

THE DEVELOPMENT OF 1435 AND 1520
RAILWAY NETWORK CONNECTIONS
IN FUTURE

POLITICAL ISSUE OR ECONOMIC BENEFIT?

Spanish Contribution



A contribution from the Spanish experience about management of two different gauge Rail Networks

- The initial decision:
 - New HS Line Madrid – Sevilla (1986)
 - Introduction Standard Gauge 1435 in Iberian Peninsula (1988) on the HS transversal corridor Sevilla-Barcelona-French border
 - 1992, new HS Line Madrid – Sevilla on service
- The big High Speed Success in Spain
- How to expand HS Success towards Conventional Network
- European Union directives (and financing)
 - Rail Market Liberalization
 - Interoperability
 - Towards a Single Railway Area
- **Developing Solutions**
 - For Passengers & Freight

Spain's success in High Speed Lines



The Spanish network, a continuous evolution from 1992

1992 - **Madrid-Sevilla: 471 km**

2003 - **Madrid-Lleida: 468 km**
(200 km/h ASFA).

Zaragoza-Huesca: 79 km

2005/06 **Lleida-Tarragona: 95 km.**

Córdoba-Antequera: 100 km.

Connection to Toledo : 21 km.

2007 - **Madrid-Lleida: 468 km**
(300 km/h from May 2007)

Madrid-Valladolid: 181 km.

Antequera-Málaga: 55 km.

2008 - **Tarragona-Barcelona: 88 km.**

2010 - **Madrid-Cuenca: 183 km.**

Madrid-Albacete: 315 km.

Madrid-Valencia: 391 km

Mollet – Girona: 75 km

Intern. Connection with France: 20 km

2011 - **Ourense – A Coruña: 150 km**
(Iberian gauge 1.668 mm)

2013 - **New Connection Barcelona-
French Border 131 km**

Albacete – Alicante: 165 km

2015 - **Santiago C. – Vigo: 94 km**
(Iberian gauge 1.668 mm)

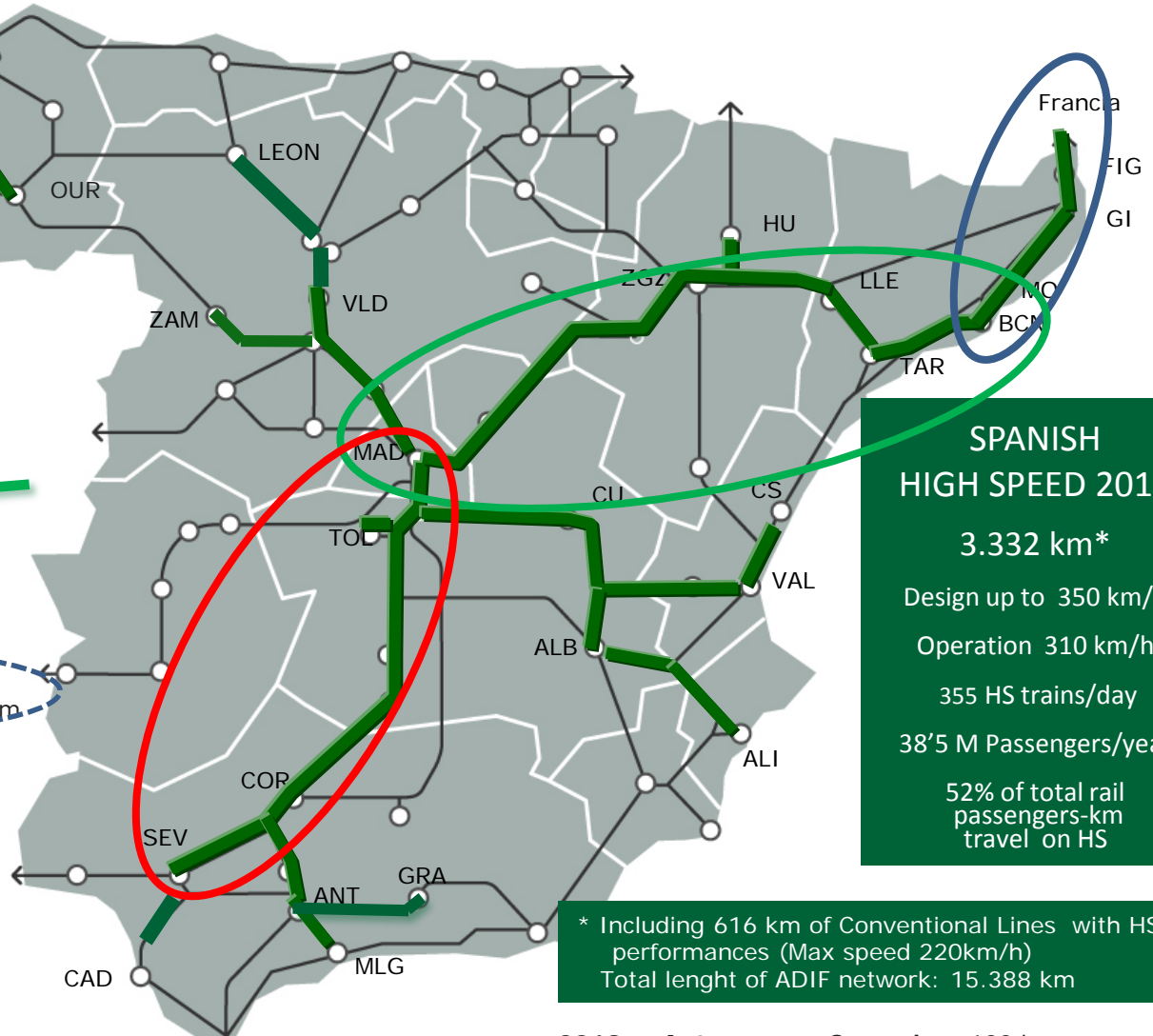
Sevilla – Cádiz : 71 km
(Iberian gauge 1.668 mm)

Valladolid – León: 166 km

Olmedo – Zamora: 103 km

2018 **Valencia – Castellón: 73 km**
(Double gauge Standard – Iberian)

2019 **Antequera – Granada: 122 km**



**SPANISH
HIGH SPEED 2018**

3.332 km*

Design up to 350 km/h

Operation 310 km/h

355 HS trains/day

38'5 M Passengers/year

52% of total rail passengers-km travel on HS

* Including 616 km of Conventional Lines with HS performances (Max speed 220km/h)
Total length of ADIF network: 15.388 km

Adif + Adif AV. Global Figures

▪ Main investor in Spain, in last 25 years (around 57 bn \$)

In 2007-2016	High Speed:	36,000 M€ (40 bn \$)
	Conventional Rail:	6,000 M€ (7 bn \$)

▪ Staff: 13,041 employees

Managed Rail Network: 15,388 km (9,504mi)

High Speed UIC gauge 1,435 mm : **2,682 km (1,666mi)**

100% electrified AC

Conventional Lines (*Iberian gauge 1,668 mm*): **11,483 km (7,135 mi)**

Out of which **616 km (383 mi) with HS parameters**

80 % electrified DC

Mixed Gauge Network (UIC + Iberian gauge) **222 km (138 mi)**

Out of which **34 km (20 mi) with HS parameters**

100 % electrified DC

Metric gauge 1,000 mm: **1,207 km (750 mi)**

▪ HS Lines under construction or project: 2,687 km (1,670 mi)

▪ Fiber Optic Network: 17,868 km

▪ Managed Traffic: 2.1 M trains /year 5,775 trains/day

198.3 M pass train-km/year 541,849 M pass trains-km/day **50,2% HSL**

▪ Passengers: 468 million passengers/year (38.5 million HS)

