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Energy, Business, and Strategy for Railway in Portugal: Reflections and Concerns

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Abstract

Among the various sectors of economic activity, the transport sector was one of those that most felt the effects of the COVID-19 pandemic, with reductions registering a significant contraction of activity in 2020. If the distribution by road and short distance has increased, the electric transport for long distance has decreased. Portugal intends to promote a progressive modal transfer of passengers and goods to the railroad, making an important contribution to the objectives of decarbonization, environmental protection, economic development and general improvement of people's quality of life. Portugal still insists on the Iberian gauge, compromising the reactivation of the Lusitania Expresso, buying old trains and to restore, less profitable and with greater environmental impact. There is therefore a concern that Portugal will become a railway island in Europe in the short term, with serious damage to passengers. The railway policy of the last decade does not seem to fulfil the European objectives of railway interoperability defined by the European Union. The present paper reflects on this problematic in a time of great construction and rebuilding.

Keywords: Energy consumption; Decision making; Economy; Strategic plan; Railway interconnection; Strategic decision; Decision making; Competitive advantage

Portuguese Transport System and Data

Representing 76.3% of total traffic (76.9% in 2020), national traffic moved 7.4Mton of goods (+10.6%, after -10.0% in 2020; -0.6% compared to 2019). In international traffic, 2.3Mton of goods were transported, with an increase of 14.2% (-12.5% in 2020). Compared to 2019, there was a decrease of 0.1%. All international transport was carried out to/from Spain. Based on the NST2007 classification, in 2021, the main group of goods carried in railway mode was group 10 - "Basic metals; manufactured metal products, except machinery and equipment", with 1.3 Mton, equivalent to 13.4% of the total (11.4% in 2020). The number of vehicles in circulation increased again in 2021; the fleet of motorized road vehicles presumably in circulation grew slightly (+1.0%), to 7.1 million vehicles. The fleet of light vehicles remained representative compared to 2020 (98.1%). Transport volume of freight in national vehicles higher than 2019 level. The results of the Road Freight Transport Survey (ITRM) for the year 2021 revealed an increase of 11.5% in the weight of transported goods (146.7Mton;-5.0% compared to 2019). The strong increase in international transport (+31.7%) raised the volume of transport to numbers above 2019: 32.1 billion tkm, +31.4% compared to the previous year and +3.2% compared to 2019. Freight transport in foreign vehicles grew less than that carried out in domestic vehicles It is estimated that 15.6Mton were transported by foreign vehicles in Portugal, which represented an increase of 7.7% compared to the previous year (+1.9% in 2020; +9.7% compared to 2019). This value represented 9.6% (-0.3 pp; +1.2 pp compared to 2019) of the total transport. Road passenger transport grew compared to 2020, but far from 2019 levels the number of passengers transported increased by 15.8% compared to 2020, to 380.2 million passengers. Compared to 2019, the number of passengers decreased by 32.8%, reflecting the mobility limitations imposed by the COVID-19 pandemic during 2021.

The movement of goods in national seaports reached 83.1Mton, growing 4.7%, partially recovering from the 7.0% decrease registered in 2020. Compared to 2019, there was a decrease of 2.6%. The port of Sines, handled 42.9Mton, having registered an

increase of 10.3% compared to 2020 (+10.3% compared to 2019) and an increase of 2.6 pp in its weight in the total, reaching a national representation of 51.6%. Leixoes decreased by 12.5% (16.3% of the national total; -3.2 pp; -13.9% in 2020), while Lisbon increased its movement of goods by 6.0% (10.7% of the total; +0.1 pp; -20.2% in 2020). Compared to 2019, there were variations of -24.7% and -15.4%, respectively. National ports registered 71.6Mton in international traffic (+4.8%, after -6.1% in 2020; -1.5% when compared to 2019), reaching 86.1% of the total. 33.1Mton of goods were loaded at national ports (+3.2% compared to the previous year; -1.8% compared to 2019). Group 07- "Coke and petroleum products", despite a reduction of 0.7% compared to 2020, remained the most representative, reaching 24.3% of the total, followed by group 09- "Other non-metallic mineral products" which, with an increase of 14.0%, compared to the previous year, reached a relative weight of 13.0% of the total of goods loaded. In 2021, 50.0Mton of goods were unloaded at national ports (+5.6% than in the previous year; -10.4% in 2020; -5.4% compared to 2019), with the groups that include energy products remaining representative; groups 02 – "Coal and lignite; crude oil and natural gas" (-10.3% compared to 2020) and 07 – "Coke and refined petroleum products" (+17.4% compared to 2020) representing respectively 26.9% and 13.7% of the total. The movement of liquid bulk reached 30.6Mton (-0.4% compared to 2020; -8.6% compared to 2019) representing 36.8% of the total movement, followed by containerized cargo (30.5Mton; +9.2% than in the previous year; +15.1% compared to 2019) which reached 36.7% of the total handled (+1.5 pp).

