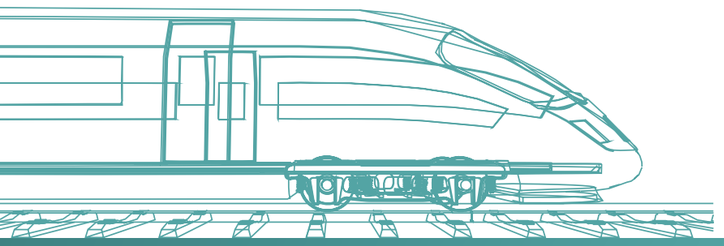


# ATLAS

## High-Speed Rail 2022

Data updated as of december 2021


Fundación de los Ferrocarriles Españoles

UIC
INTERNATIONAL UNION OF RAILWAYS

# CREDITS

**High-Speed Rail Atlas**

4th Edition: August 2022

Produced by: Geography and Railway Traffic Research Group,
Fundación de los Ferrocarriles Españoles (FFE)

Coordinated by: Marc Guigon, Philippe Lorand and Kenta Takashina (UIC)

Work team FFE: Ángeles Táuler, Sergio Martín and Matilde Benito

A special mention goes to Michel Leboeuf (UIC) for his cooperation in the development of this Atlas

Gratitude is also extended to the UIC Intercity and High-Speed Committee as well as to the people in charge of statistics and information processing of the railway companies and infrastructure managers of each country, for their collaboration

# PRESENTATION

The main characteristics of a high-speed rail system are efficiency, high levels of safety and security, availability and reliability and environmental friendliness. Furthermore, high-speed rail can offer the “triple bottom line” - economic, social and environmental sustainability - that many policymakers have called for over the years.

With that being said, the post-Covid and requirements relating to climate change offer an outstanding opportunity to further promote the use of rail and should allow policymakers and the financial sector to invest in rail to develop high-speed rail connections in all parts of the world. This is undoubtely a favourable time to invest and an exciting time globally, with many different situations nevertheless sharing common dynamics.

Saving time and shrinking space, high-speed rail contributes:

- to the development of mobility

- to trade and links between cities

- to desaturation of other infrastructure

- to sustainable development goals for society

- to regional unification

Today combatting climate change is top of the political agenda. The question that is addressed to the rail system is to cope with a massive modal shift while becoming the mode of transport of choice. Wherever high-speed rail is developed or will be developed, it has been accompanied, in parallel, by the renovation or upgrading of conventional interconnected lines to extend the benefits of high-speed services to larger and more distant regions and cities. UIC considers that railway have to become the backbone of the mobility of the future, thus it will have to develop smooth interfaces with the other public transport system and soft mobility.

In this context, high-speed rail is transforming itself into the heart of a transport system: each country when entering into high-speed development is planning to end up with a consistent network delivering a high level of satisfaction to each customer. In consequence, continuing to be a driver for the rail sector, high-speed rail is an actor and vector for digital evolution: AI, IoT, big data, and augmented intelligence technology will bring improved productivity to the high-speed rail sector in operations and maintenance, as well as better security (cybersecurity) and better services for the customer experience.

Following in the footsteps of Japan, Italy, France, Germany and Spain, many more countries have joined the club of high-speed rail pioneers. In a ten-year period, China has developed a high-speed network of 40,000 km, out of a total 59,000 km worldwide. Thousands of kilometers of new lines are being studied or are under construction in Turkey, Morocco, Europe, the United States, Iran, Russia, India, South-East Asia, China…the list goes on. More than 4,900 high-speed trainsets operate daily worldwide, transporting 2 billion customers every year. High-speed rail, wherever it has been developed, has served as a booster of innovation for the railway sector and its industry.

Why not imagine it the potential vector for high-speed freight mobility in line with e-commerce development? High-Speed Rail, wherever it has been developed, has enabled employment and growth of GDP.

As the worldwide association of railways, working alongside the research institutes and network of universities, UIC is striving to contribute to:

- Innovative ideas

- Successful projects

- Breakthrough developments for the benefit of its members

Now more than ever, UIC, together with its network of experts, is at the disposal of its members to share data, good practices and all of the expertise necessary to continue to support its members in developing the high-speed rail system around the world.

I sincerely hope that this Atlas of High-Speed Rail will provide you all with a detailed overview of the various aspects relating to high-speed rail: lines, rolling stock, etc.

**François Davenne**

**UIC Director General**

# INDEX

# ABBREVIATIONS AND SYMBOLS

| | |
|---|---|
| AC | Alternating current |
| AEG | Allgemeine Elektricitäts-Gesellschaft |
| AGV | Automotrice à Grande Vitesse |
| ASFA | Anuncio de Señales y Frenado Automático |
| ATB | Automatische TreinBeïnvloeding |
| ATC | Automatic Train Control |
| ATP-EBICAB | Automatic Train Protection-Emergency Brake Intervention in Cab |
| AWS | Automatic Warning System |
| b.s. | Block station |
| BACC | Blocco Automatico a Correnti Codificate |
| BPL | Bretagne Pays de la Loire |
| BREL | British Rail Engineering Limited |
| CAF | Construcciones y Auxiliar de Ferrocarriles |
| CMK | Centralna Magistrala Kolejowa |
| CNM | Contoumement de Nimes-Montpellier |
| CNR | Canadian National Railways |
| CR | China State Railway Group Co., Ltd |
| CTC | Centralized Traffic Control |
| CTCS | Chinese Train Control System |
| DC | Direct current |
| DSB | Danish State Railways (Danske Statsbaner) |
| ERTMS | European Rail Traffic Management System |
| ETCS | European Train Control System |
| ETR | Elettro Treno Rapido |
| FFE | Spanish Railways Foundation |
| GDP | Gross Domestic Product |
| GPSO | Le Grand Projet du Sud-Ouest |
| HS | High-Speed |
| HSL | High-Speed Line |
| HT | Hull Trains |
| Hz | Hertz |
| ICE | InterCity Express |
| IRS | International Railway Solutions |
| JNR | Japanese National Railways |
| JRC | Central Japan Railway Company |
| JRE | East Japan Railway Company |
| JRK | Kyushu Japan Railway Company |
| JRW | West Japan Railway Company |
| km | Kilometre |
| Km/h | Kilometres per hour |
| KTX | Korea Train Express |
| kV | Kilovolt |
| KVB | Contrôle de Vitesse par Balises |
| kW | Kilowatt |
| kW/t | Kilowatts per ton |
| L | Locomotive |
| LGV | Ligne à Grande Vitesse |
| LHB | Linke Hofmann Busch |
| LNMP | Ligne Nouvelle Montpellier-Perpignan |
| LNPN | Ligne Nouvelle Paris-Normandie |
| LZB | Linienzugbeeinflussung |
| M | Motor coach |
| MB | Motor Bogie |
| mm | millimeter |
| NR | Northern Rail |
| NS | Dutch railways (Nederlandse Spoorwegen) |
| NTV | Nuovo Trasporto Viaggiatori (now "Italo") |
| ÖBB | Austrian Federal Railways (Österreichische Bundesbahnen ) |
| ONCF | Moroccan National Railways (Office Nationale des Chemins de Fer) |
| PBKA | Paris-Brussels-Cologne-Amsterdam |
| PKP | Polish national Railways (Polskie Koleje Państwowe) |
| POCL | Paris-Orléans-Clermont-F.-Lyon |
| PZB | Punktförmige Zugbeeinflussung |
| RENFE | Red Nacional de los Ferrocarriles Españoles |
| RPS | Disruptive Radar Positioning System |
| S | Series (in rolling stock sections) |
| SBB | Swiss Federal Railways (Schweizerische Bundesbahnen) |
| SCMT | Sistema di Controllo della Marcia del Treno |
| SEA | Sud Europe Atlantique |
| SNCF | Societé Nationale des Chemins de fer Français |
| SR | Suseo High Speed Rail Corporation |
| T | Trailer coach |
| t | Ton |
| TALGO | Tren Articulado Ligero Goicoechea Oriol |
| TBL | Transmission Baliza-Locomotive |
| TCDD | Turkish National Railways (Türkiye Cumhuriyeti Devlet Demiryolları) |
| TGV | Train à Grande Vitesse |
| THSRC | Taiwan High Speed Rail Corporation |
| TPWS | Train Protection and Warning System |
| TVM | Transmission Voie-Machine |
| UIC | International Union Of Railways |
| ⎓ | Direct current |
| ∿ | Alternating current |
| ‰ | Per-mille |

# DEFINITIONS

| | |
|---|---|
| Alternating current | An electric current that reverses its direction many times a second at regular intervals, typically used in power supplies |
| Block station | A place at which railroad manual block signals are displayed |
| Direct current | An electric current flowing in one direction only |
| Electrification | Type of electrification installed (3 kV, 15 kV, 25 kV) |
| High-Speed passenger | Passenger carried by a High-Speed train for a trip in totality, partly or not at all on a High-Speed line |
| High-Speed train | A train able to commercially run at more than 200 km/h |
| Line in operation | It is now operating on High-speed |
| Line long-term planning | It is not approved, just planned |
| Line planned | It is approved but not start constructing |
| Line under construction | It is now constructing on High-Speed |
| Line under study | Similar to "long-term planning" status |
| Maximum commercial speed | Maximum speed at which a train can operate on a track |
| Maximum train speed | Maximum speed that a train can reach, without any limitation in the infrastructure |
| Signalling | Type/s of signalling enabled (ERTMS / ETCS, TVM, LZB, ASFA…) |

# INTRODUCTION

Within the Global Passenger Forum of UIC (the International Union of Railways), managed by the UIC Passenger Department, High-Speed Rail is a large sector whose activities are organised by the "Intercity and High-Speed Committee of UIC", a sector that draws in all companies or public bodies concerned by High-Speed Rail. It looks at all aspects to enhance the development of high-speed trains across the world:

- International studies on topics such as operation in difficult environmental conditions, economic evaluation of high-speed, technical comparison between high-speed rail systems worldwide, advice on mixed traffic operation, research projects, apprehend the new normal period after Covid-19, etc.

- Alliance of Universities to share knowledge and to create synergies and between universities from all around the world, to organise workshops and to provide studies for railways and academic parties and to help the best talent recruitment

- Worldwide trainings on High-Speed Rail

- Maintenance of the UIC high-speed database used to set up this atlas (high-speed, lines, rolling stock, traffic, maps, etc.)

- Maintenance of a website providing all publications free of charge

- Development of standards (IRS: International Railway Solutions) for all general aspects of high-speed rail

- Co-organisation of the World High-Speed Congress, which is the most important high-speed rail event in the world. The next congress will be held in Marrakech (Morocco) on 7-10 March 2023. It will highlight the truly global dimension of high-speed and other related passenger issues. It will focus on important topics as environment and spatial planning. Its motto is: High-Speed Rail: The Right Speed for our Planet

UIC's Intercity and High-Speed Committee made the decision to maintain an Atlas in order to compile all data of High-Speed Rail in the world.

The atlas provides a very detailed overview of high-speed rail worldwide as a system comprising rolling stock, infrastructure and signalling. Some information is not given in this document, particularly commercial aspects (tariffs, commercial strategies, etc.) and railway stations.

The document begins by providing global data concerning High-Speed Rail, categorised according to the UIC regions in order to reflect the overall segmentation of high-speed railways.

These global data will provide an overview of High-Speed Rail across the world: countries where High-Speed is or will be operated, length of networks, maximum speed of High-Speed Trains, historical development of High-Speed Rail.

The document then provides details on each country in each UIC region: detailed maps and information on lines in commercial operation and under construction, as well as planned lines and long-term projects.

Other subjects detailed in the atlas include rolling stock, travel times, slopes, electrification, signalling systems, centralised control systems, rolling stock factories and workshops, tunnels, viaducts..

Compared with the previous edition, this last edition includes the most recent lines (mainly in China), but also provides a new perspective on long-term projects in Africa and United States.

The quality of the atlas lies in the fact that all the data it contains has been provided and reviewed by the UIC members and other stakeholders that operate high-speed trains or will do so in the future.
Consequently, this atlas serves as a global reference for High-Speed Rail.

All the information included in the atlas is accurate as of December 2021.

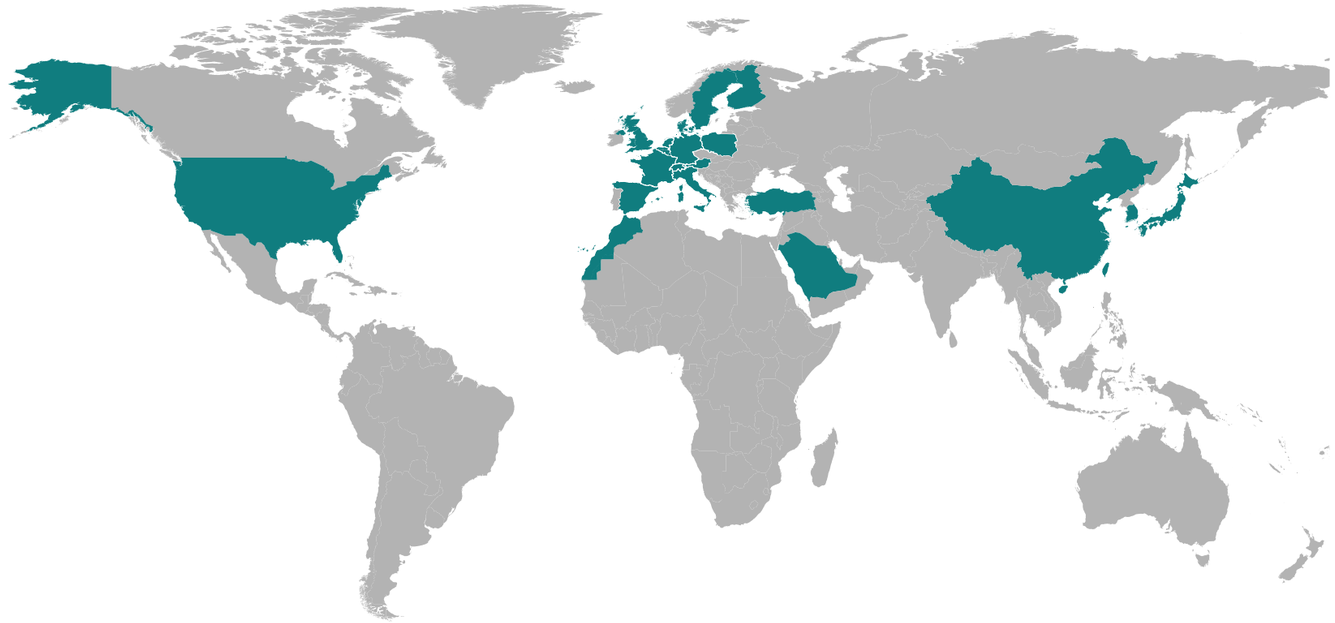
**Marc Guigon**

**UIC Passenger Director**


INTERNATIONAL UNION
OF RAILWAYS

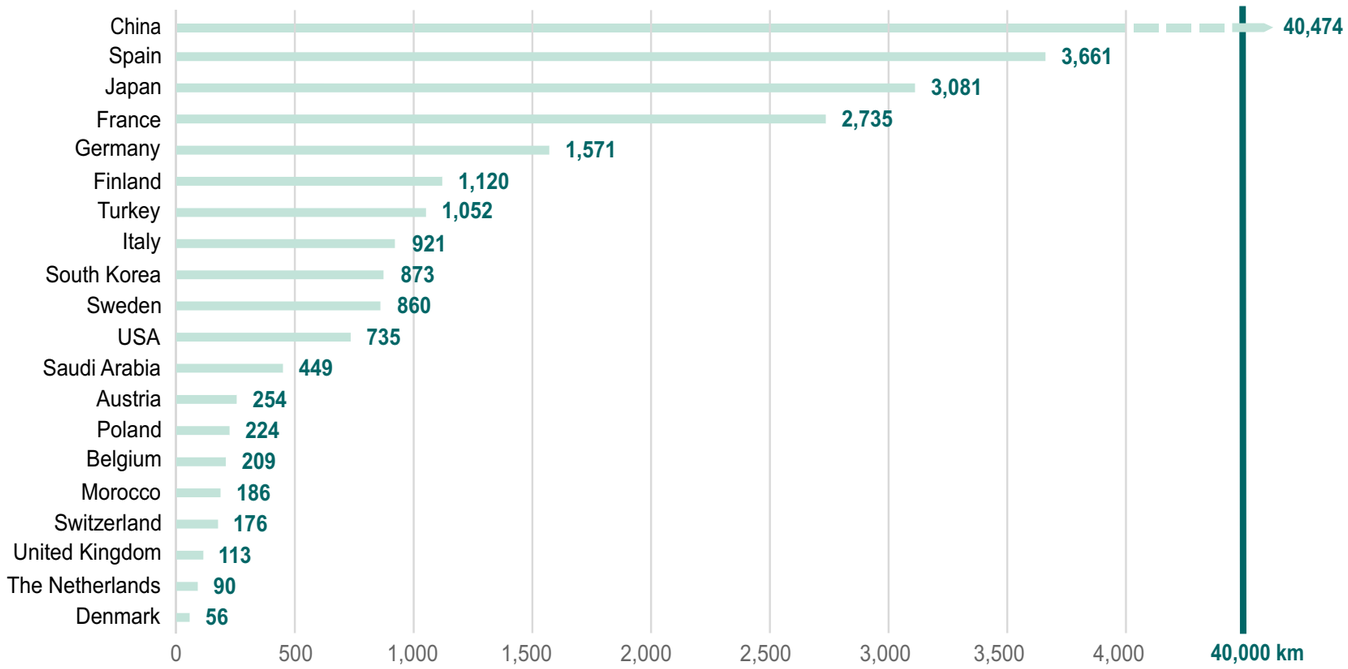
# 1.1 GLOBAL DATA

### *Countries with a high-speed rail network in commercial operation*



*Source: compiled by authors based on International Union of Railways, 2022*

### *Length of the high-speed network in commercial operation by country*




*Source: compiled by authors based on International Union of Railways, 2022*

### *Length of the high-speed network in commercial operation by UIC Regions*

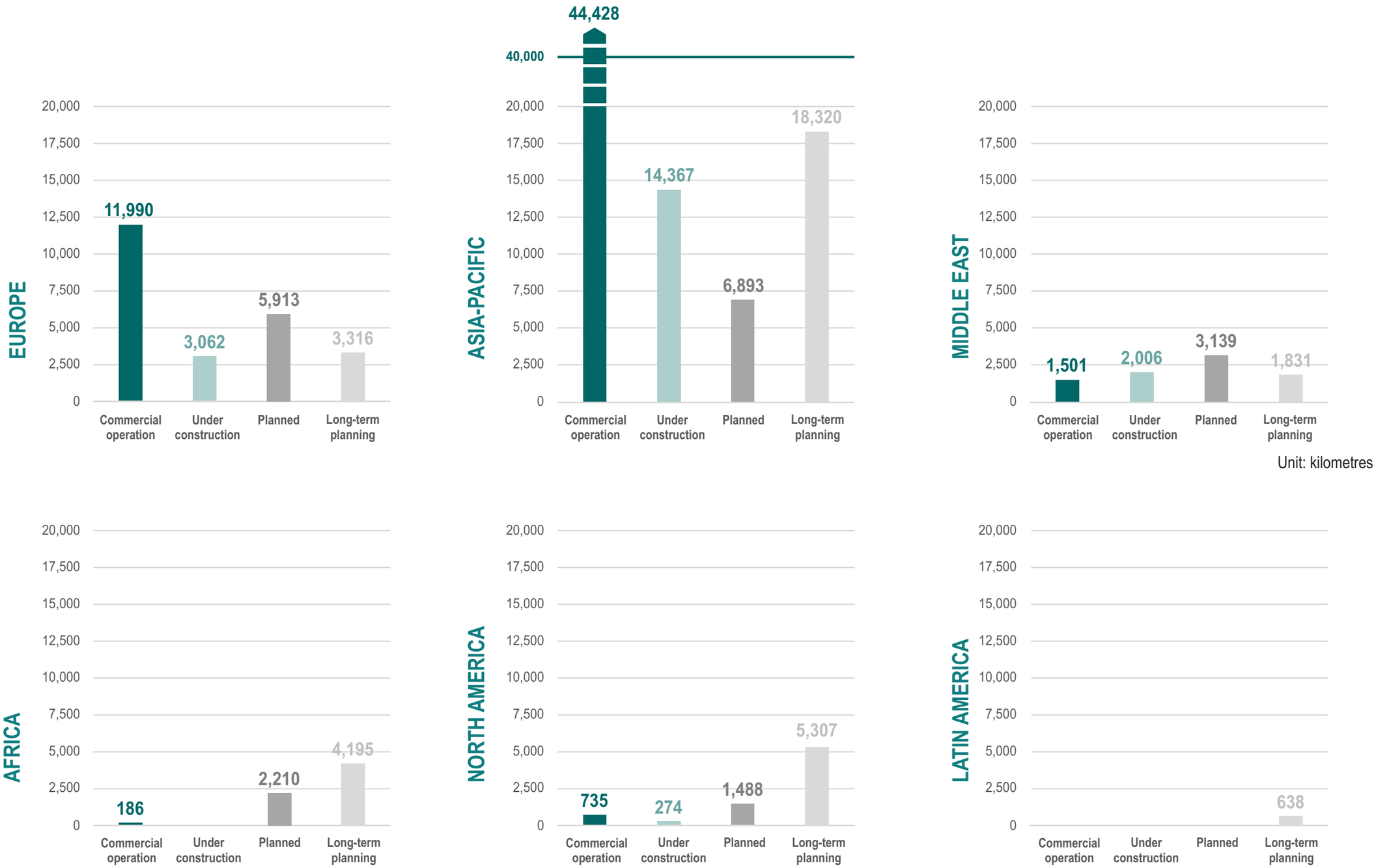

*Source: compiled by authors based on International Union of Railways, 2022*

### *Length of the high-speed network under construction by UIC Regions*


*Source: compiled by authors based on International Union of Railways, 2022*

# 1.1 GLOBAL DATA

***Length of the high-speed network by UIC Regions***



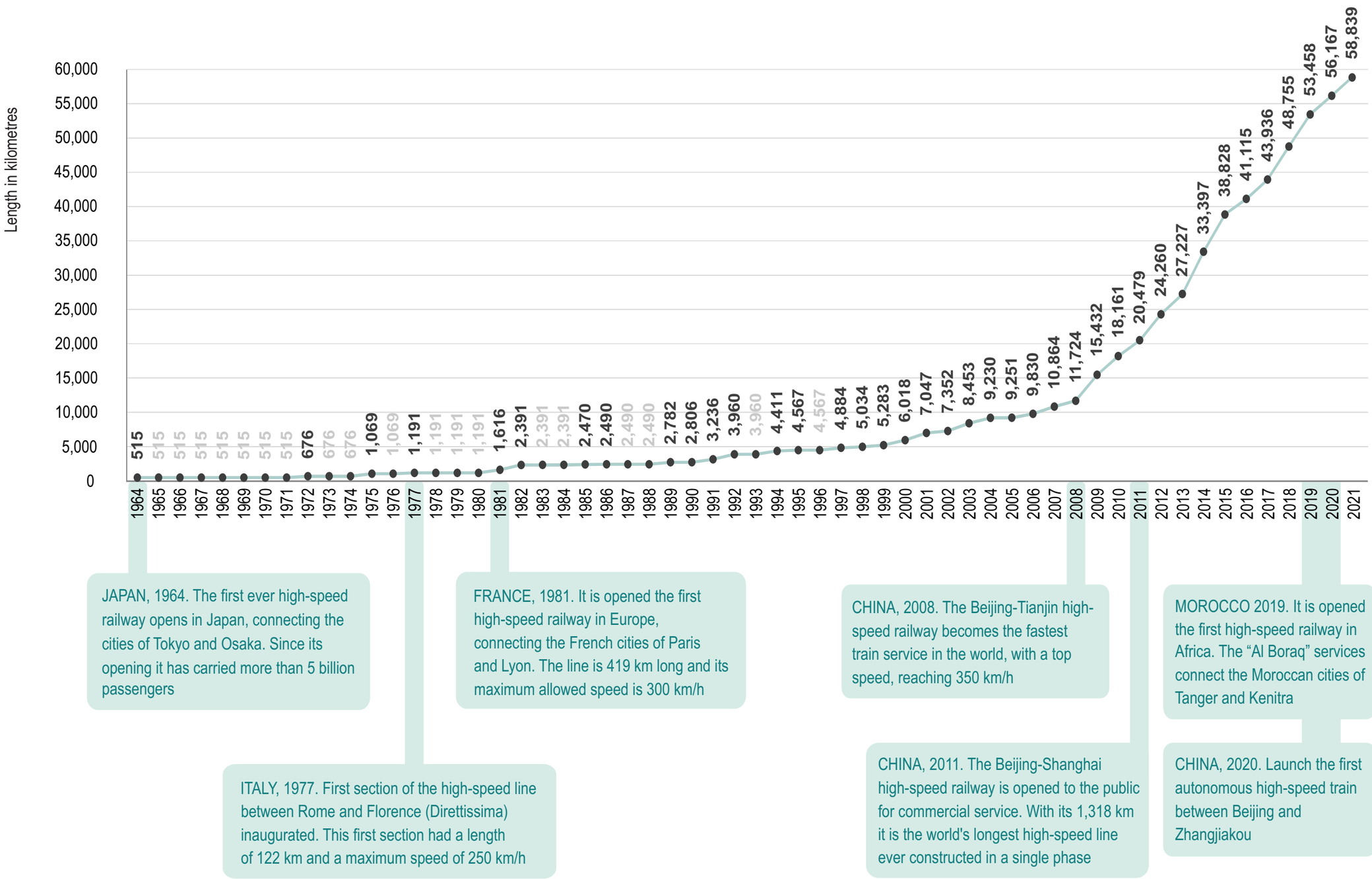

Unit: kilometres

*Source: compiled by authors based on International Union of Railways, 2022*

Unit: kilometres

# 1.1 GLOBAL DATA

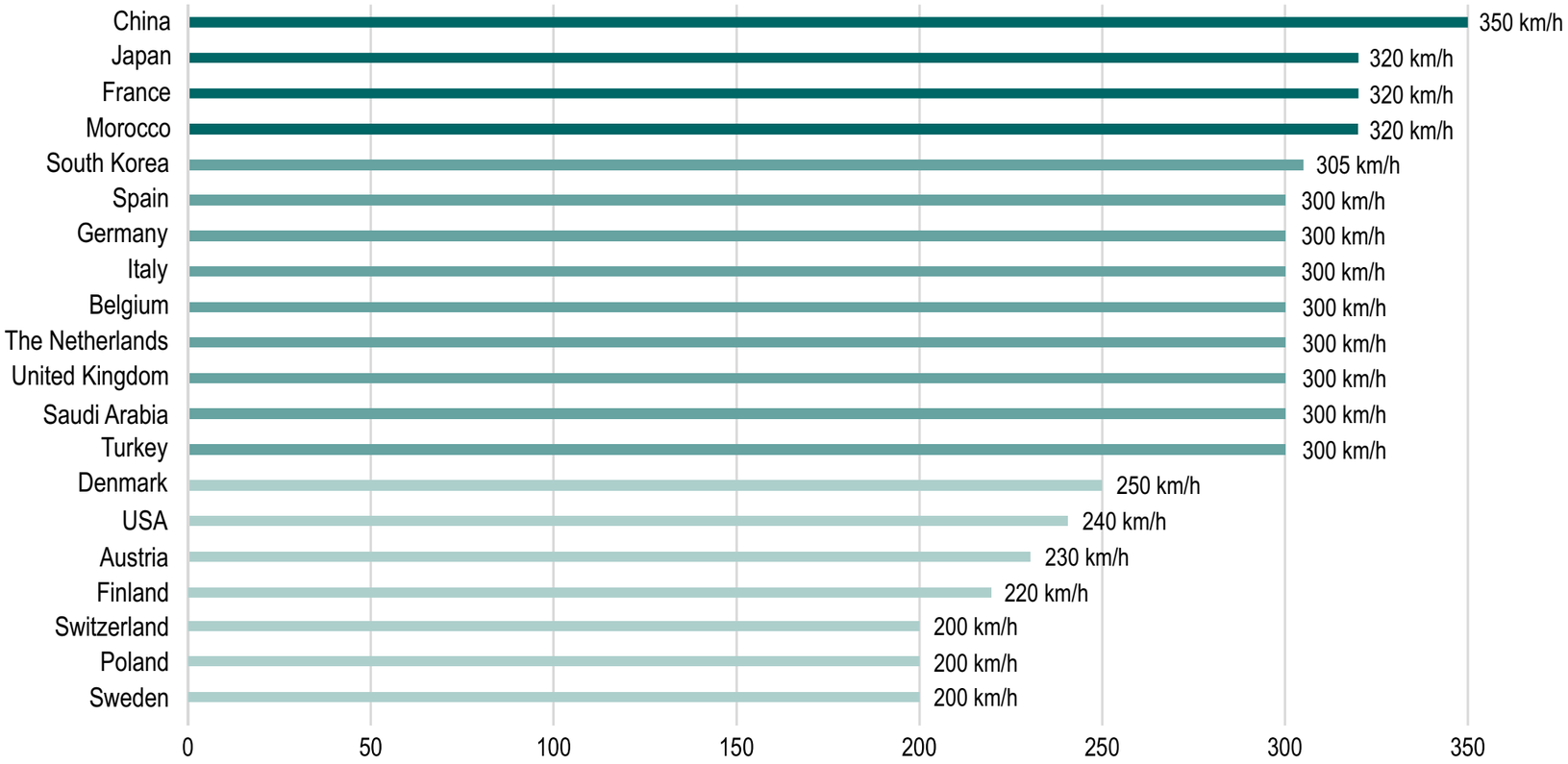
***Length of the high-speed network in commercial operation worldwide (1964-2021)***




*Source: compiled by authors based on International Union of Railways, 2022*

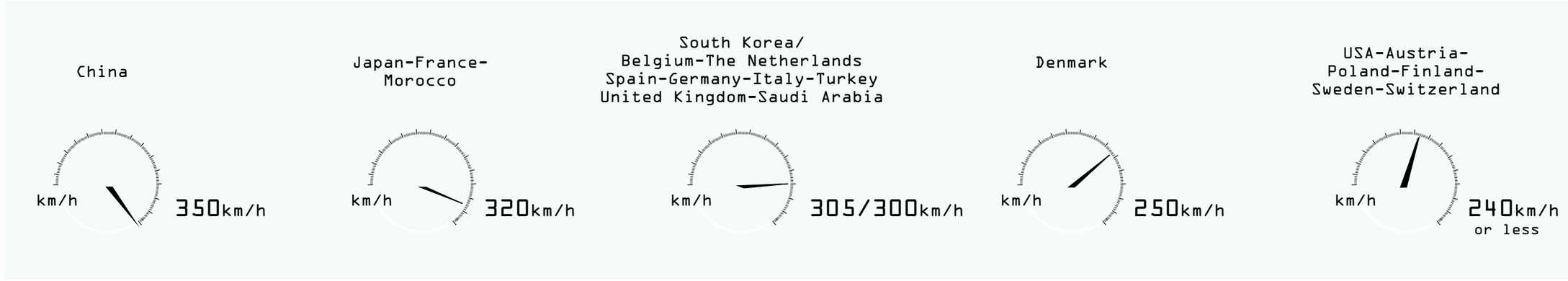
# 1.1 GLOBAL DATA

***Maximum speed of high-speed rail network by country (2021)***




*Source: compiled by authors based on International Union of Railways*

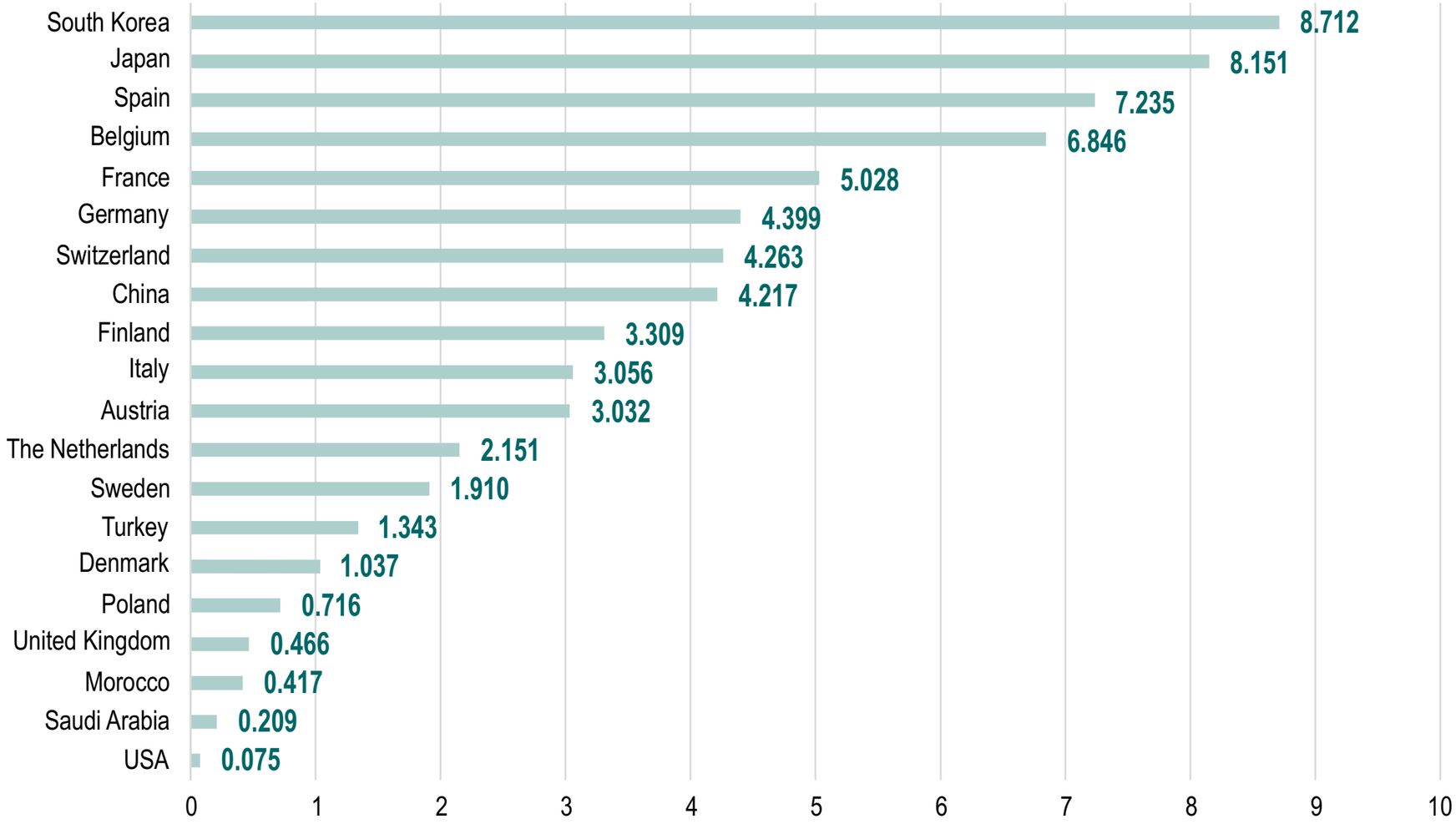
***Maximum speed of high-speed rail network by country (2021)***




*Source: compiled by authors based on International Union of Railways*

# 1.1 GLOBAL DATA

*Density of the high-speed network in 2021 (metres of high-speed lines / country area in km²)*