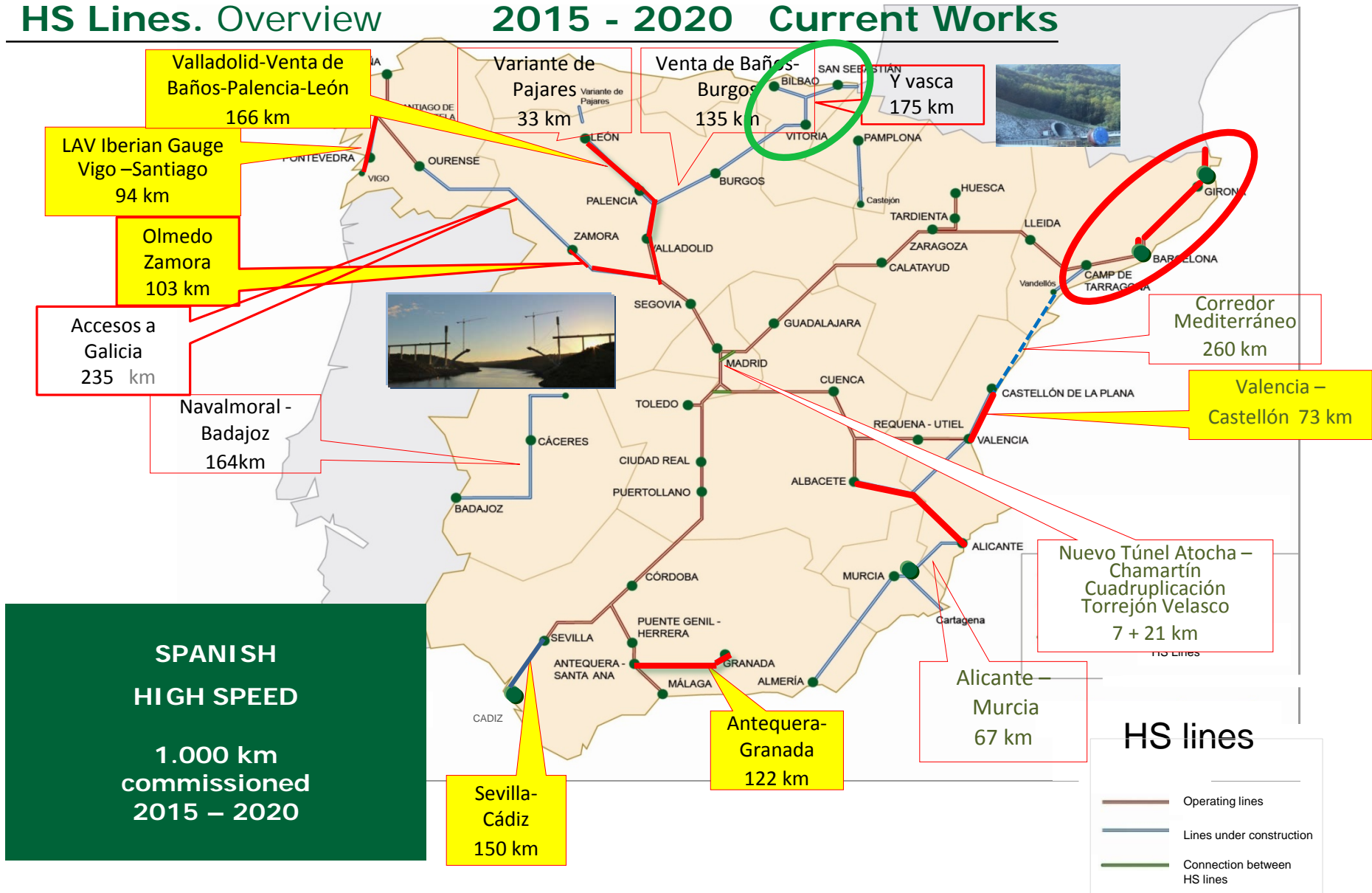
▪ HS Punctuality: 98.5%, second best in the world, after Japan

▪ Freight: 7,557 million net tons-km/year



HS Lines. Overview

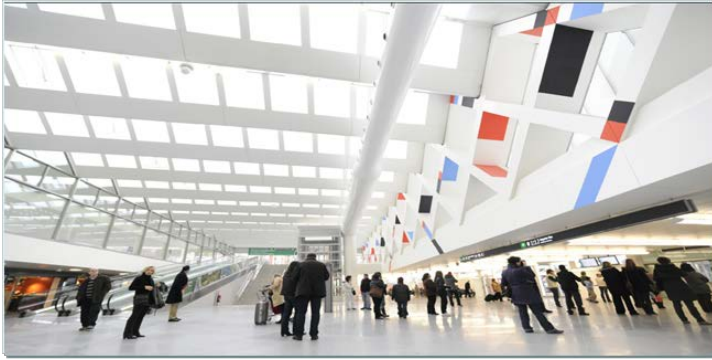
2015 - 2020 Current Works



ON SERVICE JUNE 2019



Stations: OPPORTUNITY FOR CITIES DEVELOPMENT



Madrid Puerta Atocha



Málaga María Zambrano (VIALIA)



Cuenca Fernando Zóbel (Brunel Award 2011)



- ✓ Intermodality for Mobility
- ✓ Services for citizens
- ✓ Urban development for City
- ✓ Bussineses for Rail
Company & Promotors

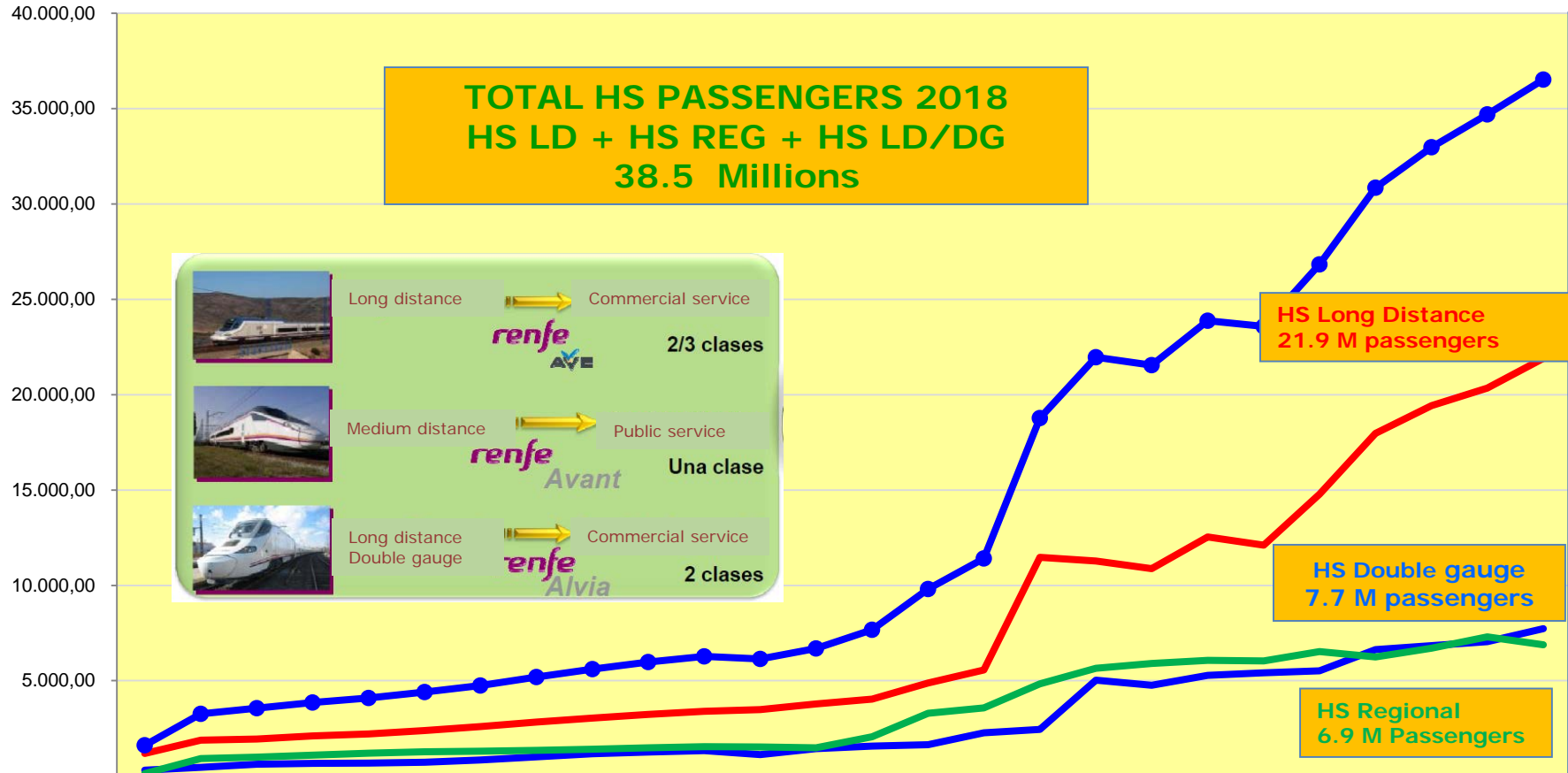
50 High Speed Train Stations + 1.900 Conventional Lines Stations

