

Developing a Successful High Speed Rail Network The Spanish Case



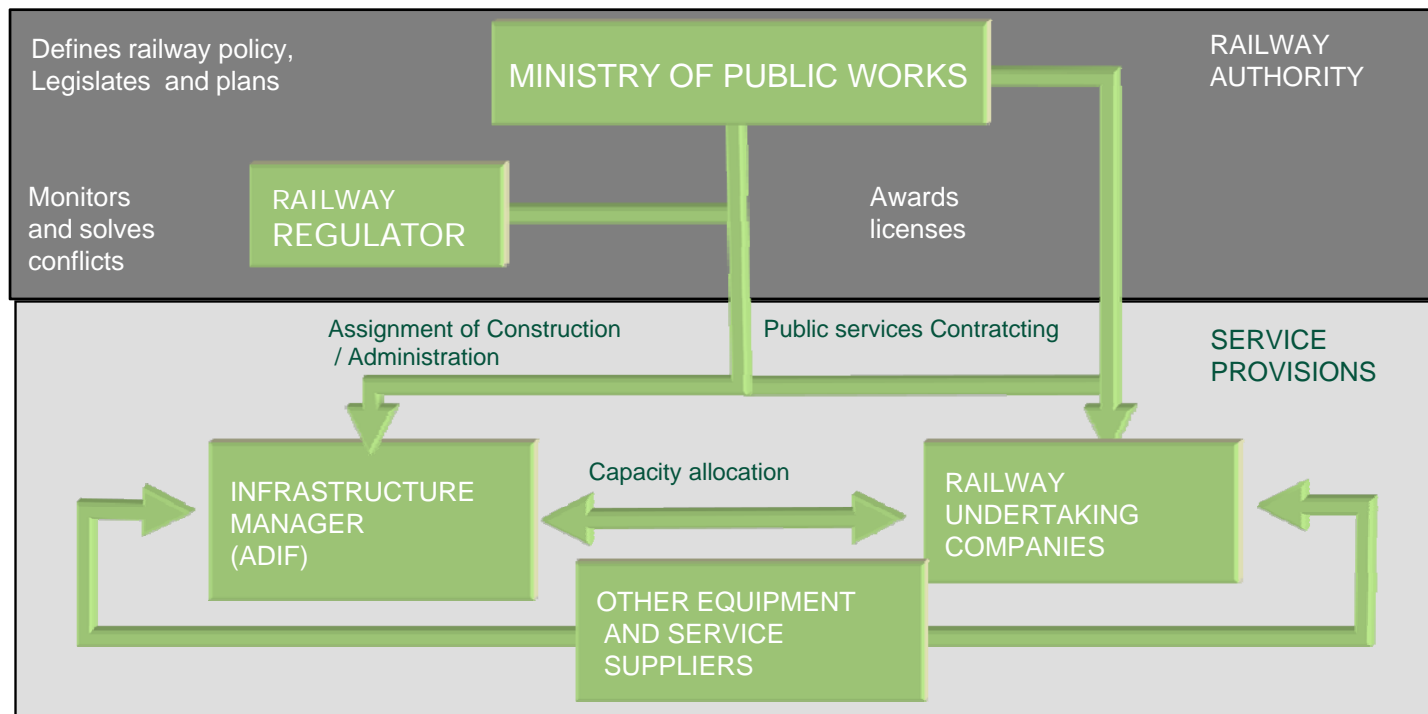
Joaquín Jiménez Otero
Director International Relations

Public Debate on High Speed Railways
Warsaw, 30th August 2011

Current railway scenario in Spain

New legal framework. Railway Industry Law 39/2003

- Infrastructure management and transport operation separation
- Opening of the freight railway market to competition



As of
January 1,
2005

Current railway scenario in Spain

■ Strategic Plan for Transport Infrastructures 2005-2020

250.000 M€

- 120.000 M€ until 2020, 48% of the total amount for railways

■ Multi-annual Contract Adif-State 2007-2010 / 2011-2014

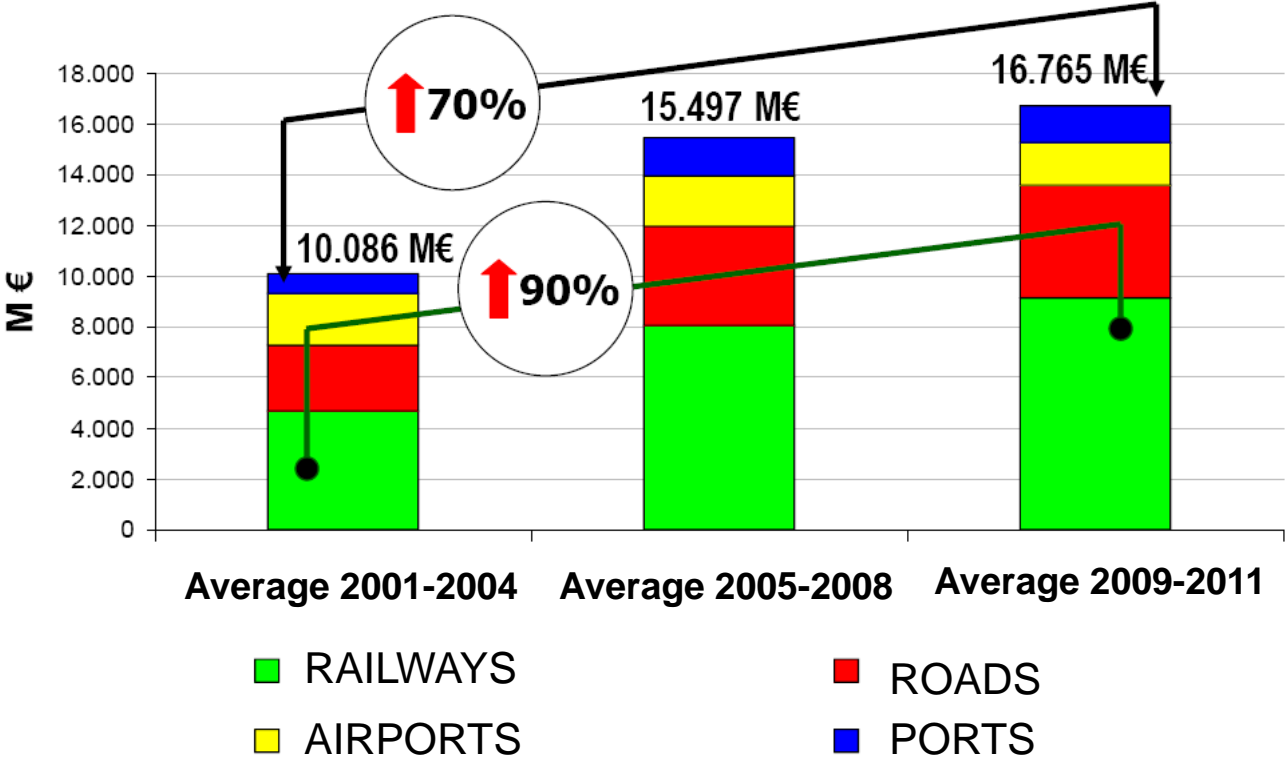
- To ensure the funding of its activities
- Commitment for improving the State's network
- Drawing up a new Multi-annual Contract