Figure 1: *Portuguese rail network at its fullest extent, with all the lines where the services of the national rail operator operated.*

Figure 2: *Active lines in 2023.*

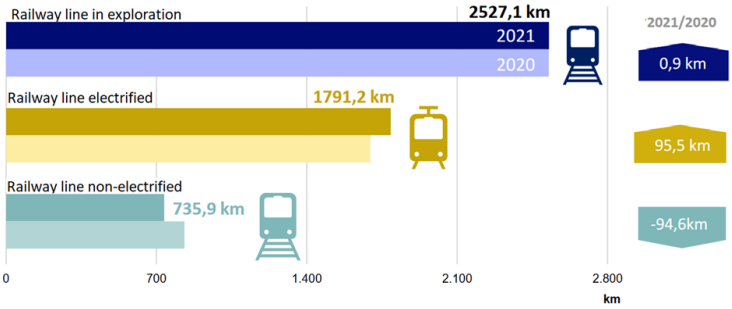

Figure 3: *Extension of the railway network in operation, by type of electrification.*

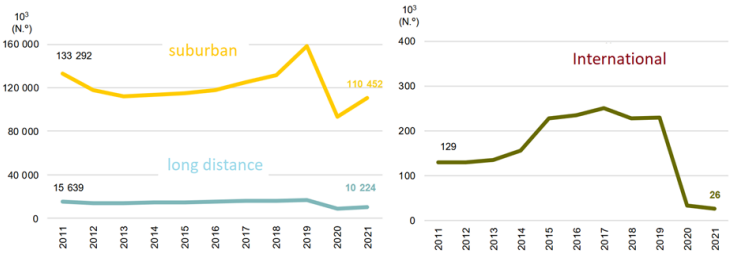

Figure 4: *Passengers carried by type of traffic.*

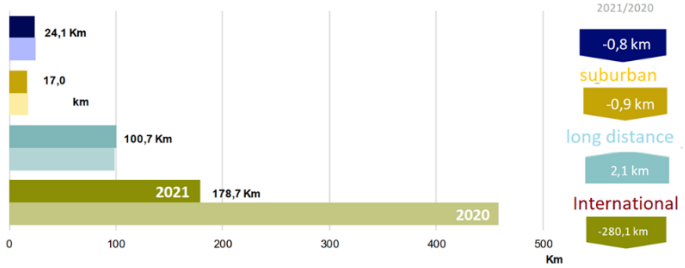

Figure 5: *Average journey of a passenger by type of traffic.*

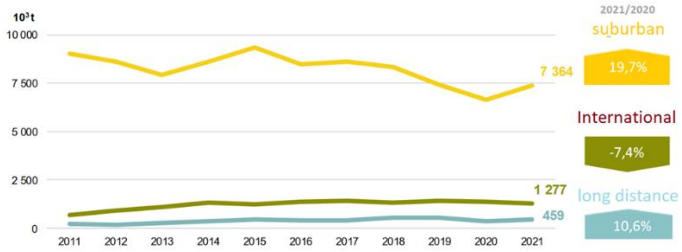

Figure 6: *Goods transported by type of traffic.*

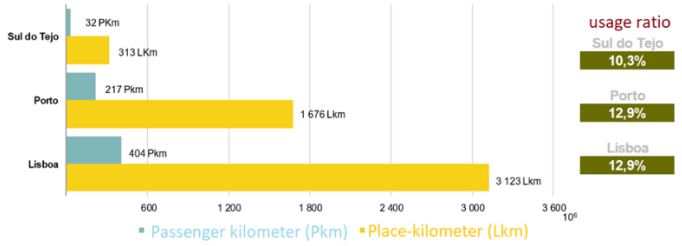

Figure 7: *Supply and demand by metropolitan system.*

Inland waterway passenger and vehicles transport increased In inland waterways in Portugal, regular (national and international) crossings ensured the transport of 13.4 million passengers (+2.0%; -41.6% compared to 2019), and 282.8 thousand vehicles (+3.2%; -25.7% compared to 2019). Increase in passenger movement at the main national airports the movement of passengers at national airports and aerodromes in 2021 amounted to 25.6 million (+39.2%, -69.4% in 2020), but still far from pre-pandemic levels (-57.4% compared to 2019). At the main airports, passenger traffic registered the following increases: +31.1% in Lisbon (-70.3% in 2020; -61.0% compared to 2019), +31.7% in Porto (-66.2% in 2020; -55.4% compared to 2019), +47.9% in Faro (-75.5% in 2020; -63.8% compared to 2019), +69.3% in Funchal (-65.1% in 2020; -40.8% compared to 2019) and +80.1 % in Ponta Delgada (-65.4% in 2020; -37.7% compared to 2019). At national airports, in 2021, in terms of the movement of goods, there were increases of 31.2% in the movement of cargo (totalling 178.9 thousand tonnes) and 10.6% in the movement of mail (11.8 thousand tonnes). Compared to 2019, there were decreases of 7.3% and 33.1%, respectively. Air traffic grew significantly, with an increase of 35.9% (-69.9% in 2020) in passengers handled at national airports. Road transport is the predominant transport mode and grew by 15.8% (-42.0% in 2020). With regard to passenger-km, growth was more pronounced (+49.8%, -50.4% in 2020). There was an increase in passenger rail transport compared to the previous year, with 120.7 million passengers in heavy rail transport (+18.1% in 2021 and -41.7% in 2020), an increase also seen in passengers-km (+14.1% in 2021 and -48.6% in 2020). Contrary to heavy rail transport, metropolitan transport with 137.5 million passengers recorded a decrease compared to the previous year (-2.4% and -47.8% in 2020). In maritime transport, there was an increase compared to the previous year (+30.1% and -41.7% in 2020) as well as in river transport (+2.0% in 2021 and -42.8% in 2020). Table 1 shows the number of passengers carried by mode of transport in Portugal (Table 1) [10].

