as population, metropolitan area size, or population density to facilitate comparisons between cities with similar characteristics.

Users can select these parameters to determine whether their city's transportation indicators fall below or above those of other similar cities. The tool is designed within Microsoft Excel, enabling users to generate graphical representations of the acquired data. Furthermore, it emphasizes the

²⁰ www.worldbank.org/en/topic/transport/brief/urbantransport

²¹ www.worldbank.org/en/topic/transport/publication/urban-transport-data-analysis-tool-ut-dat1

importance of utilizing composite indicators that consist of various distinct data points to compare each city's performance. For instance, comparing the raw number of public transportation users may not yield relevant insights due to population differences between cities. Therefore, a more suitable indicator could involve determining the percentage of the population utilizing public transportation for meaningful inter-city comparisons.



The running of the data analysis tool is represented by the flowchart on the right.

The steps are described below and detailed instructions follow:

1. The user starts the system
 - i) Database opens (matrix)
 - ii) The program runs in the background (macros)
2. When generating the report:
 - i) A form prompts the user to enter the test city
 - ii) The user selects the main city to be tested
3. The user then has the option of selecting the cities for comparison:
 - i) Manually, by selecting each city
 - ii) By range (or indicators)
 - e.g., "All cities with population <500K"
4. The user selects the indicator(s) to use as benchmark:
 - i) Only one indicator
 - ii) A combination of indicators
5. The user selects the output option (graph style) that is most convenient (bar/column/line)
6. By clicking on **Proceed**, the user generates the report.
7. The report is printed and comparison finalized.

Figure 17: Flowchart of the UT-DAT (Urban Transport Data Analysis Tool) from the World Bank (Source: World Bank)

Additionally, as highlighted previously, collecting data on urban transportation poses significant challenges, as it must be gathered from secondary sources. Therefore, comparing such data across different countries and regions is complex, as part of the information is obtained from annual reports of transportation agencies, while the rest comes from different sources. Moreover, even within the same city, there can be various data sources that do not share the same definition for the same data point. Generally, data is not provided with the same frequency, so it may not be available for the same years, and some data points may lack consistent determination methods across all cities, varying from one city to another. Due to these reasons, both the methodology used by the tool and the one employed in this report utilize an approach that classifies cities based on their relative performance compared to other cities, instead of using absolute performance values. Therefore, the numerical results obtained represent indices of relative performance compared to other cities rather than a measure of absolute performance on a defined scale. This

way, a reasonable analysis of the state of public transportation in different cities can be achieved while considering the uncertainty of the data.

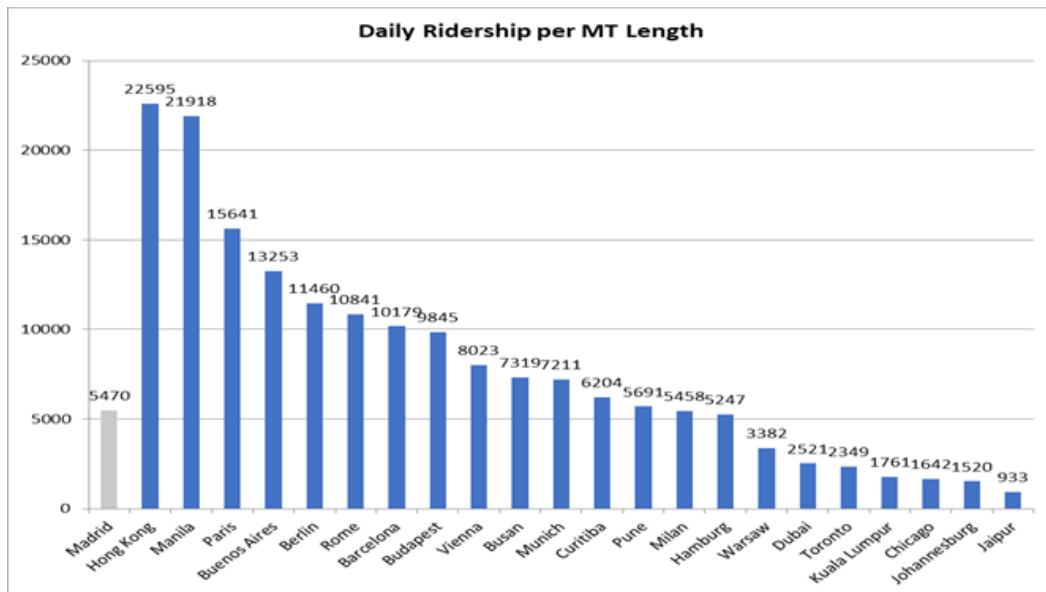


Figure 18: Example of a graph obtained for a Indicator from the UT-DAT (Source: World Bank)