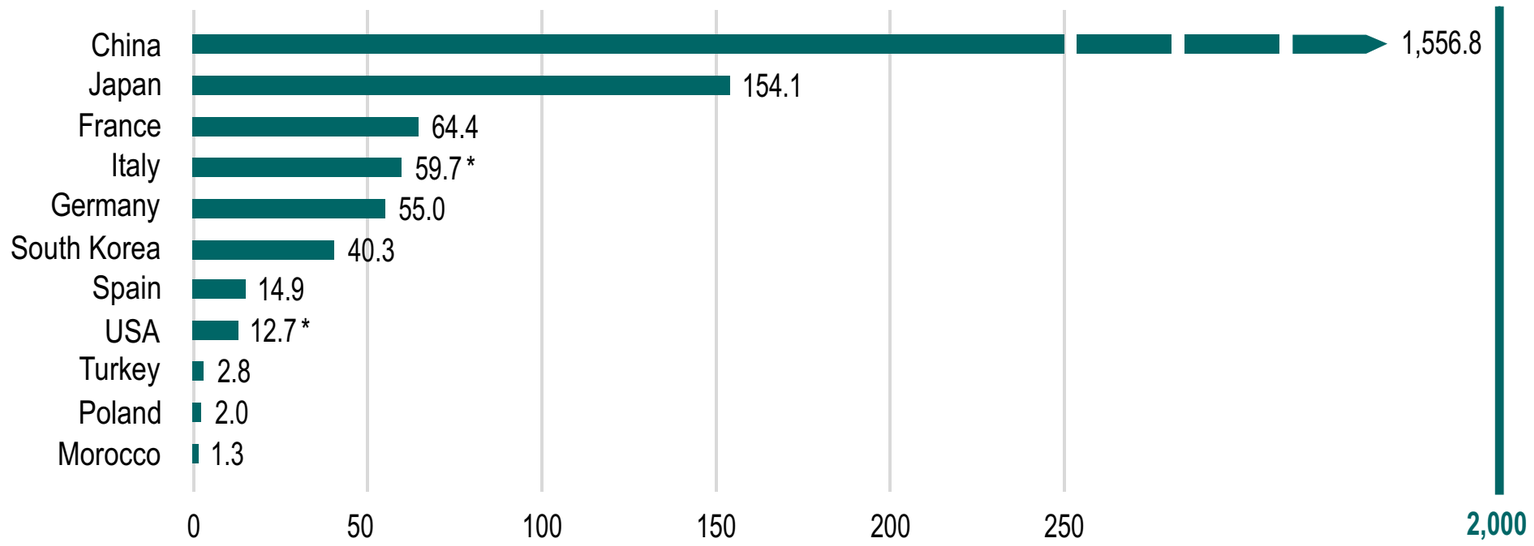



*Note:*
*The ratio of Denmark has been calculated excluding Greenland area*

*Source: compiled by authors based on International Union of Railways, 2022*

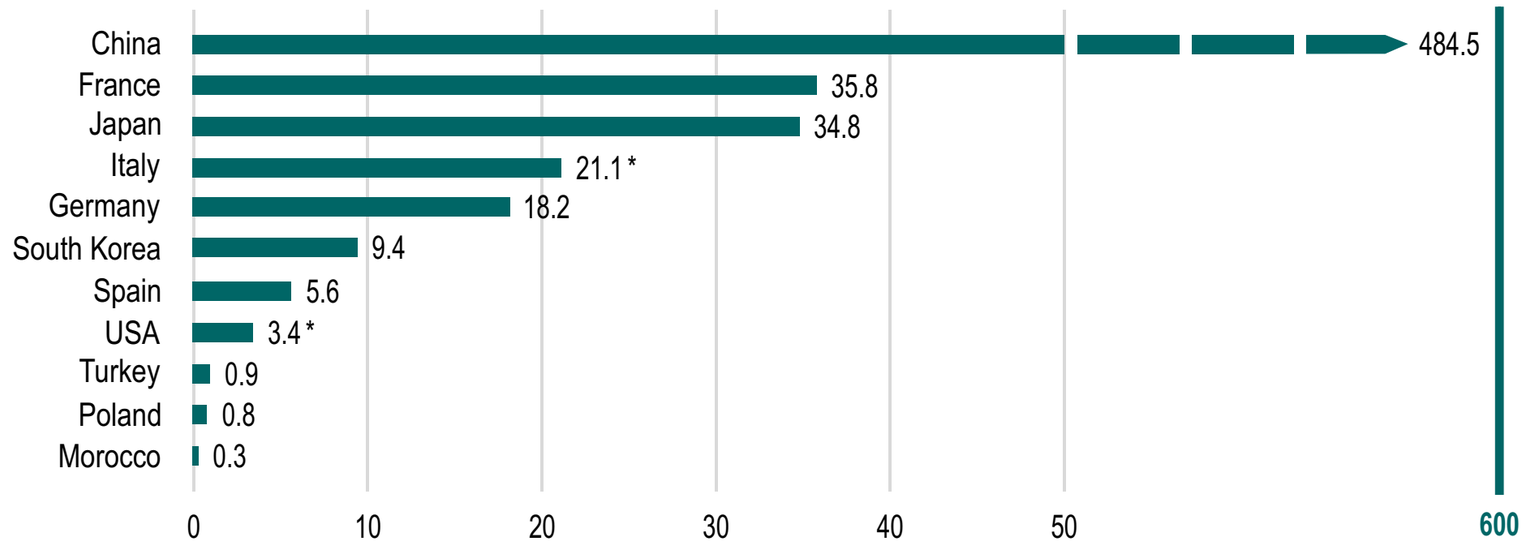
# 1.1 GLOBAL DATA

***Number of passenger (millions) by countries (2020)***




*Source: compiled by authors based on International Union of Railways, 2022*

***Number of passenger.kilometre (billions) by countries (2020)***




*Note: Data with (*) refers to 2019*

*Source: compiled by authors based on International Union of Railways, 2022*

# 1.2 HIGH-SPEED LINES IN COMMERCIAL OPERATION WORLDWIDE

***High-speed lines in Europe (I)***

| LINE | COUNTRY | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|---|
| Rome - Florence (First section) | ITALY | 250 | 1977 | 122 |
| LN1 LGV París Sud-Est | FRANCE | 300 | 1981 | 425 |
| Rome - Florence (Second section) | ITALY | 250 | 1985 | 52 |
| Rome - Florence (Third section) | ITALY | 250 | 1986 | 20 |
| LN2 - LGV Atlantique | FRANCE | 300 | 1989 | 292 |
| Linz - Wels | AUSTRIA | 200 | 1990 | 24 |
| Hannover - Würzburg | GERMANY | 280 | 1991 | 327 |
| Mannheim - Stuttgart | GERMANY | 280 | 1991 | 99 |
| Rome - Florence (Forth section) | ITALY | 250 | 1992 | 44 |
| Madrid - Sevilla | SPAIN | 270 | 1992 | 471 |
| LN4 - LGV Rhone-Alpes | FRANCE | 300 | 1992 | 122 |
| LN3 - LGV Nord - Europe | FRANCE | 300 | 1994 | 346 |
| LN3 - LGV Interconnexion EST IDF | FRANCE | 300 | 1994 | 105 |
| Helsinki - Turku | FINLAND | 200 | 1995 | 156 |
| Brussels - French border (L1) | BELGIUM | 300 | 1997 | 72 |
| Hannover - Berlin | GERMANY | 250 | 1998 | 150 |
| Stockholm - Örebro | SWEDEN | 250 | 1999 | 187 |
| St. Pölten - Ybbs | AUSTRIA | 200 | 2001 | 44 |
| Helsinki - Oulu | FINLAND | 200 | 2001 | 673 |
| Jämsänkoski - Jyväskylä | FINLAND | 200 | 2001 | 53 |
| LN5 - LGV Méditerranée | FRANCE | 300 | 2001 | 259 |
| Leuven - Liège (L2) | BELGIUM | 300 | 2002 | 65 |
| (Cologne) - Siegburg - Frankfurt | GERMANY | 300 | 2002 | 144 |
| Amstetten - St. Valentin | AUSTRIA | 200 | 2003 | 37 |
| Cologne - Düren | GERMANY | 250 | 2003 | 39 |
| Madrid - Lleida | SPAIN | 300 | 2003 | 467 |
| Zaragoza - Huesca | SPAIN | 200 | 2003 | 79 |
| Fawkham Junction - Tunnel | UNITED KINGDOM | 300 | 2003 | 74 |
| (Karlsruhe) - Raststatt Süd - Offenburg - (Basel) | GERMANY | 250 | 2004 | 44 |
| Hamburg - Berlin | GERMANY | 230 | 2004 | 286 |
| Mattstetten - Rothrist | SWITZERLAND | 200 | 2004 | 42 |
| Solothurn - Wanzwil | SWITZERLAND | 200 | 2004 | 11 |
| (Madrid -) La Sagra - Toledo | SPAIN | 220 | 2005 | 21 |
| Kinni - Otava | FINLAND | 200 | 2006 | 44 |
| Kerava - Lahti | FINLAND | 220 | 2006 | 63 |

*Source: compiled by authors based on International Union of Railways, 2021*

# 1.2 HIGH-SPEED LINES IN COMMERCIAL OPERATION WORLDWIDE

## *High-speed lines in Europe (II)*

| LINE | COUNTRY | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|---|
| Nuremberg - Ingolstadt | GERMANY | 300 | 2006 | 89 |
| Turin - Novara | ITALY | 300 | 2006 | 86 |
| Córdoba - Antequera-Santa Ana | SPAIN | 300 | 2006 | 111 |
| Lleida - Camp de Tarragona | SPAIN | 300 | 2006 | 96 |
| Hoofddorp - Rotterdam West | THE NETHERLANDS | 300 | 2006 | 44 |
| Rotterdam Lombardijen - Belgian border | THE NETHERLANDS | 300 | 2006 | 46 |
| St. Valentin - Asten-St Florian | AUSTRIA | 230 | 2007 | 16 |
| LN6 - LGV Est Europe (First phase) | FRANCE | 320 | 2007 | 335 |
| Madrid - Olmedo - Valladolid | SPAIN | 300 | 2007 | 178 |
| Antequera Santa Ana - Málaga | SPAIN | 300 | 2007 | 58 |
| Frutigen - Visp (Lötschberg base tunnel) | SWITZERLAND | 250 | 2007 | 38 |
| London - Southfleet Junction | UNITED KINGDOM | 300 | 2007 | 39 |
| Padova - Venice | ITALY | 220 | 2007 | 25 |
| Milan - Bologna | ITALY | 300 | 2008 | 182 |
| Naples - Salerno | ITALY | 250 | 2008 | 29 |
| Camp de Tarragona - Barcelona | SPAIN | 300 | 2008 | 100 |
| Gothenburg - Lund | SWEDEN | 200 | 2008 | 283 |
| Liège - German border (L3) | BELGIUM | 260 | 2009 | 36 |
| Antwerp - Dutch border (L4) | BELGIUM | 300 | 2009 | 36 |
| Lahti - Luumäki | FINLAND | 200 | 2009 | 131 |
| Rome - Naples | ITALY | 300 | 2009 | 205 |
| Novara - Milan | ITALY | 300 | 2009 | 38 |
| Florence - Bologna | ITALY | 300 | 2009 | 78 |
| Bypass Madrid | SPAIN | 200 | 2009 | 5 |
| Santiago - A Coruña | SPAIN | 200 | 2009 | 61 |
| Nyland - Umeå | SWEDEN | 200 | 2009 | 180 |
| (Figueres -) Spanish border - Perpignan | FRANCE | 300 | 2010 | 24 |
| Madrid - Albacete Junction - Valencia | SPAIN | 300 | 2010 | 362 |
| Albacete Junction - Albacete | SPAIN | 300 | 2010 | 73 |
| Figueres - French border (- Perpignan) | SPAIN | 300 | 2010 | 20 |
| Sundsvall - Nyland | SWEDEN | 200 | 2010 | 30 |
| LN7 LGV Rhin-Rhône Branche Est | FRANCE | 320 | 2011 | 146 |
| Munich - Augsburg | GERMANY | 230 | 2011 | 62 |
| Ourense - Santiago | SPAIN | 300 | 2011 | 85 |
| Vienna Knoten Hadersdorf - St. Pölten | AUSTRIA | 230 | 2012 | 50 |

*Source: compiled by authors based on International Union of Railways, 2021*

# 1.2 HIGH-SPEED LINES IN COMMERCIAL OPERATION WORLDWIDE

***High-speed lines in Europe (III)***

| LINE | COUNTRY | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|---|
| Knoten Radfeld - Knoten Baumkirchen | AUSTRIA | 220 | 2012 | 36 |
| Wels - Attnang-Puchheim | AUSTRIA | 230 | 2012 | 30 |
| (Karlsruhe) - Katzenberg tunnel - (Basel) | GERMANY | 250 | 2012 | 18 |
| Bypass Yeles | SPAIN | 200 | 2012 | 6 |
| Gothenburg - Kornsjø | SWEDEN | 200 | 2012 | 180 |
| Barcelona - Figueres | SPAIN | 290 | 2013 | 131 |
| Albacete - Alicante/Alacant | SPAIN | 300 | 2013 | 165 |
| Erfurt - Leipzig/Halle | GERMANY | 300 | 2015 | 123 |
| Grodzisk Mazowiecki - Opoczno | POLAND | 200 | 2015 | 224 |
| Santiago - Vigo | SPAIN | 200 | 2015 | 95 |
| Valladolid - León | SPAIN | 200 | 2015 | 166 |
| Olmedo - Zamora | SPAIN | 200 | 2015 | 99 |
| Sevilla - Cádiz | SPAIN | 200 | 2015 | 153 |
| Ybbs - Amstetten | AUSTRIA | 230 | 2016 | 17 |
| LN6 - LGV Est Europe (Second phase) | FRANCE | 320 | 2016 | 122 |
| Milan - Brescia | ITALY | 250 | 2016 | 40 |
| Erstfeld - Biasca (Gothard base tunnel) | SWITZERLAND | 200 | 2016 | 67 |
| LGV Bretagne Pays de la Loire | FRANCE | 320 | 2017 | 219 |
| LGV Sud Europe Atlantique (Tours-Bordeaux) | FRANCE | 320 | 2017 | 340 |
| Ebensfeld - Erfurt | GERMANY | 300 | 2017 | 107 |
| Nuremberg - Ebensfeld | GERMANY | 230 | 2017 | 83 |
| Copenhagen - Ringsted | DENMARK | 250 | 2019 | 56 |
| Valencia - Vandellós | SPAIN | 220 | 2019 | 219 |
| Antequera-Santa Ana - Granada | SPAIN | 250 | 2019 | 109 |
| Vandellós - Tarragona | SPAIN | 200 | 2020 | 47 |
| Giubiasco/S. Ant. - Vezia (Ceneri base tunnel) | SWITZERLAND | 250 | 2020 | 18 |
| Zamora - Pedralba | SPAIN | 300 | 2020 | 110 |
| Murcia Junction - Orihuela - Beniel | SPAIN | 240 | 2021 | 54 |
| Pedralba - Ourense | SPAIN | 300 | 2021 | 119 |

*Source: compiled by authors based on International Union of Railways, 2021*

# 1.2 HIGH-SPEED LINES IN COMMERCIAL OPERATION WORLDWIDE

***High-speed lines in Asia - Pacific (I)***

| LINE | COUNTRY | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|---|
| Tokyo - Shin Osaka (Tokaido) | JAPAN | 285 | 1964 | 515 |
| Shin Osaka - Okayama (San-yo) | JAPAN | 300 | 1972 | 161 |
| Okayama - Hakata (San-yo) | JAPAN | 300 | 1975 | 393 |
| Omiya - Niigata (Joetsu) | JAPAN | 240 | 1982 | 270 |
| Omiya - Utsunomiya (Tohoku) | JAPAN | 275 | 1982 | 79 |
| Utsunomiya - Morioka (Tohoku) | JAPAN | 320 | 1982 | 426 |
| Ueno - Omiya (Tohoku) | JAPAN | 130 | 1985 | 28 |
| Tokyo - Ueno (Tohoku) | JAPAN | 110 | 1991 | 4 |
| Fukushima - Yamagata (Yamagata) | JAPAN | 130 | 1992 | 87 |
| Takasaki - Nagano (Hokuriku) | JAPAN | 260 | 1997 | 117 |
| Morioka - Akita (Akita) | JAPAN | 130 | 1997 | 127 |
| Yamagata - Shinjo (Yamagata) | JAPAN | 130 | 1999 | 62 |
| Morioka - Hachinohe (Tohoku) | JAPAN | 260 | 2002 | 97 |
| Qinhuangdao - Shenyang North | CHINA | 250 | 2003 | 405 |
| Shin Yatsuhiro - Kagoshima Chuo (Kyushu) | JAPAN | 260 | 2004 | 127 |
| Geumcheon-gu (Seoul) - Dongdaegu | SOUTH KOREA | 305 | 2004 | 268 |
| Taipei - Kaohsiung | CHINA-CHINESE TAIPEI | 300 | 2007 | 345 |
| Nanjing - Hefei | CHINA | 250 | 2008 | 148 |
| Beijing South - Tianjin | CHINA | 350 | 2008 | 118 |
| Qingdao - Jinan | CHINA | 200 | 2009 | 393 |
| Hefei East - Hankou | CHINA | 250 | 2009 | 380 |
| Shijiazhuang North - Taiyuan | CHINA | 250 | 2009 | 227 |
| Ningbo - Cangnan | CHINA | 250 | 2009 | 351 |
| Wuhan - Guangzhou South | CHINA | 350 | 2009 | 1,079 |
| Chongqing North - Liangwu | CHINA | 200 | 2009 | 263 |
| Zhengzhou East - Xi'an North | CHINA | 350 | 2010 | 553 |
| Hachinohe - Shin Aomori (Tohoku) | JAPAN | 260 | 2010 | 82 |
| Dongdaegu - Busan | SOUTH KOREA | 305 | 2010 | 131 |
| Cangnan - Fuzhou | CHINA | 250 | 2010 | 211 |
| Fuzhou - Xiamen North | CHINA | 250 | 2010 | 234 |
| Chengdu - Qingchengshan | CHINA | 200 | 2010 | 65 |
| Shanghai - Nanjing | CHINA | 350 | 2010 | 323 |
| Jiujiang - Nanchang West | CHINA | 250 | 2010 | 138 |
| Shanghai Hongqiao - Hangzhou South | CHINA | 350 | 2010 | 174 |
| Haikou - Sanya | CHINA | 250 | 2010 | 308 |

*Source: compiled by authors based on International Union of Railways, 2022*

# 1.2 HIGH-SPEED LINES IN COMMERCIAL OPERATION WORLDWIDE

***High-speed lines in Asia - Pacific (II)***

| LINE | COUNTRY | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|---|
| Guangzhou South - Zhuhai | CHINA | 200 | 2011 | 143 |
| Changchun - Jilin | CHINA | 250 | 2011 | 111 |
| Hakata - Shin Yatsushiro (Kyushu) | JAPAN | 260 | 2011 | 130 |
| Beijing South - Shanghai Hongqiao | CHINA | 350 | 2011 | 1,318 |
| Guangzhou South - Futian | CHINA | 250 | 2011 | 111 |
| Longyan - Zhangzhou | CHINA | 200 | 2012 | 114 |
| Hankou - Yichang East | CHINA | 200 | 2012 | 292 |
| Zhengzhou East - Wuhan | CHINA | 350 | 2012 | 526 |
| Bengbu South - Hefei | CHINA | 350 | 2012 | 131 |
| Dalian North - Shenyang North | CHINA | 350 | 2012 | 383 |
| Shenyang North - Harbin West | CHINA | 350 | 2012 | 546 |
| Taigemu - Baotou | CHINA | 200 | 2012 | 146 |
| Suining - Chengdu East | CHINA | 200 | 2012 | 151 |
| Beijing West - Zhengzhou East | CHINA | 350 | 2012 | 676 |
| Taishansuo (block station) - Liuzhou | CHINA | 200 | 2012 | 498 |
| Nanjing South - Hangzhou East | CHINA | 350 | 2013 | 254 |
| Hangzhou South - Ningbo | CHINA | 350 | 2013 | 157 |
| Panjin North - Yingkou East | CHINA | 350 | 2013 | 90 |
| Nanchang West - Fuzhou | CHINA | 200 | 2013 | 547 |
| Yongtai - Putian | CHINA | 200 | 2013 | 59 |
| Tianjin - Qinhuangdao | CHINA | 350 | 2013 | 288 |
| Xi'an North - Baoji South | CHINA | 350 | 2013 | 184 |
| Xiamen North - Shenzhen North | CHINA | 250 | 2013 | 513 |
| Nanhu East - Xianning South | CHINA | 250 | 2013 | 76 |
| Liuzhou - Nanning | CHINA | 250 | 2013 | 223 |
| Qinzhou North - Fangchenggang | CHINA | 250 | 2013 | 62 |
| Nanning East - Beihai | CHINA | 250 | 2013 | 197 |
| Pixian West - Pengzhou | CHINA | 200 | 2013 | 21 |
| Nanning - Guangzhou South | CHINA | 250 | 2014 | 574 |
| Wuhan - Dayebei | CHINA | 250 | 2014 | 91 |
| Gedian South - Huanggangdong | CHINA | 250 | 2014 | 36 |
| Taiyuan South - Xi'an North | CHINA | 250 | 2014 | 571 |
| Hangzhou South - Changsha South | CHINA | 350 | 2014 | 911 |
| Changsha South - Xinhuang West | CHINA | 350 | 2014 | 420 |
| Jiangyou - Chengdu East | CHINA | 250 | 2014 | 153 |

*Source: compiled by authors based on International Union of Railways, 2022*

# 1.2 HIGH-SPEED LINES IN COMMERCIAL OPERATION WORLDWIDE

***High-speed lines in Asia - Pacific (III)***

| LINE | COUNTRY | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|---|
| Chengdu East - Leshan | CHINA | 250 | 2014 | 135 |
| Leshan - Emeishan | CHINA | 250 | 2014 | 27 |
| Lanzhou West - Ürümqi South | CHINA | 250 | 2014 | 1,785 |
| Guizhou East - Guangzhou South | CHINA | 250 | 2014 | 860 |
| Qingdao - Rongcheng | CHINA | 250 | 2014 | 301 |
| Zhengzhou East - Songchenglu | CHINA | 200 | 2014 | 50 |
| Ximotang - Yantai | CHINA | 250 | 2015 | 19 |
| Nanyangzhai - Jiaozuo | CHINA | 200 | 2015 | 70 |
| Xinhuang West - Guiyang North | CHINA | 350 | 2015 | 286 |
| Hefeibeicheng - Fuzhou | CHINA | 350 | 2015 | 850 |
| Harbin North - Qiqihar South | CHINA | 250 | 2015 | 269 |
| Shenyang South - Dandong | CHINA | 250 | 2015 | 207 |
| Osong - Gwangju | SOUTH KOREA | 305 | 2015 | 184 |
| Tianjin - Yujiapu | CHINA | 350 | 2015 | 43 |
| Jilin - Huichun | CHINA | 250 | 2015 | 361 |
| Nanjing East - Anqing | CHINA | 250 | 2015 | 257 |
| Nagano - Kanazawa (Hokuriku) | JAPAN | 260 | 2015 | 228 |
| Nanning - Yangxu | CHINA | 250 | 2015 | 257 |
| Dandong - Dalian North | CHINA | 200 | 2015 | 293 |
| Chengdu East - Shapingba (block station) | CHINA | 250 | 2015 | 300 |
| Tangyasuo (block station) - Wenzhou South | CHINA | 200 | 2015 | 190 |
| Ganxian - Longyan | CHINA | 200 | 2015 | 248 |
| Tianjin West - Bazhou West | CHINA | 250 | 2015 | 73 |
| Bazhou West - Xushui | CHINA | 200 | 2015 | 65 |
| Hainan West Circle (Haikou-Sanya) | CHINA | 200 | 2015 | 345 |
| Zhengzhou East - Xinzheng Airport | CHINA | 200 | 2015 | 27 |
| Taipei - Nangang | CHINA-CHINESE TAIPEI | 130 | 2016 | 9 |
| Foshan West - Zhaoqing | CHINA | 200 | 2016 | 81 |
| Changping East - Xiaojinkou | CHINA | 200 | 2016 | 53 |
| Suseo - Pyoengtaek | SOUTH KOREA | 305 | 2016 | 61 |
| Zhengzhou - Xuzhou | CHINA | 350 | 2016 | 362 |
| Chongqing North - Wanzhou North | CHINA | 250 | 2016 | 246 |
| Shin Aomori - Shin Hakodate (Hokkaido) | JAPAN | 260 | 2016 | 149 |
| Hankou - Xiaogan East | CHINA | 200 | 2016 | 61 |
| Changsha - Zhuzhou - Xiangtan | CHINA | 200 | 2016 | 82 |

*Source: compiled by authors based on International Union of Railways, 2022*

# 1.2 HIGH-SPEED LINES IN COMMERCIAL OPERATION WORLDWIDE

***High-speed lines in Asia - Pacific (IV)***

| LINE | COUNTRY | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|---|
| Guiyang North - Kunming | CHINA | 250 | 2016 | 463 |
| Yangxu - Baise | CHINA | 250 | 2016 | 452 |
| Daye North - Yangxin | CHINA | 250 | 2017 | 37 |
| Baoji South - Lanzhou West | CHINA | 250 | 2017 | 353 |
| Wulanchabu - Hohhot East | CHINA | 250 | 2017 | 128 |
| Yangxin - K23 block station | CHINA | 250 | 2017 | 82 |
| Xi'an North - Jinangyou | CHINA | 250 | 2017 | 505 |
| Huaibei North - Xiaoxian North | CHINA | 250 | 2017 | 25 |
| Seoul - Gangneung | SOUTH KOREA | 250 | 2017 | 230 |
| Shijiazhuang - Jinan East | CHINA | 250 | 2017 | 308 |
| Quzhou - Jiujiang | CHINA | 200 | 2017 | 334 |
| Dongguan - Changping East | CHINA | 200 | 2017 | 48 |
| Changsha West - Changsha | CHINA | 200 | 2017 | 22 |
| Chongqing West - Guiyang | CHINA | 200 | 2018 | 380 |
| Jiangmen - Zhanjiang West | CHINA | 200 | 2018 | 355 |
| Harbin - Jiamusi | CHINA | 200 | 2018 | 343 |
| Yuanping West - Taiyuan South | CHINA | 200 | 2018 | 111 |
| Guangtong North - Dali | CHINA | 200 | 2018 | 175 |
| Xinhui - Jiangmen | CHINA | 200 | 2018 | 3 |
| Futian - Hong Kong (boundary) | CHINA | 200 | 2018 | 4 |
| Harbin - Harbin North | CHINA | 200 | 2018 | 13 |
| Hangzhou South - Huangshan North | CHINA | 250 | 2018 | 272 |
| Harbin - Mudanjiang | CHINA | 250 | 2018 | 300 |
| Qingdao North - Ganyu North | CHINA | 200 | 2018 | 197 |
| Ganyu North - Weiyang (block station) | CHINA | 200 | 2018 | 234 |
| Huaihua South - Hengyang East | CHINA | 200 | 2018 | 319 |
| Xiantang - Yanjialong | CHINA | 200 | 2018 | 5 |
| Changtang (block station) - Hengyang North | CHINA | 200 | 2018 | 5 |
| Changtang (block station) - Chashan'ao | CHINA | 200 | 2018 | 5 |
| Qihe - Jinan West | CHINA | 200 | 2018 | 21 |
| Dazhengzhuang (b.s.) - Damoliu (b.s.) | CHINA | 200 | 2018 | 3 |
| Jinan East - Wulitang (block station) | CHINA | 200 | 2018 | 21 |
| Jinan East - Qingdao | CHINA | 350 | 2018 | 305 |
| Tongren - Dazongping | CHINA | 200 | 2018 | 46 |
| Chengdu West - Chaoyang Lake | CHINA | 200 | 2018 | 100 |

*Source: compiled by authors based on International Union of Railways, 2022*

# 1.2 HIGH-SPEED LINES IN COMMERCIAL OPERATION WORLDWIDE

***High-speed lines in Asia - Pacific (V)***

| LINE | COUNTRY | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|---|
| Nanping North - Longyan | CHINA | 200 | 2018 | 247 |
| Houling (b.s.) - Hongxing (b.s.) | CHINA | 200 | 2018 | 8 |
| Huyi (block station) - Aibei (block station) | CHINA | 200 | 2018 | 2 |
| Chengde South - Pingquan North | CHINA | 350 | 2018 | 67 |
| Pingquan North - Shenyang | CHINA | 350 | 2018 | 434 |
| Qiandingxiang W. (b.s.) - Houdingxiang E. (b.s.) | CHINA | 200 | 2018 | 2 |
| Houdingxiang E. (b.s.) - Qiandingxiang W. (b.s.) | CHINA | 200 | 2018 | 2 |
| Tongliao - Xinmin North | CHINA | 250 | 2018 | 197 |
| Yaojiawopu (b.s.) - Tianjiawopu (b.s.) | CHINA | 200 | 2018 | 6 |
| Tuancun (block station) - Daguhe (block station) | CHINA | 350 | 2018 | 4 |
| Leshan - Yibin West | CHINA | 350 | 2019 | 145 |
| Liying - Daxing Airport | CHINA | 200 | 2019 | 32 |
| Meizhou West - Chaoshan | CHINA | 200 | 2019 | 120 |
| Rizhao West - Dawangzhuang (b. s.) | CHINA | 350 | 2019 | 226 |
| Qufu East - Dawangzhuang (b. s.) | CHINA | 200 | 2019 | 10 |
| Qufu East - Nanxiasong (b. s.) | CHINA | 200 | 2019 | 4 |
| Xiaogan East - Yunmeng East | CHINA | 250 | 2019 | 21 |
| Yunmeng East - Shiyan East | CHINA | 350 | 2019 | 377 |
| Shangqiu - Hefei North City | CHINA | 350 | 2019 | 378 |
| Zhengzhou East - Xiangyang East | CHINA | 350 | 2019 | 389 |
| Zhengzhou South - Fuyang West | CHINA | 350 | 2019 | 280 |
| Yinchuan - Zhongwei South | CHINA | 250 | 2019 | 207 |
| Xintang South - Shenzhen Airport | CHINA | 140 | 2019 | 73 |
| Xintang South - Xintang | CHINA | 140 | 2019 | 3 |
| Xuzhou East (Lanxu Yard) - Yancheng (Yanxu Y.) | CHINA | 250 | 2019 | 313 |
| Dongji - Huai'an East | CHINA | 250 | 2019 | 105 |
| Yibin West - Guiyang East | CHINA | 250 | 2019 | 368 |
| Jianpo (block station) - Guiyang North | CHINA | 250 | 2019 | 9 |
| Hejia (block station) - Ganzhou West | CHINA | 350 | 2019 | 385 |
| Henggang - Hejia (block station) | CHINA | 200 | 2019 | 11 |
| Dongcun (block station) - Pushu (block station) | CHINA | 200 | 2019 | 5 |
| Fanjia (block station) - Nanjie (block station) | CHINA | 200 | 2019 | 2 |
| Ganxian North - Pingjiang (block station) | CHINA | 200 | 2019 | 3 |
| Qianjiang - Changde | CHINA | 200 | 2019 | 333 |
| Beijing North - Zhangjiakou | CHINA | 350 | 2019 | 174 |

*Source: compiled by authors based on International Union of Railways, 2022*

# 1.2 HIGH-SPEED LINES IN COMMERCIAL OPERATION WORLDWIDE

***High-speed lines in Asia - Pacific (VI)***

| LINE | COUNTRY | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|---|
| Zhangjiakou - Wulanchabu | CHINA | 350 | 2019 | 159 |
| Xiahuayuan - Taizicheng (Chongli Railway) | CHINA | 250 | 2019 | 52 |
| Huai'an - Datong South | CHINA | 250 | 2019 | 134 |
| Kazuo - Chifeng | CHINA | 250 | 2020 | 156 |
| Sunjiagou (b.s.) - Zhengzhangzi (b.s.) | CHINA | 200 | 2020 | 5 |
| Feidong - Huzhou | CHINA | 350 | 2020 | 309 |
| Zhaodian - Huangdu | CHINA | 200 | 2020 | 143 |
| Pingdong (b.s.) - Nantong West | CHINA | 200 | 2020 | 5 |
| Anshun West - Shuicheng | CHINA | 250 | 2020 | 120 |
| Guangzhou North - Qingyuan | CHINA | 200 | 2020 | 38 |
| Weifang - Laixi | CHINA | 350 | 2020 | 124 |
| Langjiazhuang (b.s.) - Pangjiatun (b.s.) | CHINA | 200 | 2020 | 3 |
| Huai'an West - Dantu | CHINA | 250 | 2020 | 199 |
| Shaobo (b.s.) - Dujiang | CHINA | 200 | 2020 | 4 |
| Shaobo (b.s.) - Tai'anzhen | CHINA | 200 | 2020 | 5 |
| Hengshan (b.s.) - Zhenjiang | CHINA | 200 | 2020 | 12 |
| Nayangzhai - Changfengjie (b.s.) | CHINA | 250 | 2020 | 362 |
| Feixi Jinggang - Shuangling (b.s.) | CHINA | 350 | 2020 | 134 |
| Shuangling (b.s.) - Longshan (b.s.) | CHINA | 200 | 2020 | 4 |
| Longshan (b.s.) - Anqing | CHINA | 200 | 2020 | 22 |
| Fuzhou - Pingtan | CHINA | 200 | 2020 | 88 |
| Xi'an North - Wuzhong | CHINA | 250 | 2020 | 545 |
| Huwang (b.s.) - Liquan South | CHINA | 200 | 2020 | 6 |
| Daxing Airport - Xiong'an | CHINA | 350 | 2020 | 59 |
| Yancheng - Chjenqiao (b.s.) | CHINA | 350 | 2020 | 158 |
| Guodaocun (b.s.) - Feixi Jinggang | CHINA | 200 | 2020 | 6 |
| Jixianlu (b.s) - | CHINA | 200 | 2020 | 10 |
| Dafu - Xiantao | CHINA | 200 | 2020 | 17 |
| Beijing - Chengde South | CHINA | 350 | 2021 | 192 |
| Xuzhou East - Houmazhuang | CHINA | 350 | 2021 | 185 |
| Shenxu (b.s.) - Lianyungang | CHINA | 200 | 2021 | 5 |
| Neijiang North - Luzhou | CHINA | 250 | 2021 | 129 |
| Chaoyang - Linghai South | CHINA | 350 | 2021 | 107 |
| Zhangjiajie West - Huaihua South | CHINA | 350 | 2021 | 247 |
| Zhangjiajie West - Shadi (b.s.) | CHINA | 200 | 2021 | 3 |

*Source: compiled by authors based on International Union of Railways, 2022*

# 1.2 HIGH-SPEED LINES IN COMMERCIAL OPERATION WORLDWIDE

### *High-speed lines in Asia - Pacific (VII)*

| LINE | COUNTRY | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|---|
| Longxingcun (b.s.) - Huaihua South | CHINA | 200 | 2021 | 4 |
| Mudanjiang - Jiamusi | CHINA | 250 | 2021 | 372 |
| Changbaishan - Dunhua South | CHINA | 250 | 2021 | 99 |
| Dunhua - Dunhua South | CHINA | 200 | 2021 | 12 |
| Hejia (b.s.) - Yangtaishan (b.s.) | CHINA | 350 | 2021 | 431 |
| Shuangling (b.s.) - Lushan | CHINA | 350 | 2021 | 176 |
| Tangxia (b.s.) - Dongguan South | CHINA | 200 | 2021 | 3 |
| Dongguan South - Tangxia (b.s.) | CHINA | 200 | 2021 | 2 |
| Yangtaishan (b.s.) - Shenzhen North | CHINA | 200 | 2021 | 8 |
| Anqing West - Longshan (b.s.) | CHINA | 200 | 2021 | 7 |
| Dawang. (b.s.) (-Qufu) - Zhuangzhai (Cao County) | CHINA | 350 | 2021 | 199 |
| Anqing West - Longshan (b.s.) | CHINA | 200 | 2021 | 5 |

### *High-speed lines in Africa*

| LINE | COUNTRY | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|---|
| Tanger - Kenitra | MOROCCO | 320 | 2018 | 186 |

### *High-speed lines in North America*

| LINE | COUNTRY | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|---|
| NE Corridor (Boston - New York - Washington) | USA | 240 | 2000 | 735 |

### *High-speed lines in Middle East*

| LINE | COUNTRY | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|---|
| Ankara - Eskisehir | TURKEY | 250 | 2009 | 245 |
| (Ankara) Polatli - Konya | TURKEY | 250 | 2011 | 212 |
| Eskisehir - İzmit - Pendik (Istanbul) | TURKEY | 250 | 2014 | 257 |
| Kayseri North Passage | TURKEY | 160 | 2016 | 23 |
| Medina - Jeddah - Mecca | SAUDI ARABIA | 300 | 2018 | 449 |
| Balışeyh (Kırıkkale) - Sivas | TURKEY | 300 | 2021 | 315 |