■ Extraordinary Infrastructure Plan

- Public-private PPP collaboration Plan
- 17.000 M€ for the next two years
- ADIF: 10.000 M€

Ministry of Public Works investments

Investment by mode of transport





Public entity attached to the Ministry of Public Works

Infrastructure Management

- Railway network of general public interest owned by the Estate
 - Own assets:
 - Madrid- Sevilla HSL (Standard Gauge)
 - HS network built by Adif (Standard Gauge)
 - Stations and Logistic Services
 - Telecommunications network
- Madrid- Toledo (2005)
Madrid- Valladolid (2007)
Córdoba- Málaga (2007)
Madrid- Barcelona (2008)
Olmedo – Medina (2008)
Connection Sur – Noroeste (2009)
Madrid- Cuenca-Valencia / Albacete (2010)



Adif. Global figures 2005-2010

- **1st investor company in Spain, in 6 years (2005/2010) 28.478 M€:**

High Speed: 23.546 M€

Conventional Network: 4.932 M€

- **Fixed Assets ⁽¹⁾ 32.398 M€**

- **Own Resources ⁽¹⁾ 15.317 M€**

- **2010 Managed rail network: 13.853 km**

High Speed 2.776 km

Iberian gauge 11.077 km

- **2011 HS Lines Construction, Project & Study 2.363 km**

- **2015 Objective HS Lines on Service 5.600 km**

- **Optical fibre network: 16.130 km**

- **Stations: 1.568**

- **Passengers 2010 at stations: 772 M**

- **Number of trains 2010: 1,8 M trains**



Adif. Functions

- Administration, maintenance and renewal of State network, commissioned by the State
- Construction of new lines when commissioned
- Management of traffic operations on both networks, the State and the own one
- Maintenance and renewal of the own network
- Network Statement
- Capacity allocation to railway undertakings
- Collecting fees and charges for the access and use of infrastructure, stations and terminals