- Only Mainland and park on behalf of third parties; transport carried out by national operators.
- In maritime and air transport, in the national transport component, and for the purposes of better comparability between modes, only boarding movements were considered (excluding landings and transits).
- Does not include cruise ships; does not include the port of Lisbon

Table 2 shows the number of Passengers-km carried by mode of transport (Table 2) [10].

The predominant modes of goods transport are road (146.7 million tons) and maritime (77.3 million tons). Rail transport moved 9.7 million tons and air transport remains the least significant (175 thousand tons at national airports). Road transport grew by 11.5% compared to the previous year (-14.8% in 2020), also reflected in the 31.4% increase in tonne-km (-21.5% in 2020), bringing the Based on the 2019 figures, there was only a negative difference of 5.0% in terms of goods transported and an increase of 3.2% in terms of tonne-km. Regarding maritime transport, there was also a growth of 4.7% in 2021 (-6.7% in 2020). These values of transported goods are 2.2% lower compared to 2019. In rail transport there is also a recovery compared to the previous year (+11.4%, -10.6% in 2020) being only 0.4% below the value of 2019. Tonne-kilometers grew by 8.1% compared to the previous year (-3.1% in 2020). Finally, in air transport, there was a recovery in the transport of goods via national airports compared to 2020 (+31.3%, -31.5% in 2020).

Table 3 shows the number of Goods transported by mode of transport (Table 3) [10].

- Only Mainland and park on behalf of third parties; transport carried out by national operators.
- In maritime and air transport, in the national transport component, and for the purposes of better comparability between modes, only boarding movements were considered (excluding landings and transits).
- Does not include cruise ships; does not include the port of Lisbon

Source: INE, Transport and Communications Statistics, 2021, Transport and Communications Statistics – 2021, ISBN 978-989-25-0616-6

Table 4 shows the number of goods in Tonne-kilometers by mode of transport (Table 4) [10].

Portuguese Railway Description

Rail transport in Portugal is essentially made up of track and traffic support infrastructure, whose management is entrusted to the company Infrastructures de Portugal, and the operation of passengers and cargo, carried out mainly by the operator Comboios de Portugal, and by other companies, such as Medway, Fertagus and Takargo. The national railway network is made up of lines and branches (in operation and not operated) with a total length of 3,621.6 km. 70% of the network is in operation, which corresponds to a length of 2,526 km, of which 1,916 km are single-track and 610 km are multi-track. The length of the electrified network, 1,791.2 km, corresponds to 70.8% of the total network in operation [1]. There are 3 international connections, with the Spanish rail network, in Vilar Formoso, Valenca and Elvas [2]. There are also several light rail systems, such as Metro do Porto [3], Metro Sul do Tejo, Trams in Lisbon [4], Porto [5] and Sintra [6], Transpraia in Costa de Caparica [7] and the Train from Praia do Barril in the Algarve [8]. There are also several elevators and funicular railways in Portugal, such as the Bom Jesus Elevator in Braga [9] or the Santa Justa Elevator in Lisbon [4].

Traditionally and since its founding, there has been a complete separation of medium-haul and long-haul services, in addition to proximity services. Currently, the division is more flexible, as there are services connecting medium-haul and long-haul trains, and also long-haul trains that admit certain medium-haul passengers between nearby cities [11,12]. Long-haul intercity lines are non-subsidised services, which generally include large on-board services such as a cafeteria, preferential class, in-seat catering or the broadcast of films. The name of each of these services normally indicates the services and type of train, although sometimes there are differences within services with the same name. Alfa Pendular is the national railway operator's premium service and is carried out by electric railcars of the 4000 Series, with tilting capacity, which allows a maximum speed of 220 km/h. The Alfa Pendular service operates the following routes:

- Lisbon Santa Apolonia - Porto Campanha (Trains 120 to 129);
- Lisbon Santa Apolonia - Braga (Trains 130 to 137);
- Lisbon Santa Apolonia- Guimaraes (Trains 140 and 141);
- Porto-Campanha - Faro (Trains with numbers 180 to 186).

This service has two classes: Tourist Class (equivalent to Second Class on Intercity services) - Cars 6 to 3 - and Comfort Class (equivalent to First Class on Intercity services) - Cars 1 and 2. The Bar is located in car 3. Note that the carriages are ordered from south to north (1 → 6). Intercidades is the fast service of the national railway operator that connects the main cities of the country. These services are carried out with Locomotive + Carriages compositions (Series 5600 with Corail or Sorefames Modernized carriages) thus allowing greater flexibility depending on demand. The maximum speed of this service is 200 km/h. The only exception is on the Casa Branca- Beja route, where the service is provided using Series 0450 diesel railcars whose interiors have been modified for this type of service. Its top speed is 120 km/h. On international connections there is the Sud-Expresso night service train (connection between Lisbon and Hendaye) and the Lusitania (connection between Lisbon and Madrid) with a maximum speed of 140 km/h, both suspended since March 17, 2020 and without forecast back. In the Medium Course there are lines, which can receive subsidies, either individually for each line sometimes through the municipalities, or globally through an agreement with the state government known as contract-programme. Most services have similar features, with a single class without a cafeteria on board and the possibility of using bicycles.

Interregional: is the fastest medium-distance service with identical technical performance to Regional, with the exception that it skips certain secondary stations on its route, thus reducing travel time. However, the length of its routes, from beginning to end, is extensive, typical of services such as Intercidades; this makes it possible to travel long interregional routes without the need for transfers for travellers who need it, although it is not the preferable option for this type of long journey, due to its multiple stops. These services are carried out on the North, Minho, Douro, West lines and on the Tomar branch.