Subsequently, in the methodology used for the preparation of this report, detailed considerations and variations will be outlined. One of these considerations is the use of more up-to-date data whenever available, in comparison to the data provided by the tool. This may also involve the utilization of different indicators or combinations of some indicators.

Therefore, when the World Bank is mentioned as a data source in this document for the compilation of certain indicators, it should be understood that this refers to a compilation of secondary sources, typically obtained from the administrations of each city. These sources are referenced within the tool for each data point.

In certain cases, some indicators directly from the database have been utilized, such as the ticket price relative to the population's GDP, adjusted to our evaluation scale. However, in the majority of cases, the defined indicators consist of a combination of data provided by the tool, updated and supplemented with data from additional secondary sources. These additional sources will be referenced both in figure captions and explanatory text sections.

6.- The International Association of Public Transport (UITP)

The International Association of Public Transport (UITP) is an organization for public transport authorities, operators, transport planners, scientific institutes, and the supply and service industries of public transport. It was founded in Belgium in 1885 by King Leopold II to support the Belgian tram and steel industries. Currently, it has an international network of about 1,600 member companies located in 96 countries, covering all modes of public transport. UITP contributes to the development of public transport and sustainable mobility by collecting and analyzing data to provide qualitative and quantitative information on key aspects of public transport and urban mobility. It produces studies, reports, articles, organizes conferences, and publishes a magazine called Public Transport International.