*Source: compiled by authors based on International Union of Railways, 2021*


INTERNATIONAL UNION
OF RAILWAYS

# 2.1 HIGH-SPEED RAIL NETWORK

## AUSTRIA
## SWITZERLAND

### *High-speed lines in commercial operation in Austria*

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| Linz - Wels | 200 | 1990 | 24 |
| St. Pölten - Ybbs | 200 | 2001 | 44 |
| Amstetten - St. Valentin | 200 | 2003 | 37 |
| St. Valentin - Asten-St. Florian | 230 | 2007 | 16 |
| Vienna Knot Hadersdorf - St. Pölten | 230 | 2012 | 50 |
| Radfeld Knot - Baumkirchen Knot | 220 | 2012 | 36 |
| Wels - Attnang-Puchheim | 230 | 2012 | 30 |
| Ybbs - Amstetten | 230 | 2016 | 17 |
| | | | **Total km = 254** |

### *High-speed lines under construction in Austria*

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| Vienna Stadlau - Slovakian border | 200 | 2022 | 38 |
| Vienna Inzersdorf Ort - Wr. Neustadt | 200 | 2023 | 47 |
| Graz - Klagenfurt | 250 | 2025 | 122 |
| Gloggnitz - Mürzzuschlag | 230 | 2026 | 28 |
| Volders-Baumkirchen - Italian border | 250 | 2027 | 46 |
| | | | **Total km = 281** |

### *High-speed lines planned in Austria*

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| Linz - Wels | 230 | 2026 | 24 |
| Gänserndorf - Czech border | 200 | 2028 | 47 |
| | | | **Total km = 71** |

### *High-speed lines in commercial operation in Switzerland*

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| Mattstetten - Rothrist | 200 | 2004 | 41.7 |
| Solothurn - Wanzwil | 200 | 2004 | 10.6 |
| Frutigen - Visp (Lötschberg base tunnel) | 200 | 2007 | 38.4 |
| Erstfeld - Biasca (Gotthard base tunnel) | 200 | 2016 | 67.1 |
| Giubiasco/S. Antonino - Vezia (Ceneri base tunnel) | 200 | 2020 | 18.1 |
| | | | **Total km = 176** |

*Source: compiled by authors based on International Union of Railways, 2021*

# 2.1 HIGH-SPEED RAIL NETWORK

***High-speed lines in Austria and Switzerland***


*Source: compiled by authors based on International Union of Railways, 2021*

# 2.1 HIGH-SPEED RAIL NETWORK

## BELGIUM
## THE NETHERLANDS

### *High-speed lines in commercial operation in Belgium*

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| Brussels - French border | 300 | 1997 | 72 |
| Leuven - Liège | 300 | 2002 | 65 |
| Liège - German border | 260 | 2009 | 36 |
| Antwerp - Dutch border | 300 | 2009 | 36 |
| | | | **Total km = 209** |

### *High-speed lines in commercial operation in The Netherlands*

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| Hoofddorp - Rotterdam West | 300 | 2006 | 44.3 |
| Rotterdam Lombardijen - Belgian border | 300 | 2006 | 45.4 |
| | | | **Total km = 90** |

*Source: compiled by authors based on International Union of Railways, 2021*

# 2.1 HIGH-SPEED RAIL NETWORK

***High-speed lines in Belgium and The Netherlands***


*Source: compiled by authors based on International Union of Railways, 2021*

# 2.1 HIGH-SPEED RAIL NETWORK

## CZECH REPUBLIC

### *High-speed lines planned in Czech Republic*

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| Plzeň - Domažlice - German border | 200 | 2027 | 58 |
| Prague - Poříčany ( - Brno) | 320 | 2028 | 22 |
| Prague - Poříčany ( - Hradec Králové) | 320 | 2028 | 29 |
| Šakvice - Břeclav - (A / SK border) | 200 | 2028 | 23 |
| Přerov - Ostrava | 320 | 2029 | 73 |
| Modřice - Šakvice | 320 | 2029 | 35 |
| Brno - Přerov | 200 | 2030 | 80 |
| Prague - Litoměřice | 320 | 2030 | 58 |
| Poříčany - Světlá nad Sázavou | 320 | 2031 | 71 |
| Velká Bíteš - Brno | 320 | 2031 | 32 |
| Světlá nad Sázavou - Velká Bíteš | 320 | 2034 | 81 |
| Prague - Beroun | 200 | 2043 | 25 |
| Litoměřice - Ústí nad Labem | 250 | 2045 | 23 |
| Hradec Králové - Trutnov - Polish border | 250 | 2050 | 69 |
| Brno - Přerov | 320 | 2050 | 74 |
| Šakvice - Břeclav | 320 | 2050 | 23 |
| Ústí nad Labem - Dresden | 200 | - | 56 |
| | | | **Total km = 832** |

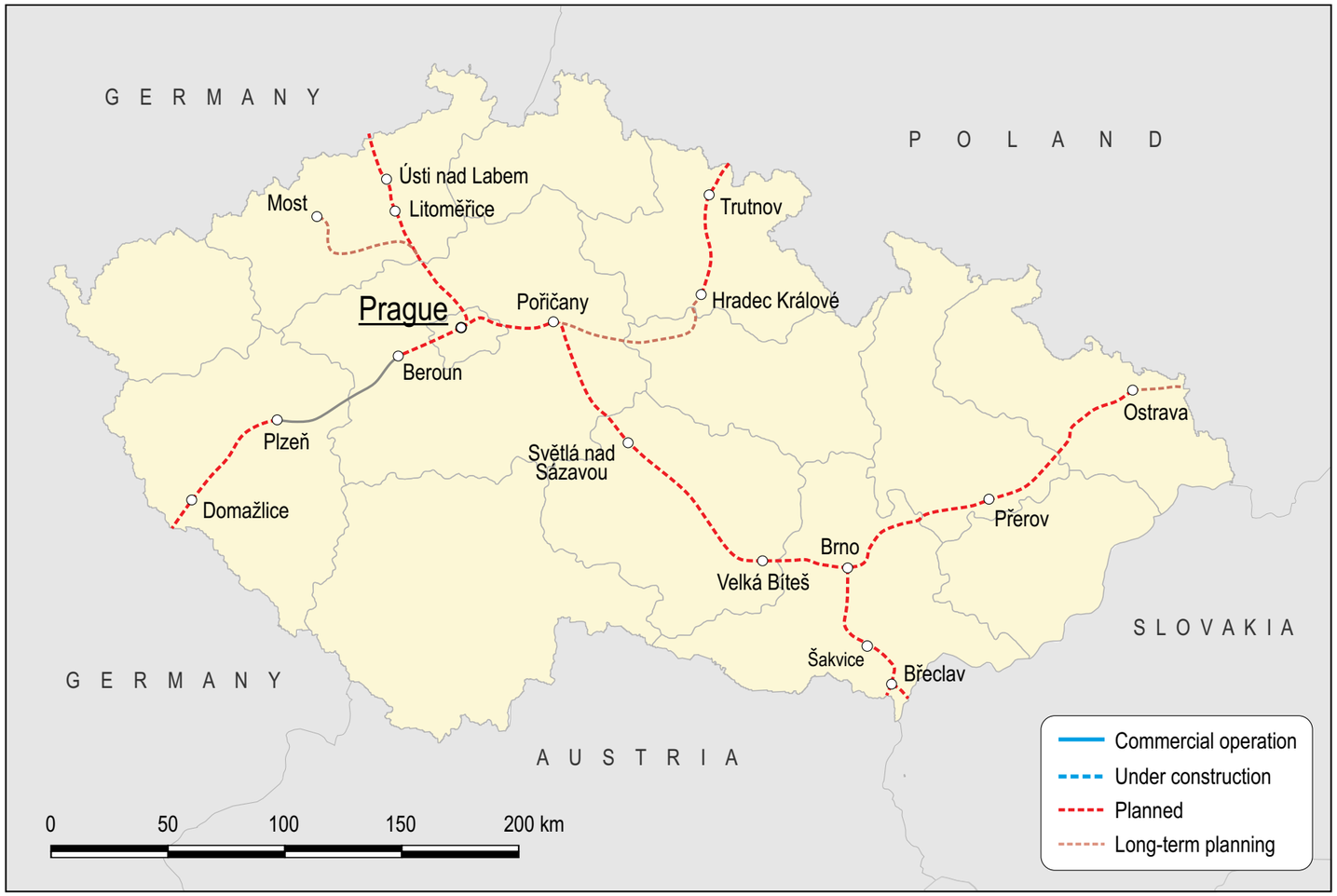
### *High-speed lines with long-term planning in Czech Republic*

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| Poříčany - Hradec Králové | 320 | 2040 | 67 |
| Odb. Veltrusy - Most | 250 | 2040 | 85 |
| Ostrava - Bohumín - Polish border | 200 | - | 21 |
| | | | **Total km = 173** |

*Source: compiled by authors based on International Union of Railways, 2021*

# 2.1 HIGH-SPEED RAIL NETWORK

***High-speed lines planned and long-term planning in Czech Republic***




*Note:*
*Beroun-Plzen is not a high-speed line but a modernization of existing line up to 160 km/h*
*Source: compiled by authors based on International Union of Railways, 2021*

# 2.1 HIGH-SPEED RAIL NETWORK

**DENMARK**
**ESTONIA**
**FINLAND**
**LATVIA**
**LITHUANIA**
**NORWAY**
**SWEDEN**

### *High-speed lines in commercial operation in Denmark*

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| Copenhagen - Ringsted | 250 | 2019 | 56 |
| | | | **Total km = 56** |

### *High-speed lines planned in Estonia*

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| Tallinn - Latvian border | 249 | 2026 | 213 |
| | | | **Total km = 213** |

### *High-speed lines in commercial operation in Finland*

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| Helsinki - Turku | 200 | 1995 | 156 |
| Helsinki - Oulu | 200 | 2001 | 673 |
| Jämsänkoski - Jyväskylä | 200 | 2001 | 53 |
| Kinni - Otava | 200 | 2006 | 44 |
| Kerava - Lahti | 220 | 2006 | 63 |
| Lahti - Luumäki | 200 | 2009 | 131 |
| | | | **Total km = 1,120** |

### *High-speed lines planned in Finland*

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| Helsinki - Porvoo - Kouvola - Vainikkala | - | 2030 | 238 |
| Helsinki - Turku | 300 | 2031 | 156 |
| | | | **Total km = 394** |

*Source: compiled by authors based on International Union of Railways, 2021*

# 2.1 HIGH-SPEED RAIL NETWORK

### *High-speed lines planned in Latvia*

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| Estonian border - Lithuanian border | 249 | 2026 | 265 |
| | | | **Total km = 265** |

### *High-speed lines planned in Lithuania*

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| Latvian border - Polish Border | 249 | 2026 | 252 |
| Kaunas - Vilnius | 249 | 2026 | 140 |
| | | | **Total km = 392** |

### *High-speed lines with long-term planning in Norway*

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| Sandbukta - Fredrikstad | 250 | - | 34 |
| Gardermoen - Hamar | 250 | - | 74 |
| Drammen - Tønsberg | 250 | - | 60 |
| Fredrikstad - Halden | 250 | - | 39 |
| Hamar - Lillehammer | 250 | - | 54 |
| Tønsberg - Skien | 250 | - | 72 |
| | | | **Total km = 333** |

*Source: compiled by authors based on International Union of Railways, 2021*

# 2.1 HIGH-SPEED RAIL NETWORK

### *High-speed lines in commercial operation in Sweden*

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| Stockholm - Örebro | 200 | 1999 | 187 |
| Gothenburg - Lund | 200 | 2008 | 283 |
| Nyland - Umeå | 200 | 2009 | 180 |
| Sundsvall - Nyland | 200 | 2010 | 30 |
| Gothenburg - Kornsjø | 200 | 2012 | 180 |
| | | | **Total km = 860** |

### *High-speed lines under construction in Sweden*

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| Umeå - Dåvå | 250 | 2024 | 12 |
| Lund - Arlöv | 200 | 2024 | 11 |
| Varberg - Hamra (Varbergtunnel) | 200 | 2025 | 7 |
| Ängelholm - Maria | 200 | 2025 | 24 |
| Järna - Linköping | 250 | 2035 | 160 |
| | | | **Total km = 214** |

### *High-speed lines planned in Sweden*

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| Dingersjö - Sundsvall | 250 | 2028 | 14 |
| Myrbacken - Uppsala | 200 | 2029 | 30 |
| Gävle - Kringlan | 200 | 2032 | 40 |
| Dåvå - Skelefteå | 250 | 2033 | 120 |
| Gothenburg - Borås (New HSL line) | 250 | 2035 | 60 |
| Hässleholm - Lund (New HSL line) | 320 | 2035 | 70 |
| Maria - Helsingborg | 200 | 2035 | 4 |
| | | | **Total km = 338** |

*Source: compiled by authors based on International Union of Railways, 2021*

# 2.1 HIGH-SPEED RAIL NETWORK

## *High-speed lines in Denmark, Estonia, Finland, Latvia, Lithuania, Norway and Sweden*


*Source: compiled by authors based on International Union of Railways, 2021*

# 2.1 HIGH-SPEED RAIL NETWORK

**FRANCE**

***High-speed lines in commercial operation in France***

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| LGV Paris Sud-Est | 300 | 1981 / 1983 | 425 |
| LGV Atlantique | 300 | 1989 / 1990 | 292 |
| LGV Rhône - Alpes (rail bypass of Lyon) | 300 | 1992 / 1994 | 122 |
| LGV Nord (inc. London - Brussels link) | 300 | 1994 / 1996 | 346 |
| LGV Interconnexion Est IDF | 300 | 1994 / 1996 | 105 |
| LGV Méditerranée | 300 | 2001 | 259 |
| LGV Est Europe (first phase) | 320 | 2007 | 335 |
| Perpignan - Spanish border (Figueres) | 300 | 2010 | 24 |
| LGV Rhin-Rhône Branche Est (first phase) | 320 | 2011 | 146 |
| LGV Est Europe (second phase) | 320 | 2016 | 122 |
| LGV Bretagne Pays de la Loire (BPL) | 320 | 2017 | 219 |
| LGV Tours - Bordeaux (SEA) | 320 | 2017 | 340 |
| | | | **Total km = 2,735** |

***High-speed lines under study in France***

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| Modernisation of HSL Paris-Lyon and Lyon bypass | 300 | 2025 | 483 |
| Paris - Normandie (LNPN) (first phase) | 250 | - | 59 |
| LGV Bordeaux - Toulouse / Dax (GPSO) | 320 | - | 327 |
| Interconnexion des LGV au sud de l'IDF | 320 | - | 31 |
| Paris - Orléans - Clermont-F. - Lyon (POCL) | 320 | - | 540 |
| Montpellier - Perpignan (LNMP) | 320 | - | 155 |
| Ligne nouvelle Rennes-Redon | 300 | - | 80 |
| LGV Rhin-Rhône Branche Est (second phase) | 320 | - | 50 |
| | | | **Total km = 1,725** |

*Source: compiled by authors based on International Union of Railways, 2021*

# 2.1 HIGH-SPEED RAIL NETWORK

***High-speed lines in France***


*Source: compiled by authors based on International Union of Railways, 2021*
*Note:*
*This map includes the Channel Tunnel that connects the English and French high-speed lines (length 50.5 km)*

# 2.1 HIGH-SPEED RAIL NETWORK

## GERMANY

### *High-speed lines in commercial operation in Germany*

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| Hannover - Würzburg | 280 | 1991 | 327 |
| Mannheim - Stuttgart | 280 | 1991 | 99 |
| (Hannover) - Oebisfelde - Berlin | 250 | 1998 | 150 |
| (Cologne) - Siegburg - Frankfurt | 300 | 2002 | 144 |
| Cologne - Düren | 250 | 2003 | 39 |
| Hamburg - Berlin | 230 | 2004 | 286 |
| (Karlsruhe) - Rastatt Süd - Offenburg - (Basel) | 250 | 2004 | 44 |
| Nuremberg - Ingolstadt | 300 | 2006 | 89 |
| Munich - Augsburg | 230 | 2011 | 62 |
| (Karlsruhe) - Katzenberg Tunnel - (Basel) | 250 | 2012 | 18 |
| Erfurt - Leipzig/Halle | 300 | 2015 | 123 |
| Ebensfeld - Erfurt | 300 | 2017 | 107 |
| Nuremberg - Ebensfeld | 230 | 2017 | 83 |
| | | | **Total km = 1,571** |

### *High-speed lines under construction in Germany*

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| Wendlingen - Ulm | 250 | 2022 | 60 |
| Stuttgart - Wendlingen | 250 | 2024 | 25 |
| Karlsruhe - Rastatt - (Basel) | 250 | 2024 | 17 |
| Buggingen - Katzenberg tunnel - (Basel) | 250 | 2025 | 32 |
| (Karlsruhe) - Katzenberg tunnel - Basel | 250 | 2025 | 13 |
| | | | **Total km = 147** |

### *High-speed lines planned in Germany*

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| (Karlsruhe) - Riegel - Buggingen - (Basel) | 200 | 2031 | 41 |
| (Karlsruhe) - Offenburg - Riegel - (Basel) | 250 | 2035 | 40 |
| | | | **Total km = 81** |

### *High-speed lines with long-term planning in Germany*

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| Frankfurt - Mannheim | 300 | - | 84 |
| (Frankfurt -) Hanau - Fulda/Würzburg | 300 | - | 126 |
| | | | **Total km = 210** |

*Source: compiled by authors based on International Union of Railways, 2021*

# 2.1 HIGH-SPEED RAIL NETWORK

***High-speed lines in Germany***


*Source: compiled by authors based on International Union of Railways, 2021*

# 2.1 HIGH-SPEED RAIL NETWORK

**HUNGARY**
**SERBIA**

### *High-speed lines planned in Hungary*

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| Budapest - Serbian border | 200 | - | 166 |
| | | | **Total km = 166** |

### *High-speed lines under construction in Serbia*

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| Belgrade - Stara Pazova - Novi Sad | 200 | - | 75 |
| | | | **Total km = 75** |

### *High-speed lines planned in Serbia*

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| Belgrade - Niš | 200 | 2023 | 204 |
| Novi Sad - Subotica - Hungarian border | 200 | - | 109 |
| | | | **Total km = 313** |

*Source: compiled by authors based on International Union of Railways, 2021*

# 2.1 HIGH-SPEED RAIL NETWORK

***High-speed lines in Hungary and Serbia***


*Source: compiled by authors based on International Union of Railways, 2021*

# 2.1 HIGH-SPEED RAIL NETWORK

ITALY

*High-speed lines in commercial operation in Italy*

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| Rome - Florence (First section) | 250 | 1977 | 122 |
| Rome - Florence (Second section) | 250 | 1985 | 52 |
| Rome - Florence (Third section) | 250 | 1986 | 20 |
| Rome - Florence (Forth section) | 250 | 1992 | 44 |
| Turin - Novara | 300 | 2006 | 86 |
| Padova - Venice | 220 | 2007 | 25 |
| Milan - Bologna | 300 | 2008 | 182 |
| Naples - Salerno | 250 | 2008 | 29 |
| Rome - Naples | 300 | 2009 | 205 |
| Novara - Milan | 300 | 2009 | 38 |
| Florence - Bologna | 300 | 2009 | 78 |
| Milan (Treviglio) - Brescia | 300 | 2016 | 40 |
| | | | **Total km = 921** |

*High-speed lines under construction in Italy*

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| Genoa - Milan (Tortona) | 250 | 2022 | 53 |
| Brescia - Verona | 300 | - | 45 |
| Naples - Bari | 200 | - | 150 |
| Verona - Padova | 250 | - | 79 |
| | | | **Total km = 327** |

*Source: compiled by authors based on International Union of Railways, 2021*

# 2.1 HIGH-SPEED RAIL NETWORK

***High-speed lines in Italy***


*Source: compiled by authors based on International Union of Railways, 2021*

# 2.1 HIGH-SPEED RAIL NETWORK

**POLAND**

### *High-speed lines in commercial operation in Poland*

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| Grodzisk Mazowiecki - Zawiercie | 200 | 2015 | 224 |
| | | | **Total km = 224** |

### *High-speed lines planned in Poland*

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| Warsaw - Poznan / Wroclaw | 350 | 2030 | 448 |
| Warsaw - Bialystok - Ełk | 200 | 2030 | 277 |
| Elk - Lithuanian border (Rail Baltica) | 250 | 2030 | 80 |
| | | | **Total km = 805** |

### *High-speed lines with long-term planning in Poland*

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| Knapówka - Katowice / Kraków | 300 | >2030 | 138 |
| Wroclaw - Czech border | 350 | >2030 | 148 |
| Poznan - German border | 350 | >2030 | 171 |
| Katowice - Czech border | 300 | >2030 | 61 |
| Warsaw - Toruń - Gdańsk | 350 | >2030 | 357 |
| | | | **Total km = 875** |

*Source: compiled by authors based on International Union of Railways, 2021*

# 2.1 HIGH-SPEED RAIL NETWORK

***High-speed lines in Poland***


*Source: compiled by authors based on International Union of Railways, 2021*

# 2.1 HIGH-SPEED RAIL NETWORK

**PORTUGAL**
**SPAIN**

### *High-speed lines under construction in Portugal*

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| Évora - Caia | 250 | 2023 | 80 |
| | | | **Total km = 80** |

### *High-speed lines planned in Portugal*

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| Lisbon - Porto | 300 | - | 306 |
| Porto - Valença | 250 | - | 112 |
| | | | **Total km = 418** |

*Source: compiled by authors based on International Union of Railways, 2021*

### *High-speed lines in commercial operation in Spain*

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| Madrid - Sevilla | 270 | 1992 | 471 |
| Madrid - Lleida | 300 | 2003 | 467 |
| Zaragoza - Huesca | 200 | 2003 | 79 |
| (Madrid -) La Sagra - Toledo | 220 | 2005 | 21 |
| Córdoba - Antequera-Santa Ana | 300 | 2006 | 111 |
| Lleida - Camp de Tarragona | 300 | 2006 | 96 |
| Madrid - Segovia - Olmedo - Valladolid | 300 | 2007 | 178 |
| Antequera-Santa Ana - Málaga | 300 | 2007 | 58 |
| Camp de Tarragona - Barcelona | 300 | 2008 | 100 |
| By pass Madrid | 200 | 2009 | 5 |
| Santiago - A Coruña | 250 | 2009 | 61 |
| (Madrid -) Torrejón de Velasco - Valencia | 300 | 2010 | 362 |
| Albacete Junction - Albacete | 300 | 2010 | 73 |
| Figueres - French border (- Perpignan) | 300 | 2010 | 20 |
| Ourense - Santiago | 300 | 2011 | 85 |
| By pass Yeles | 200 | 2012 | 6 |
| Barcelona - Figueres | 300 | 2013 | 131 |
| Albacete - Alicante/Alacant | 300 | 2013 | 165 |
| Santiago - Vigo | 200 | 2015 | 95 |
| Sevilla - Cádiz | 250 | 2015 | 153 |
| Valladolid - León | 300 | 2015 | 166 |
| Olmedo - Zamora | 300 | 2015 | 99 |
| Valencia - Vandellós | 220 | 2019 | 219 |
| Antequera-Santa Ana - Granada | 250 | 2019 | 109 |
| Vandellós - Tarragona | 200 | 2020 | 47 |
| Zamora - Pedralba | 300 | 2020 | 110 |
| Murcia Junction - Orihuela - Beniel | 240 | 2021 | 54 |
| Pedralba - Ourense | 300 | 2021 | 119 |
| | | | **Total km = 3,661** |

*Source: compiled by authors based on International Union of Railways and Spanish Ministry of Transport, 2022*

# 2.1 HIGH-SPEED RAIL NETWORK

### *High-speed lines under construction in Spain*

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| Beniel - Murcia | 300 | 2022 | 15 |
| Venta de Baños - Burgos | 300 | 2022 | 91 |
| León - Pola de Lena (Pajares New pass) | 250 | 2022 | 76 |
| Navalmoral - Plasencia - Badajoz | 300 | 2022 | 246 |
| Vitoria Gasteiz - Bilbao / San Sebastián | 250 | 2028 | 175 |
| Murcia - Almería | 300 | - | 188 |
| Castejón - Pamplona | 300 | - | 75 |
| La Encina - Valencia | 300 | - | 107 |
| Palencia - Alar del Rey | 300 | - | 82 |
| | | | **Total km = 1,055** |

### *High-speed lines planned in Spain*

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| Burgos - Vitoria | 300 | - | 110 |
| Madrid - Navalmoral | 300 | - | 223 |
| Alar del Rey - Reinosa | 300 | - | 44 |
| Zaragoza - Castejón | 250 | - | 82 |
| Ourense - Vigo (vía Cerdedo) | 250 | - | 60 |
| Sevilla - Huelva | 300 | - | 102 |
| Teruel - Zaragoza | 250 | - | 166 |
| Castejón - Logroño | 220 | - | 76 |
| | | | **Total km = 863** |

*Source: compiled by authors based on International Union of Railways and Spanish Ministry of Transport, 2022*

# 2.1 HIGH-SPEED RAIL NETWORK

***High-speed lines in Portugal and Spain***


*Note: Chamartín-Atocha new tunnel (8.2 km length and 100 km/h maximum speed) is expected to open in 2022*
*Source: compiled by authors based on International Union of Railways and Spanish Ministry of Transport, 2022*

# 2.1 HIGH-SPEED RAIL NETWORK

**RUSSIA**

### *High-speed lines under construction in Russia*

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| Moscow - St. Petersburg | 350 | 2026 | 659 |
| | | | **Total km = 659** |

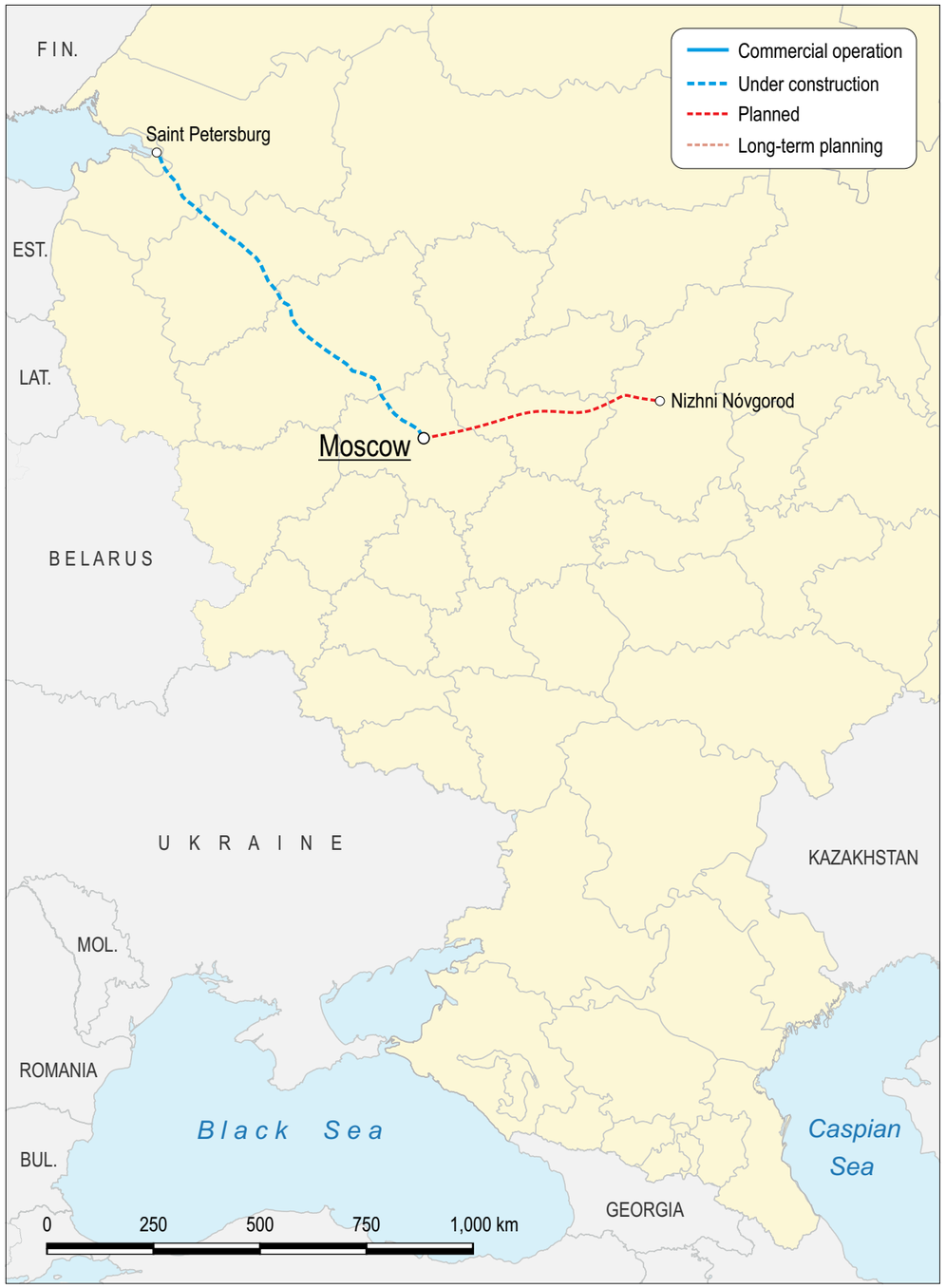
### *High-speed lines planned in Russia*

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| Moscow - Nizhni Novgorod | 350 | 2024 | 421 |
| | | | **Total km = 421** |

*Source: compiled by authors based on International Union of Railways, 2021*

# 2.1 HIGH-SPEED RAIL NETWORK

## *High-speed lines in Russia*




*Source: compiled by authors based on International Union of Railways, 2021*

# 2.1 HIGH-SPEED RAIL NETWORK

## UNITED KINGDOM

### *High-speed lines in commercial operation in the United Kingdom*

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| Fawkham Junction - Channel Tunnel | 300 | 2003 | 74 |
| London - Southfleet Junction | 230 | 2007 | 39 |
| | | | **Total km = 113** |

### *High-speed lines under construction in the United Kingdom*

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| London - Birmingham | 360 | 2026 | 225 |
| | | | **Total km = 225** |

### *High-speed lines planned in the United Kingdom*

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| Birmingham - Crewe | 300 | 2028 | 60 |
| Crewe - Manchester/Wigan | 300 | 2035 | 79 |
| Birmingham - Leeds/York | 300 | 2035 | 202 |
| | | | **Total km = 341** |

*Source: compiled by authors based on International Union of Railways, 2021*

# 2.1 HIGH-SPEED RAIL NETWORK

***High-speed lines in the United Kingdom***


*Source: compiled by authors based on International Union of Railways and HS2 railway website (www.hs2.org.uk), 2021*
*Note: this map includes the Channel Tunnel that connects the English and French high-speed lines (length 50.5 km)*

# 2.2 GROWTH OF THE HIGH-SPEED NETWORK

*High-speed network development in Europe (2021)*


*Source: compiled by authors based on International Union of Railways, 2021*

# 2.2 GROWTH OF THE HIGH-SPEED NETWORK

### *Detailed zoom of Paris*


PARIS

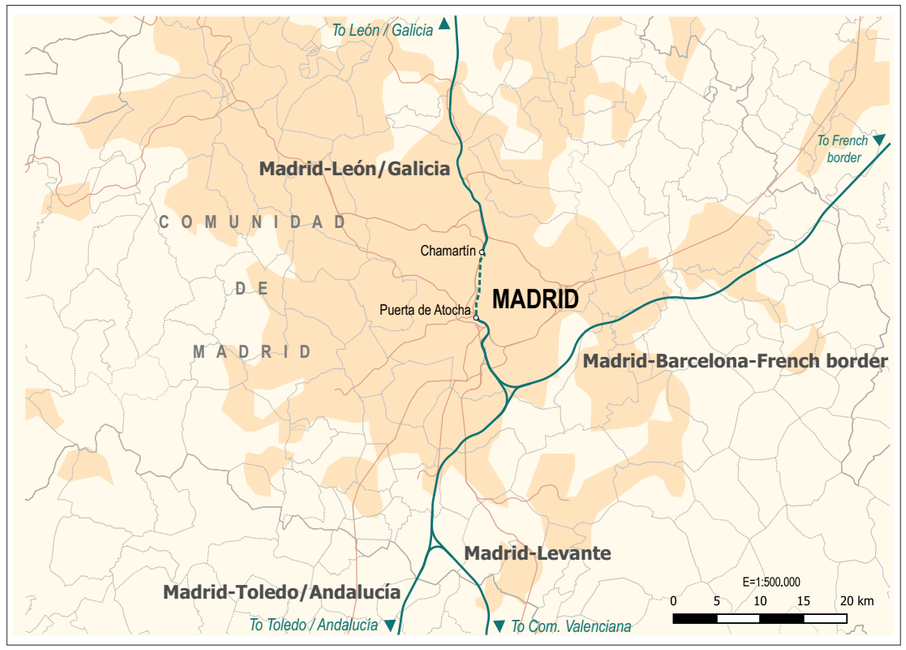
*Source: compiled by authors based on International Union of Railways, 2021*

### *Detailed zoom of Berlin*


BERLIN

*Source: compiled by authors based on International Union of Railways, 2021*

### *Detailed zoom of Madrid*




MADRID

*Source: compiled by authors based on International Union of Railways, 2021*

### *Detailed zoom of Rome*


ROME

*Source: compiled by authors based on International Union of Railways, 2021*

# 2.2 GROWTH OF THE HIGH-SPEED NETWORK

***Growth of the high-speed network in Europe: 1993, 2006, 2010 and 2021***


*Source: compiled by authors based on International Union of Railways, 2021*

**Countries with high-speed:**

**Italy, France, Austria, Germany, and Spain**

**1,998 kilometres**


*Source: compiled by authors based on International Union of Railways, 2021*

**Countries with high-speed:**

**Italy, France, Austria, Germany, Spain, Finland,
Belgium, Sweden, United Kingdom, Switzerland and The Netherlands**

**5,930 kilometres**

# 2.2 GROWTH OF THE HIGH-SPEED NETWORK

***Growth of the high-speed network in Europe: 1993, 2006, 2010 and 2021***



*Source: compiled by authors based on International Union of Railways, 2021*

**Countries with high-speed:**

**Italy, France, Austria, Germany, Spain, Finland**
**Belgium, Sweden, United Kingdom, Switzerland and The Netherlands**

**8,493 kilometres**

*Source: compiled by authors based on International Union of Railways, 2021*

**Countries with high-speed:**

**Italy, France, Austria, Germany, Spain, Finland**
**Belgium, Sweden, United Kingdom, Switzerland,**
**The Netherlands, Poland and Denmark**