Regional is the most basic service of the national railway operator, whose average speed and category (comfort) is lower than that of medium-haul services. Regional service trains usually circumscribe their routes within the same region, and stop at all stations and halts (with the exception of those close to Lisbon, Porto and Coimbra) enabled on their route, serving smaller locations, with frequencies lower fares than in urban services. These are the only passenger services provided on the Linha do Leste, Linha do Vouga and on the Guarda-Vilar Formoso sections of the Beira Alta Line, Lagos-Tunes and Faro-Vila Real de Santo Antonio on the Algarve Line. They are also provided on the lines of the North, Minho, Douro, Beira Alta, Beira Baixa, Oeste, Alentejo and Ramal de Tomar. This category includes the Via Estreita network, of which currently only the Vouga Line and the Aveiro branch line are in operation, which was inherited from the Companhia do Vouga, the Companhia do Norte and the Companhia Nacional. The national railway operator provides a public service through a service provision contract for the Mirandela Light Rail, a company in which it holds a minority stake and which was created after the closure of operations on the Tua Line.

The national railway operator is the main manager of urban service networks in Portugal. These services are always subsidized, and are offered in the country's large metropolitan areas.

In addition to its regular services, the national railway operator markets various tourist services on the Douro and Vouga lines. The

Douro Historical Train is a tourist service carried out by the steam locomotive national railway operator on the Douro Line between Regua and Tua stations, [13] has been increasingly successful in recent years, which led the national railway operator to expand the offer of this service [14]. The MiraDouro is a tourist service carried out by a 1400 diesel locomotive and rehabilitated Schindler carriages, it was launched in 2017 with a view to reinforcing the offer on the Douro Line [15,16]. In the first season, it circulated between Porto Sao Bento station and Tua station with remarkable success. However, in the second season in 2018 it was shortened to the Regua station, as a result of the operational difficulties of the national railway operator in that period, [17] which generated an abrupt drop in the number of passengers. The service was suspended in 2019 and since 2020 the company uses this name for the Porto-Pocinho Interregional services, operated by Series 1400 locomotives and Schindler and/or Sorefame carriages [18].

The Vouga historic train: tourist service carried out by the diesel locomotive, restored in its original colors, national railway operator 9004. It was launched in 2017 with the aim of boosting the Vouga Line, runs between Aveiro and Macinhata do Vouga stations, including a visit to the railway museum in this location [19]. The huge success of the first season, with occupancy rates of 100% recorded, led the national railway operator to increase the offer and number of circulations in 2018 [20-25].

Portuguese Railway Data

In 2021, the national rail network, made up of lines and branches in operation and not operated, had a total length of 3,621.6 km (+0.9 km compared to 2020). Around seventy percent of the network (69.8%) was in operation, covering a length of 2,527.1 km. The 1,791.2 km of electrified network corresponded to 70.9% of the total network in operation, representing an increase of 95.5 km compared to 2020. The distribution of the total network in operation changed slightly in 2021: 46.6% of the main network (1,177.0 km; +1.6 km than in 2020); 35.2% complementary network (890.3 km; -0.6 km); and 18.2% secondary network (459.7 km, unchanged). In terms of main infrastructure, in 2021 the railway had 1,844 bridges, 80 tunnels, 548 stations and 824 level crossings. (Figures 1-6) illustrates the extension of the railway network in operation, by type of electrification [10]. In 2021, the rail fleet consists of 406 traction vehicles (+23 units compared to 2020). This increase was the result of an increase of 5 diesel locomotives, 7 electric locomotives and 12 diesel tractors, together with the reduction of 1 diesel railcar. Regarding goods transport equipment (2298 units), in 2021 there was a decrease of 15.5% (-421 units). The number of vehicles for passenger transport (1,017 units) increased by 6 units, due to the addition of 11 passenger carriages and the reduction of 5 diesel railcars. In 2021, passenger transport by train increased by 18.1% (after -41.7% in 2020 and +18.9% in 2019), reaching 120.7 million passengers. In terms of volume, there was an increase of 14.1% (-48.6% in 2020 and +10.6% in 2019), corresponding to 2.9 billion passenger-kilometers in rail transport. The increase in passenger transport by rail was mainly due to the improvements observed in terms of suburban traffic (+18.2%, after -41.0% in 2020), with a total of 110.5 million passengers transported, and long-haul traffic (+17.1% , after -48.1% in 2020), with 10.2 million passengers. International traffic continued to fall (-23.0%, after -85.6% in 2020), transporting 25.6 thousand passengers (Figure 7). Illustrates the number of passengers carried by type of traffic [10]. In 2021, each passenger transported by train travelled, on average, 24.1 km (-0.8 km than in 2020). The average journey of a passenger on suburban trips was 17.0 km (-0.9 km compared to 2020) and in long-haul trips was 100.7 km (+2.1 km). In international journeys, the average route per passenger has decreased by 280.1 km, standing at 178.7 km in 2021 (Figure 8) [10].