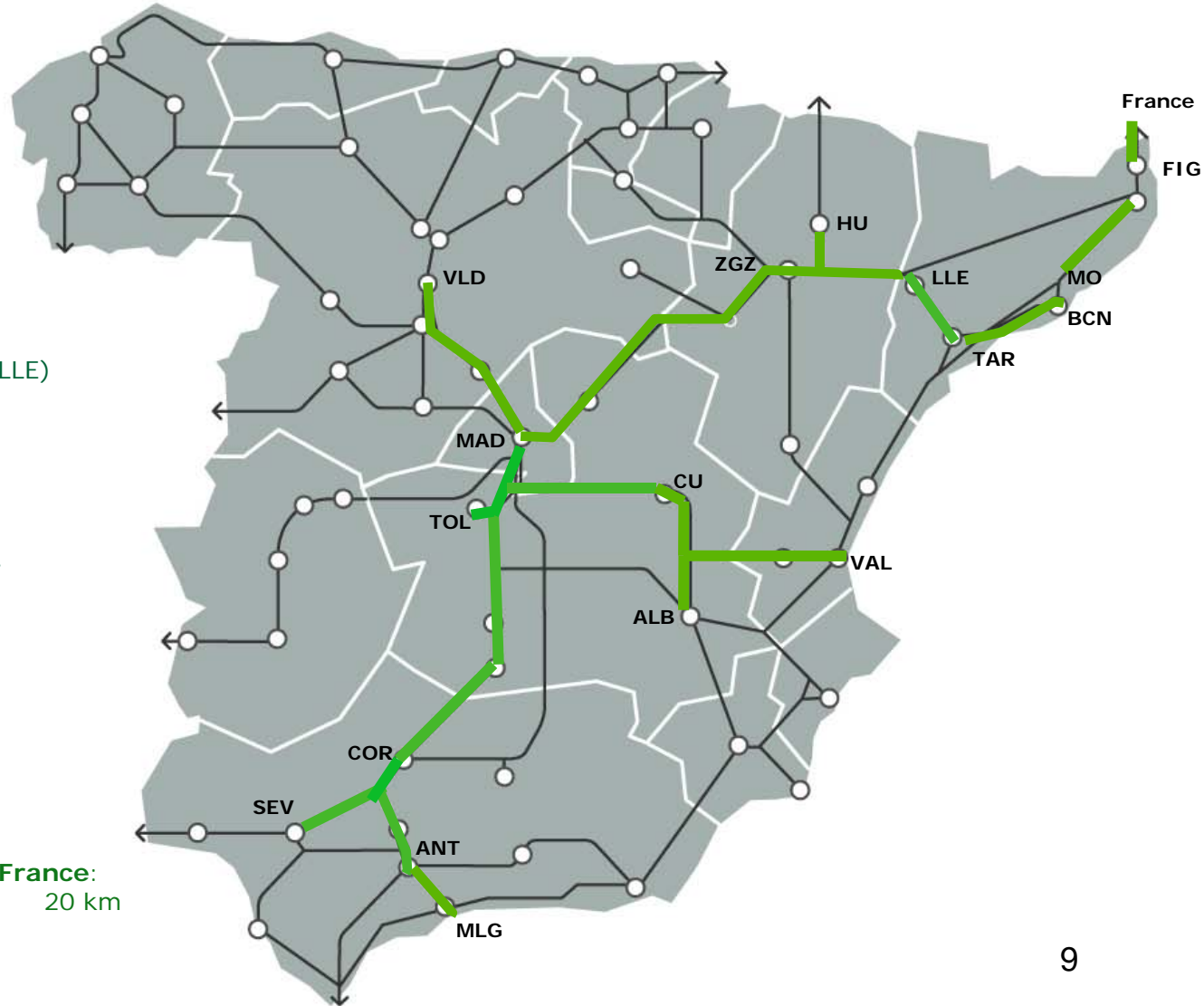


The success of the Spanish High Speed Rail Network

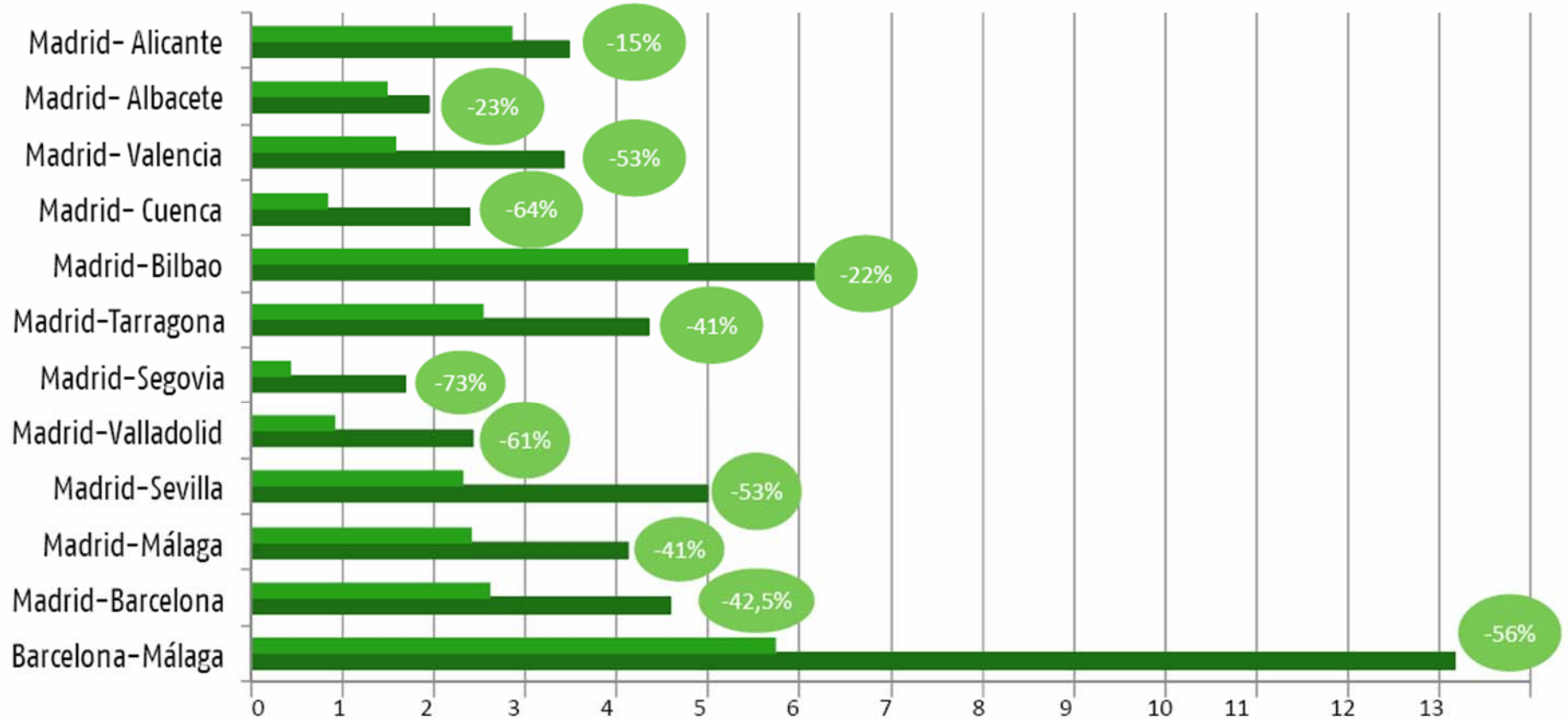


High Speed Lines. Landmarks

- 1992 - **Madrid-Sevilla:** 471 km
(MAD-SEV)
- 2003 - **Madrid-Lleida:** 468 km
(200 km/h ASFA).
(MAD-LLE)
- Zaragoza-Huesca:** 79 km
(ZGZ-HU)
- 2006 - **Lleida-Tarragona:** 95 km.
(LLE-TAR) / (COR-ANT) / TOL
- Córdoba-Antequera:** 100 km.
- Toledo connection:** 21 km.
- 2007 - **Madrid-Lleida:** 468 km (MAD-LLE)
(300 km/h since May 2007)
- Madrid-Valladolid:** 181 km.
(MAD-VLD)
- Antequera-Málaga:** 55 km.
(ANT-MLG)
- 2008 - **Tarragona-Barcelona:** 88 km.
(TAR-BCN)
- 2010 - **Madrid-Cuenca:** 183 km.
(MAD-CU)
- Madrid-Albacete:** 315 km.
(MAD-ALB)
- Madrid-Valencia:** 391 km
(MAD-VAL)
- Mollet – Figueres:** 75 km
(MO-FIG)
- International Connection to France:**
20 km



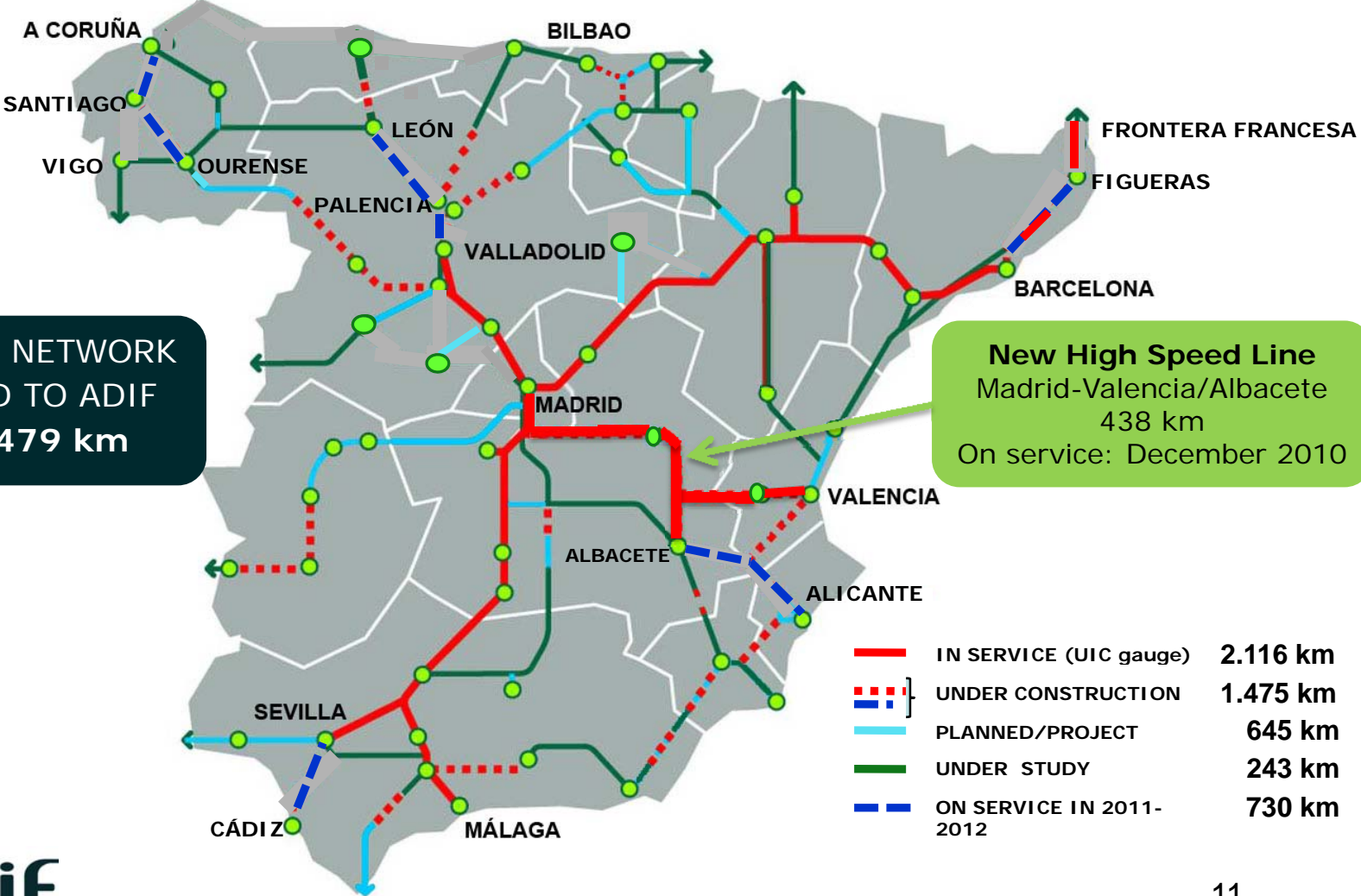
Travel time reduction in High Speed Lines