**11,990 kilometres**

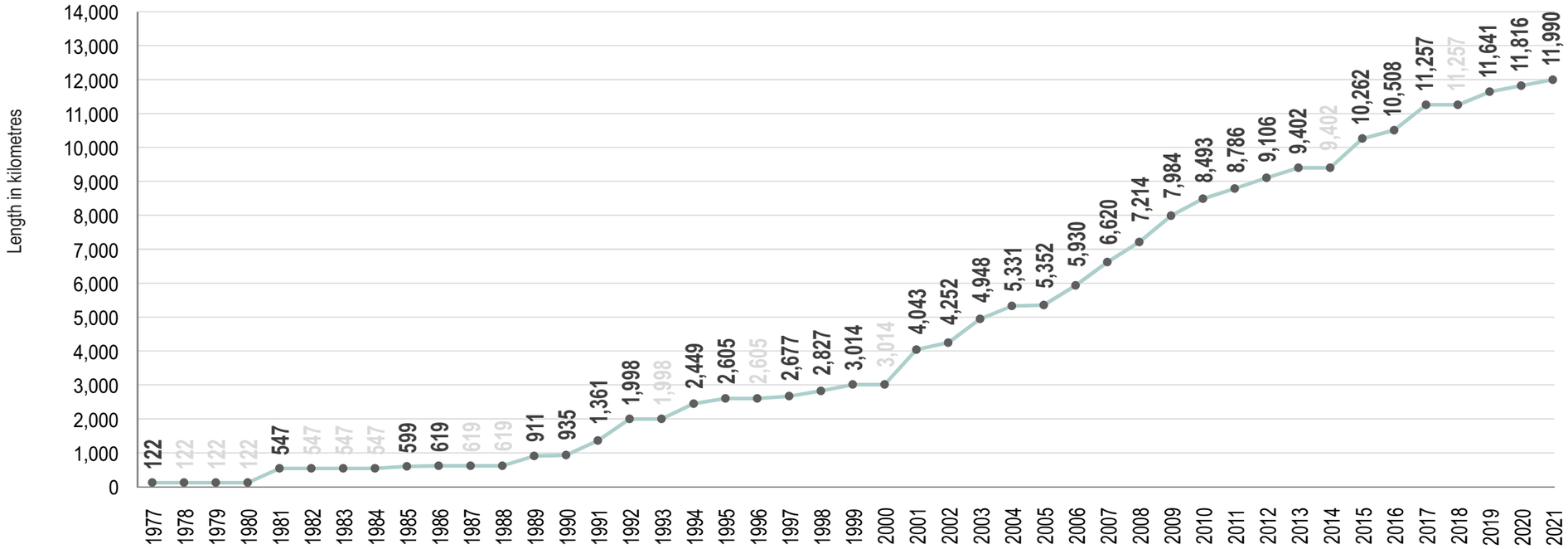
# 2.2 GROWTH OF THE HIGH-SPEED NETWORK

***Chronological map of the high-speed rail network in Europe***


*Source: compiled by authors based on International Union of Railways, 2021*

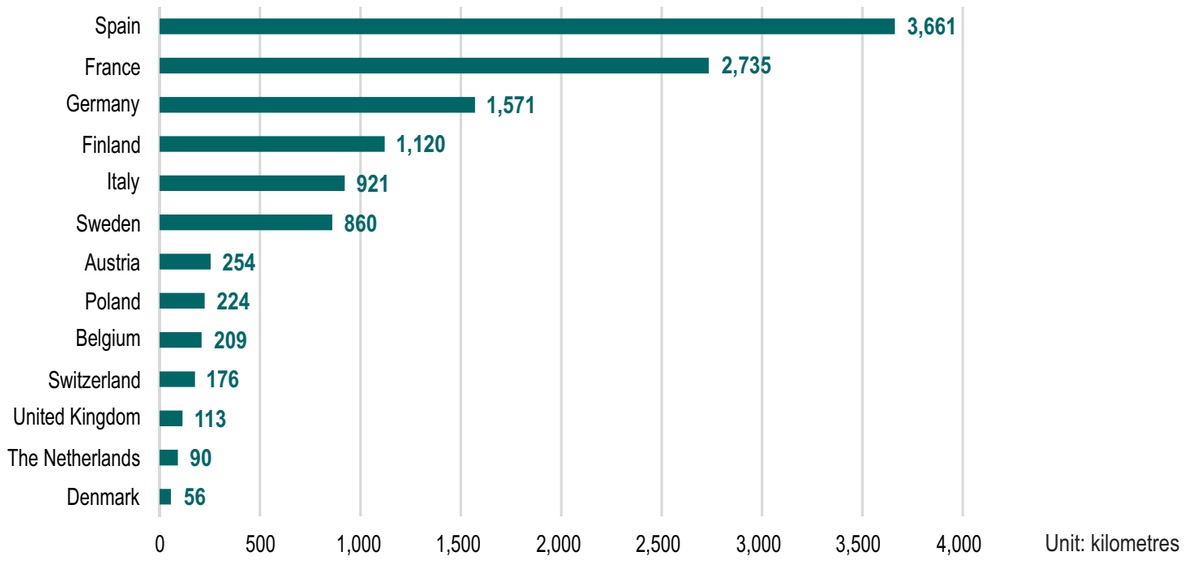
# 2.2 GROWTH OF THE HIGH-SPEED NETWORK

***Length of the high-speed network in commercial operation in Europe (1977-2021)***




*Source: compiled by authors based on International Union of Railways, 2021*

***Length of the high-speed network in commercial operation in Europe by country (2021)***




*Source: compiled by authors based on International Union of Railways, 2021*

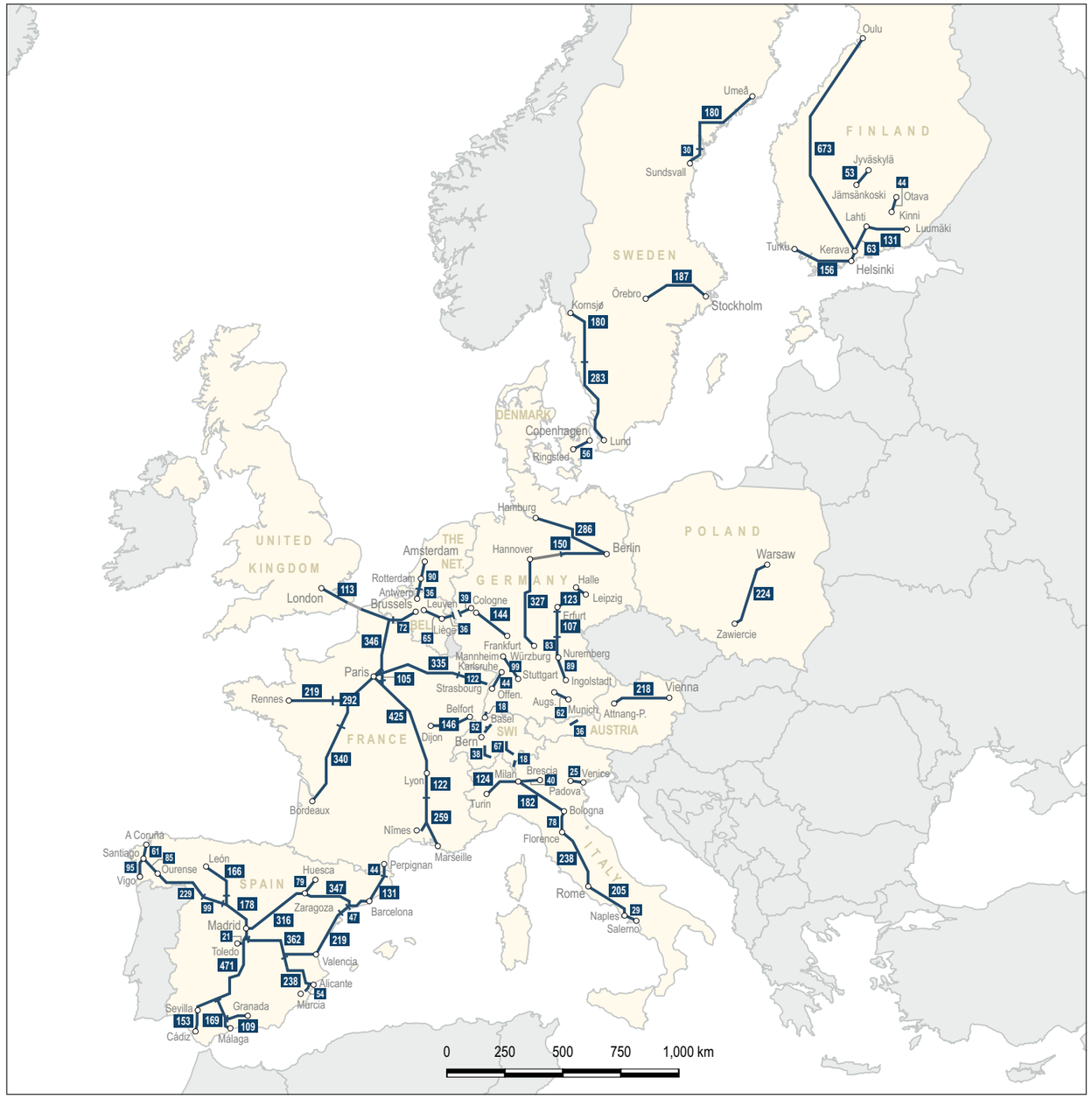
# 2.3 CHARACTERISTICS AND EQUIPMENT

## *Maximum commercial speed*


*Source: compiled by authors based on International Union of Railways, 2021*

# 2.3 CHARACTERISTICS AND EQUIPMENT

## *Distance (kilometres)*




*Source: compiled by authors based on International Union of Railways, 2021*

# 2.3 CHARACTERISTICS AND EQUIPMENT

## *Maximum slope (‰)*


*Source: compiled by authors based on International Union of Railways, 2021*

# 2.3 CHARACTERISTICS AND EQUIPMENT

## *Electrification*


*Source: compiled by authors based on International Union of Railways, 2021*

# 2.3 CHARACTERISTICS AND EQUIPMENT

## *Signalling*


*Source: compiled by authors based on International Union of Railways, 2021*

# 2.3 CHARACTERISTICS AND EQUIPMENT

## *Centralized Traffic Control (CTC)*


*Source: International Union of Railways, 2021. For United Kingdom, Austria and Denmark, miscellaneous data sources*
*Note: In Poland, CMK line does not have a centralized control traffic system. Traffic is controlled by local centers located in the frame existing stations.*

# 2.3 CHARACTERISTICS AND EQUIPMENT

## *High-speed rolling stock workshops*


*Source: International Union of Railways, 2021. For Sweden, United Kingdom, Belgium, Austria, Denmark and Finland, miscellaneous data sources*

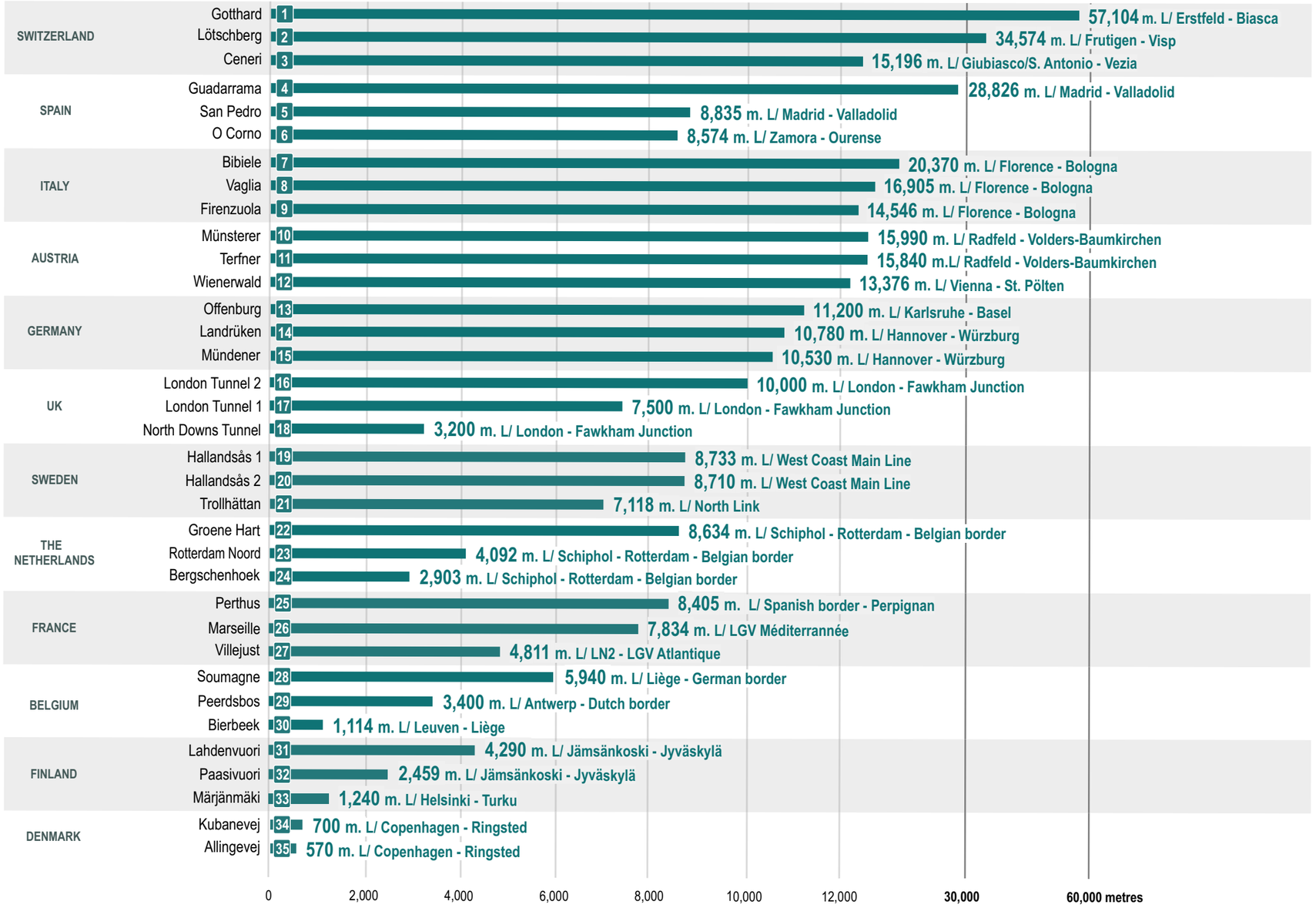
# 2.3 CHARACTERISTICS AND EQUIPMENT

## *High-speed rolling stock main factories*


*Source: International Union of Railways, 2021*

# 2.3 CHARACTERISTICS AND EQUIPMENT

## *Longest tunnels of the high-speed rail network in Europe*




*Source: International Union of Railways, 2021. For United Kingdom and Belgium, miscellaneous data sources*

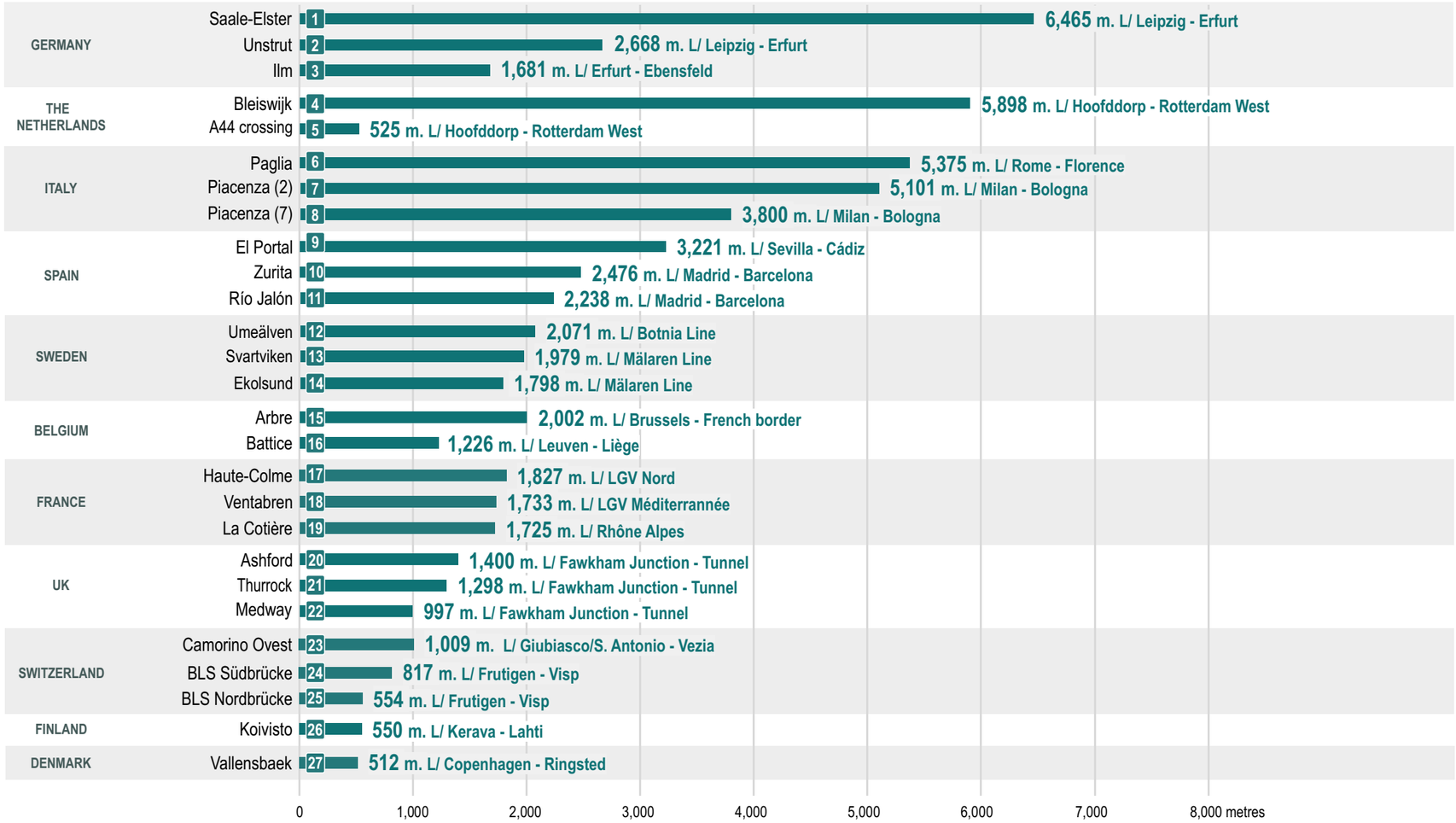
# 2.3 CHARACTERISTICS AND EQUIPMENT

## *Longest tunnels of the high-speed rail network in Europe*


*Source: International Union of Railways, 2021. For United Kingdom and Belgium, miscellaneous data sources*

# 2.3 CHARACTERISTICS AND EQUIPMENT

## *Longest viaducts of the high-speed rail network in Europe*




*Source: International Union of Railways, 2021. For United Kingdom and Belgium, miscellaneous data sources*

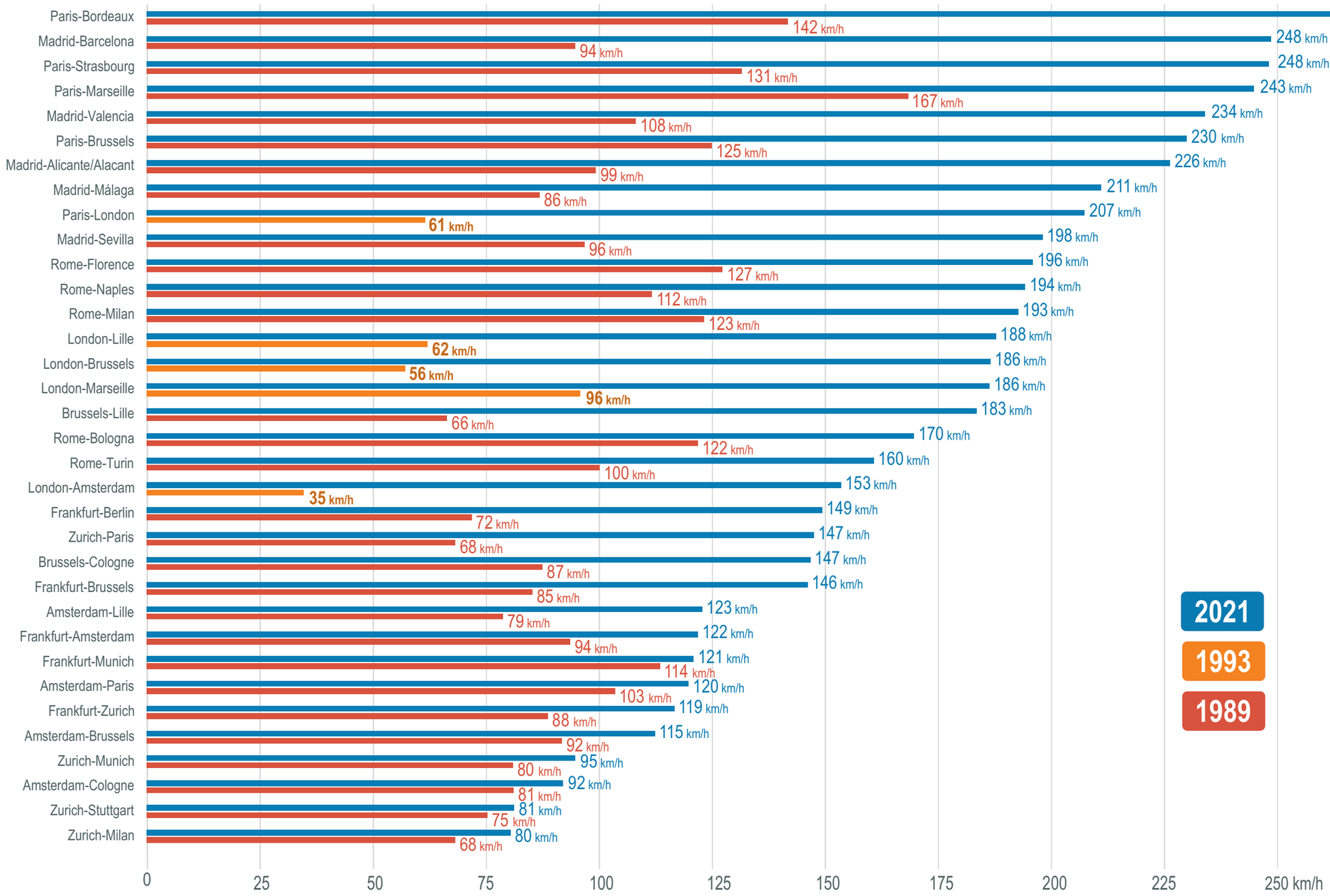
# 2.3 CHARACTERISTICS AND EQUIPMENT

## *Longest viaducts of the high-speed rail network in Europe*


*Source: International Union of Railways, 2021. For United Kingdom and Belgium, miscellaneous data sources*

# 2.4 SPEED AND TRAVEL TIMES

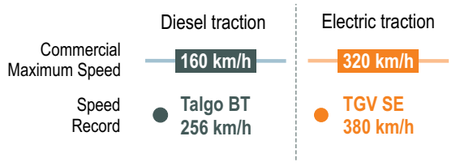
## *Evolution of average speed on European high-speed lines*

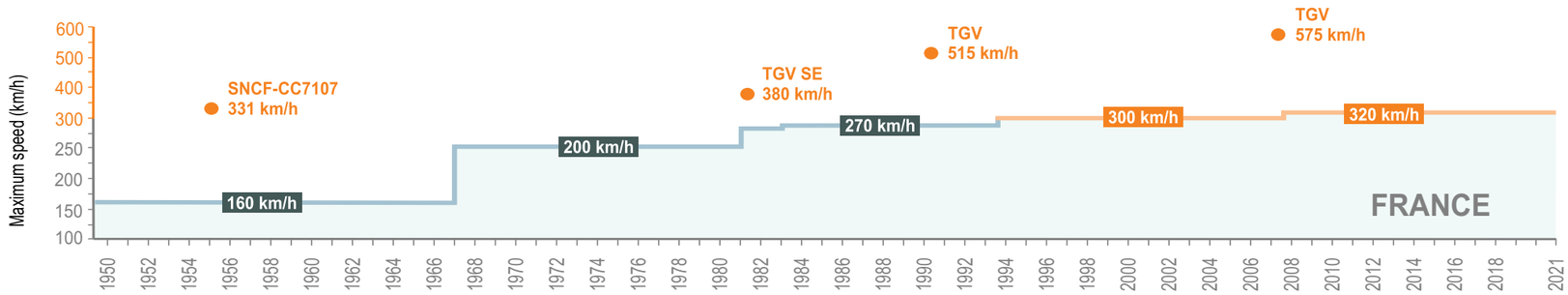



*Source: compiled by authors based on "European Timetable" Thomas Cook Travel Guides 1989, Railway Operators websites, British Rail Timetable 1993 and Indicateur Horaires Ville à Ville SNCF 1993*
*Note: before 1994, travel between London and France was carried out by Ferry or Hoverspeed with their corresponding journey times*

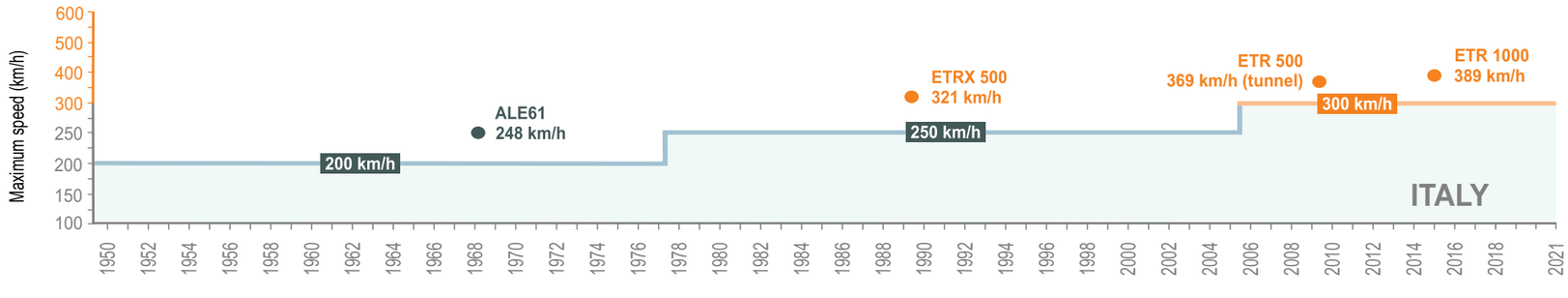
# 2.4 SPEED AND TRAVEL TIMES

## *Evolution of maximum speed in commercial services in France*

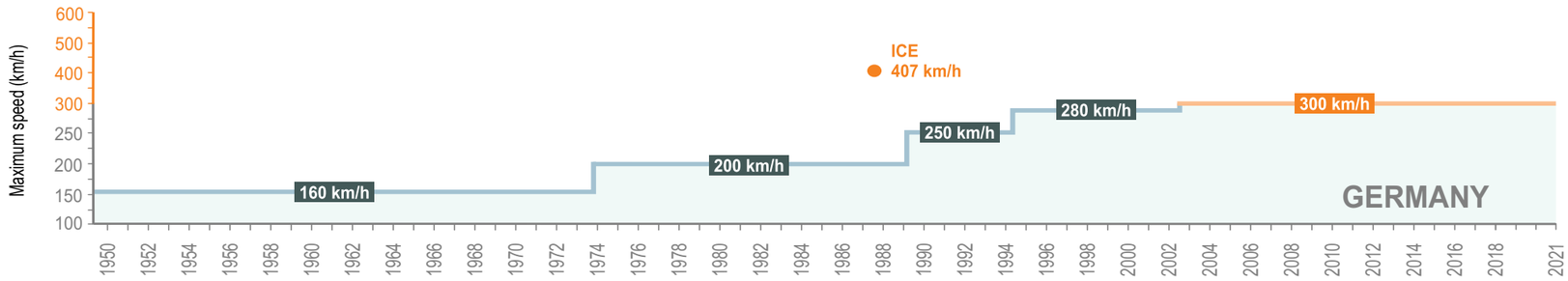


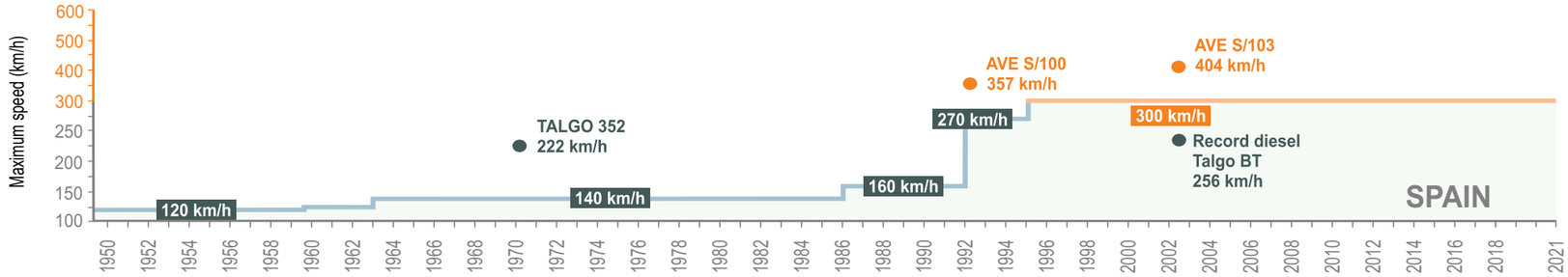

## *Evolution of maximum speed in commercial services in Italy*




## *Evolution of maximum speed in commercial services in Germany*



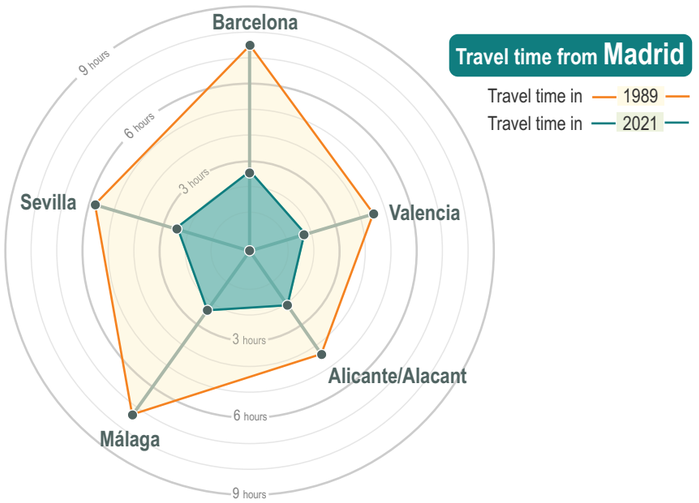

## *Evolution of maximum speed in commercial services in Spain*

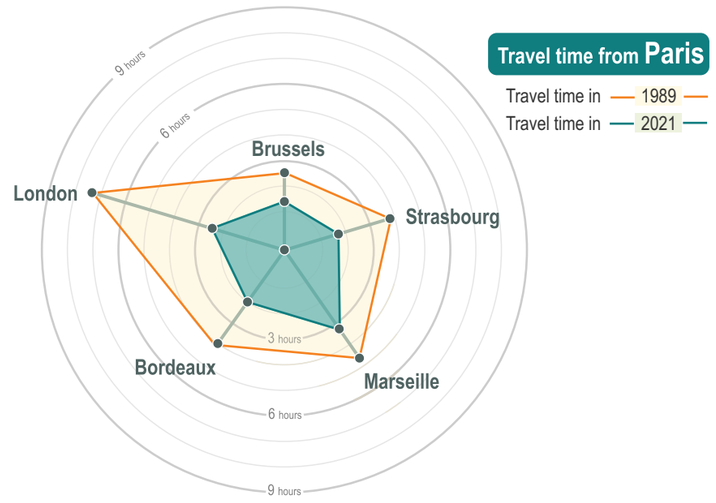


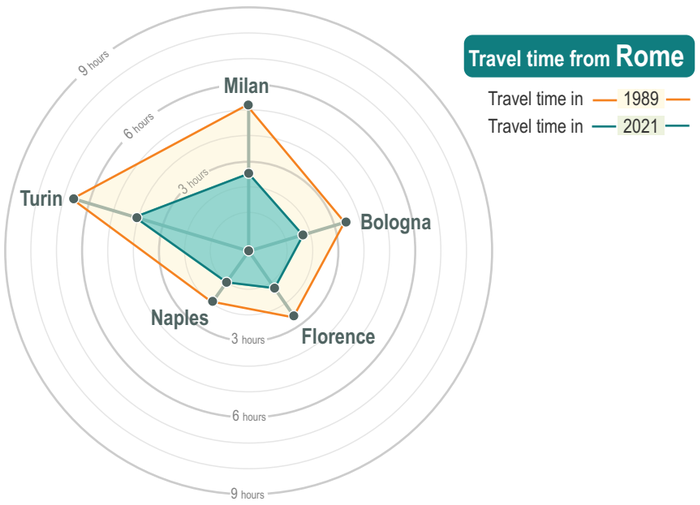

*Source: miscellaneous data sources*
*Note: speed records, signaled by dots in the graphics, were set in non-commercial operations. Representation of available data (non-exhaustive)*

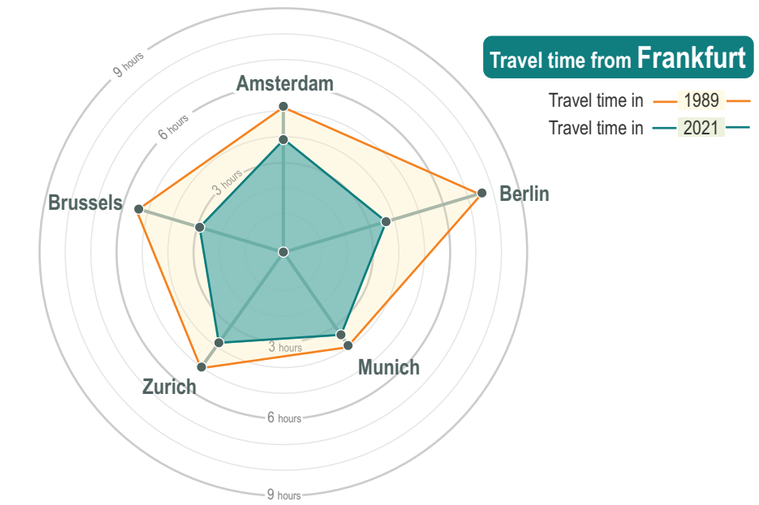
# 2.4 SPEED AND TRAVEL TIMES

## *Evolution of travel time from the main European cities*



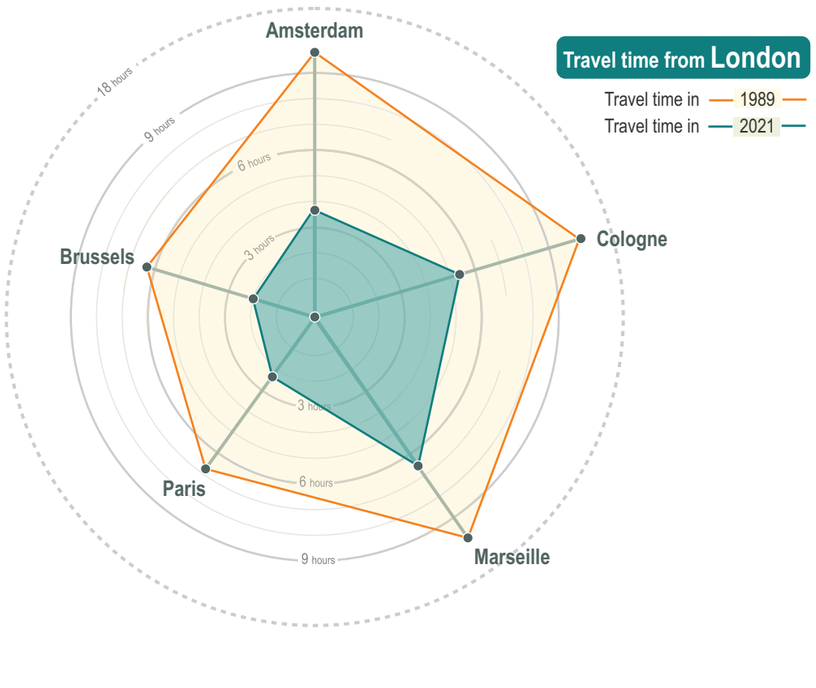



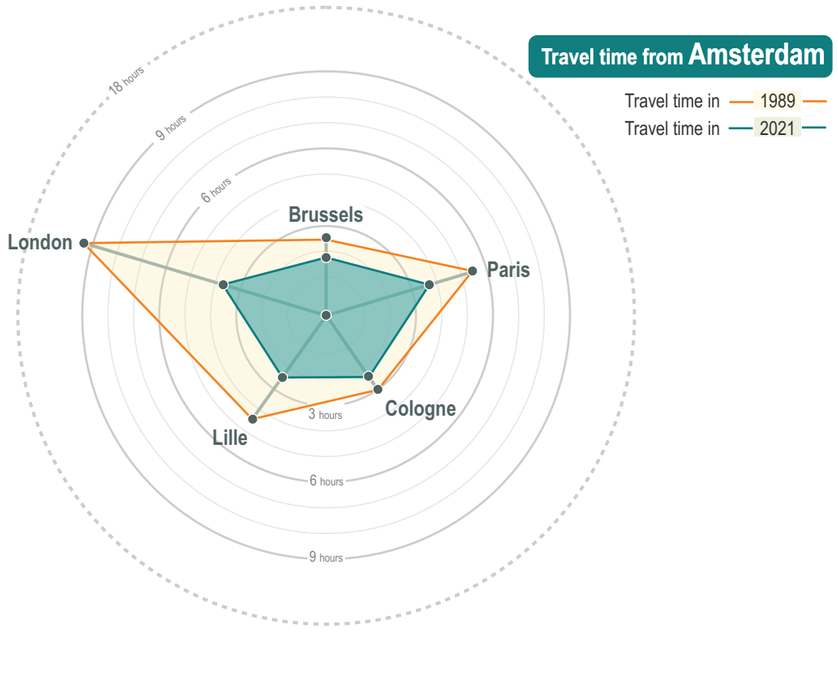



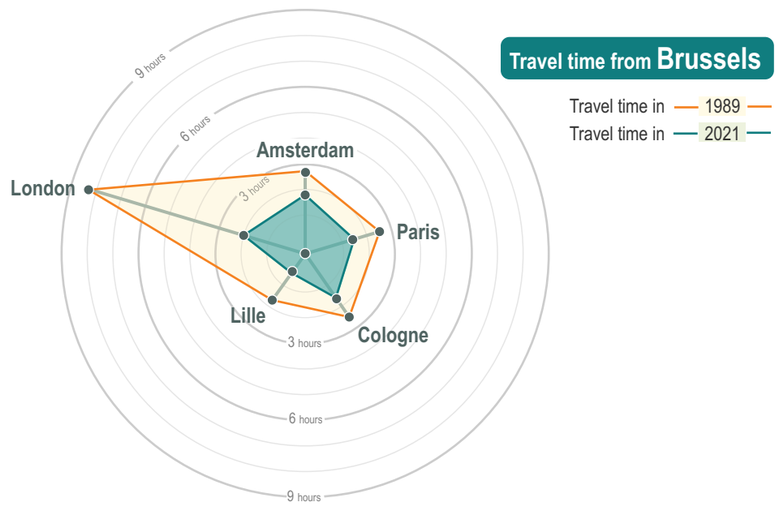

*Source: compiled by authors based on "European Timetable" Thomas Cook Travel Guides 1989 and Railway Operators websites*
*Note: before 1994, travel between London and France was carried out by Ferry or Hoverspeed with their corresponding journey times*