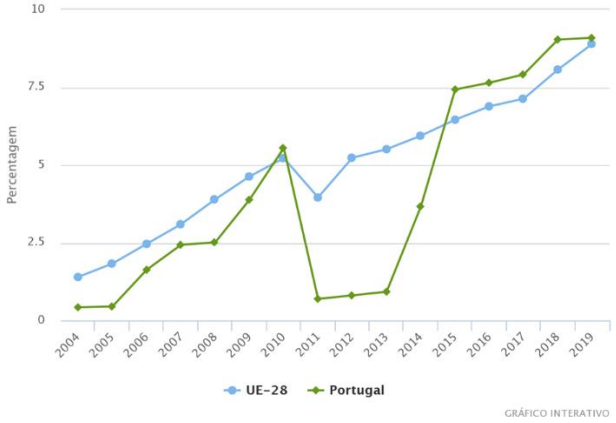

Figure 8: *Illustrates the average journey of a passenger by type of traffic.*

In 2021, 9.7 million tons of goods were transported by rail, equivalent to an increase of 11.4% (-10.6% in 2020). In volume, 2.6 billion tkm of goods were transported, which represented an increase of 8.1% (-3.1% in 2020). The average journey per ton was 269.1 km (-2.9% compared to 2020). Representing 76.3% of total traffic (76.9% in 2020), national traffic handled 7.4 million tons of goods (+10.6%, after -10.0% in 2020). In volume, this transport corresponded to 1.8 billion tonne-kilometers (+3.3%; -8.2% in 2020). In international traffic, 2.3 million tons of goods were transported, with an increase of 14.2%, after a decrease of 12.5% in 2020. All international transport was carried out from/to Spain. The quantity of goods entering national territory (1.3 million tons; -7.4%) continued to exceed outgoing goods (459 thousand tons; +19.7%), which resulted in a coverage rate of goods unloaded by loaded goods of 36.0%, after 27.8% in 2020. In third-party traffic, that is, goods moved entirely outside the national territory, but under the responsibility of national carriers, there were 553.1 thousand tons (+131.1% compared to 2020) (Figure 9) [10].

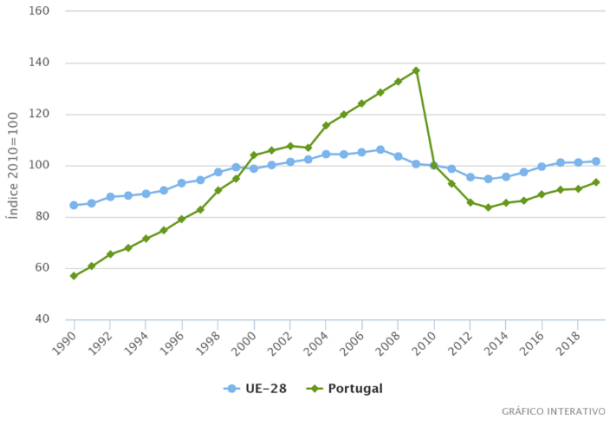

Figure 9: *Illustrates the quantity of goods transported by type of traffic*

Based on the NST2007 nomenclature, in 2021, the main group of goods transported by rail was 10 – "Base metals; processed metal products, except machinery and equipment", with 1.3 million tons, equivalent to 13.4% of the total (11.4% in 2020), followed by group 03 – "Non-energy products from extractive industries; peat; uranium and thorium", with 1.2 million tons, (12.0% of the total; 9.3% in 2020). In national territory, the main goods transported belonged to group 03 - "Non-energy products from extractive industries; peat; uranium and thorium", with 15.8% of the total (12.1% in 2020). In the output of goods by rail, groups 14 stand out - "Secondary raw materials.; municipal waste and others" - and 10 – "Base metals; processed metallic products, except machinery and equipment 2", with 100.3 thousand and 99.8 thousand tons transported, respectively (21.8% and 21.7% of the total, in the same order). In incoming goods, group 01 – "Products from agriculture, animal production, hunting and forestry; fish and other fish products" was the most represented, with 533.2 thousand tons (41.8% of the total, 48.4% in 2020). The most common distance interval in the transport of goods in national traffic was between 150 and 299 km, a situation observed in 47.8% of tons (-5.0 pp than in 2020) and in 49.4% of total tkm (-1.8 pp). Routes shorter than 150 km accounted for 30.1% (+7.0 pp) of the transported tonnage and 9.1% (+2.0 pp) of the total in terms of tkm. Goods transported in large containers (20 feet or more) weighed 4.6 million tons, which represented a decrease of 6.7% compared to the previous year (-4.4% in 2020, -1.3% in 2019 and +11.2% in 2018).

The extension of the Lisbon, Porto and South Tagus metro network (without overlapping sections) did not change in 2021 compared to the previous year: 44.5 km; 66.7 km; and 11.8 km, respectively. The number of metro vehicles in service on the three metro systems as a whole remained unchanged at 459 units in 2021. Thus, Metropolitano de Lisboa had 333 vehicles, Metro do Porto 102 vehicles and Metro Sul do Tejo 24 vehicles. In 2021, with the extension of the COVID-19 pandemic situation, passenger transport by metro registered a reduction of 2.4% (after -47.8% in 2020), with a total of 137.5 million passengers. Compared to 2019, the decrease in the number of passengers was 49.1%. Metropolitano de Lisboa was the only system to register a decrease (-7.6%, after -50.5% in 2020), transporting 83.7 million passengers. In 2021, the utilization rate in this metro system stood at 12.9% (+0.1 pp than in 2020), remaining well below pre-covid records (24.8% in 2019 and 2018). In 2021, Metro do Porto presented an increase of 5.9%, having transported 41.8 million passengers (-44.7% in 2020). The rate of use of this metro system was also set at 12.9% (12.0% in 2020 and 22.0% in 2019). Metro Sul do Tejo transported 12.0 million passengers and registered a growth of 9.9% compared to 2020 (-29.8% in 2020 and +26.4% in 2019). The utilization rate on Metro Sul do Tejo was 10.3%, +0.5 pp than in 2020 (12.2% in 2019 and 10.2% in 2018).