- Adif has great expertise in Stations commercial management and income-generating activities.
- VIALIAs are a PPP system that provide funding for the design and construction of Stations and ensure revenues for concession holders and for Adif

Evolution of High Speed traffic: A SUCCESS TO BE CONTINUED

Double Gauge trains add 8.0 Millions passengers in 2018

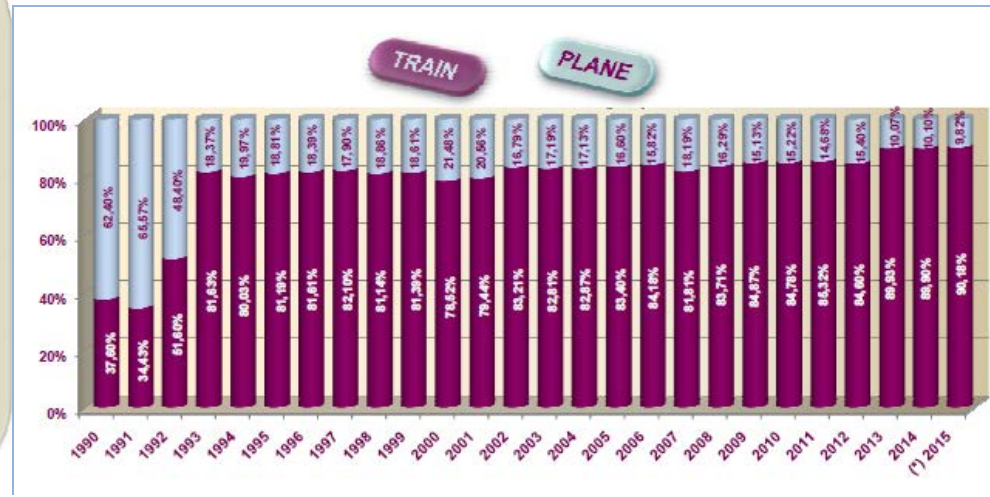
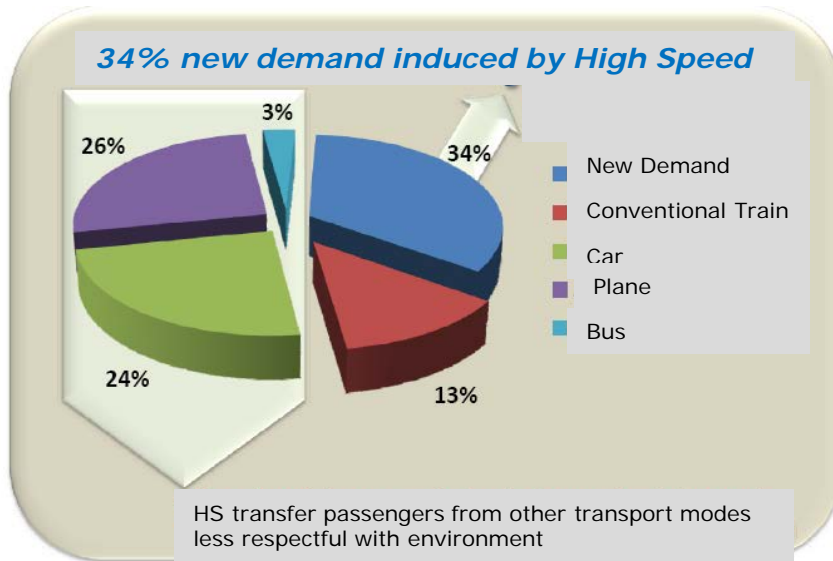
Total HS passengers Grew up 63,8 % between 2012-2018



	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
HS (AVE)	1.178,40	1.885,60	1.942,50	2.098,50	2.214,30	2.390,10	2.591,10	2.831,90	3.036,50	3.237,00	3.394,30	3.480,60	3.785,90	4.030,00	4.878,20	5.559,00	11.474,50	11.278,00	10.869,60	12.536,00	12.113,20	14.776,90	17.966,90	19.428,10	20.346,00	21.900,00
HS variable gauge (Talgo 200-Alvia)	305,60	452,10	619,40	664,70	679,90	731,30	848,70	1.010,60	1.166,10	1.267,10	1.332,60	1.125,00	1.431,60	1.570,00	1.639,00	2.267,00	2.453,60	5.027,90	4.768,50	5.277,80	5.421,70	5.523,70	6.630,90	6.844,90	7.042,40	7.730,00
HS Regional (AVANT)	135,60	918,40	991,70	1.098,40	1.200,00	1.277,00	1.309,40	1.344,20	1.412,40	1.480,60	1.548,80	1.534,30	1.476,00	2.066,10	3.288,70	3.576,40	4.841,70	5.651,90	5.901,90	6.067,70	6.044,00	6.527,50	6.251,30	6.698,80	7.305,20	6.890,00
TOTAL	1.619,60	3.256,10	3.553,60	3.861,60	4.094,20	4.398,40	4.749,20	5.186,70	5.615,00	5.984,70	6.275,70	6.139,90	6.693,50	7.666,10	9.805,90	11.402,40	18.769,80	21.957,80	21.540,00	23.881,50	23.578,90	26.828,10	30.849,10	32.971,80	34.693,60	36.520,00

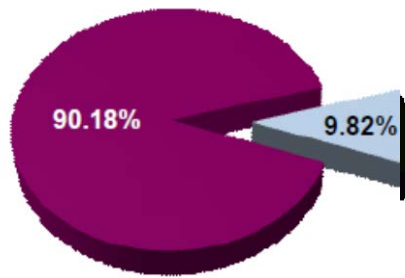
Impact on demand and mobility

HS generates Growth and employment
 HS Madrid - Sevilla: Success from 1992, the first exploitation year



Madrid - Sevilla

■ TRAIN ■ PLANE

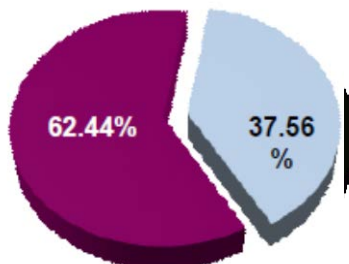


72.17%

occupation

Madrid-Barcelona

■ TRAIN ■ PLANE



86.29%

Market share
 Madrid-Sevilla
 HS 90,2% in 2015

➤ **FROM 1992 (25 YEARS) HS SERVICES IN SPAIN HAVE TRANSPORTED 358 MILLION PASSENGERS (90 M OF THEM ON VARIABLE GAUGE TRAINS) SAVING:**

12,9 MILLION TONNES OF CO₂

2,6 MILLION TON EQUIV. FUEL

4,29 Billion EUR (total investments 51,76 B EUR)

➤ HS TRAINS IN SPAIN HAVE **29% LESS ENERGY CONSUMPTION BY PASSENGER** THAN CONVENTIONAL TRAINS

➤ HS TRAINS IN SPAIN AVOID **3kg CO₂ EMISSIONS** FOR EACH PASSENGER COMING **FROM CONVENTIONAL TRAINS** AND **31kg CO₂ FROM CAR AND PLANE** AS A MEAN VALUE