Adif's High Speed Lines. Current situation

**HIGH SPEED NETWORK
ENTRUSTED TO ADIF
Total: 4.479 km**

**New High Speed Line
Madrid-Valencia/Albacete
438 km
On service: December 2010**



	IN SERVICE (UIC gauge)	2.116 km
	} UNDER CONSTRUCTION	1.475 km
	PLANNED/PROJECT	645 km
	UNDER STUDY	243 km
	ON SERVICE IN 2011-2012	730 km



High Speed lines in Europe

COUNTRY	IN SERVICE	UNDER PROJECT/ CONSTRUCTION	PLANNED
SPAIN (Adif)	2,776*	2,120	243
FRANCE	1,872	299	2,616
GERMANY	1,285	378	670
ITALY	876	-	395
BELGIUM	209	-	-
UNITED KINGDOM	113	-	-
SWITZERLAND	35	72	-
NETHERLANDS	120	-	-
PORTUGAL	-	-	1,006
SWEDEN	-	-	750
POLAND	-	-	712
RUSSIA	-	-	660
TOTAL	7,286	2,869	7,052

* Including 641 km of HSL with Iberian gauge (newly constructed) and 20 km in Spain by TP Ferro as concessionary

2010 SITUATION

HSL in Europe 7,286 km
HSL in the world 12,551 km

2015 FORECAST

HSL in Europe 10,407 km



Stations

2005-2010. HS Stations

NEW

- ✓ Antequera Santa Ana
- ✓ Camp de Tarragona
- ✓ Málaga María Zambrano (VIALIA)
- ✓ Puente Genil Herrera
- ✓ Segovia Guiomar
- ✓ Cuenca Fernando Zóbel
- ✓ Albacete Los Llanos (VIALIA)
- ✓ Requena - Utiel
- ✓ Valencia Joaquín Sorolla
- ✓ Figueres-Vilafant

REFURBISHED

- ✓ Barcelona Sants
- ✓ Madrid Chamartín
- ✓ Toledo
- ✓ Valladolid
- ✓ Madrid Puerta de Atocha



Future High Performance network (2020)



SPAIN. A World Leader in High Speed Rail

- **A global leader:** In 2010, Spain has 2.776 km of HS lines in commercial operation (including 20 km of the international connection with France), and 2.363 km in study, design and construction.
- **Longest HSL in the world:** Barcelona-Madrid- Málaga: 1,121 km
- **Speed achievement in:**
 - Lines that allow, in 90% of the route, speeds of at least 300 km/h
 - Record in a commercial standard line: 405 km/h
- **Leaders in train punctuality:** 99.6%, number 1 in the world
- **Safety and comfort.**
 - 0 Accident
 - 96% customer satisfaction
- **Cost and construction efficiency**
 - Lower cost per line in Europe 15 mill. €/km.
 - 4 years overall time from construction to operation
- **Innovative solutions and technologies**
- **At the forefront of interoperability and industrial developments**

**24 YEARS OF EXPERIENCE
IN THE COMPLETE
DEVELOPMENT PROCESS
OF HIGH SPEED**

Operations. High speed excellent service, top satisfaction

- City center and urban transport connection by new High Speed lines (24 cities), raising to 44 with double gauge High Speed trains
- Punctuality commitment (99,6%) total ticket refund if 5' delay
- Flexibility ticketing
- Comfort
- Safety (0 accidents)
- On board services
 - ✓ Facilities for handicapped
 - ✓ Free access to commuter network
 - ✓ Parking
 - ✓ Gourmet menu
 - ✓ Nursery
 - ✓ Video and music channels
 - ✓ Daily press and magazines

307 HS trains
per day

111.500
seats/day of
HS

First AVE line

95% of all customers are satisfied after 19 years of operation

New lines

96% of all customers are satisfied after the first year of operation

Adif general strategic goals

- **Guaranteeing safety**
- **To increase the global efficacy of the Railroad System**
- **To improve territory coordination by railway**
- **To help the social cohesion and the sustainable development**
- **To promote the well-being of the citizens and the quality of life**



Conventional Network (owned by State) main features



Conventional network : 11.748 km

Single track: 8.600 km

Double track: 3.148 km

Type A (more than 50 trains/day)	3.835 Km (33%)
Type B (15-30 trains/day)	2.681 Km (23 %)
Type C (less than 15 trains/day)	3.088 Km (26%)
Commuters	2.144 km (18%)

Electrified lines	6.483 km (55%)
Lines with automatic block	6.876 km (59%)
Lines with automatic liberalisation Block	1.983 km (17%)
Lines with telephone block	2.484 km (21%)
Lines with CTC	8.086 km (69%)

Lines that allow speeds from 180 to 200 km/h	403 km (3%)
Lines that allow speeds from 140 to 160 km/h	4.805 km (41%)
Lines that allow speeds from 100 to 140 km/h	3.528 km (30%)
Lines that allow speeds less than 100 km/h	3.012 km (26%)