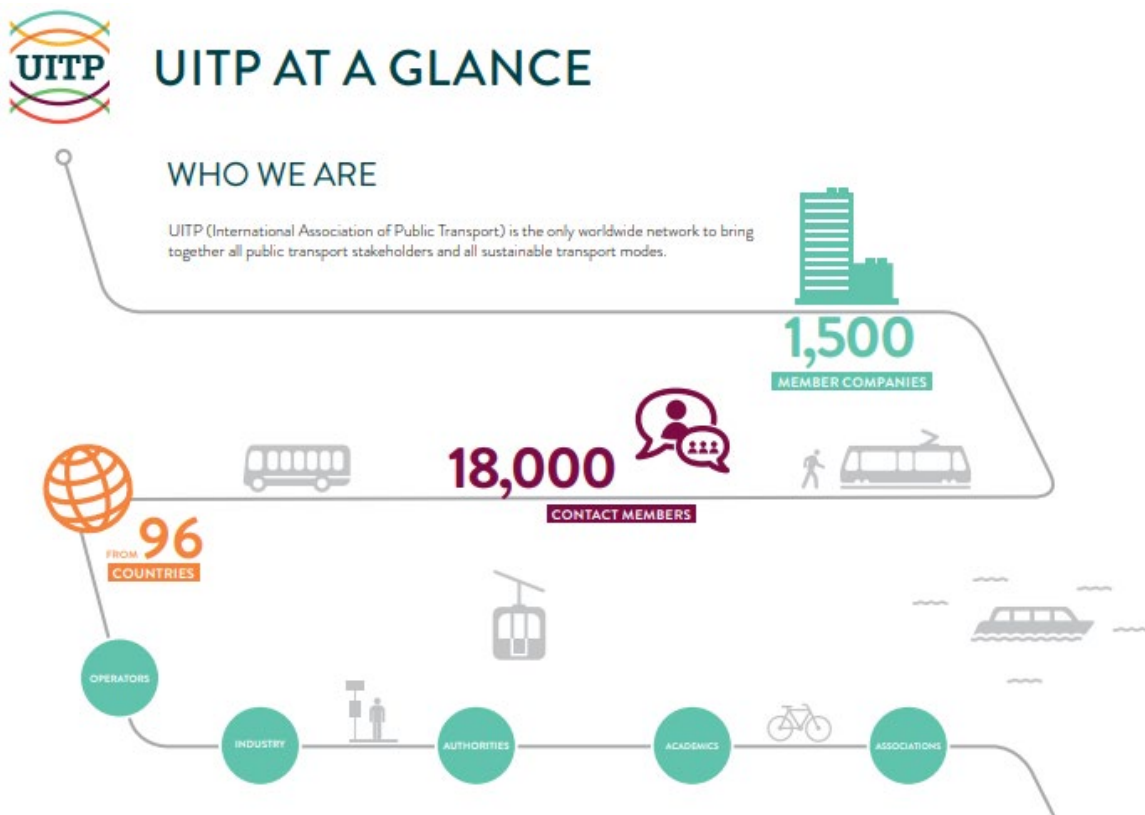


Figure 19: Infographic of UITP's Work

However, most of their publications and data are accessible only to the members of the organization or require purchase, so it is not an open and accessible data source due to restrictions. Nevertheless, they often release summaries with key aspects and some conclusions of each report that are accessible to the general public. Among all their publications, the most useful one is the Mobility in Cities Database, published in 2015 to provide information on fundamental patterns and trends in public transportation in over 60 global metropolitan areas, using a series of indicators covering various topics such as demographics, economy, traffic, transportation infrastructure, etc. This edition uses data collected in 2012 and compares it with data from 1995 and 2001 to study its evolution over time. Although these data won't be used for



this report due to their restricted access, it's interesting to observe the indicators they have considered, as well as some of the graphs provided in the summary document to analyze their conclusions and study the observed trends. Below is the full list of indicators from their database and some of the graphs from the summary document of the report.

Definition of the metropolitan area	Motorcycles per thousand inhabitants	Total public transport journeys per inhabitant
Population	Taxis per thousand inhabitants	Total public transport passenger kilometres per inhabitant
Average household size	Collective taxis per thousand inhabitants	Average public transport place occupancy rate (passenger kilometres / place kilometres)
Urban population density	Passenger cars per thousand households	Daily trips per inhabitant
Urban population + job density	Average annual distance travelled per passenger car	Percentage of daily trips on foot
Proportion of the metropolitan area's surface which is urbanised	Annual passenger car vehicle kilometres per metre of road	Percentage of daily trips by bicycle
GDP per inhabitant	Annual average distance travelled in passenger cars per inhabitant	Percentage of daily trips by private motorised modes
Proportion of the urbanised surface used for local passenger transport	Average speed on the road network	Percentage of daily trips by public transport
Length of road per thousand inhabitants	Public transport modes operated	Percentage of daily trips by other modes
Length of motorway per thousand inhabitants	Total public transport vehicles per million inhabitants	Daily motorised trips per inhabitant
Length of road per urban hectare	Total public transport vehicle kilometres per inhabitant	Percentage of daily motorised trips by public transport
Length of motorway per urban hectare	Total public transport vehicle kilometres per urban hectare	Percentage of daily motorised trips by private modes
Length of reserved public transport routes per thousand inhabitants - road modes	Total public transport place kilometres per inhabitant	Average length of a private motorised trip
Length of reserved public transport routes per thousand inhabitants - rail modes	Total public transport place kilometres per urban hectare	Average length of a public transport trip
Length of reserved public transport routes per urban hectare - road modes	Average public transport speed	Average duration of a private motorised trip
Length of reserved public transport routes per urban hectare - rail modes	Average public transport speed (road modes)	Average duration of a public transport trip
Passenger cars per thousand inhabitants	Average public transport speed (rail modes)	

Figure 20: Indicators from the UITP database



Table 1: Summary of developments in selected cities across five indicators between 1995 and 2012: public transport modal share, urban density, motorisation rate, passenger x kilometres travelled by private cars per capita and public transport supply per capita.