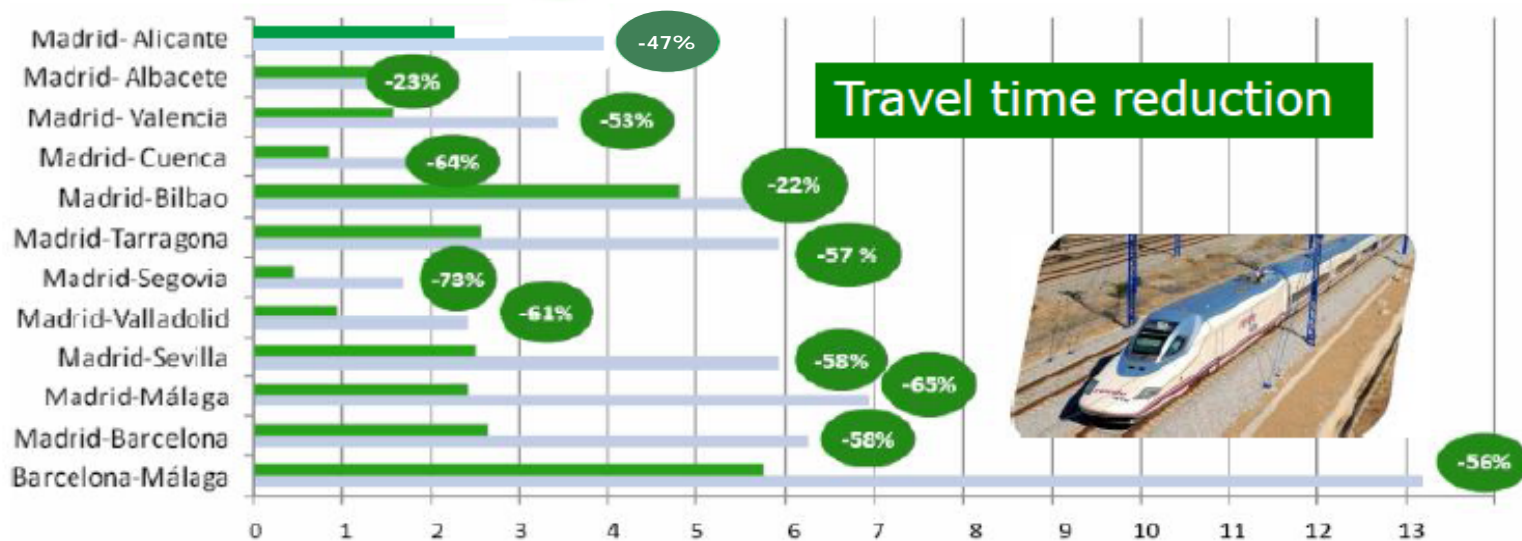
➤ RENFE'S **CARBON FOOTPATH** 24.2gr CO₂ / Unit Transport (56% less than 1990 figure)

Source: FFE / Transportation Research Record Review 2010

HS Lines. Benefits and Positive Impacts

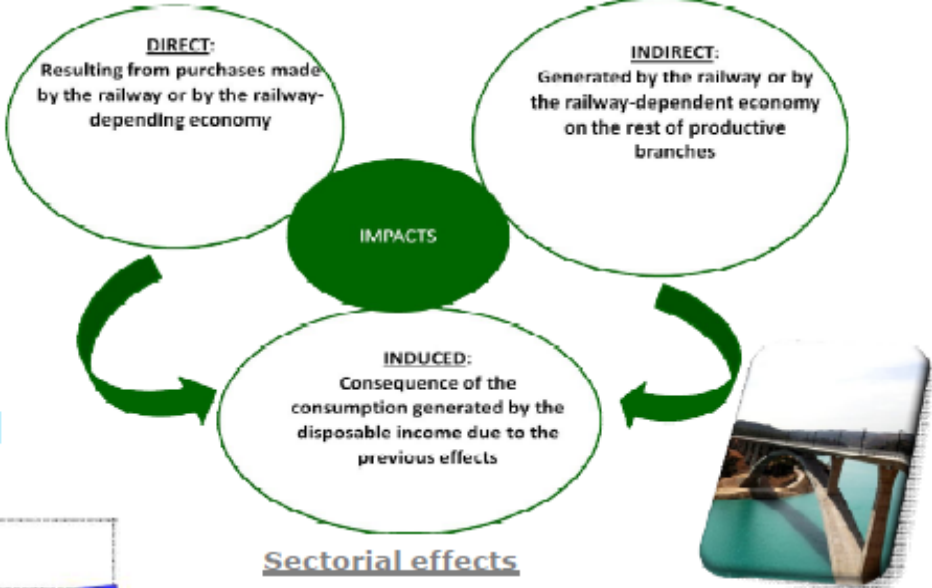
High Speed rail:

- o **attracts** an important percentage (> 30%) of new passengers
- o **is very competitive** with regard to air in short- medium distances
- o **increases its modal share** during the first 3 years up to becoming stable
- o **takes up share** from the air mode and, to a lesser extent, from the private vehicle
- o means more than 50% in travel time reduction with regard to the road

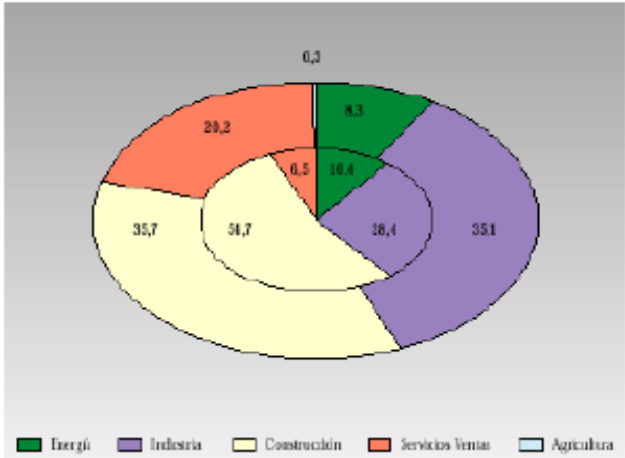
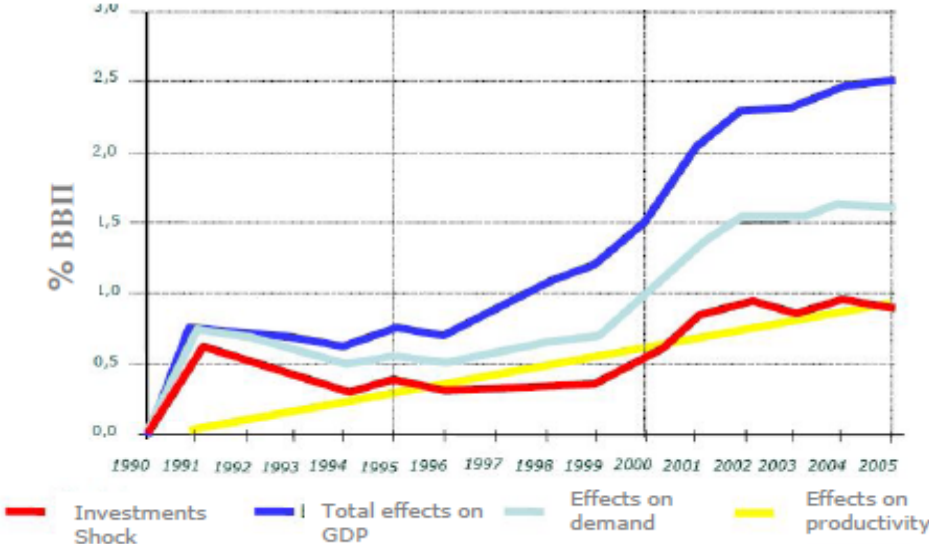


38,5 million HS passengers/year in Spain
52 % passengers-km are HS

HS Lines. Socio-economic Impacts



Socio-economic effects of the rail investments on GDP



HS Lines. Socio-economic Impacts

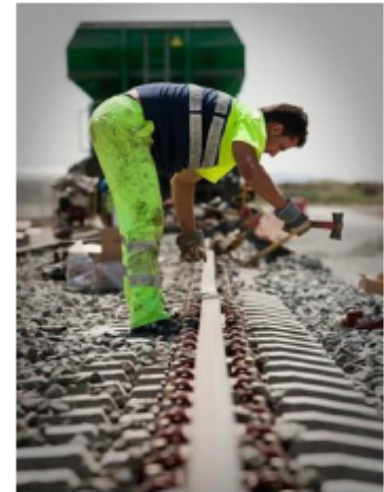
Socio-economic impacts. SEOPAN study : **fiscal return and employment created by infrastructures investment (2009).**

General employment by one infrastructure investment equivalent to 1% GDP (Spanish case) :

117,500 Direct employments
63,100 Induced employments



255 employments by 1 each km (direct + induced)