Multi-Annual Contract Adif-State 2007-2010

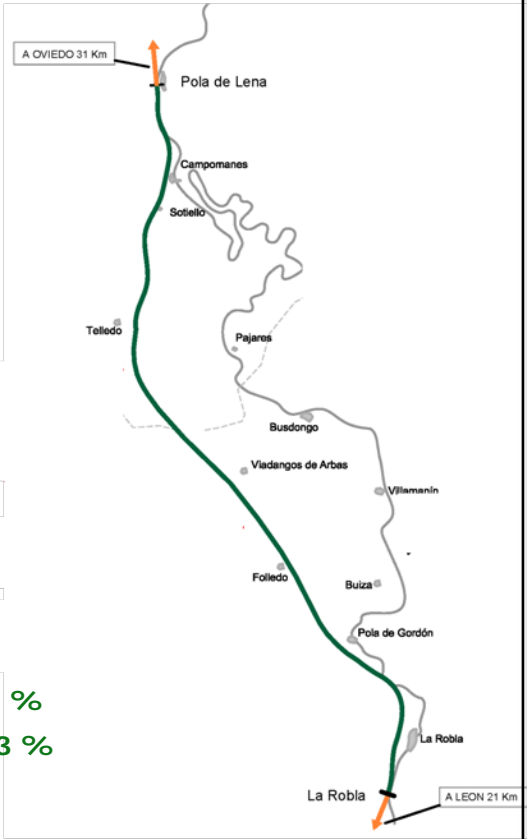
- ✓ On January 2007, Adif and the State signed a contract for the 2007-2010 period
- ✓ This contract established Adif's commitments to the conventional network owned by the State regarding:
 - Maintenance
 - Operation
 - Traffic management
 - Entrusted investments



New needs but also new possibilities. Examples

HISTORIC LINE

(since 1884)
LENGTH: 83 km
SPEED: 70-80 km/h
JOURNEY TIME: 55'
BIGGEST TUNNEL:
LA PERRUCA (3,071 m)



Cantabrian Range Crossing
(Puerto de Pajaros)

NEW HS LINE

(under construction)
LENGTH: 49 km ▼ 33 %
SPEED: 250 km/h ▲ 312 %
JOURNEY TIME: 15' ▼ 73 %
BIGGEST TUNNEL:
PAJARES (25 km)

VALLADOLID

HSL Madrid-Valladolid

250 km → 180 km ▼ 28 %
 2h 20m → 0h 50m ▼ 71 %



GUADARRAMA
 RANGE

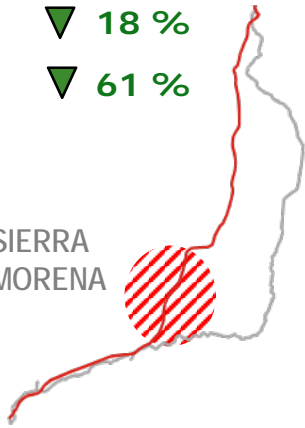
HSL Madrid-Seville

MADRID

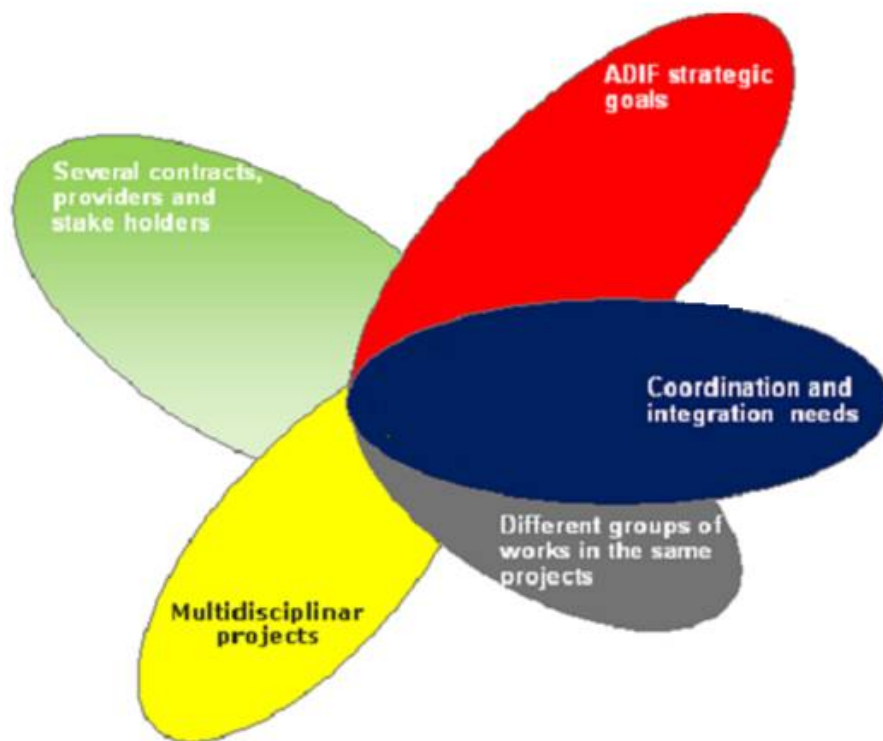
570 km → 470 km ▼ 18 %
 6 h → 2h 20m ▼ 61 %