Figure 10 illustrates the supply and demand balance by metropolitan system [10].

Energy Consumption

In 2021, 271.5 million kWh of electricity were consumed for rail transport, which represented an increase of 5.8% (-11.0% in 2020). Likewise, diesel consumption (19.2 million litres) increased by 6.4%, after a decrease of 1.2% in 2020. In 2021, the three metro systems had a total consumption of electricity of 152.5 kWh, (-3.7% than in 2020), due exclusively to the decrease in the use of energy in traction (-7.4%). At Metro de Lisboa there was a decrease in electricity consumption of 12.5% (-11.9% in traction energy), at Metro do Porto an increase of 13.0% (+0.7% in traction) and in Metro Sul do Tejo an increase of 1.8% (+3.4% in energy used in traction).

Comparison with US

As the transport sector is one of the most dependent on fossil fuels, an effort has been made to increase the percentage of fuels coming from renewable energies in this sector. Portugal showed a significant increase in the incorporation of renewable energies in fuels until 2010, and in the following year, this incorporation registered a sharp decrease. This drop is related to the mandatory sustainability certification of biofuels which, although it came into force in 2010, took a long time to be operationalized in the country. From that year onwards, a further increase has been observed, and in 2019, 9.1% of renewable energy was incorporated in transport, slightly surpassing the average observed in the EU-28, of 8.9%. At the EU-28 level, the incorporation of fuels from renewable energy sources has shown a consistent increase since 2004, with values higher than those observed in Portugal until 2014, except in 2010. In 2019, the values observed in Portugal and in the EU-28 28 seem to be converging. With regard to GHG emissions originating from the transport sector, it appears that, after a reduction between 2009 and 2013, both Portugal and the EU-28 show an increasing trend. In 2019, the values of the 2010=100 index were 93.4 and 101.6 in Portugal and in the EU-28, respectively. The Covid-19 pandemic

began in Portugal in March 2020, with the first case detected on the 2nd and the State of Emergency decreed on the 19th. 2020 and 2021, led to reductions in polluting gas emissions in the country. Within the scope of the National Emissions Inventory, which makes public the values of annual emissions of greenhouse gases (GHG) and accounts for emissions from all sectors of activity, it appears that "fuel burning" is the main source of GHG emissions in Portugal, having been responsible for 72% of emissions in the period between 2016 and 2019.

Table 1: *Passengers carried by mode of transport in Portugal (thousands).*

						Annual variation rates		
		2018	**2019**	**2020**	**2021**	**2019**	**2020**	**2021**
Railway	Heavy	147408	175333	102224	120702	18.90%	-41.70%	18.10%
	Metropolitan	244137	27026	140938	137506	10.60%	-47.80%	-2.40%
Roadway		543144	565911	328175	380168	4.20%	-42.00%	15.80%
Maritime (b) (c)		907	929	542	705	2.40%	-41.70%	30.10%
river		21415	22858	1385	13350	6.70%	-42.80%	2.00%
national aerial	Airports (b)	51000	54748	16482	22403	7.30%	-69.90%	35.90%
	air transport companies	17620	19075	5477	7234	8.30%	-71.30%	32.10%

(a) Only Mainland and park on behalf of third parties; transport carried out by national operators.
(b) In maritime and air transport, in the national transport component, and for the purposes of better comparability between modes, only boarding movements were considered (excluding landings and transits).
(c) Does not include cruise ships; does not include the port of Lisbon.

Table 2: *Passengers-km carried by mode of transport (thousands).*

						Annual variation rates		
		2018	**2019**	**2020**	**2021**	**2019**	**2020**	**2021**
Railway	Heavy	4487	4964	2552	2912	10.60%	-48.60%	14.10%
	Metropolitan	1177	1292	666	653	9.80%	-48.50%	-1.90%
Roadway		7926	7941	3939	5900	0.20%	-50.40%	49.80%
aerial	national air transport companies	40780	44682	12852	16734	9.60%	-71.20%	30.20%

(a) Only transport carried out by national vehicles.

Table 3: *Goods transported by mode of transport.*

						Annual variation rates		
		2018	**2019**	**2020**	**2021**	**2019**	**2020**	**2021**
Railway		10582	9695	8665	9653	-8.40%	-10.60%	11.40%
Roadway		157826	154407	131545	146724	-2.20%	-14.80%	11.50%
Maritime (b) (c)		84046	79055	73780	77283	-5.90%	-6.70%	4.70%
aerial	national airports (b)	174	194	133	175	11.90%	-31.50%	31.30%

	national air transport companies	97	137	49	78	41.70%	-64.00%	58.30%

(a) Only Mainland and park on behalf of third parties; transport carried out by national operators.
(b) In maritime and air transport, in the national transport component, and for the purposes of better comparability between modes, only boarding movements were considered (excluding landings and transits).
(c) Does not include cruise ships; does not include the port of Lisbon
Source: INE, Transport and Communications Statistics, 2021, Transport and Communications Statistics – 2021, ISBN 978-989-25-0616-6.