Spreading Benefits

Integration of Conventional Lines & European Dimension

Improved Conventional lines

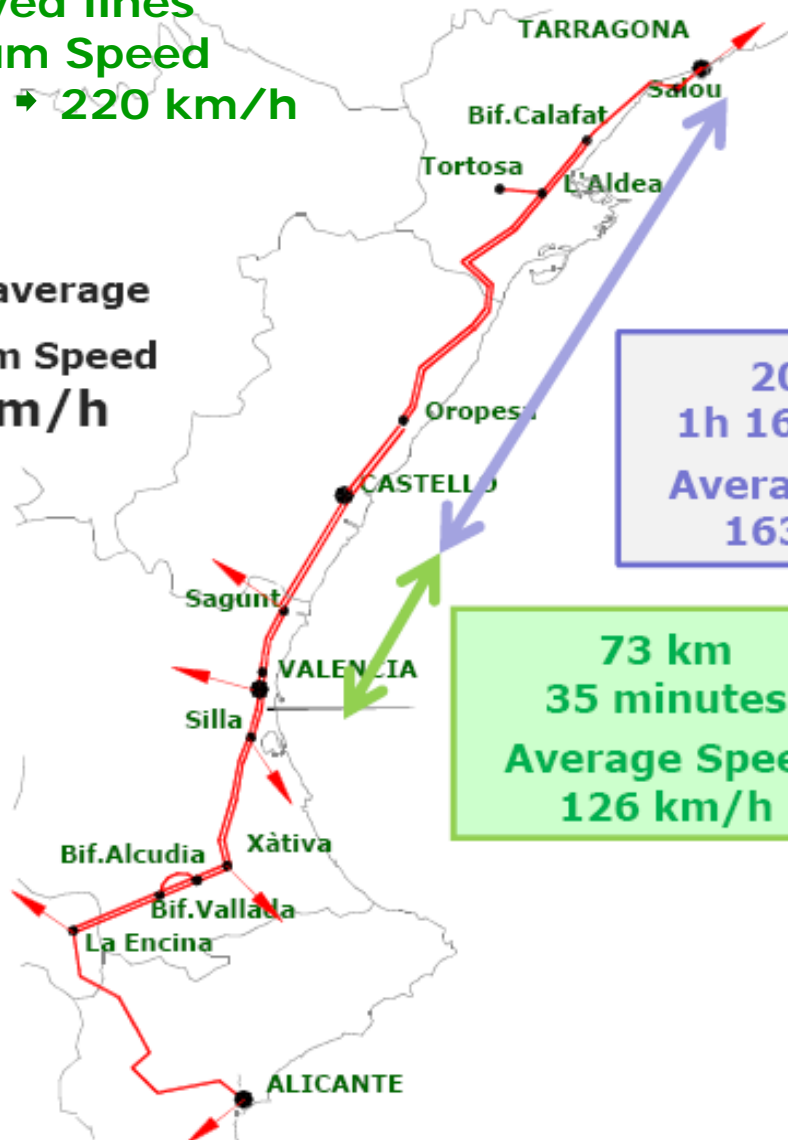
Maximum speed 160 ➡ 200 ➡ 220 km/h



Improvement actions on conventional lines: MEDITERRANEAN CORRIDOR

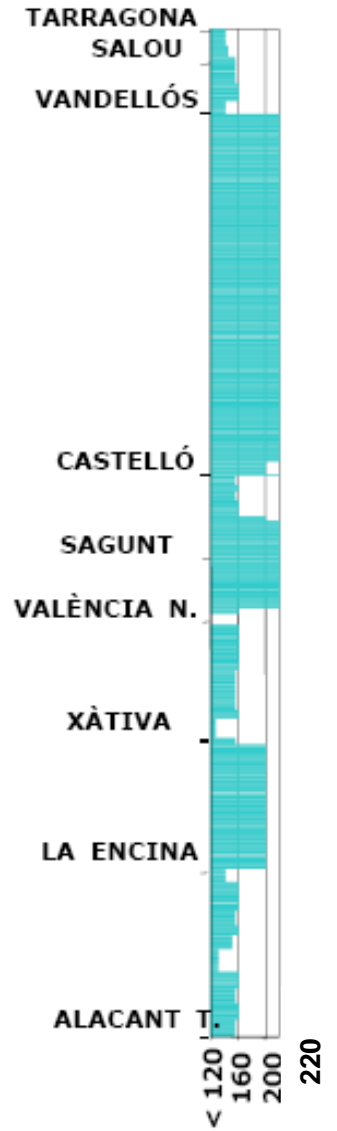
Improved lines
Maximum Speed
160 → 200 → 220 km/h

Weighted average
of Maximum Speed
197 Km/h



207 km
1h 16 minutes
Average Speed
163 km/h

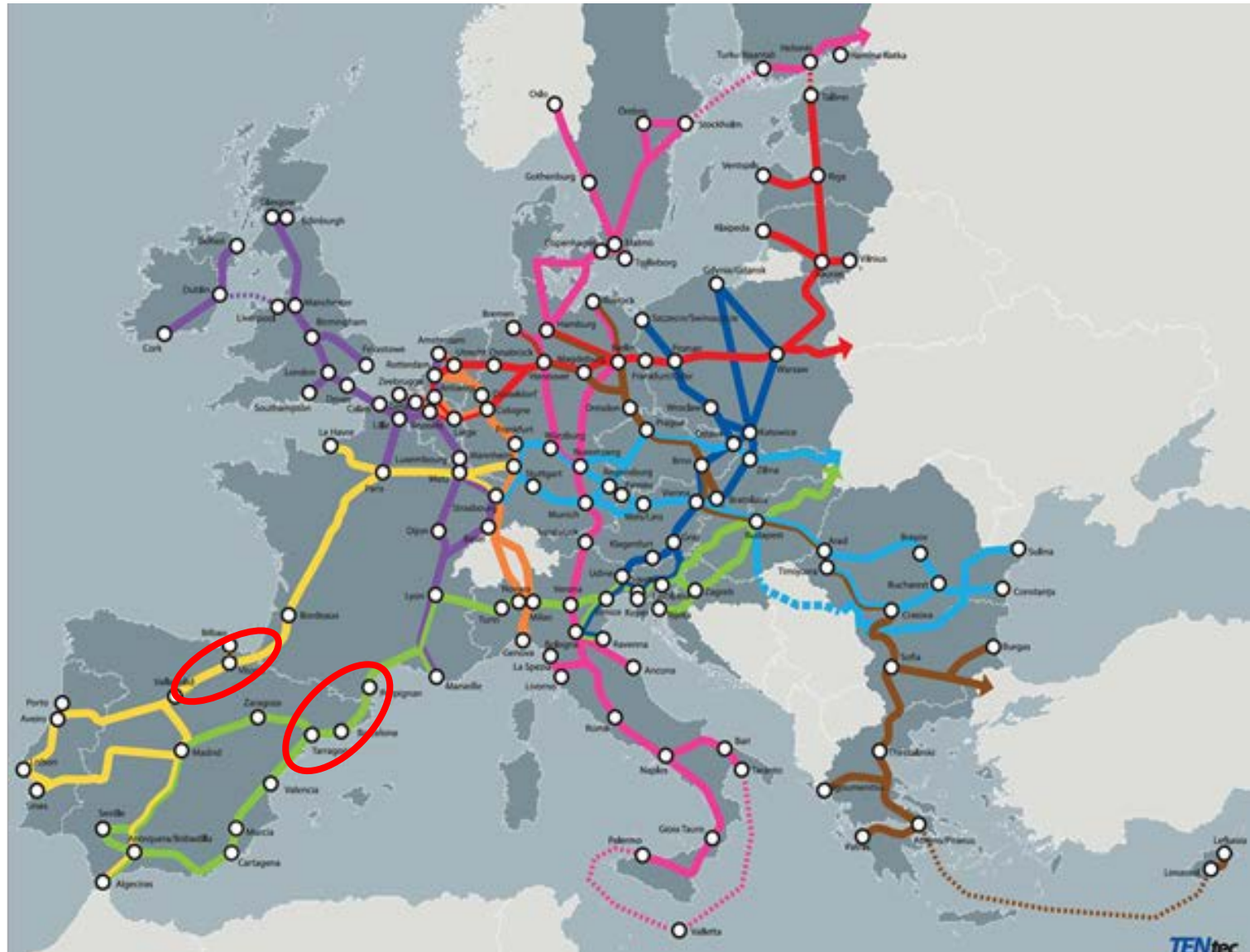
73 km
35 minutes
Average Speed
126 km/h



European Dimension: Multimodal Corridors of the Core TEN T Network

RFC Rail Freight Corridors

1. Baltic Adriatic
2. North Sea - Baltic
3. Mediterranean
4. Orient / East - Med
5. Scandinavian – Mediterranean
6. Rhine – Alpine
7. Atlantic
8. North Sea – Mediterranean
9. Rhine – Danube