SIERRA
 MORENA

SEVILLA

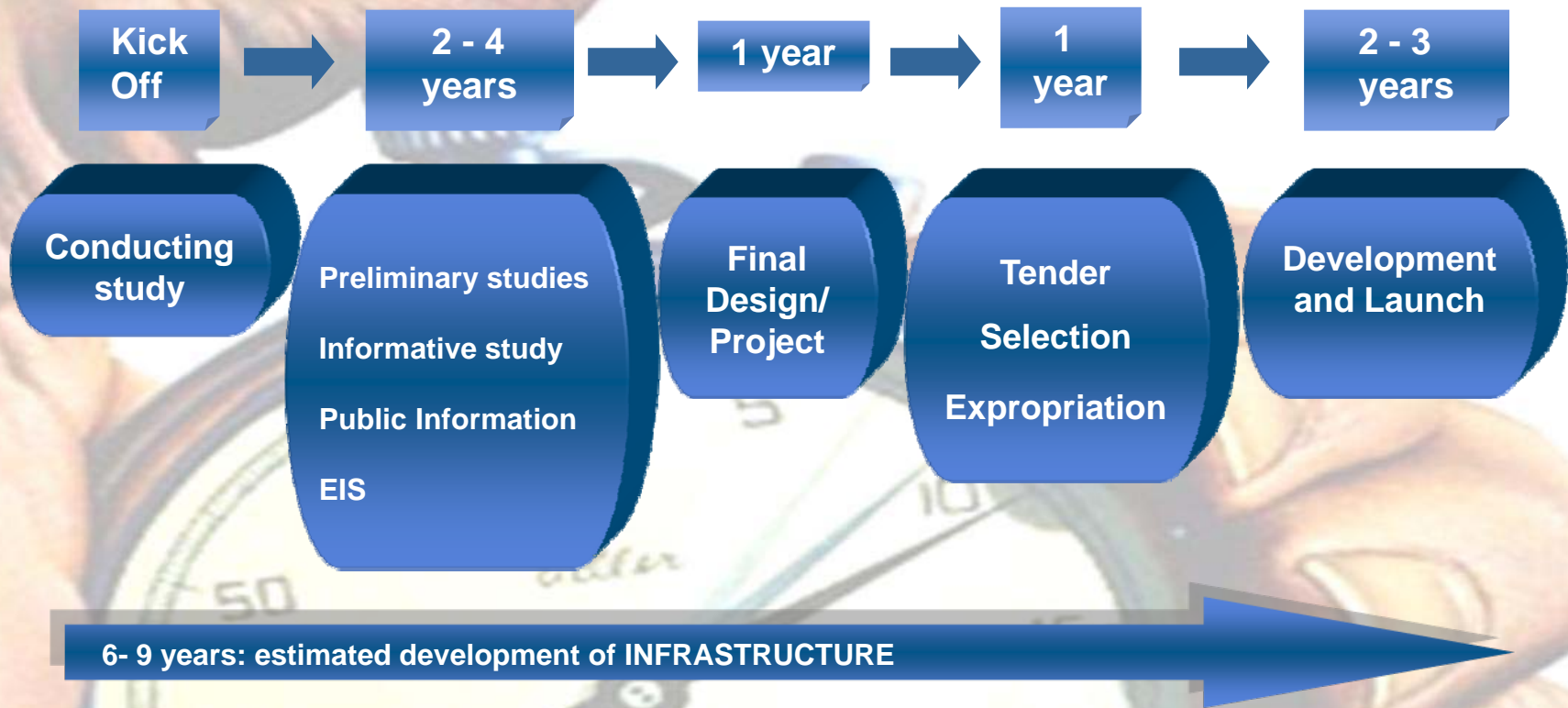


ADIF: Strategic Approach for HS Lines Projects and Construction



HS Project Steps

Phases: **IDEA to INSTALLATION OF SERVICES**
(DECISION MAKING STEPS ARE NOT INCLUDED)

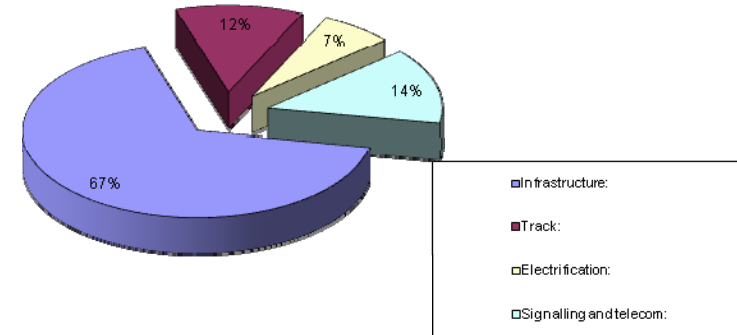


A practical case: Madrid-Valencia/Albacete New HSL (438 km): 7 years

An idea of real costs in Spanish HSL and Stations

Real costs in Spanish HSL :

- ✓ Infrastructure: 5.4 – 14.6 M €/km
- ✓ Track: 1.7 – 2.0 M €/km
- ✓ Electrification: 0.8 – 1.3 M €/km
- ✓ Signaling and telecom: 1.1 – 3.3 M €/km
- ✓ Total Cost: 9.4 – 20.9 M €/km



Unit Cost for large and medium-sized stations

- ✓ Medium-sized 15 -50 M €
- ✓ Large 50-200 M €



Overcoming speed limits imposed by infrastructure



SPANISH STRENGTH IN RAILWAYS TECHNOLOGY

Highlighted references

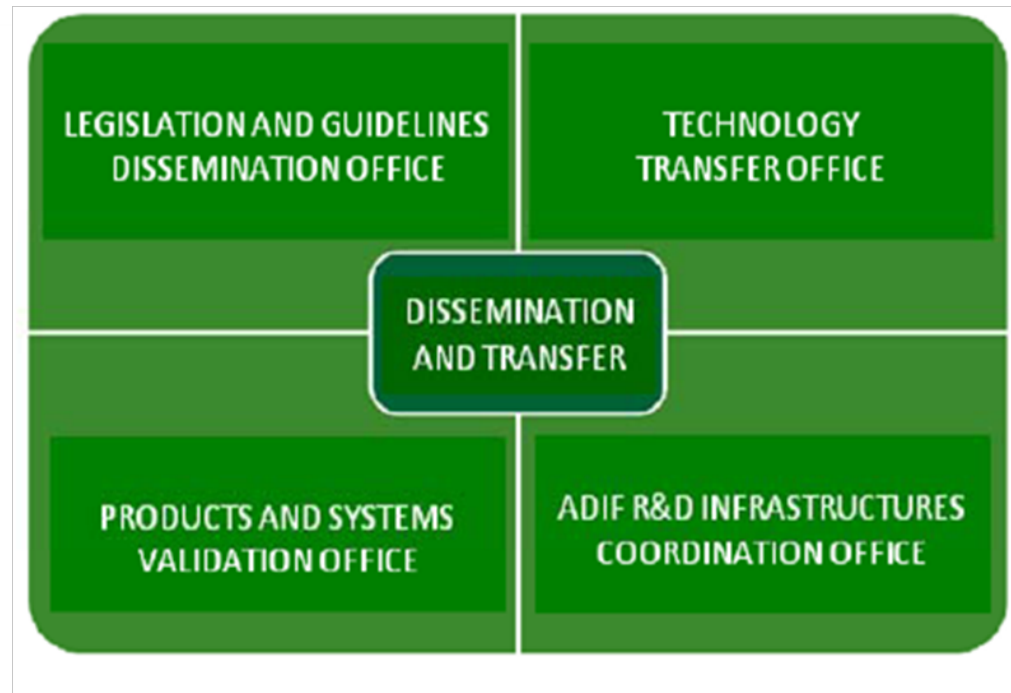
- **Tunnels:** Guadarrama Tunnel, 28km, 5th worldwide; Pajares Tunnel, 25km, 6th world record in drilling with tunnel boring machine: 90 meters/day
- **Viaducts:** world record using the launched deck method
- **Track:** world record in commercial operation sector, 405 km/h
- **Switches:** 350 km/h switches, to be crossed at 220 km/h through a deviation
- **Catenary:** Spanish HS catenary (350 km/h + 10%) interoperable TSI
- **Sub-stations:** own design 2 x 25 kv
- **Maintenance technologies:** laboratory and track examination trains
- **DAVINCI:** traffic control and management system
- **ERTMS:** At the vanguard of Europe's interoperable system (48% of ERTMS in Europe / 1.491 km)
- **Track gauge exchangers** for International and Iberian gauge (1,435 vs 1,668 mm)
- **High Speed Line's Km. Record being exploited** (1.121 km Barcelona-Málaga)
- **Challenge of punctuality reached:** 99,6%
- **R+D+i:** energy efficient, raising ballast, track models...
- **Sostenibility aim**
- **Lower average Europe prices**