City	Public transport modal share	Urban density	Motorisation rate	Passenger x km per inhabitant in private cars	Vehicle x km per inhabitant by public transport
On track for better mobility					
Vienna	Green	Green	Yellow	Orange	Green
Paris	Green	Yellow	Yellow	Orange	Green
London	Green	Yellow	Yellow	Orange	Green
Oslo	Green	Green	Green	Orange	Yellow
Prague	Green	Green	Grey	Orange	Green
Geneva	Green	Yellow	Yellow	Yellow	Green
Maintaining the status quo					
Barcelona	Green	Grey	Yellow	Yellow	Green
Berlin	Yellow	Yellow	Yellow	Yellow	Green
Munich	Yellow	Green	Yellow	Green	Green
Helsinki	Yellow	Grey	Green	Yellow	Yellow
Hamburg	Yellow	Yellow	Yellow	Yellow	Green
Glasgow	Yellow	Grey	Green	Grey	Orange
Tokyo	Yellow	Grey	Yellow	Orange	Yellow
Under pressure					
Tehran	Orange	Grey	Green	Green	Orange
Casablanca	Orange	Green	Green	Grey	Orange
Delhi	Orange	Green	Green	Orange	Grey
Other trajectories					
Hong Kong	Green	Orange	Green	Orange	Green
Budapest	Orange	Green	Green	Green	Yellow
Singapore	Green	Yellow	Yellow	Orange	Orange
Dubai	Green	Grey	Green	Orange	Green

The colours in each cell represent the evolution over the studied period according to the following scale:

- Growth above 10%
- Relative stability: the variation is between -10% and +10%
- Decrease by 10% or more
- Data not available, or not verified at the time of publication

Figure 21: Results of the cities evaluated by the UITP

There are also other reports published on more specific aspects, such as urban transport trends in the 21st century, analyzing the distribution of different modes of transportation, the number of annual trips in each country, the fleet of public transport vehicles per million inhabitants, among others. Other reports focus on specific modes of transportation such as metro, tram, bus, or on specific regions such as Europe, Asia, or the Americas. These reports are also restricted to UITP members, but they provide a summary document with key conclusions and figures accessible to the general public, making them highly useful for comparing conclusions and trends in public transportation over time in different countries and regions around the world.



Another report conducted by Arthur D. Little (ADL), an international consulting firm based in Boston, in collaboration with UITP, is *The Future of Mobility*²², with the most recent version published in 2018 being version 3.0. In this report, despite using data provided by UITP and other authorities that are not freely accessible, the methodology and indicators used to obtain the final rating for each city are defined in the accessible version of the report. Therefore, it is of great interest to study the indicators they use for certain categories, even if we don't have the same data, and ultimately compare the results obtained from their overall indicator with our methodology.

Figure 48: Arthur D. Little Urban Mobility Index 3.0 assessment criteria

Maturity [max. 36 points]		Innovation [max. 24 points]		Performance [max. 40 points]	
Criteria	Weight	Criteria	Weight	Criteria	Weight
1. Financial attractiveness of PT	4	1. Mobility smart cards penetration	4	1. Transport-related CO ₂ emissions	4
2. Share of PT in modal split	6	2. Mobility platforms	2	2. NO ₂ concentration	4
3. Share of zero-emission modes	6	3. Bike-sharing performance	4	3. PM ₁₀ concentration	4
4. Road density	4	4. Car-sharing performance (B2C)	4	4. PM _{2.5} concentration	4
5. Cycle-path network density	4	5. P2P car-sharing platforms	2	5. Traffic-related fatalities	4
6. Urban agglomeration density	4	6. E-hail services and taxi platforms	2	6. Increase share of PT in modal split	6
7. Public-transport frequency	4	7. Ride-sharing platforms	2	7. Increase share zero-emission modes	6
8. Urban mobility initiatives*	2	8. Self-driving vehicles initiatives	2	8. Mean travel time to work	4
9. Urban logistics initiatives*	2	9. Other smart mobility initiatives	2	9. Motorization level	4

Source: Arthur D. Little Mobility Index

Notes : The maximum of 100 points is defined by any city in the sample for each criteria; * Initiatives of public sector