Table 4: *Tonne-kilometers by mode of transport.*

						Annual variation rates		
		2018	**2019**	**2020**	**2021**	**2019**	**2020**	**2021**
Railway		2765	2478	2402	2597	-10.40%	-3.10%	8.10%
Roadway		32676	31087	24402	32074	-4.90%	-21.50%	31.40%
aerial	national air transport companies	475	559	277	420	17.60%	-50.50%	51.70%

Future and Strategic Options and Aims

PETI3+ (Resolution of the Council of Ministers No. 61-A/2015 - Diario da Republica No. 162/2015, 1st Supplement, Series I of 2015-08-20), on which the investment plan contained in the Ferrovia 2020, the Railway Investment Plan presented by the Government in February 2016, defined a set of priorities duly identified by a wide range of stakeholders, namely:

International commitments, including bilateral ones with Spain and those resulting from the Atlantic Corridor;

Fostering the transport of goods and, in particular, exports;

Articulation between national ports and the main land borders with Spain.

To achieve these objectives, there is a financial package made up of community funds from the Connecting Europe Facility Program (CEF) both in the General component (30 to 50% co-payment) and the Cohesion component (85% co-payment) and the Portugal 2020 Program (85% co-payment), regional development and cohesion funds, both under national management, to which can be added the Juncker Plan and the direct contribution from the Infrastructures de Portugal budget. The National Railway Plan (PFN) is the instrument that will define the railway network that ensures communications of national and international interest in Portugal. This plan is intended to provide stability to the planning of the rail network for the medium and long term. The starting point will be the identification of accessibility, mobility, cohesion and development needs to which rail transport can provide an adequate response in different territories. The railway should, therefore, assert itself as a means of transport with high capacity and environmental sustainability, becoming the structuring element of transport networks. The National Railway Plan (PFN) is the instrument that will define the railway network that ensures communications of national and international interest in Portugal. This plan is intended to provide stability to the planning of the rail network for the medium and long term. The starting point will be the identification of accessibility, mobility, cohesion and development needs to which rail transport can provide an adequate response in different territories. The railway should, therefore, assert itself as a means of transport with high capacity and environmental sustainability, becoming the structuring element of transport networks. After decades of disinvestment in the railway, closure of lines and priority given to the road and individual transport that brought us to an enormous dependence on the car, Portuguese Governments are carrying out a revolution that had a first moment of recovery and stabilization. It was necessary to stop the fall and it was at that moment that we reintegrated the Railway Equipment Maintenance Company (EMEF) into national railway operator, recovered dozens of trains that were parked in Portugal, bought used rolling stock outside the country, renewed through national industry, reinforced the staff of the national railway operator and Infrastructures de Portugal (IP), created a Railway Competence Centre and moved from projects to works, from paper to land. The carriages, locomotives and railcars that a short time ago were abandoned and that are currently running like new; a drastic reduction in deletions; have already managed to make some increases in supply, even if occasional; and have almost all the main lines in the country, from north to south, from the coast to the interior, under construction. With this new line, we place our two Metropolitan Areas just over 1h15 apart; we put Aveiro, Coimbra, Leiria and the entire axis between Braga and Setubal, where about 8 million people live, just over 2 hours away from each other. But this is much more than a new line between Porto and Lisbon: it is a new line that structures the existing network, giving it a speed and capacity incomparable to the current ones. The reductions in travel times will also reach connections to Beira Interior, Minho, Alentejo or the Algarve. With this new Porto-Lisbon Line, Guarda will save 1h20 on the journey to Porto and 50 minutes on the journey to Lisbon. Leiria will be 40 minutes from Lisbon. Braga at 2am. We brought the North and South of the country closer together and the Interior closer to the Coast.

Conclusions

In the rail system, infrastructure and services are inseparable at all levels, from the planning level to the technological compatibility. Defining a plan for the rail network is an iterative process starting from a certain standard of services that is considered desirable, places it before the infrastructure constraints, and successively adapts the standard of service and the infrastructure intervention needs. The classification of the Trans-European Transport Networks already has a hierarchy and a network segmentation. In the PFN, the hierarchy of the network is made, for passengers, in terms of coverage of different categories of service. There is no set level of benefits for the infrastructure that must support each type of passenger service. Are before defined travel time objectives for the services themselves and envisaged in a way generic the characteristics of the infrastructure that should support it. In addition to time, it established a service cadence objective that will determine the level of capacity necessary. In the case of the transport of goods, bearing in mind that this is important in long distances and international transport, the hierarchy of TEN-T is assumed, since this corresponds to the most relevant national and international axes. The adoption of a National Railway Plan is foreseen in the program of the XXII Constitutional Government, which also establishes the objectives of taking the railway to all district capitals, reducing travel time between Lisbon and Porto and promoting better connections of the railway network to port infrastructure. And airports. In addition to these, the PFN should ensure adequate coverage of the territory and the connection of the most relevant urban centres, as well as Iberian cross-border connections and integration in the trans-European network. It should also guarantee the integration of rail transport in the main national and international logistics chains.

In land transport of goods, the railroad competes, essentially, with road transport. Two fundamental factors stand out in this competition:

- Cost, where the railroad has an advantage that is greater the greater the distances greater the distances to travel and the greater the load capacity allowed by train;
- Reliability, where the railway often struggles to reach levels equivalent to road transport. With regard to the unit cost of transport, this is directly linked to the system productivity and the economic and environmental efficiency of the operation.