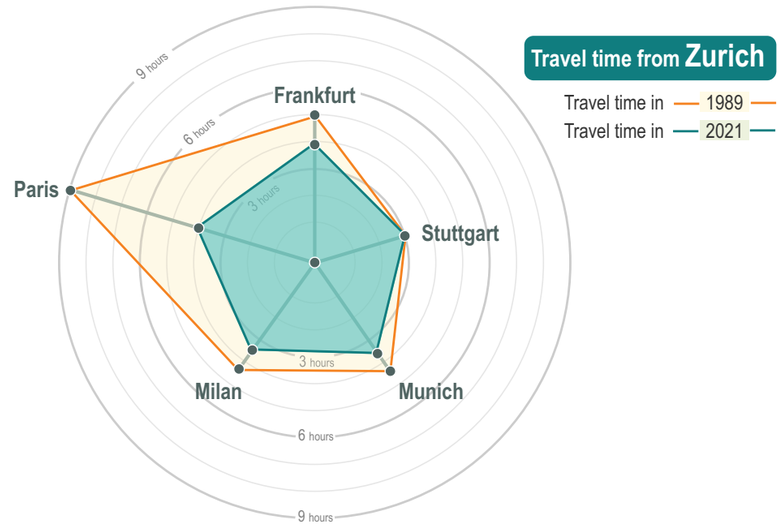
# 2.4 SPEED AND TRAVEL TIMES

## *Evolution of travel time from the main European cities*




*Source: compiled by authors based on "European Timetable" Thomas Cook Travel Guides 1989, Railway Operators websites, British Rail Timetable 1993 and Indicateur Horaires Ville à Ville SNCF 1993*
*Note: before 1994, travel between London and France was carried out by Ferry or Hoverspeed with their corresponding journey times*

# 2.5 ROLLING STOCK



(1) M-Motor coach • T-Trailer coach• L-Locomotive
MB-Motor Bogie

AC – alternating current
DC – direct current


| General characteristics | "Railjet" Siemens Taurus (OBB 1216) + Siemens Viaggio *(Austria)* | 4010 *(Austria)* | SM3 "Pendolino" *(Finland)* |
|---|---|---|---|
| (1) Composition | L+7T | M+4T+M | T+4M+T |
| Suppliers | Siemens | Stadler | Alstom |
| Owners or operators | ÖBB | WestBahn | VR |
| Year in service | 2008 | 2011 | 1995 |
| Articulated | No | No | No+Tilting |
| Track gauge (mm) | 1,435 | 1,435 | 1,524 |
| Electrification voltage (kV) | 25 kV 50 Hz AC / 15 kV 16.7 Hz AC / 3 kV DC (partially) | 15 kV 16.7 Hz AC | 25 kV 50 Hz AC |
| Maximum train speed / operation speed (km/h) | 230 / 230 | 200 / 200 | 220 / 220 |
| Power (kW) | 6,400 | 6,000 | 4,000 |
| Traction | Concentrated traction | Distributed traction | Distributed traction |
| Signalling | LZB / PZB, ZUB, ETCS | LZB / PZB, ZUB | EBICAB900 |
| Train sets currently used / planned | 60 | 7 | 18 |
| **Weight and dimensions** | | | |
| Unladen weight in running order (t) | 446 | 296 | 328 |
| Maximum axle load (t) | 22.5 | 12.3 | 14.3 |
| Power weight ratio (kW/t) | 13.4 | 17.9 | 11.5 |
| Train length (m) | 206 | 150 | 159 |
| Train width (m) | 2.825 | 2.800 | 3.200 |
| **Seats** | | | |
| 1st class seats* | 16+76 / 6+42 (partially) | 60 | 47 |
| 2nd class seats | 316, 394 (partially) | 441 | 238 (+2 hp) |
| Total seats | 408, 442 (partially) | 501 | 285 (+2 hp) |
| **Observations** | | | |
| | Locomotive: Class 1116, partially 1216 | | Broad gauge (1,524) |

* For 3 classes train, 1st and 2nd classes are included in 1st class

*Source: International Union of Railways*

# 2.5 ROLLING STOCK




| SM6 "Allegro" *(Finland, Russia)* | TGV Atlantique *(France)* | Thalys PBA *(France / Belgium / The Netherlands)* | General characteristics |
|---|---|---|---|
| M+T+M+T+M+T+M | L+10T+L | L+8T+L | (1) Composition |
| Alstom | Alstom | Alstom | Suppliers |
| Karelian Railways | SNCF | Thalys | Owners or operators |
| 2010 | 1989 | 1996 | Year in service |
| No+Tilting | Yes (except for ends) | Yes (except for ends) | Articulated |
| 1,520 / 1,522 | 1,435 | 1,435 | Track gauge (mm) |
| 25 kV 50 Hz AC / 3 kV DC | 25 kV 50 Hz AC / 1.5 kV DC | 25 kV 50 Hz AC / 3 kV DC / 1.5 kV DC | Electrification voltage (kV) |
| 220 / 220 | 300 / 300 | 320 / 300 | Maximum train speed / operation speed (km/h) |
| 5,500 | 8,800 | 8,800 | Power (kW) |
| Distributed traction | Concentrated traction | Concentrated traction | Traction |
| EBICAB900 | TVM / KVB | TVM / KVB, TBL, ATB, ETCS | Signalling |
| 4 | 54 | 9 | Train sets currently used / planned |
| | | | **Weight and dimensions** |
| 409 (loaded) | 435 | 385 | Unladen weight in running order (t) |
| 17 | 17 | 17 | Maximum axle load (t) |
| 13.4 | 18.6 | 21.2 | Power weight ratio (kW/t) |
| 184.8 | 237 | 200 | Train length (m) |
| 3.200 | 2.904 | 2.904 | Train width (m) |
| | | | **Seats** |
| 48 | 116 | 120 | 1st class seats* |
| 304 (+2 hp) | 364 | 257 | 2nd class seats |
| 352 (+2 hp) | 480 | 377 | Total seats |
| | | | **Observations** |
| Broad gauge (1,522 and 1,520)<br>Operated by RZD and VR | No. 301-405<br>Renovated to Lacroix 455 places (105+350)<br>TVM430 is installed from No. 386 to No. 405 | No. 4531-4540, owned by SNCF<br>Same series as TGV Réseau (tric.)<br>4531 (now 4551) is used for SNCF | |

(1) M-Motor coach • T-Trailer coach• L-Locomotive
MB-Motor Bogie

AC – alternating current
DC – direct current

* For 3 classes train, 1st and 2nd classes are included in 1st class

*Source: International Union of Railways*

# 2.5 ROLLING STOCK



(1) M-Motor coach • T-Trailer coach• L-Locomotive
MB-Motor Bogie

AC – alternating current
DC – direct current

| General characteristics | Thalys PBKA *(France / Belgium / The Netherlands)* | TGV Réseau (bicourant) *(France)* | TGV Réseau (tricourant) *(France)* |
|---|---|---|---|
| (1) Composition | L+8T+L | L+8T+L | L+8T+L |
| Suppliers | Alstom | Alstom | Alstom |
| Owners or operators | Thalys | SNCF | SNCF |
| Year in service | 1996 | 1993 | 1993 |
| Articulated | Yes (except for ends) | Yes (except for ends) | Yes (except for ends) |
| Track gauge (mm) | 1,435 | 1,435 | 1,435 |
| Electrification voltage (kV) | 25 kV 50 Hz AC / 15 kV 16.7 Hz AC / 3 kV DC / 1.5 kV DC | 25 kV 50 Hz AC / 1.5 kV DC | 25 kV 50 Hz AC / 3 kV DC / 1.5 kV DC |
| Maximum train speed / operation speed (km/h) | 320 / 300 | 320 / 320 | 320 / 320 |
| Power (kW) | 8,800 | 8,800 | 8,800 |
| Traction | Concentrated traction | Concentrated traction | Concentrated traction |
| Signalling | TVM/KVB, TBL, TBL2, ATB, PZB/LZB, ETCS | TVM / KVB | TVM / KVB, TBL, SCMT |
| Train sets currently used / planned | 17 | 26 | 27 |
| **Weight and dimensions** | | | |
| Unladen weight in running order (t) | 385 | 383 | 383 |
| Maximum axle load (t) | 17 | 17 | 17 |
| Power weight ratio (kW/t) | 21.2 | 21.3 | 21.3 |
| Train length (m) | 200 | 200 | 200 |
| Train width (m) | 2.904 | 2.904 | 2.904 |
| **Seats** | | | |
| 1st class seats* | 120 | 118 | 118 |
| 2nd class seats | 257 | 257 | 257 |
| Total seats | 377 | 375 | 375 |
| **Observations** | | | |
| | No. 4301-4346<br>SNCF 6 (No. 4341-4346)<br>NS 4 (No. 4321-4322,4331-4332)<br>SNCB 7 (No. 4301-4307)<br>No. 4321-4322 → DB → NS | No. 501-553, 19 (No. 515-533) sets are converted to POS and Duplex Réseau<br>3 sets are added from Réseau tric. (No. 551-553)<br>No. 502 was abandoned after the accident at Bierne<br>Renovating by Lacroix to 355 places (105+252) | No. 4501-4529, No. 4551<br>3 sets (No. 4507-4509) are converted to Réseau bi<br>No. 4530 → IRIS320<br>No. 4531 →No. 4551<br>Thalys PBA4507-30: suited for Belgium (TBL)<br>4501-06: suited for Italy (SCMT) |

* For 3 classes train, 1st and 2nd classes are included in 1st class

*Source: International Union of Railways*

# 2.5 ROLLING STOCK

| | TGV Duplex *(France)* | TGV Réseau Duplex *(France)* | TGV POS *(France)* |
|---|---|---|---|
| (1) Composition | L+8T+L | L+8T+L | L+8T+L |
| Suppliers | Alstom | Alstom | Alstom |
| Owners or operators | SNCF | SNCF | SNCF, SBB |
| Year in service | 1996 | 2006 | 2006 |
| Articulated | Yes (except for ends) + Double Decker | Yes (except for ends) + Double Decker | Yes (except for ends) + Double Decker |
| Track gauge (mm) | 1,435 | 1,435 | 1,435 |
| Electrification voltage (kV) | 25 kV 50 Hz AC / 1.5 kV DC | 25 kV 50 Hz AC / 15 kV 16.7 Hz AC / 1.5 kV DC | 25 kV 50 Hz AC / 15 kV 16.7 Hz AC / 1.5 kV DC |
| Maximum train speed / operation speed (km/h) | 320 / 320 | 320 / 320 | 320 / 320 |
| Power (kW) | 8,800 | 8,800 | 9,280 |
| Traction | Concentrated traction | Concentrated traction | Concentrated traction |
| Signalling | TVM / KVB | TVM / KVB | TVM / KVB, PZB / LZB, SUB, ETCS |
| Train sets currently used / planned | 79 | 19 | 18 |
| **Weight and dimensions** | | | |
| Unladen weight in running order (t) | 390 | 380 | 423 |
| Maximum axle load (t) | 17 | 17 | 17 |
| Power weight ratio (kW/t) | 20.4 | 20.9 | 20.6 |
| Train length (m) | 200 | 200 | 200 |
| Train width (m) | 2.896 | 2.896 | 2.904 |
| **Seats** | | | |
| 1st class seats* | 182 | 182 | 105 |
| 2nd class seats | 330 | 330 | 252 |
| Total seats | 512 | 512 | 357 |
| **Observations** | | | |
| | No. 201-289 | No. 601-619<br>613-615: tri-voltage (15kV 16.7Hz) | No. 4401-4419<br>No. 4406: SBB |

(1) M-Motor coach • T-Trailer coach• L-Locomotive
MB-Motor Bogie

AC – alternating current
DC – direct current

* For 3 classes train, 1st and 2nd classes are included in 1st class

*Source: International Union of Railways*

# 2.5 ROLLING STOCK



(1) M-Motor coach • T-Trailer coach• L-Locomotive
MB-Motor Bogie

AC – alternating current
DC – direct current



| General characteristics | TGV Dasye (France) | TGV Euroduplex 3UA (France) | TGV Euroduplex 3UF / 3UH (France) |
|---|---|---|---|
| (1) Composition | L+8T+L | L+8T+L | L+8T+L |
| Suppliers | Alstom | Alstom | Alstom |
| Owners or operators | SNCF | SNCF | SNCF |
| Year in service | 2009 | 2011 | 2013 |
| Articulated | Yes (except for ends) + Double Decker | Yes (except for ends) + Double Decker | Yes (except for ends) + Double Decker |
| Track gauge (mm) | 1,435 | 1,435 | 1,435 |
| Electrification voltage (kV) | 25 kV 50 Hz AC / 1.5 kV DC | 25 kV 50 Hz AC / 15 kV 16.7 Hz AC / 1.5 kV DC | 25 kV 50 Hz AC / 1.5 kV DC |
| Maximum train speed / operation speed (km/h) | 320 / 320 | 320 / 320 | 320 / 320 |
| Power (kW) | 9,280 | 9,280 | 9,280 |
| Traction | Concentrated traction | Concentrated traction | Concentrated traction |
| Signalling | TVM / KVB, ETCS | TVM / KVB, PZB / LZB, ETCS | TVM / KVB, ETCS |
| Train sets currently used / planned | 11 | 30 | 16 |
| **Weight and dimensions** | | | |
| Unladen weight in running order (t) | 390 | 390 | 390 |
| Maximum axle load (t) | 17 | 17 | 17 |
| Power weight ratio (kW/t) | 21.5 | 21.5 | 21.5 |
| Train length (m) | 200 | 200 | 200 |
| Train width (m) | 2.896 | 2.896 | 2.896 |
| **Seats** | | | |
| 1st class seats* | 182 | 181 | 181 |
| 2nd class seats | 330 | 328 | 328 |
| Total seats | 512 | 509 | 509 |
| **Observations** | | | |
| | No. 701-749 | No. 4701-4730<br>Used for Lyria and Alleo | No. 801-825 for first 25 sets<br>16 sets are for domestic use, 9 sets are operable in Spain |

* For 3 classes train, 1st and 2nd classes are included in 1st class

*Source: International Union of Railways*

# 2.5 ROLLING STOCK

## TGV Euroduplex 3UFC Océane
*(France)*


## TGV Duplex renov Océane
*(France)*


## TGV Ouigo
*(France)*

(1) M-Motor coach • T-Trailer coach• L-Locomotive
MB-Motor Bogie

AC – alternating current
DC – direct current

| General characteristics | | | |
|---|---|---|---|
| (1) Composition | L+8T+L | L+8T+L | L+8T+L |
| Suppliers | Alstom | Alstom | Alstom |
| Owners or operators | SNCF | SNCF | SNCF |
| Year in service | 2016 | 1996 | 2009 |
| Articulated | Yes (except for ends) + Double Decker | Yes (except for ends) + Double Decker | Yes (except for ends) + Double Decker |
| Track gauge (mm) | 1,435 | 1,435 | 1,435 |
| Electrification voltage (kV) | 25 kV 50 Hz AC / 1.5 kV DC | 25 kV 50 Hz AC / 1.5 kV DC | 25 kV 50 Hz AC / 1.5 kV DC |
| Maximum train speed / operation speed (km/h) | 320 / 320 | 320 / 320 | 320 / 320 |
| Power (kW) | 9,280 | 8,800 | 9,280 |
| Traction | Concentrated traction | Concentrated traction | Concentrated traction |
| Signalling | TVM, KVB, ETCS | TVM, KVB, ETCS | TVM, KVB, ETCS |
| Train sets currently used / planned | 59 | 9 | 38 |
| **Weight and dimensions** | | | |
| Unladen weight in running order (t) | 390 | 390 | 390 |
| Maximum axle load (t) | 17 | 17 | 17 |
| Power weight ratio (kW/t) | 21.4 | 20.4 | 21.5 |
| Train length (m) | 200 | 200 | 200 |
| Train width (m) | 2.896 | 2.896 | 2.896 |
| **Seats** | | | |
| 1st class seats* | 158 | 158 | - |
| 2nd class seats | 398 | 398 | - |
| Total seats | 556 | 556 | 634 |
| **Observations** | | | |

* For 3 classes train, 1st and 2nd classes are included in 1st class

*Source: International Union of Railways*

# 2.5 ROLLING STOCK



(1) M-Motor coach • T-Trailer coach• L-Locomotive
MB-Motor Bogie

AC – alternating current
DC – direct current

| General characteristics | TGV-TMST 373 e300 *(France / UK / Belgium)* | 401 (ICE 1) *(Germany)* | 402 (ICE 2) *(Germany)* |
|---|---|---|---|
| (1) Composition | L+18T+L (+2MB) | L+12T+L | L+7T |
| Suppliers | Alstom | Siemens-Bombardier | Siemens-Bombardier |
| Owners or operators | Eurostar | DB AG | DB AG |
| Year in service | 1993 | 1991 | 1996 |
| Articulated | Yes (except for ends) | No | No |
| Track gauge (mm) | 1,435 | 1,435 | 1,435 |
| Electrification voltage (kV) | 25 kV 50 Hz AC / 3 kV DC / 1.5 kV DC | 15 kV 16.7 Hz AC | 15 kV 16.7 Hz AC |
| Maximum train speed / operation speed (km/h) | 300 / 300 | 280 / 280 | 280 / 280 |
| Power (kW) | 12,200 | 9,600 | 4,800 |
| Traction | Concentrated traction | Concentrated traction | Concentrated traction |
| Signalling | TVM / KVB, TBL 1+, AWS / TPWS | ETCS, LZB / PZB, ZUB | LZB / PZB |
| Train sets currently used / planned | 8 | 59 | 44 |
| **Weight and dimensions** | | | |
| Unladen weight in running order (t) | 752 | 782 | 418 |
| Maximum axle load (t) | 17 | 19.5 | 19.5 |
| Power weight ratio (kW/t) | 15 | 11.5 | 10.7 |
| Train length (m) | 394 | 358 | 205 |
| Train width (m) | 2.814 | 3.020 | 3.020 |
| **Seats** | | | |
| 1st class seats* | 206 | 197 | 106 |
| 2nd class seats | 540 | 506 | 275 |
| Total seats | 746 | 703 | 381 |
| **Observations** | | | |
| | | Sets have 197/506 seats after modernisation (which is completed now)<br>1 was abandoned by Eschede accident<br>19 sets also suited for traffic to Switzerland (ZUB installed) | Passenger car consists of 6 coaches and driving trailer |

* For 3 classes train, 1st and 2nd classes are included in 1st class

*Source: International Union of Railways*

# 2.5 ROLLING STOCK

| | 403 (ICE 3) *(Germany)* | 406 (ICE 3M) *(Germany / The Netherlands)* | 406 (ICE 3MF) *(Germany)* |
|---|---|---|---|
| | M+T+M+T+T+M+T+M | M+T+M+T+T+M+T+M | M+T+M+T+T+M+T+M |
| | Siemens-Bombardier | Siemens-Bombardier | Siemens-Bombardier |
| | DB AG | DB AG, NS (46 ICE3M) | DB AG |
| | 2000 | 2000 | 2000 |
| | No | No | No |
| | 1,435 | 1,435 | 1,435 |
| | 15 kV 16.7 Hz AC | 25 kV 50 Hz AC / 15 kV 16.7 Hz AC / 3 kV DC / 1.5 kV DC | 25 kV 50 Hz AC / 15 kV 16.7 Hz AC / 3 kV DC / 1.5 kV DC |
| | 330 / 300 | 330-220 (DC) / 300 | 330-220 (DC) / 320 |
| | 8,000 | 8,000 | 8,000 |
| | Distributed traction | Distributed traction | Distributed traction |
| | ETCS, LZB / PZB | ETCS, LZB / PZB, ATB, TBL | LZB / PZB, ATB, TBL, TVM / KVB |
| | 50 | 10 | 6 |
| | | | |
| | 409 | 435 | 435 |
| | 16 | 16 | 16 |
| | 18 | 17.1 | 17.1 |
| | 200 | 200 | 200 |
| | 2.950 | 2.950 | 2.950 |
| | | | |
| | 101 | 93 | 91 |
| | 349 | 326 | 322 |
| | 450 | 419 | 413 |
| | | | |
| | Last 13 delivered since 2005 (with 98/344 seats) | 4 sets belong to NS, 4 sets belong to NS for Frankfurt-Brussels/Amsterdam and Basel-Amsterdam 3,500 kW and 220 km/h under DC | From Frankfurt to Paris (2007-2015) |

(1) M-Motor coach • T-Trailer coach• L-Locomotive
MB-Motor Bogie

AC – alternating current
DC – direct current

| General characteristics |
|---|
| (1) Composition |
| Suppliers |
| Owners or operators |
| Year in service |
| Articulated |
| Track gauge (mm) |
| Electrification voltage (kV) |
| Maximum train speed / operation speed (km/h) |
| Power (kW) |
| Traction |
| Signalling |
| Train sets currently used / planned |
| **Weight and dimensions** |
| Unladen weight in running order (t) |
| Maximum axle load (t) |
| Power weight ratio (kW/t) |
| Train length (m) |
| Train width (m) |
| **Seats** |
| 1st class seats* |
| 2nd class seats |
| Total seats |
| **Observations** |

* For 3 classes train, 1st and 2nd classes are included in 1st class

*Source: International Union of Railways*

# 2.5 ROLLING STOCK



(1) M-Motor coach • T-Trailer coach• L-Locomotive
MB-Motor Bogie

AC – alternating current
DC – direct current


| General characteristics | 407 (ICE 3) *(Germany)* | 411 (ICE-T) *(Germany / Austria)* | 411 (ICE-T2) *(Germany)* |
|---|---|---|---|
| (1) Composition | M+T+M+T+T+M+T+M | M+T+M+T+M+T+M | M+T+M+T+M+T+M |
| Suppliers | Siemens | Siemens-Bombardier-Alstom | Siemens-Bombardier-Alstom |
| Owners or operators | DB AG | DB AG, ÖBB (4011 ICE-T) | DB AG |
| Year in service | 2013 | 2000 | 2004 |
| Articulated | No | No + Tilting | No + Tilting |
| Track gauge (mm) | 1,435 | 1,435 | 1,435 |
| Electrification voltage (kV) | 25 kV 50 Hz AC / 15 kV 16.7 Hz AC / 3 kV DC / 1.5 kV DC | 15 kV 16.7 Hz AC | 15 kV 16.7 Hz AC |
| Maximum train speed / operation speed (km/h) | 320 / 320 | 230 / 230 | 230 / 230 |
| Power (kW) | 8,000 | 4,000 | 4,000 |
| Traction | Distributed traction | Distributed traction | Distributed traction |
| Signalling | LZB / PZB, ATB, TBL, TVM / KVB, ETCS | LZB / PZB, ZUB | LZB / PZB |
| Train sets currently used / planned | 17 | 30 | 29 |
| **Weight and dimensions** | | | |
| Unladen weight in running order (t) | 454 | 350 | 350 |
| Maximum axle load (t) | 14.2 | 15 | 15 |
| Power weight ratio (kW/t) | 16.3 | 10.6 | 10.5 |
| Train length (m) | 201 | 185 | 185 |
| Train width (m) | 2.950 | 2.850 | 2.850 |
| **Seats** | | | |
| 1st class seats* | 111 | 55 | 55 |
| 2nd class seats | 333 | 304 | 321 |
| Total seats | 444 | 359 | 376 |
| **Observations** | | | |
| | Several trainsets for Frankfurt-Paris (2015) | 3 were sold from DB to ÖBB (class 4011)<br>5 sets with ZUB are suited for operation in Switzerland | Additional ICE-T trainsets (named ICE-T2) with more seating capacity |

* For 3 classes train, 1st and 2nd classes are included in 1st class

*Source: International Union of Railways*

# 2.5 ROLLING STOCK

| 415 (ICE-T) *(Germany)* | 412 (ICE 4 - 7 car) *(Germany)* | 412 (ICE 4 - 12 car) *(Germany)* | General characteristics |
|---|---|---|---|
| T+M+M+M+T | T+M+T+2M+2T | T+2M+T+2M+T+M+T+M+2T | (1) Composition |
| Siemens-Bombardier-Alstom | Siemens-Bombardier | Siemens-Bombardier | Suppliers |
| DB AG | DB AG | DB AG | Owners or operators |
| 1999 | 2017 | 2017 | Year in service |
| No + Tilting | No | No | Articulated |
| 1,435 | 1,435 | 1,435 | Track gauge (mm) |
| 15 kV 16.7 Hz AC | 25 kV 50 Hz AC / 15 kV 16.7 Hz AC / 3 kV DC / 1.5 kV DC | 15 kV 16.7 Hz AC | Electrification voltage (kV) |
| 230 / 230 | 250 / 249 | 250 / 249 | Maximum train speed / operation speed (km/h) |
| 3,000 | 4,950 | 9,900 | Power (kW) |
| Distributed traction | Distributed traction | Distributed traction | Traction |
| LZB / PZB, ZUB | LZB / PZB, ZUB, ETCS | LZB / PZB, ETCS | Signalling |
| 10 | 0 / 37 | 25 / 100 | Train sets currently used / planned |
| | | | **Weight and dimensions** |
| 273 | 455 | 659 | Unladen weight in running order (t) |
| 15 | <18 | <18 | Maximum axle load (t) |
| 10.2 | 10.1 | 13.6 | Power weight ratio (kW/t) |
| 133 | 200 | 346 | Train length (m) |
| 2.850 | 2.852 | 2.852 | Train width (m) |
| | | | **Seats** |
| 41 | 77 | 205 | 1st class seats* |
| 209 | 379 | 625 | 2nd class seats |
| 250 | 456 | 830 | Total seats |
| | | | **Observations** |
| Similar to class 411<br>5 are suited for operation in Switzerland | ICE 4 | | |

(1) M-Motor coach • T-Trailer coach• L-Locomotive
MB-Motor Bogie

AC – alternating current
DC – direct current

* For 3 classes train, 1st and 2nd classes are included in 1st class

*Source: International Union of Railways*

# 2.5 ROLLING STOCK



(1) M-Motor coach • T-Trailer coach• L-Locomotive
MB-Motor Bogie

AC – alternating current
DC – direct current

| General characteristics | 605 (ICE TD) *(Germany / Denmark)* | ETR 450 *(Italy)* | ETR 460 *(Italy)* |
|---|---|---|---|
| (1) Composition | 4M | 4M+T+4M | 2M+2T+2M+T+2M |
| Suppliers | Siemens-Bombardier-Alstom | Alstom | Alstom |
| Owners or operators | DB AG, DSB | Trenitalia | Trenitalia |
| Year in service | 2001 | 1988 | 1995 |
| Articulated | No + Tilting | No + Tilting | No + Tilting |
| Track gauge (mm) | 1,435 | 1,435 | 1,435 |
| Electrification voltage (kV) | Diesel | 3 kV DC | 3 kV DC |
| Maximum train speed / operation speed (km/h) | 200 / 200 | 250 / 250 | 250 / 250 |
| Power (kW) | 2,240 | 5,000 | 5,880 |
| Traction | Distributed traction | Distributed traction | Distributed traction |
| Signalling | LZB / PZB, ZUB | SCMT / BACC | SCMT / BACC |
| Train sets currently used / planned | 6 | 6 | 9 |
| **Weight and dimensions** | | | |
| Unladen weight in running order (t) | 216 | 435 | 445 |
| Maximum axle load (t) | 14.5 | 12.5 (unloaded) | 13.5 (unloaded) |
| Power weight ratio (kW/t) | 9.7 | 10.7 | 12.2 |
| Train length (m) | 106 | 233.9 | 237 |
| Train width (m) | 2.850 | 2.750 | 2.800 |
| **Seats** | | | |
| 1st class seats* | 41 | 170 | 139 |
| 2nd class seats | 154 | 220 | 341 |
| Total seats | 195 | 390 | 480 |
| **Observations** | | | |
| | 6 were transferred from DB to DSB and are equipped with Danish signalling system and radio for international services. 14 is out of service<br>Tilting system is not used | 15 trainsets were produced | 10 trainsets were produced |

* For 3 classes train, 1st and 2nd classes are included in 1st class

*Source: International Union of Railways*

# 2.5 ROLLING STOCK

| ETR 470 *(Italy / Switzerland)* | ETR 480 *(Italy)* | ETR 500 *(Italy)* | General characteristics |
|---|---|---|---|
| 2M+2T+2M+T+2M | 2M+2T+2M+T+2M | L+11T+L | (1) Composition |
| Alstom | Alstom | Ansaldobreda-Alstom-Bombardier | Suppliers |
| Trenitalia, SBB | Trenitalia | Trenitalia | Owners or operators |
| 1996 | 1997 | 1995 | Year in service |
| No + Tilting | No + Tilting | No | Articulated |
| 1,435 | 1,435 | 1,435 | Track gauge (mm) |
| 15 kV 16.7 Hz AC / 3 kV DC | 25 kV 50 Hz AC / 3 kV DC | 25 kV 50 Hz AC / 3 kV DC | Electrification voltage (kV) |
| 200 / 200 | 280 / 250 | 360 / 300 | Maximum train speed / operation speed (km/h) |
| 5,880 | 5,880 | 8,800 | Power (kW) |
| Distributed traction | Distributed traction | Concentrated traction | Traction |
| SCMT / BACC, ZUB | SCMT / BACC | SCMT / BACC, ETCS | Signalling |
| 5 | 15 | 59 | Train sets currently used / planned |
| | | | **Weight and dimensions** |
| 460 | 422 | 640 (loaded) | Unladen weight in running order (t) |
| 15.1 | 13.5 (unloaded) | 17 | Maximum axle load (t) |
| 11.8 | 12.8 | 13.8 | Power weight ratio (kW/t) |
| 236.6 | 237 | 354 | Train length (m) |
| 2.800 | 2.800 | 2.860 | Train width (m) |
| | | | **Seats** |
| 151 | 139 | - | 1st class seats* |
| 324 | 341 | - | 2nd class seats |
| 475 | 480 | 574 | Total seats |
| | | | **Observations** |
| Trenitalia: 5 sets<br>SBB: 0 sets | AC electric equipment was installed to ETR 480 and renumbered as ETR 485 | Figures are for 3-class<br>4-class are introduced since 2012 | |

(1) M-Motor coach • T-Trailer coach• L-Locomotive
MB-Motor Bogie

AC – alternating current
DC – direct current

* For 3 classes train, 1st and 2nd classes are included in 1st class

*Source: International Union of Railways*

# 2.5 ROLLING STOCK



(1) M-Motor coach • T-Trailer coach• L-Locomotive
MB-Motor Bogie

AC – alternating current
DC – direct current

| General characteristics | ETR 600 *(Italy)* | ETR 610 *(Italy / Switzerland)* | ETR 700 *(Italy)* |
|---|---|---|---|
| (1) Composition | M+T+M+T+M+T+M | M+T+M+T+M+T+M | M+T+M+T+T+M+T+M |
| Suppliers | Alstom | Alstom | Ansaldobreda |
| Owners or operators | Trenitalia | Trenitalia, SBB | Trenitalia |
| Year in service | 2008 | 2009 | 2019 |
| Articulated | No + Tilting | No + Tilting | No |
| Track gauge (mm) | 1,435 | 1,435 | 1,435 |
| Electrification voltage (kV) | 25 kV 50 Hz AC / 3 kV DC | 25 kV 50 Hz AC / 15 kV 16.7 Hz AC<br>3 kV DC | 25 kV 50 Hz AC / 3 kV DC / 1.5 kV DC |
| Maximum train speed / operation speed (km/h) | 280 / 250 | 250 / 250 | 250 / 250 |
| Power (kW) | 5,600 | 5,500 | 5,500 |
| Traction | Distributed traction | Distributed traction | Distributed traction |
| Signalling | SCMT / BACC, ETCS | SCMT / BACC, LZB / PZB, ZUB, ETCS | ATB, TBL, LZB, ETCS |
| Train sets currently used / planned | 12 | 26 | 4 (17) |
| **Weight and dimensions** | | | |
| Unladen weight in running order (t) | 443 (loaded) | 466 | 423 |
| Maximum axle load (t) | 17 | 17 | 17 |
| Power weight ratio (kW/t) | 12.6 | 12.2 | 11.8 |
| Train length (m) | 187.4 | 187.4 | 200.9 |
| Train width (m) | 2.830 | 2.830 | 2.870 |
| **Seats** | | | |
| 1st class seats* | 126 | 108+18 | 52+148 |
| 2nd class seats | 306 | 304 (Trenitalia), 296 (SBB) | 300 |
| Total seats | 432 | 430 (Trenitalia), 422 (SBB) | 500 |
| **Observations** | | | |
| | | Trenitalia: 7 sets<br>SBB: 19 sets | Trenitalia: 17 sets since jun. 2019<br>Former V250 series (NS) |

* For 3 classes train, 1st and 2nd classes are included in 1st class

*Source: International Union of Railways*

# 2.5 ROLLING STOCK

## ETR 1000
*(Italy)*


## AGV 575
*(Italy)*


## "Evo Pendolino"
*(Italy)*

| General characteristics | ETR 1000 | AGV 575 | "Evo Pendolino" |
|---|---|---|---|
| (1) Composition | M+T+M+2T+M+T+M | EMU-11 (5MB+7TB) | M+T+M+T+M+T+M |
| Suppliers | Alstom-Hitachi Rail Italy-Bombardier | Alstom | Alstom |
| Owners or operators | Trenitalia | NTV | NTV |
| Year in service | 2015 | 2012 | 2018 |
| Articulated | No | Yes | Yes |
| Track gauge (mm) | 1,435 | 1,435 | 1,435 |
| Electrification voltage (kV) | 25 kV 50 Hz AC / 15 kV 16.7 Hz AC<br>3 kV DC / 1.5 kV DC | 25 kV 50 Hz AC / 3 kV DC | 25 kV 50 Hz AC / 3 kV DC |
| Maximum train speed / operation speed (km/h) | 400 / 300 | 300 / 300 | 250 / 250 |
| Power (kW) | 9,800 | 7,500 | 5,500 |
| Traction | Distributed traction | Distributed traction | Distributed traction |
| Signalling | ETCS | SCMT / BACC, ETCS | SCMT / BACC, ETCS |
| Train sets currently used / planned | 50 (64) | 25 | 10 (22) |
| **Weight and dimensions** | | | |
| Unladen weight in running order (t) | 500 (loaded) | 398 | 407 |
| Maximum axle load (t) | 17 | 17 | 25 |
| Power weight ratio (kW/t) | 19.6 | 15 | 13.5 |
| Train length (m) | 202 | 201 | 187.3 |
| Train width (m) | 2.924 | 3.000 | 2.950 |
| **Seats** | | | |
| 1st class seats* | 10+71+76 | 19+143 | - |
| 2nd class seats | 300 | 288 | - |
| Total seats | 457 | 450 | 472 |
| **Observations** | | | |
| | Operation since 2015 in 300 km/h | 3-class | Pendolino Design |