Figure 50: Arthur D. Little Urban Mobility Index 3.0 – City ranking

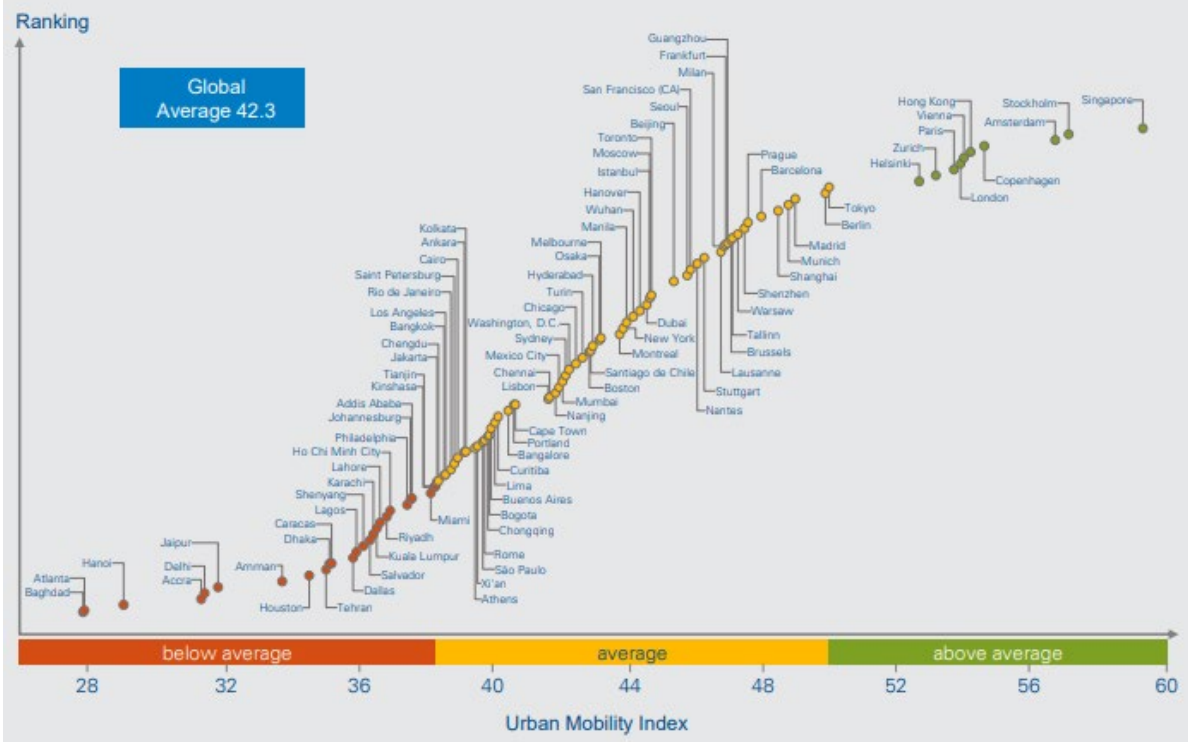


Figure 22: Results of the Urban Mobility Index 3.0. (Source: ADL and UITP)

²² www.adlittle.com/futuremobilitylab/



Indicators are not only present at the international level; in addition to internationally recognized indicators, each country develops its own indicators, which generally tend to be very similar. In this document, we have selected the United States and Spain as examples for detailed analysis. However, typically, each country generates its own reports using data provided by public authorities from a significant number of cities within the country. These reports should be used as reference documents for comparing the state of urban public transportation infrastructure among cities within each country.



ANNEXE 5

Indicators of Urban Public Transportation from the main Spanish organizations



In Spain, there are several essential organizations that provide data on urban public transportation. Particularly noteworthy is the Metropolitan Mobility Observatory (OMM), an initiative for analysis and reflection established by Public Transport Authorities (ATP) of the main Spanish metropolitan areas, funded by the Ministry of Transport, Mobility, and Urban Agenda, with the support of the Ministry for Ecological Transition and Demographic Challenge, the Directorate-General for Traffic (DGT), Renfe, and other institutions such as the Association of Urban and Metropolitan Public Transport (ATUC Sustainable Mobility), the Spanish Federation of Municipalities and Provinces (FEMP), INECO, IDAE, and the trade union Comisiones Obreras (CC.OO.).