Spanish Solutions

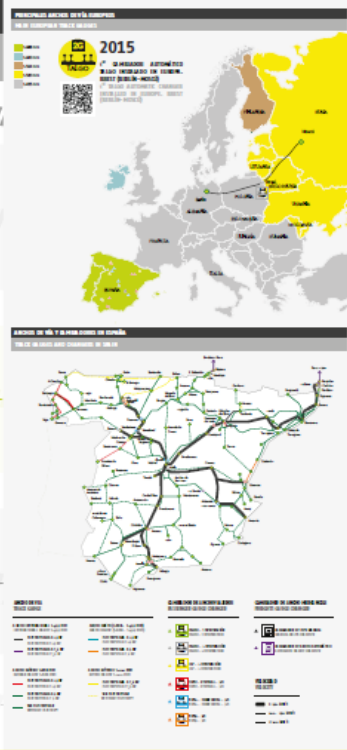
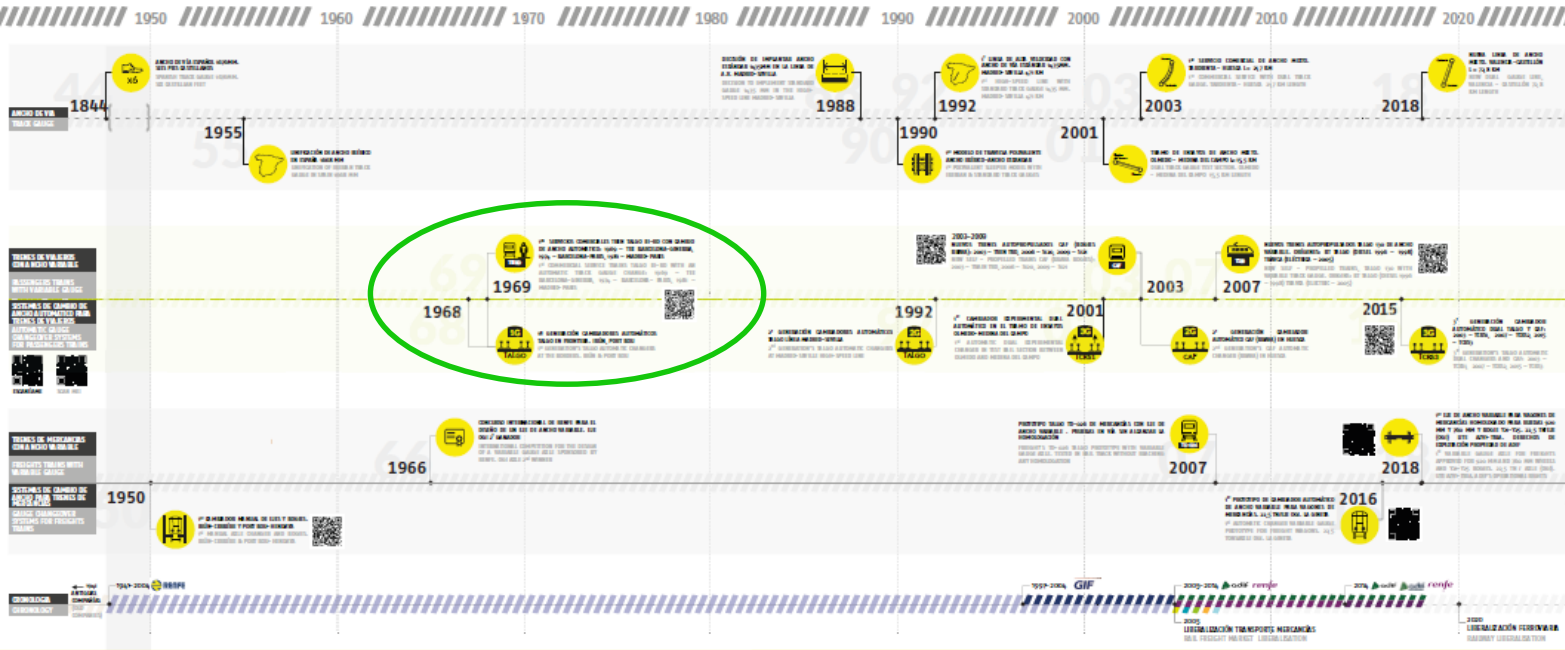
Technology to solve
different gauges
operation



SPAIN TRACK GAUGE INNOVATION STORY: A practical experience starting in 1968 and speeding from 1992

HISTORIA DE LA INNOVACIÓN DEL ANCHO DE VÍA EN ESPAÑA

SPAIN TRACK GAUGE INNOVATION HISTORY



First step: solutions for passengers

Evolution from an initial solution designed for passenger coaches to the introduction of variable gauge also for traction axles on locomotives and EMUs/DMUs

Talgo



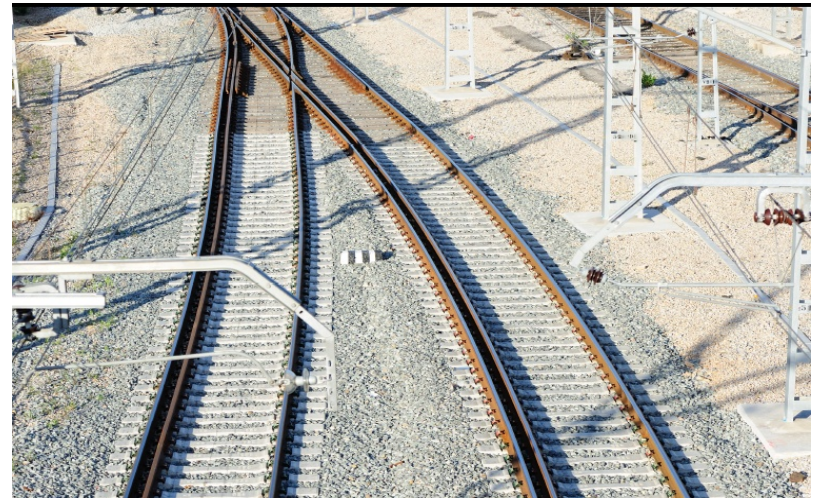
CAF



adif

Solutions for passengers could to be applied in a similar way to Freight + Solution to be applied on tracks

- Automatic track gauge switches for international and Spanish gauge performed at 20 km/h (Passengers*)
 - * Similar to that applied by Talgo and RZD for Talgo Train Moscow – Berlin (1520-1435)
- Technology of three rails track for Spanish and international gauge (Freight)



SPANISH APPROACH: HS STANDARD GAUGE & IMPROVEMENT ON TRACK

Main Projects

OF EXISTING LINES

International Gauge Implementation – France-Barcelona-Tarragona



- **In operation – 159 km**
 - Figueres-French Border – **2 x UIC**
 - Mollet-Girona-Figueres – **2 x UIC**
 - Castellbisbal-Mollet – **Double 3 rails-track**
 - PortBCN-Castellbisbal – **3rails-track**
- **Under construction – 97 km**
 - Castellbisbal-Tarragona
 - **Double 3rails-track**
 - 5 sidings -750m-
 - 417 M€