ADIF Railway Technologies Center (R&D Facilities)

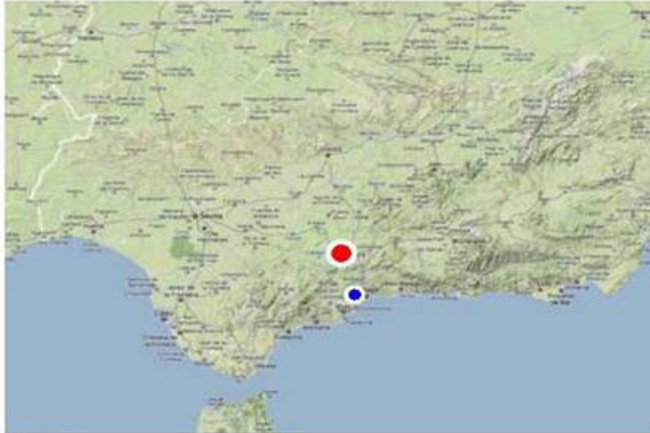
Services and Activities

- R&D Projects
- Monitoring and Surveying Technology
- R&D Management Consulting
- Validation and Certification of Products
- R&D Centers and Laboratories
- Specialized Technical Consultancy
- Training Activities

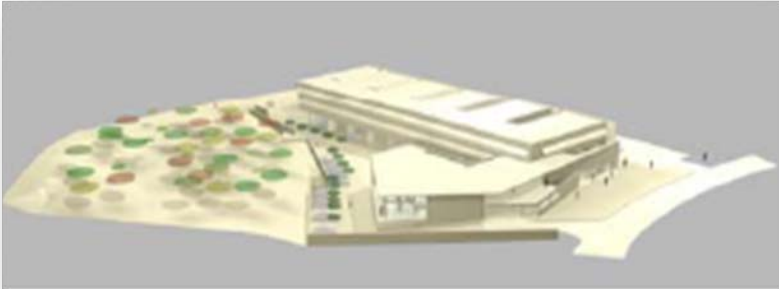


Railway Region: R&D Facilities (RCF)

- Andalusia Technologies Centre
- R&D Facilities



Railway Innovation Region

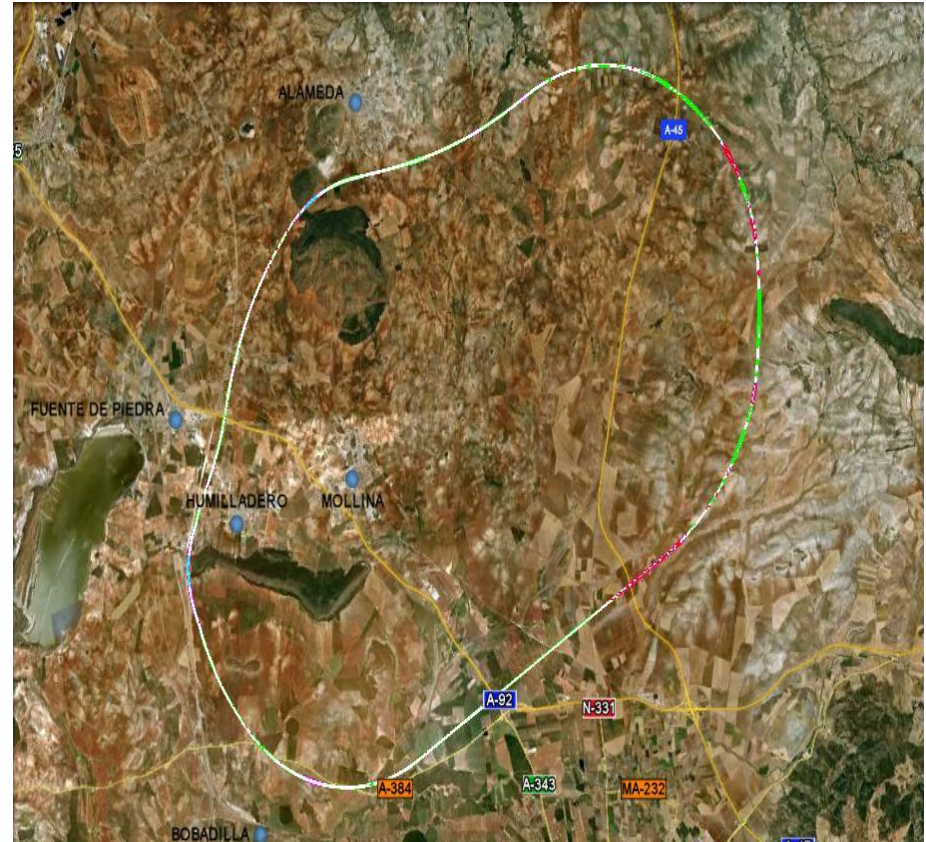


Railway Test Center in Spain

Bobadilla, Málaga (Antequera region)

TEST TRACKS:

- Main track: **Maximum speed 520 km/h**, length 57,5 km, UIC gauge
- Secondary track: Maximum speed 220 km/h, length 20 km, Iberian and UIC gauge
- Other tracks and sections with UIC, Iberian and Metric gauge (5 km) to carry out test for urban transport vehicles (trams and light rail trains):
 - Test tracks for safety tests against derailment on twisted tracks
 - Small radius curves for dynamic tests
 - S sections to validate traffic on curve - reverse curve
 - Test tracks with different slopes and lengths
 - Sections with vertical radius agreement (UIC and metric. It may incorporate Spanish)
- Office buildings, control center, craft workshop.