(1) M-Motor coach • T-Trailer coach• L-Locomotive
MB-Motor Bogie

AC – alternating current
DC – direct current

*Source: International Union of Railways*

* For 3 classes train, 1st and 2nd classes are included in 1st class

# 2.5 ROLLING STOCK



(1) M-Motor coach • T-Trailer coach• L-Locomotive
MB-Motor Bogie

AC – alternating current
DC – direct current

| General characteristics | ED250 (Poland) | S100 (bicourant) (Spain) | S100 (tricourant) (Spain) |
|---|---|---|---|
| (1) Composition | 2M+3T+2M | L+8T+L | L+8T+L |
| Suppliers | Alstom | Alstom | Alstom |
| Owners or operators | PKP Intercity | Renfe Operadora | Renfe Operadora |
| Year in service | 2014 | 1992 | 1992 |
| Articulated | No | Yes (except for ends) | Yes (except for ends) |
| Track gauge (mm) | 1,435 | 1,435 | 1,435 |
| Electrification voltage (kV) | 25 kV 50 Hz AC / 15 kV 16.7 Hz AC 3 kV DC | 25 kV 50 Hz AC / 3 kV DC | 25 kV 50 Hz AC / 3 kV DC / 1.5 kV DC |
| Maximum train speed / operation speed (km/h) | 250 / 250 | 300 / 300 | 300 / 300 |
| Power (kW) | 5,500 | 8,800 | 8,800 |
| Traction | Distributed traction | Concentrated traction | Concentrated traction |
| Signalling | SHP, Mirel, LZB / PZB, ETCS | ASFA / LZB, ETCS | ASFA / LZB, TVM / KVB, ETCS |
| Train sets currently used / planned | 20 | 14 | 10 |
| **Weight and dimensions** | | | |
| Unladen weight in running order (t) | 395.5 | 392 | 392 |
| Maximum axle load (t) | 17 | 17.2 | 17.2 |
| Power weight ratio (kW/t) | 14.2 | 21 | 21 |
| Train length (m) | 187.4 | 200.15 | 200.15 |
| Train width (m) | 2.830 | 2.904 | 2.904 |
| **Seats** | | | |
| 1st class seats* | 57 | 80 (1) | 80 (1) |
| 2nd class seats | 345 | 265 (+2 hp) | 265 (+2 hp) |
| Total seats | 402 | 345 (+2 hp) | 345 (+2 hp) |
| **Observations** | | | |
| | | AVE "3 classes"<br>(1) Includes 8 places in club room | AVE "3 classes"<br>10 sets are tri-current and operable in France since 2013<br>(1) Includes 8 places in club room |

* For 3 classes train, 1st and 2nd classes are included in 1st class

*Source: International Union of Railways*

# 2.5 ROLLING STOCK




| S101 (Spain) | S102 (Spain) | S103 (Spain) | General characteristics |
|---|---|---|---|
| L+8T+L | L+12T+L | M+T+M+2T+M+T+M | (1) Composition |
| Alstom | Talgo-Bombardier | Siemens | Suppliers |
| Renfe Operadora | Renfe Operadora | Renfe Operadora | Owners or operators |
| 1996-2010 | 2005 | 2007 | Year in service |
| Yes (except for ends) | Yes, by independent wheels (except for ends) + Tilting | No | Articulated |
| 1,668 | 1,435 | 1,435 | Track gauge (mm) |
| 3 kV DC | 25 kV 50 Hz AC | 25 kV 50 Hz AC | Electrification voltage (kV) |
| 200 / 200 | 330 / 300 | 350 / 300 | Maximum train speed / operation speed (km/h) |
| 5,400 | 8,000 | 8,800 | Power (kW) |
| Concentrated traction | Concentrated traction | Distributed traction | Traction |
| ASFA / EBICAB900 | ASFA / LZB, ETCS | ASFA / LZB / ETCS | Signalling |
| 0 | 16 | 26 | Train sets currently used / planned |
| | | | **Weight and dimensions** |
| 392 | 322 | 425 | Unladen weight in running order (t) |
| 17.2 | 17 | 15 | Maximum axle load (t) |
| 12.9 | 24.7 | 20.7 | Power weight ratio (kW/t) |
| 200.15 | 200.24 | 200 | Train length (m) |
| 2.904 | 2.960 | 2.950 | Train width (m) |
| | | | **Seats** |
| 112 | 71 (1) | 88 (1) | 1st class seats* |
| 200 (+2 hp) | 261 (+2 hp) | 332 (+2 hp) | 2nd class seats |
| 312 (+2 hp) | 332 (+2 hp) | 420 (+2 hp) | Total seats |
| | | | **Observations** |
| "Euromed"<br>Track gauge 1,668<br>All sets converted to S100 | AVE "3 classes"<br>(1) Includes 8 places in club room | AVE "3 classes"<br>(1) Includes 8 places in club room | |

(1) M-Motor coach • T-Trailer coach• L-Locomotive
MB-Motor Bogie

AC – alternating current
DC – direct current

* For 3 classes train, 1st and 2nd classes are included in 1st class

*Source: International Union of Railways*

# 2.5 ROLLING STOCK



(1) M-Motor coach • T-Trailer coach• L-Locomotive
MB-Motor Bogie

AC – alternating current
DC – direct current

| General characteristics | S104 (Spain) | S106/122 (Spain) | S108 (Spain) |
|---|---|---|---|
| (1) Composition | 4M | M+12T+M | L+8T+L |
| Suppliers | CAF-Alstom | Talgo-Bombardier | Alstom |
| Owners or operators | Renfe Operadora | Renfe Operadora | SNCF |
| Year in service | 2004 | 2022 | 2021 |
| Articulated | No | Yes, by independent wheels (except for ends) + Tilting | Yes (except for ends) + Double Decker |
| Track gauge (mm) | 1,435 | 1,435 | 1,435 |
| Electrification voltage (kV) | 25 kV 50 Hz AC | 25 kV 50 Hz AC / 3 kV DC / 1.5 kV DC | 25 kV 50 Hz AC / 1.5 kV DC |
| Maximum train speed / operation speed (km/h) | 270 / 250 | 330 / 300 | 320 / 320 |
| Power (kW) | 4,000 | 8,000 (25 kV) / 6,500 (3 kV) / 4,300 (1.5 kV) | 9,280 |
| Traction | Distributed traction | Concentrated traction | Concentrated traction |
| Signalling | ASFA / LZB / ETCS | ASFA / LZB / ETCS / TVM430 / KVB / RPS | EQS (ETCS/ASFA) |
| Train sets currently used / planned | 20 | 0 / 30 | 9 |
| **Weight and dimensions** | | | |
| Unladen weight in running order (t) | 221.5 | 317.0 | 390 |
| Maximum axle load (t) | 17 | 17 | 17 |
| Power weight ratio (kW/t) | 18.1 | 23.4 | 21.5 |
| Train length (m) | 107.1 | 201.9 | 200 |
| Train width (m) | 2.920 | 3.200 | 2.896 |
| **Seats** | | | |
| 1st class seats* | 30 | 76 (+2 hp) | 181 |
| 2nd class seats | 206 (+1 hp) | 429 | 328 |
| Total seats | 236 (+1 hp) | 505 (+2 hp) | 509 |
| **Observations** | | | |
| | "Avant" | Standard (1,435) or dual gauge (1,435 - 1,668) trainsets 10 trainsets for international use, include TVM-430, KVB, RPS | |

* For 3 classes train, 1st and 2nd classes are included in 1st class

*Source: International Union of Railways and miscellaneous data sources*

# 2.5 ROLLING STOCK

**S112**
*(Spain)*

| | |
|---|---|
| (1) Composition | L+12T+L |
| Suppliers | Talgo-Bombardier |
| Owners or operators | Renfe Operadora |
| Year in service | 2010 |
| Articulated | Yes, by independent wheels (except for ends) + Tilting |
| Track gauge (mm) | 1,435 |
| Electrification voltage (kV) | 25 kV 50 Hz AC |
| Maximum train speed / operation speed (km/h) | 330 / 300 |
| Power (kW) | 8,000 |
| Traction | Concentrated traction |
| Signalling | ASFA / LZB / ETCS |
| Train sets currently used / planned | 30 |
| **Weight and dimensions** | |
| Unladen weight in running order (t) | 322 |
| Maximum axle load (t) | 17 |
| Power weight ratio (kW/t) | 24.7 |
| Train length (m) | 200.24 |
| Train width (m) | 2.960 |
| **Seats** | |
| 1st class seats* | 71 |
| 2nd class seats | 292 (+2 hp) |
| Total seats | 363 (+2 hp) |
| **Observations** | |
| | Similar to S102 but capacity is increased |

**S112 M**
*(Spain)*

| | |
|---|---|
| (1) Composition | L+12T+L |
| Suppliers | Talgo-Bombardier |
| Owners or operators | Renfe Operadora |
| Year in service | 2021 |
| Articulated | Yes, by independent wheels (except for ends) + Tilting |
| Track gauge (mm) | 1,435 |
| Electrification voltage (kV) | 25 kV 50 Hz AC |
| Maximum train speed / operation speed (km/h) | 330 / 300 |
| Power (kW) | 8,000 |
| Traction | Concentrated traction |
| Signalling | ASFA / LZB / ETCS |
| Train sets currently used / planned | 5 / 30 |
| **Weight and dimensions** | |
| Unladen weight in running order (t) | 322 |
| Maximum axle load (t) | 17 |
| Power weight ratio (kW/t) | 24.7 |
| Train length (m) | 200.24 |
| Train width (m) | 2.960 |
| **Seats** | |
| 1st class seats* | - |
| 2nd class seats | 438 (+2 hp) |
| Total seats | 438 (+2 hp) |
| **Observations** | |
| | "Avlo" Similar to S112 but capacity is increased |

**S114**
*(Spain)*

| | |
|---|---|
| (1) Composition | 4M |
| Suppliers | CAF-Alstom |
| Owners or operators | Renfe Operadora |
| Year in service | 2011 |
| Articulated | No |
| Track gauge (mm) | 1,435 |
| Electrification voltage (kV) | 25 kV 50 Hz AC |
| Maximum train speed / operation speed (km/h) | 270 / 250 |
| Power (kW) | 4,000 |
| Traction | Distributed traction |
| Signalling | ASFA / LZB / ETCS |
| Train sets currently used / planned | 13 |
| **Weight and dimensions** | |
| Unladen weight in running order (t) | 221.5 |
| Maximum axle load (t) | 17 |
| Power weight ratio (kW/t) | 18.1 |
| Train length (m) | 107.9 |
| Train width (m) | 2.830 |
| **Seats** | |
| 1st class seats* | - |
| 2nd class seats | 236 (+2 hp) |
| Total seats | 236 (+2 hp) |
| **Observations** | |
| | "Avant" |

(1) M-Motor coach • T-Trailer coach• L-Locomotive
MB-Motor Bogie

AC – alternating current
DC – direct current

* For 3 classes train, 1st and 2nd classes are included in 1st class

*Source: International Union of Railways*

# 2.5 ROLLING STOCK



(1) M-Motor coach • T-Trailer coach• L-Locomotive
MB-Motor Bogie

AC – alternating current
DC – direct current




| General characteristics | S120 (Spain) | S120.5 (Spain) | S121 (Spain) |
|---|---|---|---|
| (1) Composition | 4M | 4M | 4M |
| Suppliers | CAF-Alstom | CAF-Alstom | CAF-Alstom |
| Owners or operators | Renfe Operadora | Renfe Operadora | Renfe Operadora |
| Year in service | 2006 | 2006 | 2008 |
| Articulated | No | No | No |
| Track gauge (mm) | 1,435 / 1,668 | 1,435 / 1,668 | 1,435 / 1,668 |
| Electrification voltage (kV) | 25 kV 50 Hz AC / 3 kV DC | 25 kV 50 Hz AC / 3 kV DC | 25 kV 50 Hz AC / 3 kV DC |
| Maximum train speed / operation speed (km/h) | 250 (25 kV)-220 (3 kV) / 250 (25 kV)-220 (3 kV) | 250 (25 kV)-220 (3 kV) / 250 (25 kV)-220 (3 kV) | 250 (25 kV)-220 (3 kV) / 250 (25 kV)-220 (3 kV) |
| Power (kW) | 4,000 (25 kV)-2,500 (3 kV) | 4,000 (25 kV)-2,500 (3 kV) | 4,000 (25 kV)-2,500 (3 kV) |
| Traction | Distributed traction | Distributed traction | Distributed traction |
| Signalling | ASFA / LZB / ETCS / EBICAB | ASFA / LZB / ETCS | ASFA / LZB / ETCS |
| Train sets currently used / planned | 12 | 15 | 29 |
| **Weight and dimensions** | | | |
| Unladen weight in running order (t) | 233 | 232 | 225 |
| Maximum axle load (t) | 16.2 | 16.2 | 15.75 |
| Power weight ratio (kW/t) | 17.2 | 17.2 | 17.8 |
| Train length (m) | 107.4 | 107.4 | 107.4 |
| Train width (m) | 2.920 | 2.920 | 2.920 |
| **Seats** | | | |
| 1st class seats* | 81 | 74 (+1 hp) | - |
| 2nd class seats | 156 (+1 hp) | 148 | - |
| Total seats | 237 (+1 hp) | 222 (+1 hp) | 280 (+2 hp) |
| **Observations** | | | |
| | "Alvia" Dual gauge track (1,435 - 1,668) | "Alvia" Dual gauge track (1,435 - 1,668) | "Avant" Dual gauge track (1,435 - 1,668) |

* For 3 classes train, 1st and 2nd classes are included in 1st class

*Source: International Union of Railways*

| S130 (Spain) | S730 (Spain) | X2 (X2000) (Sweden) | |
|---|---|---|---|
| L+11T+L | M+9T+M | L+5T / L+6T | (1) Composition |
| Talgo-Bombardier | Talgo-Bombardier | Bombardier | Suppliers |
| Renfe Operadora | Renfe Operadora | SJ | Owners or operators |
| 2007 | 2012 | 1990 | Year in service |
| Yes, by independent wheels (except for ends) + Tilting | Yes, by independent wheels (except for ends) + Tilting | No + Tilting | Articulated |
| 1,435 / 1,668 | 1,435 / 1,668 | 1,435 | Track gauge (mm) |
| 25 kV 50 Hz AC / 3 kV DC | 25 kV 50 Hz AC / 3 kV DC / diesel | 15 kV 16.7 Hz AC | Electrification voltage (kV) |
| 250 (25 kV)-220 (3 kV) / 250 (25 kV)-220 (3 kV) | 250 (25 kV)-220 (3 kV)-180 (diesel) / 250 (25 kV)-220 (3 kV)-180 (diesel) | 200 / 200 | Maximum train speed / operation speed (km/h) |
| 4,800 (25 kV) / 4,000 (3 kV) | 4,800 (25 kV) / 4,000 (3 kV) / 3,600 (diesel) | 3,260 | Power (kW) |
| Concentrated traction | Concentrated traction | Concentrated traction | Traction |
| ASFA / LZB / EBICAB / ETCS | ASFA / LZB / EBICAB / ETCS | EBICAB700 | Signalling |
| 30 | 14 | 7 - 36 | Train sets currently used / planned |
| | | | **Weight and dimensions** |
| 312 | 384 | 360 (6T) | Unladen weight in running order (t) |
| 18 | 18 | 18.5 | Maximum axle load (t) |
| 15.4 | 12.5 | 8.5 | Power weight ratio (kW/t) |
| 184.2 | 186 | 140 / 165 | Train length (m) |
| 2.960 | 2.960 | 3.080 | Train width (m) |
| | | | **Seats** |
| 62 (+1 hp) | 47 (+1 hp) | 48 / 96 | 1st class seats* |
| 236 | 216 | 213 | 2nd class seats |
| 298 (+1 hp) | 263 (+1 hp) | 261 (+2 hp) / 309 (+2 hp) | Total seats |
| | | | **Observations** |
| "Alvia"<br>Dual gauge track (1,435 - 1,668)<br>15 sets will be converted to S130H | Diesel hybrid version of S130<br>Diesel engines are installed on 2 end cars next to the locomotive<br>15 sets are converted from S130<br>Dual gauge track (1,435 - 1,668)<br>No. 12 abandoned after the accident at Santiago | | |

(1) M-Motor coach • T-Trailer coach• L-Locomotive
MB-Motor Bogie

AC – alternating current
DC – direct current

* For 3 classes train, 1st and 2nd classes are included in 1st class

*Source: International Union of Railways*

(1) M-Motor coach • T-Trailer coach• L-Locomotive
MB-Motor Bogie

AC – alternating current
DC – direct current

| General characteristics | X40 (Sweden) | X3 (Sweden) | X55 (SJ 3000) (Sweden) |
|---|---|---|---|
| (1) Composition | 2M / 3M | M+2T+M | EMU-4 (4M) |
| Suppliers | Alstom | Alstom | Bombardier |
| Owners or operators | SJ | Arlanda Express | SJ |
| Year in service | 2005 | 1999 | 2012 |
| Articulated | No + Double Decker | No | No |
| Track gauge (mm) | 1,435 | 1,435 | 1,435 |
| Electrification voltage (kV) | 15 kV 16.7 Hz AC | 15 kV 16.7 Hz AC | 15 kV 16.7 Hz AC |
| Maximum train speed / operation speed (km/h) | 200 / 200 | 200 / 200 | 250 / 200 |
| Power (kW) | 1,600 / 2,400 | 2,240 | 3,180 |
| Traction | Distributed traction | Distributed traction | Distributed traction |
| Signalling | EBICAB700 | EBICAB700 | EBICAB700, ETCS |
| Train sets currently used / planned | 16 - 27 | 7 | 20 |
| **Weight and dimensions** | | | |
| Unladen weight in running order (t) | 140 / 205 | 193 | 274 |
| Maximum axle load (t) | - | - | - |
| Power weight ratio (kW/t) | 10.4 | 10.8 | 10.8 |
| Train length (m) | 55.1 - 81.5 | 93.4 | 107 |
| Train width (m) | 2.960 | 3.063 | 3.430 |
| **Seats** | | | |
| 1st class seats* | - | 0 | 64 |
| 2nd class seats | 180 / 288 | 190 | 181 |
| Total seats | 180 / 288 | 190 | 245 |
| **Observations** | | | |

* For 3 classes train, 1st and 2nd classes are included in 1st class

*Source: International Union of Railways*

# 2.5 ROLLING STOCK

| | RABDe500 (ICN) *(Switzerland)* | RABe501 (EC250) *(Switzerland)* | IC125 *(United Kingdom)* |
|---|---|---|---|
| (1) Composition | 2M+3T+2M | TB+2MB+4TB+2MB+3TB | L+7T+L - L+8T+L |
| Suppliers | Bombardier-Alstom | Stadler | BREL |
| Owners or operators | SBB | SBB | CC, EC, EM, FGW, GC, V |
| Year in service | 2000 | 2020 | 1976 |
| Articulated | No + Tilting | Yes | No |
| Track gauge (mm) | 1,435 | 1,435 | 1,435 |
| Electrification voltage (kV) | 15 kV 16.7 Hz AC | 25 kV 50 Hz AC / 15 kV 16.7 Hz AC<br>3 kV DC | Diesel |
| Maximum train speed / operation speed (km/h) | 220 / 200 | 250 / 250 | 200 / 200 |
| Power (kW) | 5,200 | 6,000 | 3,360 |
| Traction | Distributed traction | Distributed traction | Concentrated traction |
| Signalling | ZUB | SCMT / BACC / LZB / PZB / ZUB / ETCS | AWS / TPWS |
| Train sets currently used / planned | 44 | 28 | 80 |
| **Weight and dimensions** | | | |
| Unladen weight in running order (t) | 355 | 380 | 383 (L+7+L) |
| Maximum axle load (t) | 12 | 17.3 | 10.7 |
| Power weight ratio (kW/t) | 13.3 | 15.8 | 8.8 |
| Train length (m) | 188 | 202 | 197 (L+7T+L) - 220 (L+8T+L) |
| Train width (m) | 2.830 | 2.900 | 2.740 |
| **Seats** | | | |
| 1st class seats* | 125 | 117 | - |
| 2nd class seats | 326 | 288 | - |
| Total seats | 451 | 405 | 472 |
| **Observations** | | | |
| | | SBB "Giruno"<br>Stadler "SMILE" | CC: Cross Country<br>EC: East Coast<br>EM: East Midlands<br>FGW: First Great Western<br>GC: Grand Central<br>V: Virgin |

(1) M-Motor coach • T-Trailer coach• L-Locomotive
MB-Motor Bogie

AC – alternating current
DC – direct current

* For 3 classes train, 1st and 2nd classes are included in 1st class

*Source: International Union of Railways*

# 2.5 ROLLING STOCK



(1) M-Motor coach • T-Trailer coach• L-Locomotive
MB-Motor Bogie

AC – alternating current
DC – direct current

| General characteristics | IC225 *(United Kingdom)* | 180 *(United Kingdom)* | 220 *(United Kingdom)* |
|---|---|---|---|
| (1) Composition | L+9T | 5M | 4M |
| Suppliers | BREL, Alstom | Alstom | Bombardier |
| Owners or operators | East Coast | EC, GC, HT, NR | Cross Country |
| Year in service | 1989 | 2000 | 2001 |
| Articulated | No | No | No |
| Track gauge (mm) | 1,435 | 1,435 | 1,435 |
| Electrification voltage (kV) | 25 kV 50 Hz AC | Diesel | Diesel |
| Maximum train speed / operation speed (km/h) | 225 / 200 | 200 / 200 | 200 / 200 |
| Power (kW) | 4,350 | 2,800 | 2,200 |
| Traction | Concentrated traction | Distributed traction | Distributed traction |
| Signalling | AWS / TPWS | AWS / TPWS | AWS / TPWS |
| Train sets currently used / planned | 30 | 14 | 34 |
| **Weight and dimensions** | | | |
| Unladen weight in running order (t) | 476 | 252.5 | 185.6 |
| Maximum axle load (t) | 11.9 | 12.6 | 11.6 |
| Power weight ratio (kW/t) | 9.1 | 10.2 | 11 |
| Train length (m) | 226 | 116.5 | 93.34 |
| Train width (m) | 2.740 | 2.730 | 2.730 |
| **Seats** | | | |
| 1st class seats* | 112 | 42 | 26 |
| 2nd class seats | 368 | 226 | 162 |
| Total seats | 480 | 268 | 188 |
| **Observations** | | | |
| | | "Adelante"<br>EC: East Coast,<br>GC: Grand Central,<br>HT: Hull Trains,<br>NR: Northern Rail | "Voyager" |

* For 3 classes train, 1st and 2nd classes are included in 1st class

*Source: International Union of Railways*

# 2.5 ROLLING STOCK

**221**
*(United Kingdom)*

| |
|---|
| 4M - 5M |
| Bombardier |
| Cross Country, Virgin |
| 2002 |
| No + Tilting |
| 1,435 |
| Diesel |
| 200 / 200 |
| 2,240 (4M) - 2,800 (5M) |
| Distributed traction |
| AWS / TPWS |
| 4 (4M) - 40 (5M) |
| |
| 227 (4M) - 282.8 (5M) |
| 14.1 |
| 9.2 |
| 93.3 (4M) - 116.2 (5M) |
| 2.730 |
| |
| 26 |
| 162 (4M) - 224 (5M) |
| 188 (4M) - 250 (5M) |
| |
| "Super Voyager" |

**222**
*(United Kingdom)*

| |
|---|
| 4M - 5M - 7M |
| Bombardier |
| East Midlands |
| 2004 |
| No |
| 1,435 |
| Diesel |
| 200 / 200 |
| 2,240 (4M) - 2,800 (5M) - 3,920 (7M) |
| Distributed traction |
| AWS / TPWS |
| 4 (4M) - 17 (5M) - 6 (7M) |
| |
| 227 (4M) - 282.5 (5M) - 395.5 (7M) |
| 14.1 |
| 9.9 |
| 93.3 (4M) - 116.2 (5M) - 161.8 (7M) |
| 2.730 |
| |
| 33 (4M) - 50 (5M) - 106 (7M) |
| 132 (4M) - 192 (5M) - 236 (7M) |
| 165 (4M) - 242 (5M) - 342 (7M) |
| |
| "Meridian" |


**374 e320**
*(UK / France / Belgium / The Netherlands)*

| |
|---|
| M+T+M+T+T+M+T+M+M+T+M+T+T+M+T+M |
| Siemens |
| Eurostar |
| 2015 |
| No |
| 1,435 |
| 25 kV 50 Hz AC / 15 kV 16.7 Hz AC / 3 kV DC / 1.5 kV DC |
| 320 / 300 |
| 16,000 |
| Distributed traction |
| TVM / KVB, TBL, ATB, ETCS |
| 17 |
| |
| 878 |
| 17 |
| 18.2 |
| 400 |
| 2.950 |
| |
| 222 |
| 672 |
| 894 |
| |
| No. 4001-4034<br>Siemens Velaro D series |

(1) M-Motor coach • T-Trailer coach• L-Locomotive
MB-Motor Bogie

AC – alternating current
DC – direct current

| General characteristics |
|---|
| (1) Composition |
| Suppliers |
| Owners or operators |
| Year in service |
| Articulated |
| Track gauge (mm) |
| Electrification voltage (kV) |
| Maximum train speed / operation speed (km/h) |
| Power (kW) |
| Traction |
| Signalling |
| Train sets currently used / planned |
| **Weight and dimensions** |
| Unladen weight in running order (t) |
| Maximum axle load (t) |
| Power weight ratio (kW/t) |
| Train length (m) |
| Train width (m) |
| **Seats** |
| 1st class seats* |
| 2nd class seats |
| Total seats |
| **Observations** |

* For 3 classes train, 1st and 2nd classes are included in 1st class

*Source: International Union of Railways*

# 2.5 ROLLING STOCK



(1) M-Motor coach • T-Trailer coach• L-Locomotive
MB-Motor Bogie

AC – alternating current
DC – direct current

| General characteristics | 390 *(United Kingdom)* | 395 *(United Kingdom)* | 800 *(United Kingdom)* |
|---|---|---|---|
| (1) Composition | 2M+T+M+T+M+T+2M | T+4M+T | T+3M+T / T+2M+T+M+T+2M+T |
| Suppliers | Alstom | Hitachi | Hitachi-Hitachi Rail Europe (UK) |
| Owners or operators | Virgin | Southeastern | IEP (Great Western, East Coast main line) |
| Year in service | 2002 | 2009 | 2017 |
| Articulated | No + Tilting | No | No |
| Track gauge (mm) | 1,435 | 1,435 | 1,435 |
| Electrification voltage (kV) | 25 kV 50 Hz AC | 25 kV 50 Hz AC / 0.75 kV DC | 25 kV 50 Hz AC + Diesel (Bi-mode) |
| Maximum train speed / operation speed (km/h) | 225 / 200 | 225 / 225 | 200 / 200 |
| Power (kW) | 5,500 | 3,360 | 2,100 - 3,500 |
| Traction | Distributed traction | Distributed traction | Distributed traction |
| Signalling | AWS / TPWS | TVM / KVB, AWS / TPWS | AWS / TPWS |
| Train sets currently used / planned | 56 | 29 | 6 / 46 - 34 |
| **Weight and dimensions** | | | |
| Unladen weight in running order (t) | 458 (loaded) | 265 | 300 - 540 |
| Maximum axle load (t) | 16.1 | 11 (unloaded avg.) | 18.4 |
| Power weight ratio (kW/t) | 12 | 12.7 | - |
| Train length (m) | 217 | 121.8 | 93.7 - 208.7 |
| Train width (m) | 2.730 | 2.810 | 2.730 |
| **Seats** | | | |
| 1st class seats* | 145 | - | 45-101 |
| 2nd class seats | 294 | 348 | 270 - 526 |
| Total seats | 439 | 348 | 315 - 627 |
| **Observations** | | | |
| | Decided to increasing train length to 11 car for 31 train sets and creation of 4 new 11 car trainsets | | Agility Trains<br>Bi-mode is possible to be propelled by both electricity and diesel engine<br>5-cars: 46 sets; 36 sets for Great Western Main Line, 10 sets for East Coast main line<br>9-cars: 34 sets; 21 sets for Great Western Main Line, 13 sets for East Coast main line |

* For 3 classes train, 1st and 2nd classes are included in 1st class

*Source: International Union of Railways*

# 2.5 ROLLING STOCK

| | 801 *(United Kingdom)* | 802 *(United Kingdom)* |
|---|---|---|
| (1) Composition | T+3M+T / T+2M+T+M+T+2M+T | T+3M+T / T+2M+T+M+T+2M+T |
| Suppliers | Hitachi-Hitachi Rail Europe (UK) | Hitachi-Hitachi Rail Europe (UK) |
| Owners or operators | IEP (East Coast main line) | Great Western |
| Year in service | 2018 | 2018 |
| Articulated | No | No |
| Track gauge (mm) | 1,435 | 1,435 |
| Electrification voltage (kV) | 25 kV 50 Hz AC + Diesel (Bi-mode) | 25 kV 50 Hz AC + Diesel (Bi-mode) |
| Maximum train speed / operation speed (km/h) | 200 / 200 | 200 / 200 |
| Power (kW) | 2,100 - 3,500 | 2,100 - 3,500 |
| Traction | Distributed traction | Distributed traction |
| Signalling | AWS / TPWS | AWS / TPWS |
| Train sets currently used / planned | 0 / 12 - 0 / 30 | 0 / 22 - 14 |
| **Weight and dimensions** | | |
| Unladen weight in running order (t) | 300 - 540 | 300 - 540 |
| Maximum axle load (t) | 18.4 | 18.4 |
| Power weight ratio (kW/t) | - | - |
| Train length (m) | 93.7 - 208.7 | 130 - 234 |
| Train width (m) | 2.730 | 2.730 |
| **Seats** | | |
| 1st class seats* | 45-101 | - |
| 2nd class seats | 270 - 526 | - |
| Total seats | 315 - 627 | 326 - 655 |
| **Observations** | | |
| | Agility Trains,<br>5-cars: 12 sets for East Coast main line<br>9-cars: 30 sets for East Coast main line | Bi-mode, AT300<br>Bi-mode is possible to be propelled by both electricity and diesel engine who provide electricity to motors |

(1) M-Motor coach • T-Trailer coach• L-Locomotive
MB-Motor Bogie

AC – alternating current
DC – direct current

* For 3 classes train, 1st and 2nd classes are included in 1st class

*Source: International Union of Railways*


INTERNATIONAL UNION
OF RAILWAYS

# 3.1 HIGH-SPEED RAIL NETWORK

## CHINA

*High-speed lines in commercial operation in China (I)*

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| Qinhuangdao - Shenyang North | 250 | 2003 | 405 |
| Taipei - Kaohsiung | 300 | 2007 | 345 |
| Nanjing - Hefei | 250 | 2008 | 148 |
| Beijing South - Tianjin | 350 | 2008 | 118 |
| Qingdao - Jinan | 200 | 2009 | 393 |
| Hefei East - Hankou | 250 | 2009 | 380 |
| Shijiazhuang North - Taiyuan | 250 | 2009 | 227 |
| Chongqing - Liangwu | 200 | 2009 | 263 |
| Ningbo - Cangnan | 250 | 2009 | 351 |
| Wuhan - Guangzhou South | 350 | 2009 | 1,079 |
| Zhengzhou East - Xi'an North | 350 | 2010 | 553 |
| Cangnan - Fuzhou | 250 | 2010 | 211 |
| Fuzhou - Xiamen North | 250 | 2010 | 234 |
| Chengdu - Qingchengshan | 200 | 2010 | 65 |
| Shanghai - Nanjing | 350 | 2010 | 323 |
| Jiujiang - Nanchang West | 250 | 2010 | 138 |
| Shanghai Hongqiao - Hangzhou South | 350 | 2010 | 174 |
| Haikou - Sanya | 250 | 2010 | 308 |
| Guangzhou South - Zhuhai | 200 | 2011 | 143 |
| Changchun - Jilin | 250 | 2011 | 111 |
| Beijing South - Shanghai Hongqiao | 350 | 2011 | 1,318 |
| Guangzhou South - Futian | 250 | 2011 | 111 |
| Longyan - Zhangzhou | 200 | 2012 | 114 |
| Hankou - Yichang East | 200 | 2012 | 292 |
| Zhengzhou East - Wuhan | 350 | 2012 | 526 |

*Source: compiled by authors based on International Union of Railways, 2022*

# 3.1 HIGH-SPEED RAIL NETWORK

***High-speed lines in commercial operation in China (II)***

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| Bengbu South - Hefei | 350 | 2012 | 131 |
| Dalian North - Shenyang North | 350 | 2012 | 383 |
| Shenyang North - Harbin West | 350 | 2012 | 546 |
| Taigemu - Baotou | 200 | 2012 | 146 |
| Suining - Chengdu East | 200 | 2012 | 151 |
| Beijing West - Zhengzhou East | 350 | 2012 | 676 |
| Taishansuo (block station) - Liuzhou | 200 | 2012 | 498 |
| Nanjing South - Hangzhou East | 350 | 2013 | 254 |
| Hangzhou South - Ningbo | 350 | 2013 | 157 |
| Panjin North - Yingkou East | 350 | 2013 | 90 |
| Nanchang West - Fuzhou | 200 | 2013 | 547 |
| Yongtai - Putian | 200 | 2013 | 59 |
| Tianjin - Qinhuangdao | 350 | 2013 | 288 |
| Xi'an North - Baoji South | 350 | 2013 | 184 |
| Xiamen North - Shenzhen North | 250 | 2013 | 513 |
| Nanhu East - Xianning South | 250 | 2013 | 76 |
| Liuzhou - Nanning | 250 | 2013 | 223 |
| Qinzhou North - Fangchenggang | 250 | 2013 | 62 |
| Nanning East - Beihai | 250 | 2013 | 197 |
| Pixian West - Pengzhou | 200 | 2013 | 21 |
| Nanning - Guangzhou South | 250 | 2014 | 574 |
| Wuhan - Dayebei | 250 | 2014 | 91 |
| Gedian South - Huanggangdong | 250 | 2014 | 36 |
| Taiyuan South - Xi'an North | 250 | 2014 | 571 |
| Hangzhou South - Changsha South | 350 | 2014 | 911 |

*Source: compiled by authors based on International Union of Railways, 2022*

# 3.1 HIGH-SPEED RAIL NETWORK

***High-speed lines in commercial operation in China (III)***

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| Changsha South - Xinhuang West | 350 | 2014 | 420 |
| Jiangyou - Chengdu East | 250 | 2014 | 153 |
| Chengdu East - Leshan | 250 | 2014 | 135 |
| Leshan - Emeishan | 250 | 2014 | 27 |
| Lanzhou West - Ürümqi South | 250 | 2014 | 1,785 |
| Guizhou East - Guangzhou South | 250 | 2014 | 860 |
| Qingdao - Rongcheng | 250 | 2014 | 301 |
| Zhengzhou East - Songchenglu | 200 | 2014 | 50 |
| Ximotang - Yantai | 250 | 2015 | 19 |
| Nanyangzhai - Jiaozuo | 200 | 2015 | 70 |
| Xinhuang West - Guiyang North | 350 | 2015 | 286 |
| Hefeibeicheng - Fuzhou | 350 | 2015 | 850 |
| Harbin North - Qiqihar South | 250 | 2015 | 269 |
| Shenyang South - Dandong | 250 | 2015 | 207 |
| Tianjin - Yujiapu | 350 | 2015 | 43 |
| Jilin - Huichun | 250 | 2015 | 361 |
| Nanjing East - Anqing | 250 | 2015 | 257 |
| Nanning - Yangxu | 250 | 2015 | 257 |
| Dandong - Dalian North | 200 | 2015 | 293 |
| Chengdu East - Shapingba | 250 | 2015 | 300 |
| Tangyasuo (block station) - Wenzhou South | 200 | 2015 | 190 |
| Ganxian - Longyan | 200 | 2015 | 248 |
| Tianjin West - Bazhou West | 250 | 2015 | 73 |
| Bazhou West - Xushui | 200 | 2015 | 65 |
| Hainan West Circle (Haikou-Sanya) | 200 | 2015 | 345 |