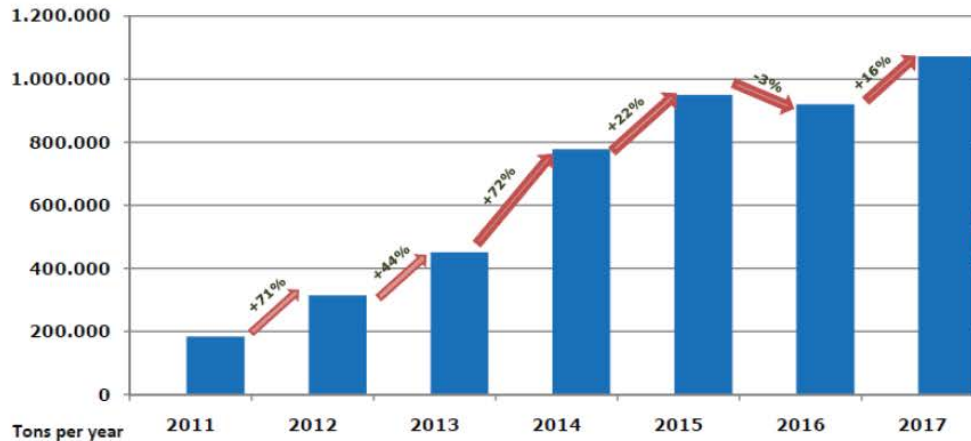
Results: International Freight Rail Traffic Patterns in the Corridor

1.- Recovery of International Freight Rail Traffic on Barcelona – French Border section

	2012	2013	2014	2015	2016	2017	2012-2017
Tons	1.048.097	1.237.208	1.605.058	2.248.696	2.249.581	2.306.107	+120%
Trains	1.852	2.088	2.521	2.773	2.762	2.785	+50%

International Freight Trains registered at Portbou and Figueres Stations

2.- Higher Increase on Standard Gauge Freight Traffic (Barcelona-LFP-Perpignan)



2011 227 trains/year
 2014 870 trains/year
 2017 1.118 trains/year

2019 ↑ 27%
2020 ↑↑ +70% additional

765 Tons/Train Iberian Gauge
1.081 Tons/Train Standard Gauge

New container traffic service between Monzón and Lyon on standard gauge tracks

Renfe Mercancías, Terminal Intermodal de Monzón (TIM) and TP Nova have launched a new international intermodal container traffic service between Spain and France using the high-speed track and the Perthus Tunnel.

(19/12/2018) class="MsoNormal" style="text-align:justify">

Trains run between Monzón Intermodal Terminal, Best, located in the Port of Barcelona, and the French one, the Lyon-Vénissieux terminal, from where they return also loaded with containerized goods. From the Spanish and French terminals, the containers are distributed to their final destination both by road and by rail.

This traffic, which has a load capacity of up to 72 Teus per train, is initially a weekly service, although Renfe Mercancías plans to increase the number of trains at a later stage.



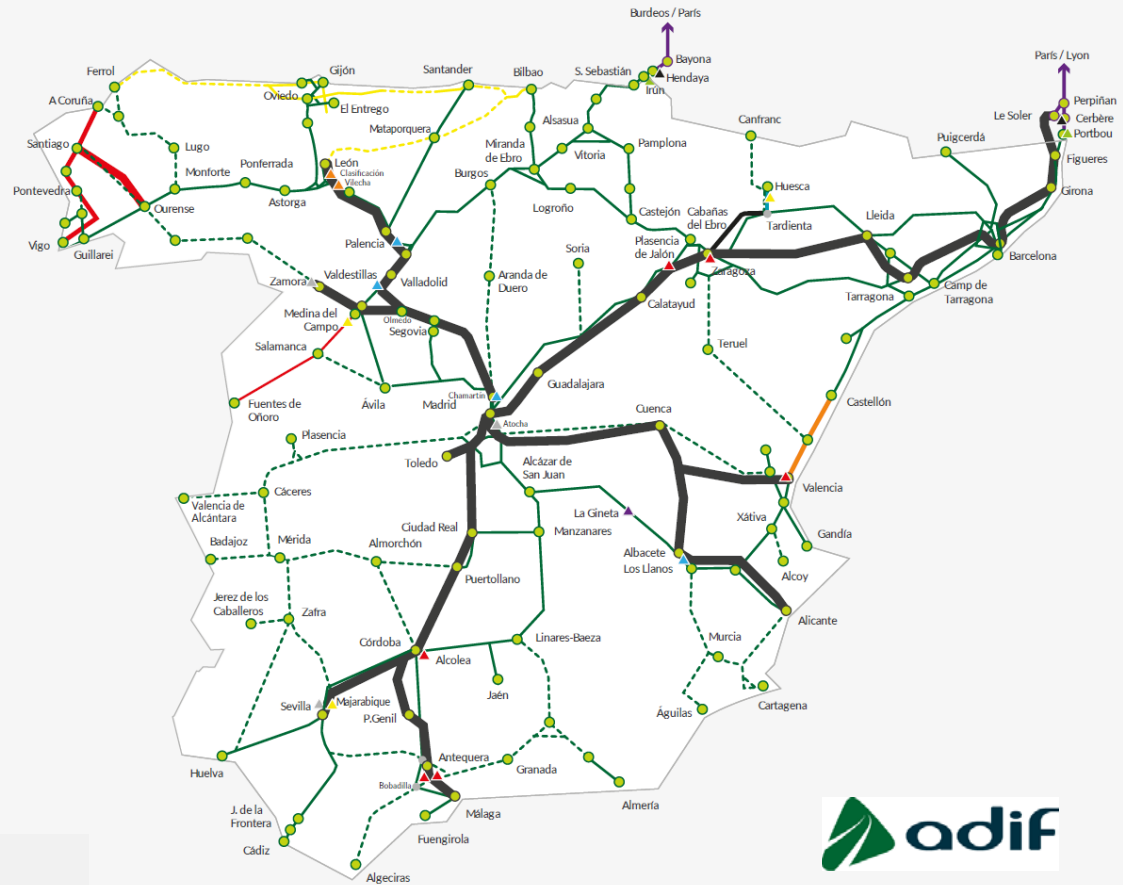
Up to 72 TEUs per train from Barcelona Port to Lyon-Vénissieux...and return...on standard gauge tracks

Adif experience: Passenger solution

- Starting **1969** Talgo coaches
- From **2007** also traction axles
- Talgo and Caf whole trainsets
- **15** changeover facilities

ANCHOS DE VÍA Y CAMBIADORES EN ESPAÑA

TRACK GAUGES AND CHANGERS IN SPAIN



CAMBIADOR DE ANCHO VIAJEROS
(PASSENGER GAUGE CHANGER)

- TALGO - 1 GENERACIÓN
TALGO - 1 GENERATION
- TALGO - 2 GENERACIÓN
TALGO - 2 GENERATION
- CAF - 2 GENERACIÓN
CAF - 2 GENERATION
- TCRS1 - VERTICAL - 3G
TCRS1 - VERTICAL - 3G
- TCRS2 - HORIZONTAL - 3G
TCRS2 - HORIZONTAL - 3G
- TCRS3 - 3G
TCRS3 - 3G