Track quality in Spain continues its improvements

- **Automatic track gauge exchanges** for international and Spanish gauge performed at **30 km/h**
- Technology for **three lane track** for **Spanish and international gauge**
- Switches: at speed of **350 km/h over switches crossed at 220 km/h in deviations**
- **2 km/day alignment over ballast** achieved



Interoperability. Gauge exchangers



Gauge exchangers. Extension of HS

Travel times current reduction

- Madrid – Noroeste:
 - ▼ up to 1h30 min.
- Madrid - Granada/ Algeciras/ Huelva / Cádiz:
 - ▼ up to 1h30 min
- Madrid / Barcelona – Navarra – La Rioja:
 - ▼ up to 2h30 min
- Madrid – Valencia / Albacete-Alicante:
 - ▼ up to 35 min

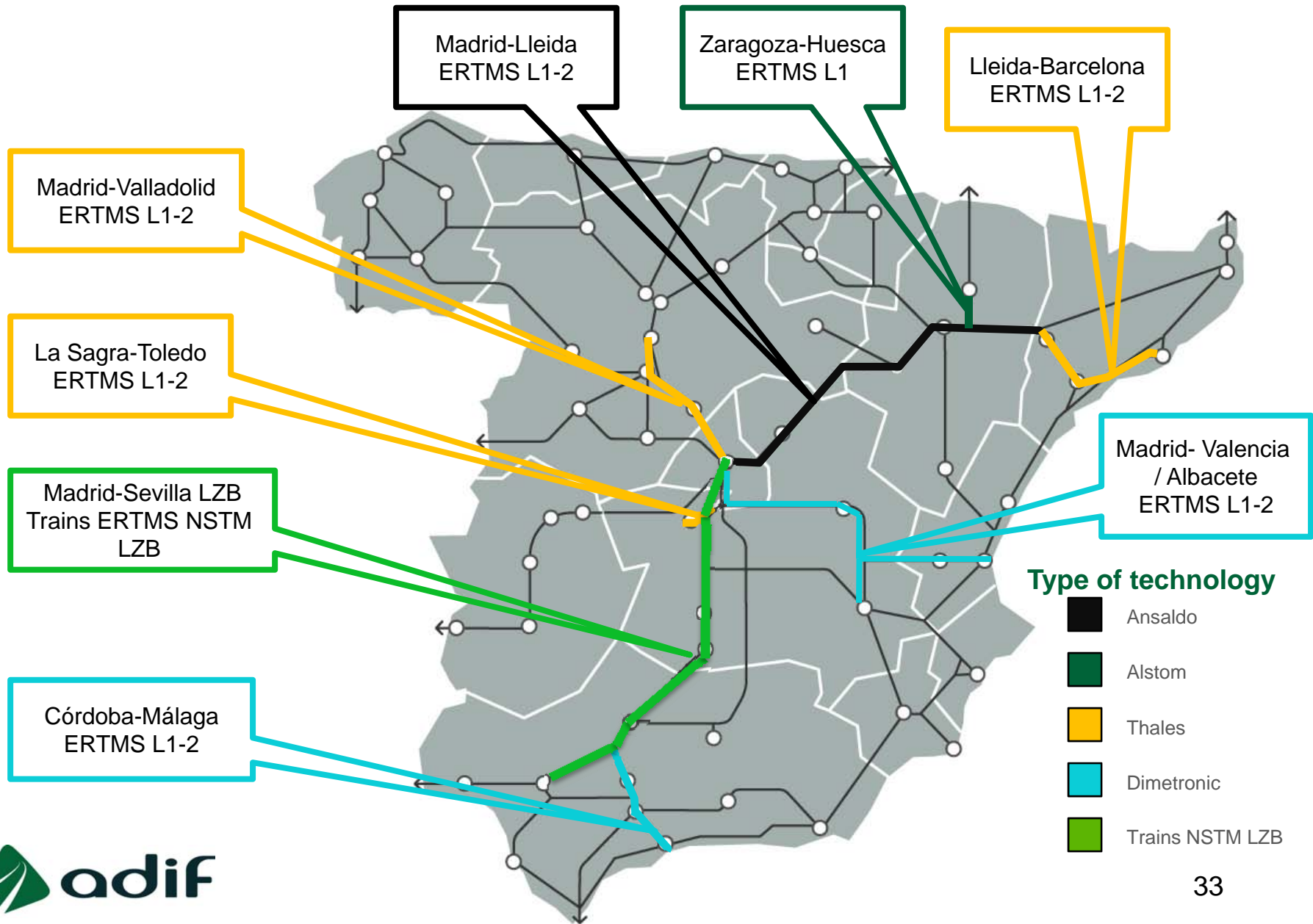


Spanish experience in ERTMS

- Spain has set up ERTMS in 1.491 km of High Speed lines (48% out of the total km in Europe; and more km than any other European country)
- Madrid- Sevilla line runs with LZB system
- Madrid- Barcelona line is pioneer in using ERTMS:
 - ✓ March 2006: speed increase from 200 to 250 km/h
 - ✓ October 2006: speed increase to 280 km/h
 - ✓ May 2007: speed increase to 300 km/h
 - ✓ ERTMS level 2, speed increase to more than 300 km/h
- This system has been set up in Córdoba- Málaga, Madrid- Valladolid and Madrid-Valencia/Albacete lines.
- ERTMS system will be deployed in all lines currently under construction, as well as in Madrid- Sevilla HSL.

5 years of
experience in
rail
Interoperability

Spanish experience in ERTMS



DaVinci system

The Spanish DaVinci system was designed to manage HS lines.

- Integration of all telecommands in the HSL allowing centralized real time operation
 - Centralized Train Control CTC
 - ERMTS central post
 - Energy Supply
 - Communications Supervision (Fixed and mobile communications)
 - Auxiliary supervision systems
 - Video surveillance
- In addition includes the following environments.
 - Simulation and Training
 - Integrated reconstruction of events
 - Validation and testing environments



The DaVinci experience

Adif lines

FEVE lines

London & Medellín Underground

Morocco lines

Lithuanian lines

Electrification

At the forefront of overhead catenary systems, efficient power equipment and electrical engineering

- Catenary EAC-350: 100% Spanish design specific for 350 km/h. Interoperability certification
- Power telecontrol system integrated in CRC



Detection Systems

Equipment developed by the Spanish HSR industry

- Obstruction detectors
- Hot box detectors
- Weather stations
- Wind monitoring systems
- Track impact detectors
- Gauge detectors



Conclusions

HIGH SPEED: SPAIN AT THE TOP

World leader

In 2011, 2.776 km of HS lines, more than any other country in Europe.

2nd HS Network in the world

Longest HS corridor in the world

Barcelona - Málaga (1.121 km)



Madrid-Barcelona: at least 300 km/h speed along 90% of the journey (572 km)

Punctuality: 99,6%, world leader



Thank you for your kind attention



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