*Source: compiled by authors based on International Union of Railways, 2022*

# 3.1 HIGH-SPEED RAIL NETWORK

### *High-speed lines in commercial operation in China (IV)*

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| Zhengzhou East - Xinzheng Airport | 200 | 2015 | 27 |
| Taipei - Nangang | 130 | 2016 | 9 |
| Foshan West - Zhaoqing | 200 | 2016 | 81 |
| Changping East - Xiaojinkou | 200 | 2016 | 53 |
| Zhengzhou - Xuzhou | 350 | 2016 | 362 |
| Chongqing North - Wanzhou North | 250 | 2016 | 246 |
| Hankou - Xiaogan East | 200 | 2016 | 61 |
| Changsha - Zhuzhou - Xiangtan | 200 | 2016 | 82 |
| Guiyang North - Kunming | 250 | 2016 | 463 |
| Yangxu - Baise | 250 | 2016 | 452 |
| Daye North - Yangxin | 250 | 2017 | 37 |
| Baoji South - Lanzhou West | 250 | 2017 | 353 |
| Wulanchabu - Hohhot East | 250 | 2017 | 128 |
| Yangxin - K23 block station | 250 | 2017 | 82 |
| Xi'an North - Jinangyou | 250 | 2017 | 505 |
| Huaibei North - Xiaoxian North | 250 | 2017 | 25 |
| Shijiazhuang - Jinan East | 250 | 2017 | 308 |
| Quzhou - Jiujiang | 200 | 2017 | 334 |
| Dongguan - Changping East | 200 | 2017 | 48 |
| Changsha West - Changsha | 200 | 2017 | 22 |
| Chongqing West - Guiyang | 200 | 2018 | 380 |
| Jiangmen - Zhanjiang West | 200 | 2018 | 355 |
| Harbin - Jiamusi | 200 | 2018 | 343 |
| Yuanping West - Taiyuan South | 200 | 2018 | 111 |
| Guangtong North - Dali | 200 | 2018 | 175 |

*Source: compiled by authors based on International Union of Railways, 2022*

# 3.1 HIGH-SPEED RAIL NETWORK

***High-speed lines in commercial operation in China (V)***

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| Xinhui - Jiangmen | 200 | 2018 | 3 |
| Futian - Hong Kong (boundary) | 200 | 2018 | 4 |
| Harbin - Harbin North | 200 | 2018 | 13 |
| Hangzhou South - Huangshan North | 250 | 2018 | 272 |
| Harbin - Mudanjiang | 250 | 2018 | 300 |
| Qingdao North - Ganyu North | 200 | 2018 | 197 |
| Ganyu North - Weiyang (block station) | 200 | 2018 | 234 |
| Huaihua South - Hengyang East | 200 | 2018 | 319 |
| Xiantang - Yanjialong | 200 | 2018 | 5 |
| Changtang (block station) - Hengyang North | 200 | 2018 | 5 |
| Changtang (block station) - Chashan'ao | 200 | 2018 | 5 |
| Qihe - Jinan West | 200 | 2018 | 21 |
| Dazhengzhuang (b.s.) - Damoliu (b.s.) | 200 | 2018 | 3 |
| Jinan East - Wulitang (block station) | 200 | 2018 | 21 |
| Jinan East - Qingdao | 350 | 2018 | 305 |
| Tongren - Dazongping | 200 | 2018 | 46 |
| Chengdu West - Chaoyang Lake | 200 | 2018 | 100 |
| Nanping North - Longyan | 200 | 2018 | 247 |
| Houling (block station) - Hongxing (block station) | 200 | 2018 | 8 |
| Huyi (block station) - Aibei (block station) | 200 | 2018 | 2 |
| Chengde South - Pingquan North | 350 | 2018 | 67 |
| Pingquan North - Shenyang | 350 | 2018 | 434 |
| Qiandingxiang W. (b.s.) - Houdingxiang E. (b.s.) | 200 | 2018 | 2 |
| Houdingxiang E. (b.s.) - Qiandingxiang W. (b.s.) | 200 | 2018 | 2 |
| Tongliao - Xinmin North | 250 | 2018 | 197 |

*Source: compiled by authors based on International Union of Railways, 2022*

# 3.1 HIGH-SPEED RAIL NETWORK

***High-speed lines in commercial operation in China (VI)***

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| Yaojiawopu (block station) - Tianjiawopu (b.s.) | 200 | 2018 | 6 |
| Tuancun (block station) - Daguhe (block station) | 350 | 2018 | 4 |
| Leshan - Yibin West | 350 | 2019 | 145 |
| Liying - Daxing Airport | 200 | 2019 | 32 |
| Meizhou West - Chaoshan | 200 | 2019 | 120 |
| Rizhao West - Dawangzhuang (block station) | 350 | 2019 | 226 |
| Qufu East - Dawangzhuang (block station) | 200 | 2019 | 10 |
| Qufu East - Daxiasong (block station) | 200 | 2019 | 4 |
| Xiaogan East - Yunmeng East | 250 | 2019 | 21 |
| Yunmeng East - Shiyan East | 350 | 2019 | 377 |
| Shangqiu - Hefei North City | 350 | 2019 | 378 |
| Zhengzhou East - Xiangyang East | 350 | 2019 | 389 |
| Zhengzhou South - Fuyang West | 350 | 2019 | 280 |
| Yinchuan - Zhongwei South | 250 | 2019 | 207 |
| Xintang South - Shenzhen Airport | 140 | 2019 | 73 |
| Xintang South - Xintang | 140 | 2019 | 3 |
| Xuzhou (Lanxu Yard) - Yancheng (Yanxu Y.) | 250 | 2019 | 313 |
| Dongji - Huai'an East | 250 | 2019 | 105 |
| Yibin West - Guiyang East | 250 | 2019 | 368 |
| Jianpo (block station) - Guiyang North | 250 | 2019 | 9 |
| Hejia (block station) - Ganzhou West | 350 | 2019 | 385 |
| Henggang - Hejia (block station) | 200 | 2019 | 11 |
| Dongcun (block station) - Pushu (block station) | 200 | 2019 | 5 |
| Fanjia (block station) - Nanjie (block station) | 200 | 2019 | 2 |
| Ganxian North - Pingjiang (block station) | 200 | 2019 | 3 |

*Source: compiled by authors based on International Union of Railways, 2022*

# 3.1 HIGH-SPEED RAIL NETWORK

***High-speed lines in commercial operation in China (VII)***

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| Qianjiang - Changde | 200 | 2019 | 333 |
| Beijing North - Zhangjiakou | 350 | 2019 | 174 |
| Zhangjiakou - Wulanchabu | 350 | 2019 | 159 |
| Xiahuayuan - Taizicheng (Chongli Railway) | 250 | 2019 | 52 |
| Huai'an - Datong South | 250 | 2019 | 134 |
| Kazuo - Chifeng | 250 | 2020 | 156 |
| Sunjiagou (b.s.) - Zhengzhangzi (b.s.) | 200 | 2020 | 5 |
| Feidong - Huzhou | 350 | 2020 | 309 |
| Zhaodian - Huangdu | 200 | 2020 | 143 |
| Pingdong (b.s.) - Nantong West | 200 | 2020 | 5 |
| Anshun West - Shuicheng | 250 | 2020 | 120 |
| Guangzhou North - Qingyuan | 200 | 2020 | 38 |
| Weifang - Laixi | 350 | 2020 | 124 |
| Langjiazhuang (b.s.) - Pangjiatun (b.s.) | 200 | 2020 | 3 |
| Huai'an West - Dantu | 250 | 2020 | 199 |
| Shaobo (b.s.) - Dujiang | 200 | 2020 | 4 |
| Shaobo (b.s.) - Tai'anzhen | 200 | 2020 | 5 |
| Hengshan (b.s.) - Zhenjiang | 200 | 2020 | 12 |
| Nayangzhai - Changfengjie (b.s.) | 250 | 2020 | 362 |
| Feixi Jinggang - Shuangling (b.s.) | 350 | 2020 | 134 |
| Shuangling (b.s.) - Longshan (b.s.) | 200 | 2020 | 4 |
| Longshan (b.s.) - Anqing | 200 | 2020 | 22 |
| Fuzhou - Pingtan | 200 | 2020 | 88 |
| Xi'an North - Wuzhong | 250 | 2020 | 545 |
| Huwang (b.s.) - Liquan South | 200 | 2020 | 6 |

*Source: compiled by authors based on International Union of Railways, 2022*

# 3.1 HIGH-SPEED RAIL NETWORK

***High-speed lines in commercial operation in China (VIII)***

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| Daxing Airport - Xiong'an | 350 | 2020 | 59 |
| Yancheng - Chjenqiao (b.s.) | 350 | 2020 | 158 |
| Guodaocun (b.s.) - Feixi Jinggang | 200 | 2020 | 6 |
| Jixianlu (b.s) | 200 | 2020 | 10 |
| Dafu - Xiantao | 200 | 2020 | 17 |
| Beijing - Chengde South | 350 | 2021 | 192 |
| Xuzhou East - Houmazhuang | 350 | 2021 | 185 |
| Shenxu (b.s.) - Lianyungang | 200 | 2021 | 5 |
| Neijiang North - Luzhou | 250 | 2021 | 129 |
| Chaoyang - Linghai South | 350 | 2021 | 107 |
| Zhangjiajie West - Huaihua South | 350 | 2021 | 247 |
| Zhangjiajie West - Shadi (b.s.) | 200 | 2021 | 3 |
| Longxingcun (b.s.) - Huaihua South | 200 | 2021 | 4 |
| Mudanjiang - Jiamusi | 250 | 2021 | 372 |
| Changbaishan - Dunhua South | 250 | 2021 | 99 |
| Dunhua - Dunhua South | 200 | 2021 | 12 |
| Hejia (b.s.) - Yangtaishan (b.s.) | 350 | 2021 | 431 |
| Shuangling (b.s.) - Lushan | 350 | 2021 | 176 |
| Tangxia (b.s.) - Dongguan South | 200 | 2021 | 3 |
| Dongguan South - Tangxia (b.s.) | 200 | 2021 | 2 |
| Yangtaishan (b.s.) - Shenzhen North | 200 | 2021 | 8 |
| Anqing West - Longshan (b.s.) | 200 | 2021 | 7 |
| Dawang. (b.s.) (-Qufu) - Zhuangzhai (Cao County) | 350 | 2021 | 199 |
| Anqing West - Longshan (b.s.) | 200 | 2021 | 5 |
| | | | **Total km = 40,474** |

*Source: compiled by authors based on International Union of Railways, 2022*

# 3.1 HIGH-SPEED RAIL NETWORK

***High-speed lines under construction in China (I)***

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| Guangzhou (Xintang) - Shanwei | 350 | 2022 | 206 |
| Changde - Yiyang - Changsha | 350 | 2022 | 158 |
| Zhengzhou - Puyang | 350 | 2022 | 237 |
| Beijing - Baodi | 350 | 2022 | 90 |
| Baodi - Tangshan | 350 | 2022 | 59 |
| Hangzhou - Shaoxing - Taizhou | 350 | 2022 | 227 |
| Nanning - Chongzuo | 250 | 2022 | 120 |
| Xi'an - Hancheng (intercity railway) | 250 | 2022 | 176 |
| Huanggang - Huangmei | 350 | 2022 | 125 |
| Fuzhou - Xiamen | 350 | 2022 | 277 |
| Shantou - Shanwei | 350 | 2022 | 163 |
| Fangchenggang - Dongxing | 250 | 2022 | 48 |
| Huzhou - Hangzhou West (tie line) | 350 | 2022 | 137 |
| Chengdu - Huangshengguan | 200 | 2022 | 275 |
| Yinchuan - Huinong | 250 | 2022 | 101 |
| Zhongwei - Lanzhou | 350 | 2022 | 219 |
| Xingshan - Wanzhou | 350 | 2022 | 269 |
| Nanchang - Jingdezhen - Huangshan | 350 | 2022 | 281 |
| Xiangyang - Xingshan | 350 | 2022 | 182 |
| Panxian - Xingyi | 250 | 2022 | 98 |
| Baodi - Binhai New Area | 350 | 2022 | 98 |
| Tianjin - New airport (tie line) | 250 | 2022 | 57 |
| Yiwu - Wenzhou | 350 | 2022 | 201 |
| Xuancheng - Jixi | 350 | 2023 | 112 |
| Lankao - Heze | 350 | 2023 | 86 |

*Source: compiled by authors based on International Union of Railways, 2022*

# 3.1 HIGH-SPEED RAIL NETWORK

### *High-speed lines under construction in China (II)*

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| Guiyang - Nanning | 350 | 2023 | 482 |
| Jiangsu South Riverside Railway | 350 | 2023 | 278 |
| Chongqing - Qianjiang | 350 | 2023 | 265 |
| Chengdu - Zigong | 350 | 2023 | 178 |
| Zhongchuan Airport - Wuwei | 250 | 2023 | 195 |
| Langfang - Daxing Airport (tie line) | 200 | 2023 | 40 |
| Nanjing - Huai'an (intercity railway) | 350 | 2023 | 201 |
| Zigong - Yibin (Sichuan South intercity railway) | 350 | 2023 | 82 |
| Jinan - Laiwu (intercity railway) | 350 | 2023 | 116 |
| Longyan - Wuping | 250 | 2023 | 93 |
| Nanning - Yulin | 350 | 2023 | 193 |
| Tieli - Yichun | 250 | 2024 | 112 |
| Hefei - Xinyi | 350 | 2024 | 208 |
| Huangshan - Chizhou | 350 | 2024 | 145 |
| Shijiazhuang - Hengshui - Cangzhou (int. railway) | 350 | 2024 | 224 |
| Huaibei - Fuyang | 350 | 2024 | 230 |
| Bazhong - Nanchong | 250 | 2024 | 152 |
| Laixi - Rongcheng (intercity railway) | 350 | 2024 | 192 |
| Yulin - Cenxi | 350 | 2024 | 111 |
| Chongzuo - Pingxiang | 250 | 2024 | 81 |
| Taicang - Situan | 200 | 2024 | 112 |
| Guangzhou - Zhanjiang | 350 | 2024 | 400 |
| Hepu - Zhanjiang | 350 | 2024 | 137 |
| Puyang - Ji'nan | 350 | 2024 | 208 |
| Mile - Mengzi | 250 | 2024 | 130 |

*Source: compiled by authors based on International Union of Railways, 2022*

# 3.1 HIGH-SPEED RAIL NETWORK

***High-speed lines under construction in China (III)***

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| Chaohu - Ma'anshan (intercity railway) | 250 | 2024 | 75 |
| Huangbei - Suzhou - Bengbu (intercity railway) | 350 | 2024 | 160 |
| Weifang - Yantai (intercity railway) | 350 | 2024 | 237 |
| Longchuan - Meizhou | 350 | 2024 | 96 |
| Jining - Datong - Yuanping | 250 | 2025 | 270 |
| Xi'an - Yan'an | 350 | 2025 | 292 |
| Yichang - Zhengwan HS (tie line) | 350 | 2025 | 109 |
| Chongqing - Fuling | 350 | 2025 | 69 |
| Shenyang - Baihe | 350 | 2025 | 429 |
| Shanghai - Suzhou - Huzhou | 350 | 2025 | 163 |
| Fuling - Wanzhou | 350 | 2025 | 183 |
| Chongqing - Kunming | 350 | 2025 | 699 |
| Chengdu - Dazhou - Wanzhou | 350 | 2025 | 488 |
| Liu'an - Anqing | 250 | 2025 | 168 |
| Shenzhen - Jiangmen | 250 | 2026 | 116 |
| Lanzhou - Hezuo | 200 | 2026 | 184 |
| Xi'an - Shiyan | 350 | 2026 | 256 |
| Xining - Huangshengguan | 200 | 2028 | 502 |
| | | | **Total km = 13,063** |

*Source: compiled by authors based on International Union of Railways, 2022*

### *High-speed lines planned in China*

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| Tianjin - Weifang | 350 | 2025 | 350 |
| Shanghai - Hangzhou | 350 | 2025 | 193 |
| Zhangzhou - Shantou | 350 | 2025 | 167 |
| Shenzhen - Shanwei | 350 | 2025 | 126 |
| Xiong'an - Shangqiu | 350 | 2025 | 638 |
| Jiujiang - Nanchang | 350 | 2025 | 137 |
| Xiangyang - Jingmen | 350 | 2025 | 117 |
| Shaoyang - Yongzhou | 250 | 2025 | 91 |
| Xiong'an - Xinzhou | 350 | 2025 | 343 |
| Baotou - Huinong | 250 | 2025 | 440 |
| Wuhan - Hefei | 350 | 2025 | 332 |
| Wuhan - Jingmen - Yichang | 350 | 2025 | 296 |
| Wuhan hub through line | 350 | 2025 | 121 |
| Changsha - Zhangzhou | 350 | 2025 | 421 |
| Harbin - Suihua - Tieli | 250 | 2025 | 190 |
| Nanjing - Ma'anshan | 250 | 2025 | 65 |
| Nangang - Yilan | - | 2030 | 77 |
| | | | **Total km = 4,104** |

*Source: compiled by authors based on International Union of Railways, 2022*

# 3.1 HIGH-SPEED RAIL NETWORK

***High-speed lines with long-term planning in China***

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| Wenzhou - Fuzhou | 350 | After 2025 | 290 |
| Weifang - Suqian | 350 | After 2025 | 342 |
| Fuyang - Macheng - Huanggang | 350 | After 2025 | 325 |
| Guangzhou - Zhuhai - Macao (& Guig. - Nang. t. l.) | 350 | After 2025 | 358 |
| Yichang - Changde | 350 | After 2025 | 212 |
| Yiyang - Loudi | 250 | After 2025 | 109 |
| Xi'an - Ankang | 350 | After 2025 | 170 |
| Chongqing - Ankang | 350 | After 2025 | 540 |
| Baotou - Ordos | 350 | After 2025 | 130 |
| Ordos - Yan'an | 350 | After 2025 | 390 |
| Taiyuan - Suide | 350 | After 2025 | 270 |
| Hefei - Nanjing - Shanghai | 350 | After 2025 | 532 |
| Fuling - Yichang | 350 | After 2025 | 430 |
| Chengdu - Chongqing (midline) | 350 | After 2025 | 275 |
| Dunhua - Mudanjiang | 250 | After 2025 | 190 |
| Nantong - Suzhou - Jiaxing | 350 | After 2025 | 208 |
| Jiaxing - Ningbo (cross-sea project) | 350 | After 2025 | 90 |
| Wuwei - Zhangye | 250 | After 2025 | 244 |
| Tianjin - Chengde (intercity railway) | 350 | After 2025 | 234 |
| Yancheng - Taizhou - Wuxi - Changz. - Yixing | 250 | After 2025 | 358 |
| Zhenjiang - Xuancheng | 250 | After 2025 | 173 |
| Nanjing - Shangyuanmen (cross. Yangzi river) | 250 | After 2025 | 17 |
| Nanjing - Chuzhou - Bengbu (intercity railway) | 250 | After 2025 | 197 |
| Jinhua - Yiwu (intercity railway) | 350 | After 2025 | 52 |
| Guangzhou - Zhongshan - Zhujiang - Macao (i. r.) | 350 | After 2025 | 85 |
| Mianyang - Suining - Neijiang (i. r.) | 250 | After 2025 | 257 |
| Changchun - Liaoyuan - Tonghua | 250 | After 2025 | 255 |
| Jinan - Binzhou | 350 | After 2025 | 146 |
| Jiaozuo - Luoyang - Pingdingshan | 350 | After 2025 | 255 |
| | | | **Total km = 7,134** |

*Source: compiled by authors based on International Union of Railways, 2022*

# 3.1 HIGH-SPEED RAIL NETWORK

## *High-speed lines in China*


*Source: compiled by authors based on International Union of Railways, 2022*

# 3.1 HIGH-SPEED RAIL NETWORK

**INDIA**

*High-speed lines under construction in India*

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| Mumbai - Ahmedabad | 320 | 2023 | 508 |
| | | | **Total km = 508** |

*High-speed lines with long-term planning in India*

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| Delhi - Varanasi | - | - | 855 |
| Varanasi - Patna | - | - | 250 |
| Patna - Kolkata | - | - | 530 |
| Delhi - Udaipur - Ahmedabad | - | - | 886 |
| Hyderabad - Bangalore | - | - | 618 |
| Nagpur - Varanasi | - | - | 855 |
| Mumbai - Nagpur | - | - | 789 |
| Mumbai - Hyderabad | - | - | 709 |
| Patna - Guwahati | - | - | 850 |
| Delhi - Chandigarh - Amritsar | - | - | 485 |
| Amritsar - Pathankot - Jammu | - | - | 190 |
| Chennai - Bangalore - Mysuru | - | - | 462 |
| | | | **Total km = 7,479** |

*Source: compiled by authors based on International Union of Railways, 2021*

# 3.1 HIGH-SPEED RAIL NETWORK

### *High-speed lines in India*


*Source: compiled by authors based on International Union of Railways, 2021*

## 3.1 HIGH-SPEED RAIL NETWORK

**INDONESIA**
**THAILAND**
**VIETNAM**

### *High-speed lines under construction in Indonesia*

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| Jakarta - Bandung | 300 | 2022 | 142 |
| | | | **Total km = 142** |

### *High-speed lines planned in Indonesia*

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| Bandung - Surabaya | 300 | - | 570 |
| | | | **Total km = 570** |

### *High speed lines under construction in Thailand*

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| Bangkok - Nakhon Ratchasima | 250 | 2026 | 253 |
| | | | **Total km = 253** |

### *High-speed lines planned in Thailand*

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| 3 Airports Link | 250 | 2024 | 220 |
| Bangkok - Hua Hin | 250 | - | 211 |
| | | | **Total km = 431** |

### *High-speed lines with long-term planning in Thailand*

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| Nakhon Ratchasima - Vientiane | 250 | 2026 | 355 |
| Bangkok - Phitsanulok | 300 | - | 380 |
| Phitsanulok - Chiang Mai | 300 | - | 288 |
| Hua Hin - Padang Besar | 250 | - | 765 |
| U Tapao - Rayong Trat | - | - | 170 |
| | | | **Total km = 1,958** |

### *High-speed lines planned in Vietnam*

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| Hanoi - Vinh - Nha Trang - Hô Chi Minh | 350 | 2030 | 1,545 |
| | | | **Total km = 1,545** |

*Source: compiled by authors based on International Union of Railways, 2021*

# 3.1 HIGH-SPEED RAIL NETWORK

***High-speed lines under construction, planned and long-term planning in Indonesia, Thailand and Vietnam***


*Source: compiled by authors based on International Union of Railways, 2021*

# 3.1 HIGH-SPEED RAIL NETWORK

**JAPAN**

### *High-speed lines in commercial operation in Japan*

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| Tokyo - Shin Osaka (Tokaido) | 285 | 1964 | 515 |
| Shin Osaka - Okayama (San-yo) | 300 | 1972 | 161 |
| Okayama - Hakata (San-yo) | 300 | 1975 | 393 |
| Omiya - Utsunomiya (Tohoku) | 275 | 1982 | 79 |
| Utsunomiya - Morioka (Tohoku) | 320 | 1982 | 426 |
| Omiya - Niigata (Joetsu) | 240 | 1982 | 270 |
| Ueno - Omiya (Tohoku) | 130 | 1985 | 28 |
| Tokyo - Ueno (Tohoku) | 110 | 1991 | 4 |
| Fukushima - Yamagata (Yamagata) | 130 | 1992 | 87 |
| Morioka - Akita (Akita) | 130 | 1997 | 127 |
| Takasaki - Nagano (Hokuriku) | 260 | 1997 | 117 |
| Yamagata - Shinjo (Yamagata) | 130 | 1999 | 62 |
| Morioka - Hachinohe (Tohoku) | 260 | 2002 | 97 |
| Shin Yatsuhiro - Kagoshima Chuo (Kyushu) | 260 | 2004 | 127 |
| Hachinohe - Shin Aomori (Tohoku) | 260 | 2010 | 82 |
| Hakata - Shin Yatsushiro (Kyushu) | 260 | 2011 | 130 |
| Nagano - Kanazawa (Hokuriku) | 260 | 2015 | 228 |
| Shin Aomori - Shin Hakodate (Hokkaido) | 260 | 2016 | 149 |
| | | | **Total km = 3,081** |

### *High-speed lines under construction in Japan*

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| Takeo Onsen - Nagasaki (Nishi Kyushu) | 260 | 2022 | 66 |
| Kanazawa - Tsuruga (Hokuriku) | - | 2023 | 125 |
| Shin Hakodate - Sapporo (Hokkaido) | - | 2031 | 211 |
| | | | **Total km = 402** |

### *High-speed lines planned in Japan*

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| Tsuruga - Shin Osaka (Hokuriku) | - | 2046 | 143 |
| Shin Tosu - Takeo Onsen (Nishi Kyushu) | - | - | 51 |
| | | | **Total km = 194** |

*Source: compiled by authors based on International Union of Railways, 2021*

# 3.1 HIGH-SPEED RAIL NETWORK

### *High-speed lines in Japan*


*Source: compiled by authors based on International Union of Railways, 2021*

# 3.1 HIGH-SPEED RAIL NETWORK

## SOUTH KOREA

### *High-speed lines in commercial operation in South Korea*

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| Geumcheon-gu (Seoul) - Dongdaegu | 305 | 2004 | 268 |
| Dongdaegu - Busan | 305 | 2010 | 131 |
| Osong - Gwangju | 305 | 2015 | 184 |
| Suseo - Pyoengtaek | 305 | 2016 | 61 |
| Seoul - Gangneung | 250 | 2017 | 230 |
| | | | **Total km = 873** |

### *High-speed lines planned in South Korea*

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| Gwangjiu - Mokpo | 300 | 2025 | 49 |
| | | | **Total km = 49** |

*Source: compiled by authors based on International Union of Railways, 2021*

# 3.1 HIGH-SPEED RAIL NETWORK

***High-speed lines in South Korea***


*Source: compiled by authors based on International Union of Railways, 2021*

# 3.1 HIGH-SPEED RAIL NETWORK

## AUSTRALIA

***High-speed lines with long-term planning in Australia***

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| Sydney - Canberra | 350 | 2035 | 283 |
| Melbourne - Gunning (- Sydney) | 350 | 2040 | 611 |
| Sydney - Newcastle | 350 | 2045 | 134 |
| Brisbane - Gold Coast | 350 | 2051 | 115 |
| Newcastle - Bronelton (- Gold Coast) | 350 | 2058 | 606 |
| | | | **Total km = 1,749** |