Number of changes

2009	24.036
2010	28.540
...
2019(*)	> 40.000

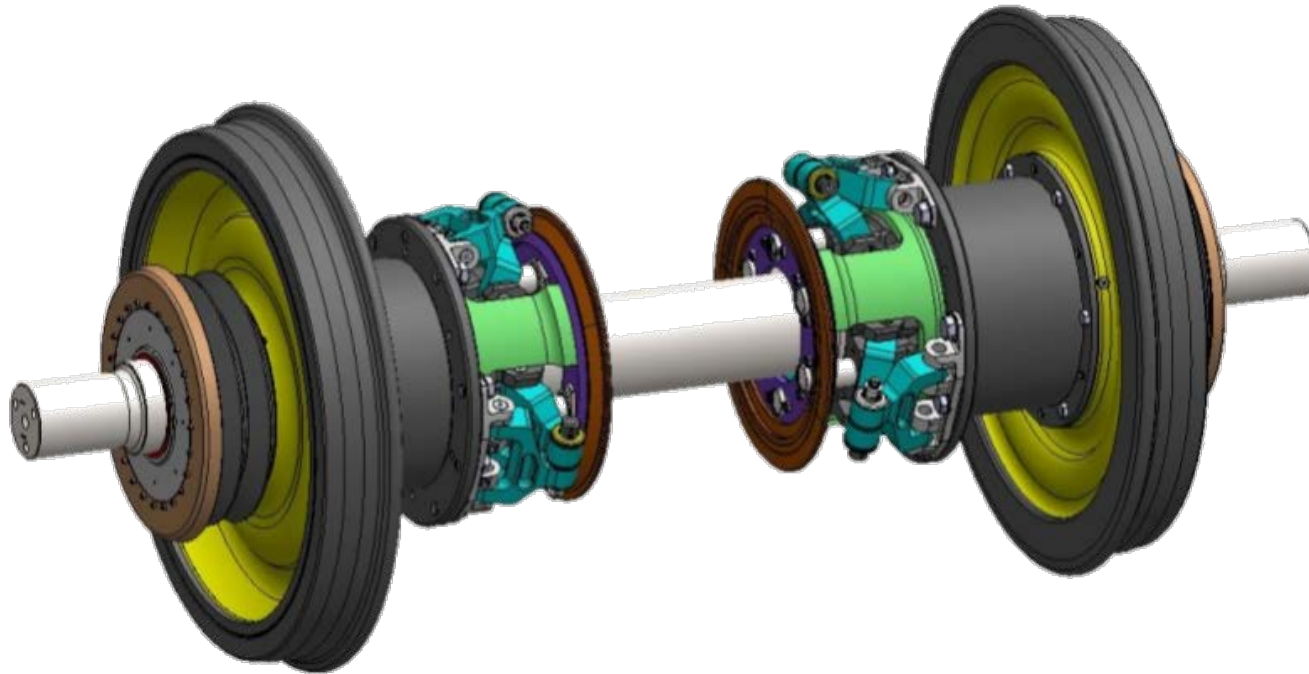
Interoperability:

Passenger Services by HS trains with automatic gauge changing



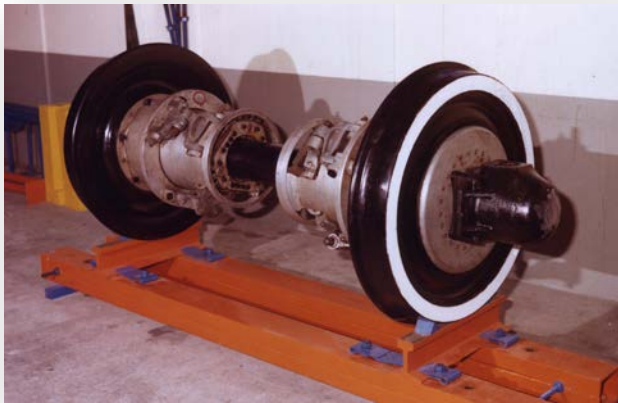
CURRENT SOLUTION BEING DEVELOPED FOR FREIGHT

Variable gauge OGI axle for freight



Variable gauge OGI axle for freight

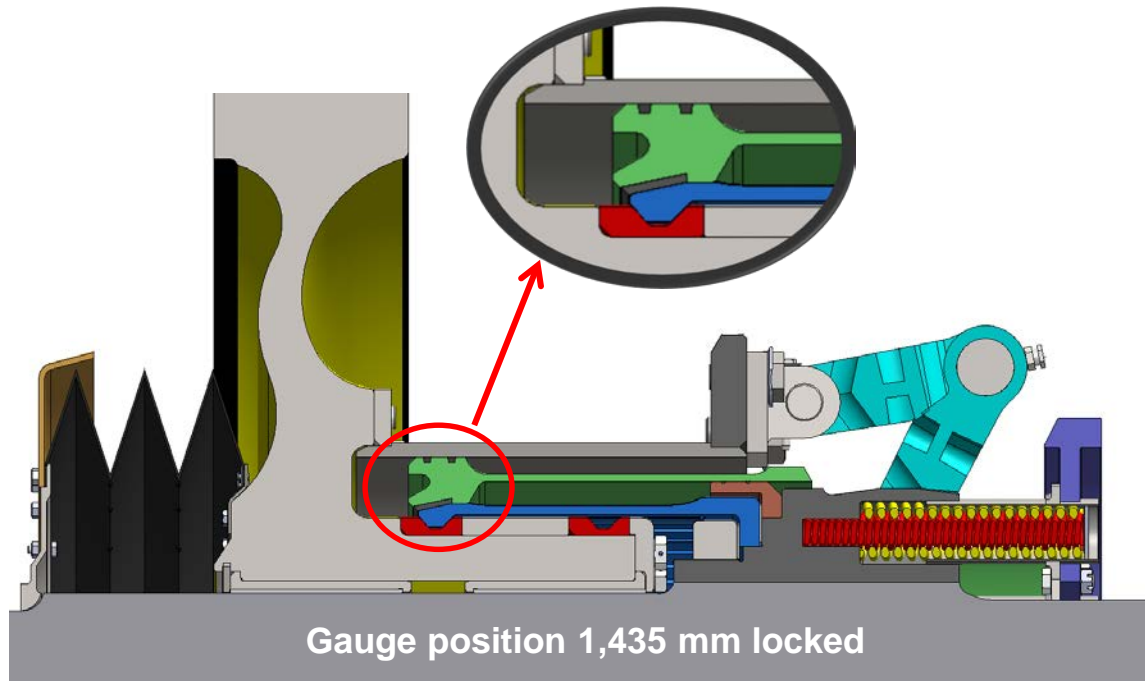
- 1,668/1,435 mm. Also adaptable to, 1,520.
- Maximum load up to 22.5tn/axle.
- Y21 or Y25 bogies and two-axle wagons.
- Gauge changeover process without stopping.
- **Homologated by AESF (Spanish Agency for Railway Safety) for wheels 760 and 920 mm.**



Variable gauge OGI axle for freight



- GAUGE CHANGEOVER Process



Variable gauge OGI axle for freight

- Status of the **PROJECT**



Homologation process according to the Spanish Technical Specifications for Homologation (ETH) Rolling Stock. Wagons



Laboratory Tests: carried out in Cetest.

- Axle with 920 mm wheel: 10 million of cycles
- Axle with 760 mm wheel: 10 million of cycles

On Track Tests: 500 gauge changeover processes at the Adif facility in La Gineta, Albacete.

Carried out between June 21 and 29, 2017.

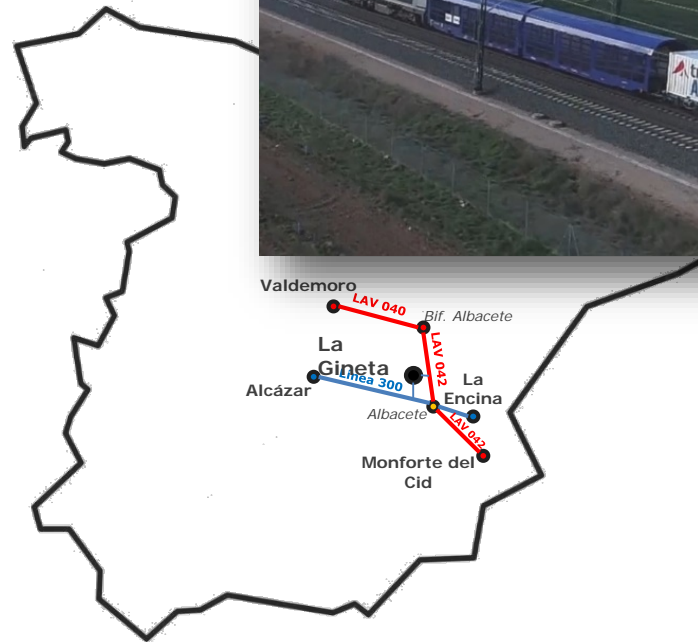


Variable gauge OGI axle for freight



- On service TESTS

- **Phase I: 50,000 km** carried out in **Iberian gauge**. Railway Lines 310, Stretch: Aranjuez-Cuenca and 300, Stretch: Alcázar de San Juan-La Encina. Finished in November, 2017.
- **Phase II : 50,000 km** carried out in **Iberian gauge and 20 % in UIC gauge**. Finished in April, 2018.
- **Phase III : 150,000 km test ongoing**. Finish expected november 2019.
 - Iberian gauge: on Lines 310 and 300.
 - UIC gauge: on High-Speed Line Madrid-Valencia-Alicante, between Valdemoro AV and Monforte del Cid.





Many thanks for your attention

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