The capacity of freight per train and per locomotive is, here, the crucial variable, which is directly linked to the maximum length of the trains and the maximum slopes of the routes. The latter limit the maximum weight that can be towed by each locomotive. If the problem of the maximum length of trains is solvable with investments relatively modest, since the elimination of existing in-line pendants can have costs very high or prove to be technically impossible without the construction of a new line. For this reason, the solution for increasing the transport capacity of trains of goods is not always infrastructural, and there may be options for adapting the operating model or technical operating conditions. In all situations, you must evaluate yourself and select the solution that yields the greatest benefit to your organization as a whole. Economy and society

Ferrovia 2020 Strategic Objectives

Increase the Competitiveness of Rail Transport

Reduction of journey times;

Reduction of transport costs (€/km/container);

Increased capacity (number and length of trains).

Improve International Connections

Sines/Setubal/Lisbon-Caia corridor;

Leixoes/Aveiro Corridor – Vilar Formoso;

Promote the use of the railroad on journeys to and from national ports.

Creating Conditions for Rail Interoperability

Electrification: + 480 km of electrified lines;

Signalling: + 400 km of lines with electronic signalling;

Length of freight trains – increase to 750 m;

Gauge - installation of sleepers (multipurpose) that allow changing the gauge on international corridors.

With all this, it is intended to promote a progressive modal transfer of passengers and goods to the railroad, making an important contribution to the objectives of decarbonization, environmental protection, economic development and general improvement of people's quality of life. As a negative aspect, Spain seized the opportunity of European money to carry out a true revolution in the European gauge and high-speed rail transport, while Portugal still insists on the prehistoric Iberian gauge and jeopardizing the reactivation of the Lusitania Expresso. While Spain buys ultra-modern and comfortable trains, Portugal buys Renfe scrap cheaply to have it restored in Gaia. While Spain, in the space of three years, has increased and continues to increase Spain's map of high-speed lines, Portugal is improving outdated lines, always exceeding deadlines and contract prices and never guaranteeing faster trains. Thus, while Portugal basically continues with a rail service the same as it had in the mid-20th century, in Spain the high-speed line already covers thousands of kilometres connecting the whole country and its trains are three times faster, five times cheaper, four times the number of passengers, all more profitable and with less environmental impact. There is therefore a concern that Portugal will become a railway island in Europe in the short term, with serious damage to passengers. The railway policy of the last decade does not seem to fulfil the European objectives of railway interoperability defined by the European Union and required by the needs of the Portuguese economy, namely the exporting sectors. It should be noted that 70% of Portuguese exports are to Europe and of these 80% are done by road, which is an unsustainable model for environmental and energy reasons, in addition to being

condemned by the European Union. The negative effects of these policies are also visible in the ability to attract investment and the economy is losing competitiveness and the country is becoming impoverished. In Spain, the growth of foreign investment is very visible (more than 30,000 million euros recently announced), foreign investment in Portuguese industry has practically disappeared and not all the conditions are created for the permanence of important factories and industries in Portugal.

References

1. Arminda A, Antonio M, Adriano C. the state business sector in Portugal and in the EEC Lisbon countries: national press / mint and center for the study of public and social economy. 1983; 471.
2. Inigo H. The best beaches in Portugal 4th ed. Lisbon: publications Dom Quixote and editorial Geoplanetea. 2003.
3. Pedro L, Ferreira da SA. Economic History of Portugal 1700-2000. The 19th Century. 2nd ed. Lisbon: ICS - Soc Sci Press. 2005; 2.
4. Joao M, Madalena B, Miguel de S; et al. The Railway Revisited: The Railway in Portugal from 1856 to 1996. [Sl]: Portuguese Railways. 1996.
5. Francisco R, Rose G, Gilberto G, et al. The Portuguese Railways 1856-2006. Lisbon: national railway operator-Comboios de Portugal and Publico-Comuniccao Social. 2006.
6. Hermano SJ, Maria G. Diary of the history of Portugal. Lisbon: Cultural Diffusion. 1998; 3.
7. Joao T, Joaquim E. 100 works of civil architecture in the 20th century: Portugal 2nd ed. Lisbon: order of engineers. 2000.
8. Mario L. The imperative of the European gauge. Coimbra: Riscos Sociedade Editora. 2015.
9. Railroad Gauge Width.
10. INE, transport and communications statistics, 2021, transport and communications statistics – 2021.
11. Portugal, trains of. History of the national railway operator | national railway operator - Comboios de Portugal. National railway operator.pt | trains from Portugal (in English). 2020.
12. Portugal, trains of. Railway culture | national railway operator - Comboios de Portugal. National railway operator.pt | trains from Portugal (in English). 2020.
13. Portugal, trains of. Historical train of the Douro. cp.pt | trains from Portugal (in English). 2018.
14. Historical train in the Douro: chronicle of an announced success – Portugal Ferroviario. portugalferroviario.net. 2018.
15. Portugal, trains of. Mira Douro. cp.pt | trains from Portugal (in English). 2018.
16. Rita CA. The charming 40 train returns to the lines of the Douro. PUBLIC.
17. Charles C. CP reduces offer of tourist trains this summer. PUBLIC.
18. Mira Douro tourist train is back. JN
19. Portugal, trains of. Historic train of Vouga. cp.pt | trains from Portugal (in English). 2018.
20. Carlos C. Vouguinha returns on the 30th of June and stays until October. PUBLIC.
21. Another year of historic train. And now? - News from Aveiro. News from Aveiro. 2018.
22. Energy and carbon intensity of transport.
23. Directorate-General for Energy and Geology.
24. Eurostat database.
25. Portuguese environment agency (memoranda on the effect of the covid-19 pandemic on national greenhouse gas emissions).