*Source: compiled by authors based on International Union of Railways, 2021*

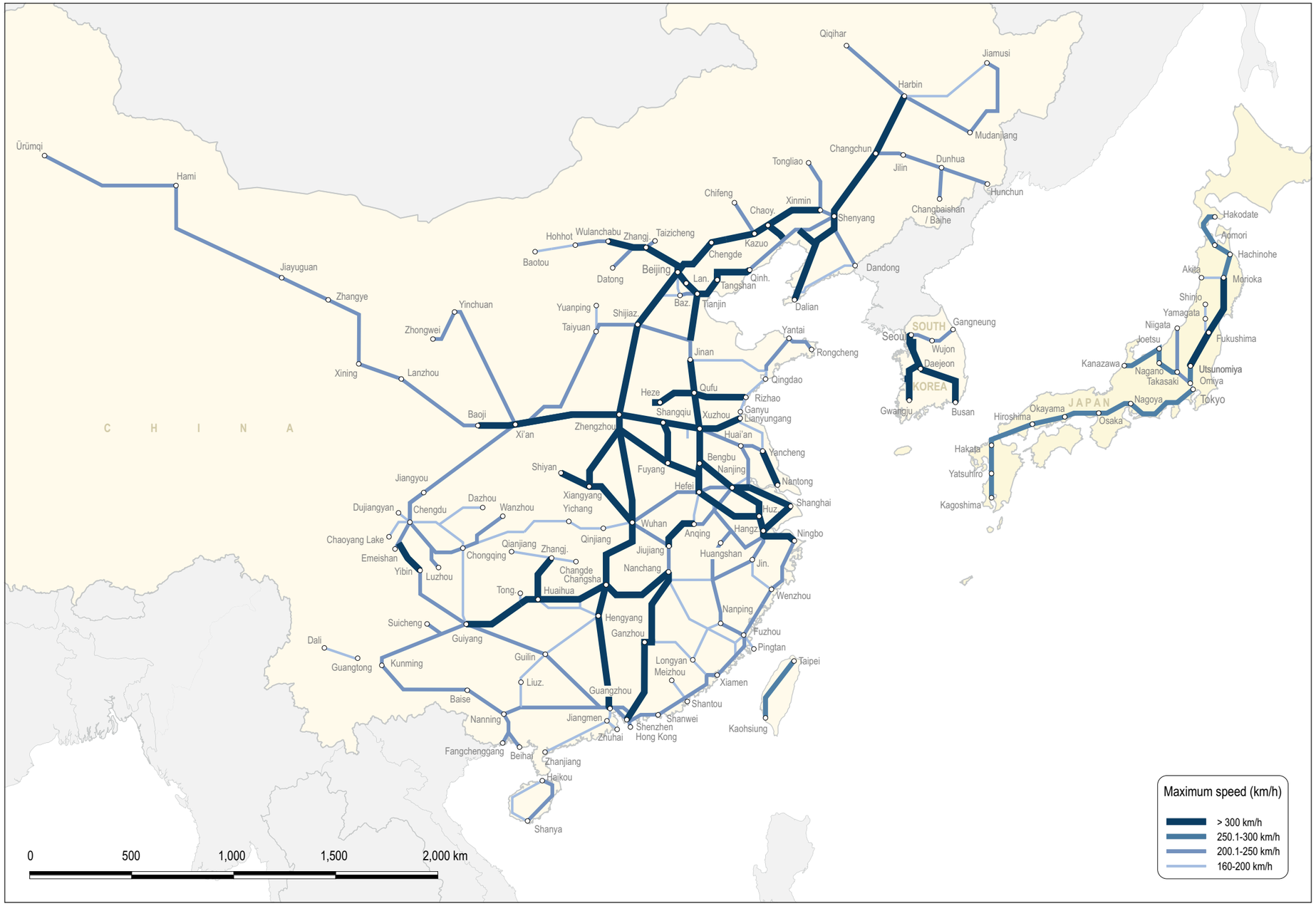
# 3.1 HIGH-SPEED RAIL NETWORK

***High-speed lines with long-term planning in Australia***


*Source: compiled by authors based on International Union of Railways, 2021*

# 3.2 CHARACTERISTICS AND EQUIPMENT

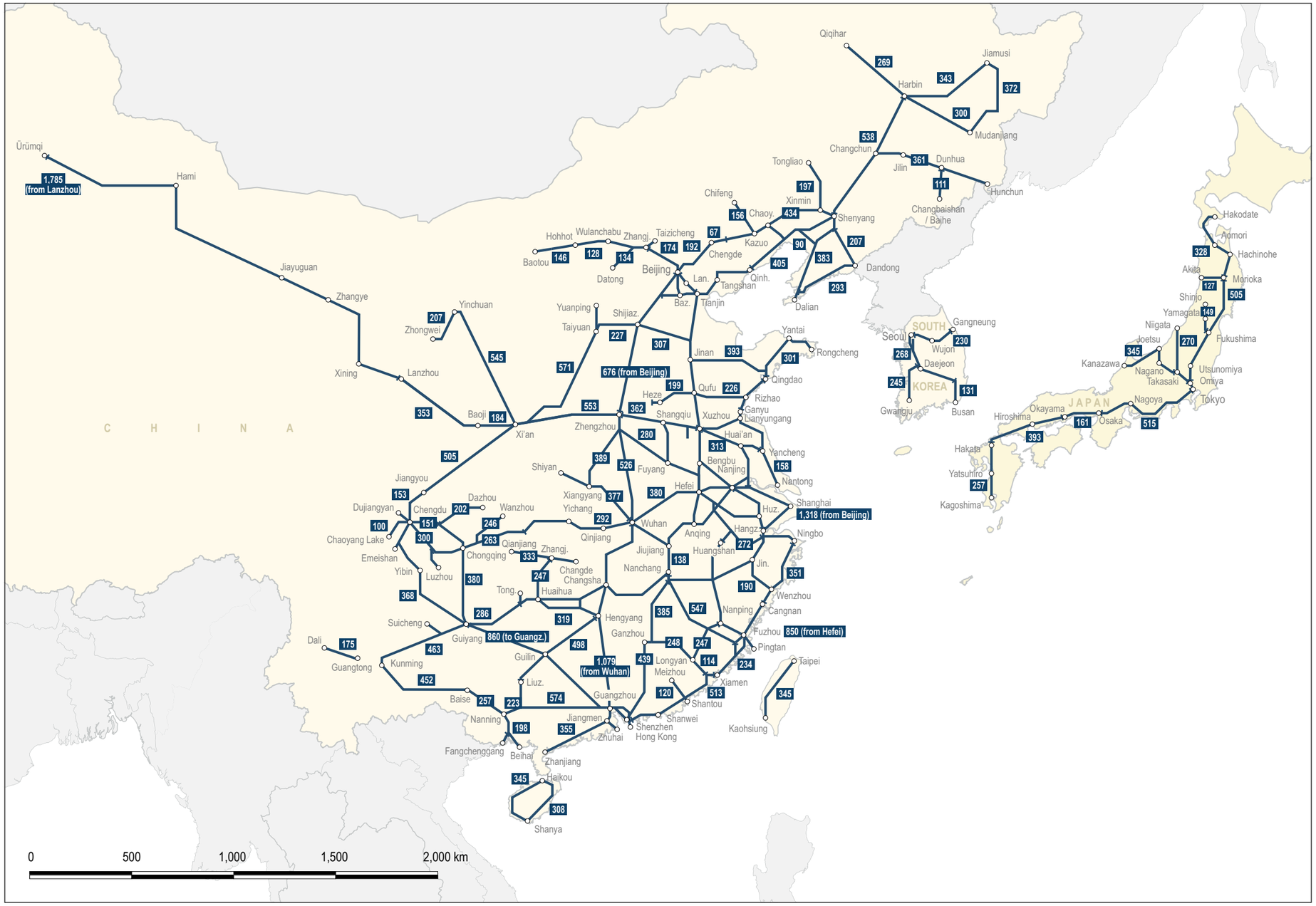
## *Maximum commercial speed*




*Source: compiled by authors based on International Union of Railways, 2022*

# 3.2 CHARACTERISTICS AND EQUIPMENT

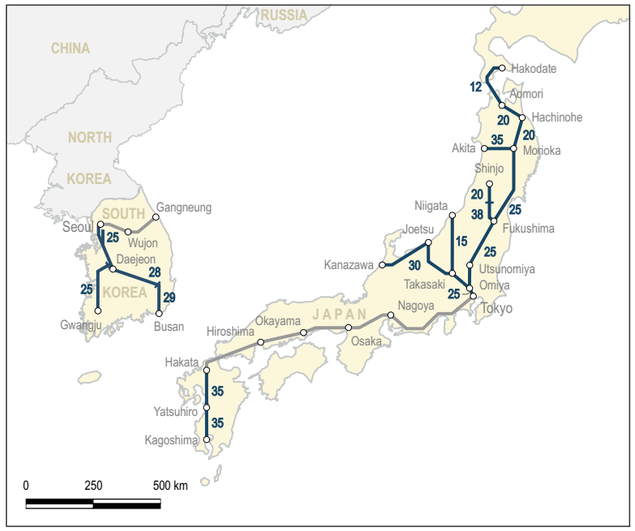
## *Distance (kilometres)*



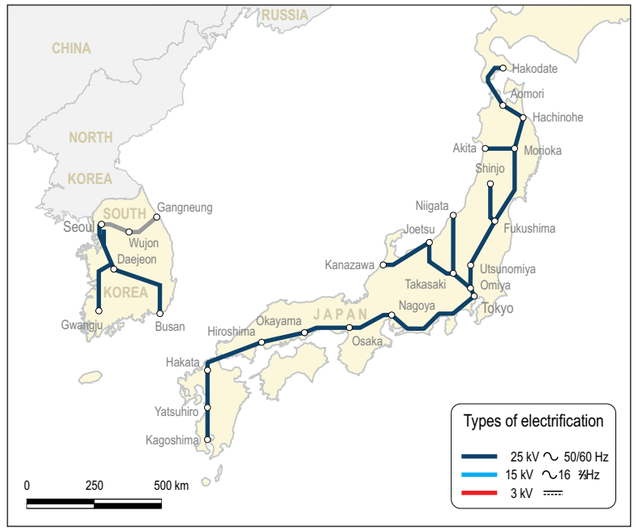

*Source: compiled by authors based on International Union of Railways, 2022*

# 3.2 CHARACTERISTICS AND EQUIPMENT (Japan / South Korea)

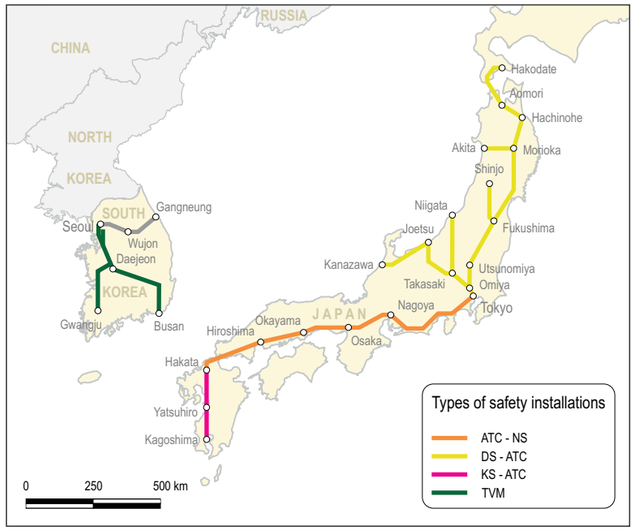
### *Maximum slope (‰)*



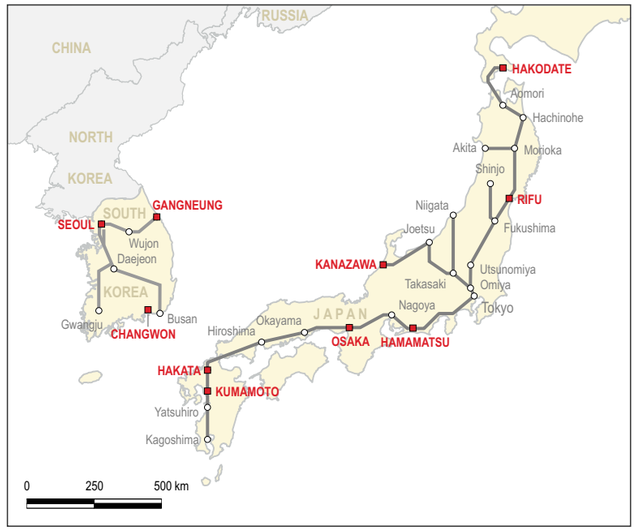

### *Electrification*




### *Signalling*



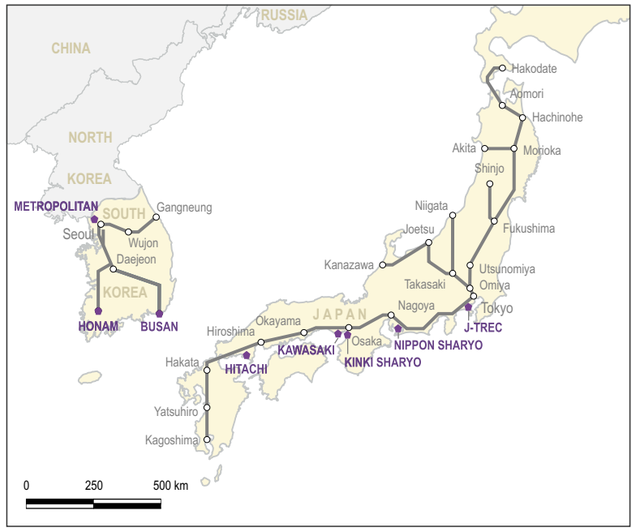

### *High-speed rolling stock main workshops*



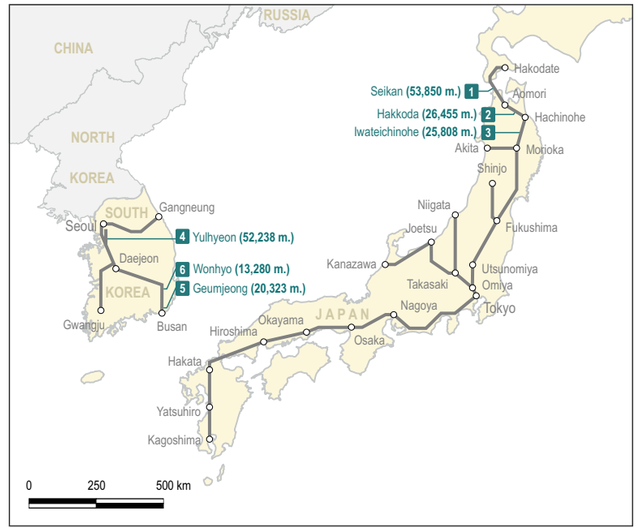

*Source: compiled by authors based on International Union of Railways, 2022*

# 3.2 CHARACTERISTICS AND EQUIPMENT (Japan / South Korea)

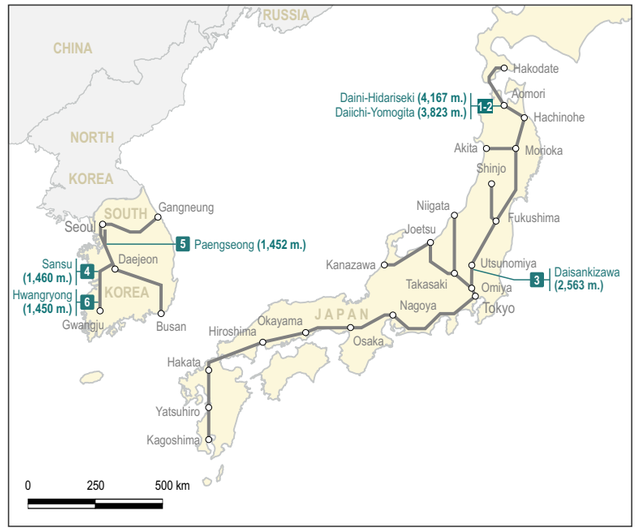
### *High-speed rolling stock main factories*



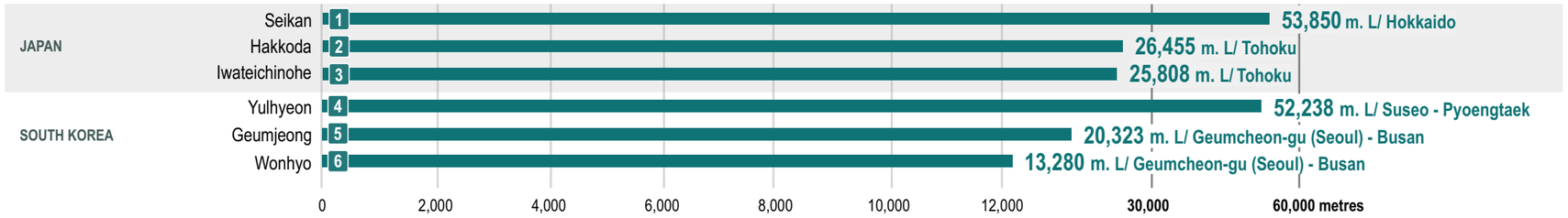

### *Longest tunnels*



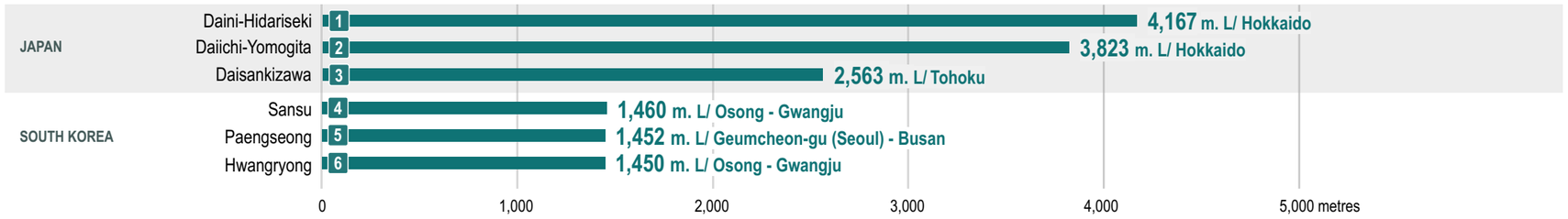

### *Longest viaducts*




### *Longest tunnels of the high-speed rail network in Japan / South Korea*



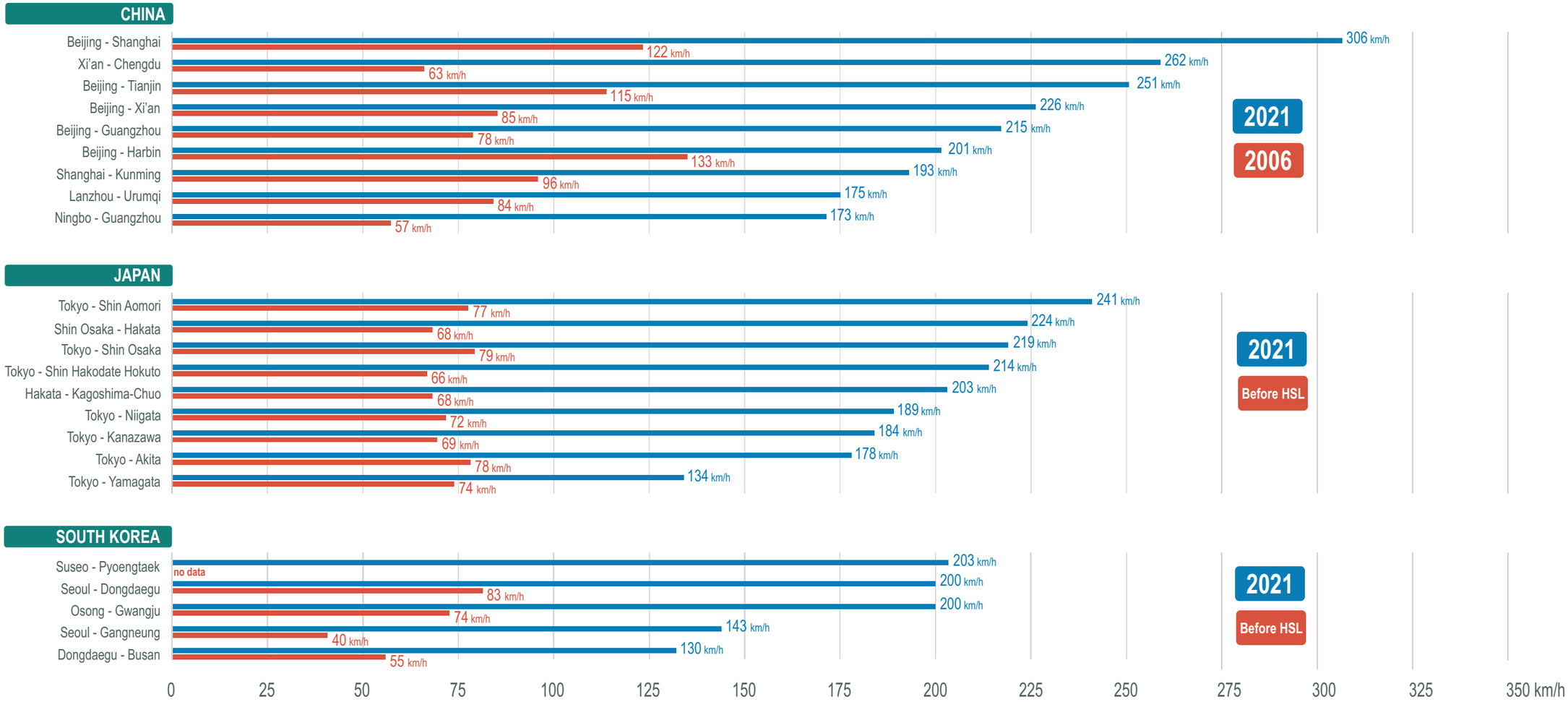

### *Longest viaducts of the high-speed rail network in Japan / South Korea*




*Source: compiled by authors based on International Union of Railways, 2022*

# 3.3 SPEED AND TRAVEL TIMES

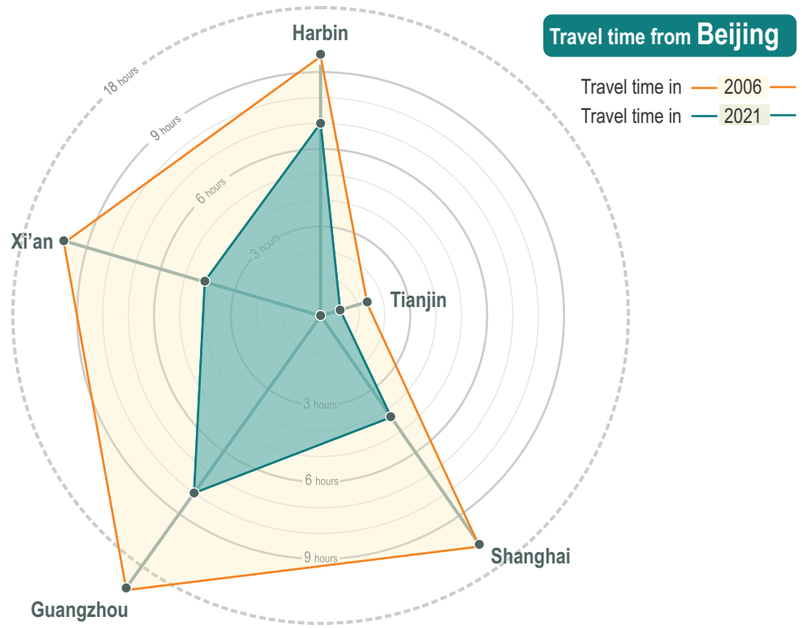
## *Evolution of average speed on Asia-Pacific high-speed lines*

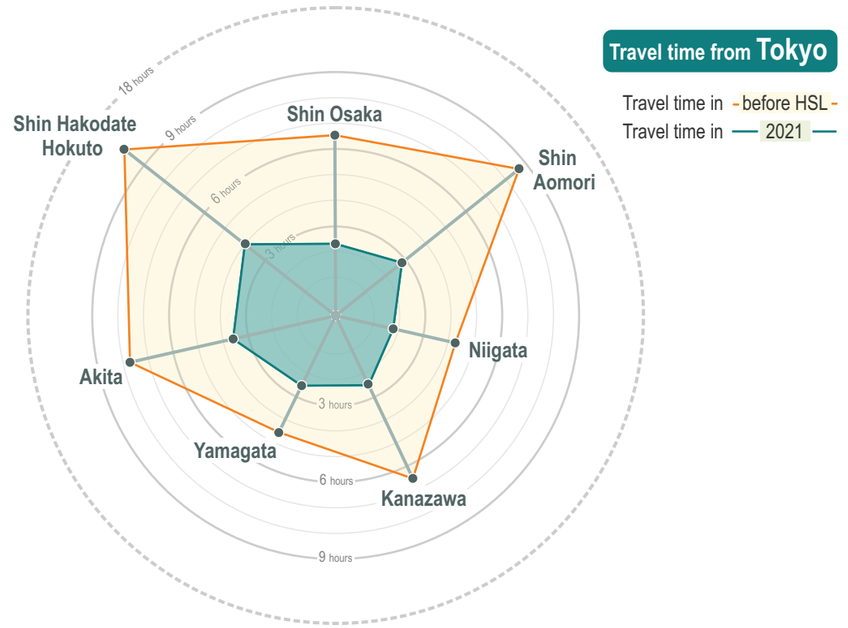



*Source: International Union of Railways*

# 3.3 SPEED AND TRAVEL TIMES

## *Evolution of travel time from the main chinese and japanese cities*




*Source: International Union of Railways*

# 3.4 ROLLING STOCK

(1) M-Motor coach • T-Trailer coach• L-Locomotive
MB-Motor Bogie

AC – alternating current
DC – direct current


| General characteristics | CRH1A (China) | CRH1A-A (China) | CRH1B (China) |
|---|---|---|---|
| (1) Composition | M+T+2M+T+M+T+M | M+T+2M+T+M+T+M | M+T+2M+T+M+T+2M+T+M+T+2M+T+M |
| Suppliers | CSR-Bombardier | CSR-Bombardier | CSR-Bombardier |
| Owners or operators | CR | CR | CR |
| Year in service | 2006 | 2016 | 2008 |
| Articulated | No | No | No |
| Track gauge (mm) | 1,435 | 1,435 | 1,435 |
| Electrification voltage (kV) | 25 kV 50 Hz AC | 25 kV 50 Hz AC | 25 kV 50 Hz AC |
| Maximum train speed / operation speed (km/h) | 250 / 200 | 250 / 200 | 250 / 200 |
| Power (kW) | 5,500 | 5,500 | 11,000 |
| Traction | Distributed traction | Distributed traction | Distributed traction |
| Signalling | CTCS 2 | CTCS 2 | CTCS 2 |
| Train sets currently used / planned | 128 / 151 | 87 | 24 |
| **Weight and dimensions** | | | |
| Unladen weight in running order (t) | 435 | 435 | 850 |
| Maximum axle load (t) | 16.5 | 16.5 | 16.5 |
| Power weight ratio (kW/t) | 11.3 | 11.3 | 11.5 |
| Train length (m) | 213.5 | 213.5 | 426,3 |
| Train width (m) | 3.328 | 3.328 | 3.328 |
| **Seats** | | | |
| 1st class seats* | 144 (128) | 40 | 208 |
| 2nd class seats | 524 (483) | 565 | 1,091 |
| Total seats | 668 (611) | 605 | 1,299+2 |
| **Observations** | | | |
| | As for the number of seats, outside the parenthesis is for the fixed seats, inside the parenthesis is for the rotatable seats No. 46 was abandoned after the accident in Wenzhou | | |

* For 3 classes train, 1st and 2nd classes are included in 1st class

*Source: International Union of Railways*

# 3.4 ROLLING STOCK

| | CRH1E *(China)* | CRH2A *(China)* | CRH2B *(China)* |
|---|---|---|---|
| (1) Composition | M+T+2M+T+M+T+2M+T+M+T+2M+T+M | T+2M+2T+2M+T | T+2M+2T+2M+2T+2M+2T+2M+T |
| Suppliers | CSR-Bombardier | Kawasaki Heavy Industries, CSR-Sifang | CSR-Sifang |
| Owners or operators | CR | CR | CR |
| Year in service | 2009 | 2008 | 2008 |
| Articulated | No | No | No |
| Track gauge (mm) | 1,435 | 1,435 | 1,435 |
| Electrification voltage (kV) | 25 kV 50 Hz AC | 25 kV 50 Hz AC | 25 kV 50 Hz AC |
| Maximum train speed / operation speed (km/h) | 250 / 200 | 250 / 200 | 250 / 200 |
| Power (kW) | 11,000 | 4,800 | 9,600 |
| Traction | Distributed traction | Distributed traction | Distributed traction |
| Signalling | CTCS 2 | CTCS 2 | CTCS 2 |
| Train sets currently used / planned | 20 | 473 | 20 |
| **Weight and dimensions** | | | |
| Unladen weight in running order (t) | 890 | 359.7 | 758.8 |
| Maximum axle load (t) | 16.5 | 14 | 14 |
| Power weight ratio (kW/t) | 11.7 | 11.8 | 11.8 |
| Train length (m) | 428.9 | 201.4 | 401.4 |
| Train width (m) | 3.328 | 3.380 | 3.380 |
| **Seats** | | | |
| 1st class seats* | 16+480 (sleeping car) | 51 | 155 |
| 2nd class seats | 122 | 559 | 1,074 |
| Total seats | 618+2 | 610 | 1,229 |
| **Observations** | 13 cars are class sleeping cars (1 car is special 1st class sleeping)<br>2 cars are 2nd class seating cars<br>1 car is a dining car | 1 car is 1st seating car<br>7 cars are 2nd seating cars<br>1 set is used as the inspection car | 3 cars are 1st seating cars,12 cars are 2nd seating cars, 1 car is dining car |

(1) M-Motor coach • T-Trailer coach• L-Locomotive
MB-Motor Bogie

AC – alternating current
DC – direct current

* For 3 classes train, 1st and 2nd classes are included in 1st class

*Source: International Union of Railways*

# 3.4 ROLLING STOCK

(1) M-Motor coach • T-Trailer coach• L-Locomotive
MB-Motor Bogie

AC – alternating current
DC – direct current

| General characteristics | CRH2C *(China)* | CRH2C2 *(China)* | CRH2E *(China)* |
|---|---|---|---|
| (1) Composition | T+6M+T | T+6M+T | T+2M+2T+2M+2T+2M+2T+2M+T |
| Suppliers | CSR-Sifang | CSR-Sifang | CSR-Sifang |
| Owners or operators | CR | CR | CR |
| Year in service | 2008 | 2008 | 2009 |
| Articulated | No | No | No |
| Track gauge (mm) | 1,435 | 1,435 | 1,435 |
| Electrification voltage (kV) | 25 kV 50 Hz AC | 25 kV 50 Hz AC | 25 kV 50 Hz AC |
| Maximum train speed / operation speed (km/h) | 350 / 300 | 350 / 300 | 250 / 200 |
| Power (kW) | 8,760 | 8,760 | 9,600 |
| Traction | Distributed traction | Distributed traction | Distributed traction |
| Signalling | CTCS 2,3 | CTCS 2,3 | CTCS 2 |
| Train sets currently used / planned | 49 | 11 | 24 |
| **Weight and dimensions** | | | |
| Unladen weight in running order (t) | 370.8 | 370.8 | 778.9 |
| Maximum axle load (t) | 14 | 15 | 14 |
| Power weight ratio (kW/t) | 19.5 | 19.5 | 11.6 |
| Train length (m) | 201.4 | 201.4 | 401 |
| Train width (m) | 3.380 | 3.380 | 3.380 |
| **Seats** | | | |
| 1st class seats* | 51 | 51 | 520 (Sleeping car) |
| 2nd class seats | 559 | 559 | 110 |
| Total seats | 610 | 610 | 630 |
| **Observations** | | | |
| | 1 car is 1st seating car<br>6 cars are 2nd seating cars<br>1 car is 2nd seating/dining car<br>1 set is used as the inspection car | 1 car is 1st seating car<br>6 cars are 2nd seating cars<br>1 car is 2nd seating/dining car<br>1 set is used as the inspection car | 13 cars are 1st sleeping cars<br>2 cars are 2nd seating cars<br>1 car is 2nd seating/dining car |

* For 3 classes train, 1st and 2nd classes are included in 1st class

*Source: International Union of Railways*

# 3.4 ROLLING STOCK

| CRH2G *(China)* | CRH3A *(China)* | CRH3C *(China)* | General characteristics |
|---|---|---|---|
| T+2M+2T+2M+T | T+2M+2T+2M+T | M+T+M+2T+M+T+M | (1) Composition |
| CSR-Sifang | CNR-Tanshang | Siemens, CNR-Tanshang | Suppliers |
| CR | CR | CR | Owners or operators |
| 2015 | 2017 | 2008 | Year in service |
| No | No | No | Articulated |
| 1,435 | 1,435 | 1,435 | Track gauge (mm) |
| 25 kV 50 Hz AC | 25 kV 50 Hz AC | 25 kV 50 Hz AC | Electrification voltage (kV) |
| 250 / 250 | 250 / 250 | 350 / 300 | Maximum train speed / operation speed (km/h) |
| 9,280 | 5,120 | 8,800 | Power (kW) |
| Distributed traction | Distributed traction | Distributed traction | Traction |
| CTCS 2 | CTCS 2 | CTCS 2.3 | Signalling |
| 20 | 1 | 80 | Train sets currently used / planned |
| | | | **Weight and dimensions** |
| 494.4 | - | 425 | Unladen weight in running order (t) |
| 15.45 | - | 17 | Maximum axle load (t) |
| 18.8 | - | 18.7 | Power weight ratio (kW/t) |
| 201.4 | - | 200 | Train length (m) |
| 3.380 | 3.300 | 3.260 | Train width (m) |
| | | | **Seats** |
| 48 | - | 66 | 1st class seats* |
| 565 | - | 490 | 2nd class seats |
| 613 | 616 | 556+1 | Total seats |
| | | | **Observations** |
| | | 1 car is 1st seating car<br>6 cars are 2nd seating cars<br>1 car is 2nd seating/dining car | |

(1) M-Motor coach • T-Trailer coach• L-Locomotive
MB-Motor Bogie

AC – alternating current
DC – direct current

* For 3 classes train, 1st and 2nd classes are included in 1st class

*Source: International Union of Railways*

# 3.4 ROLLING STOCK

(1) M-Motor coach • T-Trailer coach• L-Locomotive
MB-Motor Bogie

AC – alternating current
DC – direct current

| General characteristics | CRH5A (China) | CRH5G (China) | CRH6A (China) |
|---|---|---|---|
| (1) Composition | 2M+T+M+2T+2M | 2M+T+M+2T+2M | T+2M+2T+2M+T |
| Suppliers | Alstom, CNR-Changchun | Alstom, CNR-Changchun | CSR-Puzhen Rolling stock Co. Lit. |
| Owners or operators | CR | CR | CR |
| Year in service | 2007 | 2007 | 2013 |
| Articulated | No | No | No |
| Track gauge (mm) | 1,435 | 1,435 | 1,435 |
| Electrification voltage (kV) | 25 kV 50 Hz AC | 25 kV 50 Hz AC | 25 kV 50 Hz AC |
| Maximum train speed / operation speed (km/h) | 250 / 200 | 250 / 200 | 220 / 200 |
| Power (kW) | 5,500 | 5,500 | 5,520 |
| Traction | Distributed traction | Distributed traction | Distributed traction |
| Signalling | CTCS 2 | CTCS 2 | CTCS 2,3 |
| Train sets currently used / planned | 140 | 88 | 27 |
| **Weight and dimensions** | | | |
| Unladen weight in running order (t) | 451 | 451 | 496 |
| Maximum axle load (t) | <17 | <17 | 15.5 |
| Power weight ratio (kW/t) | 11 | 11 | 0,0 |
| Train length (m) | 211.5 | 211.5 | 201.4 |
| Train width (m) | 3.200 | 3.200 | 3.300 |
| **Seats** | | | |
| 1st class seats* | 60 (112) | 60 (112) | - |
| 2nd class seats | 562 (474) | 562 (474) | 557 |
| Total seats | 622 (586) | 622 (586) | 1,488 (max. capacity) |
| **Observations** | | | |
| | As for the seat's number, the figure outside the parenthesis is for the fixed seats<br>Inside the parenthesis is for the rotatable seats | As for the seat's number, the figure outside the parenthesis is for the fixed seats<br>Inside the parenthesis is for the rotatable seats | CRH6A will be existed. Operating speed is under 200 km/h |

* For 3 classes train, 1st and 2nd classes are included in 1st class

*Source: International Union of Railways*

# 3.4 ROLLING STOCK

| CRH380A (China) | CRH380AL (China) | CRH380B (China) | General characteristics |
|---|---|---|---|
| T+6M+T | T+14M+T | M+T+M+2T+M+T+M | (1) Composition |
| CSR-Sifang | CSR-Sifang | CNR-Changchun | Suppliers |
| CR | CR | CR | Owners or operators |
| 2010 | 2011 | 2011 | Year in service |
| No | No | No | Articulated |
| 1,435 | 1,435 | 1,435 | Track gauge (mm) |
| 25 kV 50 Hz AC | 25 kV 50 Hz AC | 25 kV 50 Hz AC | Electrification voltage (kV) |
| 350 / 300 | 350 / 300 | 350 / 300 | Maximum train speed / operation speed (km/h) |
| 9,600 | 21,560 | 9,200 | Power (kW) |
| Distributed traction | Distributed traction | Distributed traction | Traction |
| CTCS 2.3 | CTCS 2.3 | CTCS 2.3 | Signalling |
| 316 | 113 | 354 | Train sets currently used / planned |
| | | | **Weight and dimensions** |
| 480 | 960 | 544 | Unladen weight in running order (t) |
| <15 | <15 | <17 | Maximum axle load (t) |
| 20 | 22.5 | 16.9 | Power weight ratio (kW/t) |
| 203 | 403 | 200 | Train length (m) |
| 3.380 | 3.380 | 3.260 | Train width (m) |
| | | | **Seats** |
| 12+95 | 56+6+76 | 72 | 1st class seats* |
| 373 | 923 | 528 | 2nd class seats |
| 480 | 1,061 | 600+1 | Total seats |
| | | | **Observations** |
| 12 seats: "sightseeing"<br>There are other 14 seats for dining car | 56 seats: business class<br>6 seats: "sightseeing" | | |

(1) M-Motor coach • T-Trailer coach• L-Locomotive
MB-Motor Bogie

AC – alternating current
DC – direct current

* For 3 classes train, 1st and 2nd classes are included in 1st class

*Source: International Union of Railways*

# 3.4 ROLLING STOCK

(1) M-Motor coach • T-Trailer coach• L-Locomotive
MB-Motor Bogie

AC – alternating current
DC – direct current

| General characteristics | CRH380BL (China) | CRH380BG (China) | CRH380CL (China) |
|---|---|---|---|
| (1) Composition | M+T+M+2T+M+T+2M+T+M+2T+M+T+M | M+T+M+2T+M+T+M | M+T+M+2T+M+T+2M+T+M+2T+M+T+M |
| Suppliers | CNR-Tanshang, CNR-Changchun | CNR-Changchun | CNR-Changchun |
| Owners or operators | CR | CR | CR |
| Year in service | 2011 | 2011 | 2011 |
| Articulated | No | No | No |
| Track gauge (mm) | 1,435 | 1,435 | 1,435 |
| Electrification voltage (kV) | 25 kV 50 Hz AC | 25 kV 50 Hz AC | 25 kV 50 Hz AC |
| Maximum train speed / operation speed (km/h) | 350 / 300 | 350 / 300 | 350 / 300 |
| Power (kW) | 18,400 | 9,200 | 18,400 |
| Traction | Distributed traction | Distributed traction | Distributed traction |
| Signalling | CTCS 2.3 | CTCS 2.3 | CTCS 2.3 |
| Train sets currently used / planned | 149 | 141 | 25 |
| **Weight and dimensions** | | | |
| Unladen weight in running order (t) | 1,088 | 544 | 1,088 |
| Maximum axle load (t) | <17 | <17 | <17 |
| Power weight ratio (kW/t) | 16.9 | 16.9 | 16.9 |
| Train length (m) | 400 | 200 | 428 |
| Train width (m) | 3.260 | 3.260 | 3.358 |
| **Seats** | | | |
| 1st class seats* | 24+190 | 72 | 24+190 |
| 2nd class seats | 791 | 528 | 791 |
| Total seats | 1,005 | 600+1 | 1.005 |
| **Observations** | | | |
| | 24 seats: business | | |

* For 3 classes train, 1st and 2nd classes are included in 1st class

*Source: International Union of Railways*

# 3.4 ROLLING STOCK

**CRH380D**
*(China)*

| | |
|---|---|
| M+T+M+2T+M+T+M | |
| CSR-Bombardier | |
| CR | |
| 2012 | |
| No | |
| 1,435 | |
| 25 kV 50 Hz AC | |
| 350 / 300 | |
| 10,000 | |
| Distributed traction | |
| CTCS 2,3 | |
| 85 | |
| | |
| 462 | |
| 17 | |
| 17.6 | |
| 251.3 | |
| 3.358 | |
| | |
| 14+90 | |
| 391 | |
| 495 | |
| | |
| VIP class: 14 seats | |

**CRH380DL**
*(China)*

| | |
|---|---|
| M+T+M+2T+M+T+2M+T+M+2T+M+T+M | |
| CSR-Bombardier | |
| CR | |
| 2012 | |
| No | |
| 1,435 | |
| 25 kV 50 Hz AC | |
| 350 / 300 | |
| 20,000 | |
| Distributed traction | |
| CTCS 2,3 | |
| 60 | |
| | |
| 934 | |
| <17 | |
| 19.2 | |
| 428.1 | |
| 3,358 | |
| | |
| 52+126 | |
| 835 | |
| 1.013 | |
| | |
| VIP class: 52 seats | |

**CRH400AF**
*(China)*

| | |
|---|---|
| M+T+M+2T+M+T+M | |
| CRRC Sigang-CRRC Changchun-CRRC Tagshan | |
| CR | |
| 2017 | |
| No | |
| 1,435 | |
| 25 kV 50 Hz AC | |
| 400 / 350 | |
| < 9,600 | |
| Distributed traction | |
| - | |
| 18 | |
| | |
| 544 | |
| <17 | |
| 17.6 | |
| 209 | |
| 3.360 | |
| | |
| 10+28 | |
| 518 | |
| 556 | |
| | |
| Business class: 10 seats<br>First class: 28 seats | |

(1) M-Motor coach • T-Trailer coach• L-Locomotive
MB-Motor Bogie

AC – alternating current
DC – direct current

| General characteristics |
|---|
| (1) Composition |
| Suppliers |
| Owners or operators |
| Year in service |
| Articulated |
| Track gauge (mm) |
| Electrification voltage (kV) |
| Maximum train speed / operation speed (km/h) |
| Power (kW) |
| Traction |
| Signalling |
| Train sets currently used / planned |
| **Weight and dimensions** |
| Unladen weight in running order (t) |
| Maximum axle load (t) |
| Power weight ratio (kW/t) |
| Train length (m) |
| Train width (m) |
| **Seats** |
| 1st class seats* |
| 2nd class seats |
| Total seats |
| **Observations** |

* For 3 classes train, 1st and 2nd classes are included in 1st class

*Source: International Union of Railways*

# 3.3 ROLLING STOCK

(1) M-Motor coach • T-Trailer coach• L-Locomotive
MB-Motor Bogie

AC – alternating current
DC – direct current

| General characteristics | CRH400BF (China) | CRH400BF-A (China) | MTR CRH380A (China) |
|---|---|---|---|
| (1) Composition | M+T+M+2T+M+T+M | M+T+M+2T+M+T+2M+T+M+2T+M+T+M | T+6M+T |
| Suppliers | CRRC Sigang-CRRC Changchun-CRRC Tagshan | CRRC Tagshan | CRRC |
| Owners or operators | CR | CR | MTR |
| Year in service | 2017 | - | 2018 |
| Articulated | No | No | No |
| Track gauge (mm) | 1,435 | 1,435 | 1,435 |
| Electrification voltage (kV) | 25 kV 50 Hz AC | 25 kV 50 Hz AC | 25 kV 50 Hz AC |
| Maximum train speed / operation speed (km/h) | 400 / 350 | - | 350 / 300 |
| Power (kW) | < 9,600 | - | 9,600 |
| Traction | Distributed traction | Distributed traction | Distributed traction |
| Signalling | - | - | CTCS 2.3 |
| Train sets currently used / planned | 9 | 0 / 16 | 9 |
| **Weight and dimensions** | | | |
| Unladen weight in running order (t) | 544 | - | 408 |
| Maximum axle load (t) | < 17 | - | < 15 |
| Power weight ratio (kW/t) | 17.6 | - | 23.5 |
| Train length (m) | 209 | - | 203 |
| Train width (m) | 3.360 | - | 3.380 |
| **Seats** | | | |
| 1st class seats* | 10+28 | - | - |
| 2nd class seats | 518 | - | - |
| Total seats | 556 | 1,193 | 579 (+2 hp) |
| **Observations** | | | |
| | Business class: 10 seats<br>First class: 28 seats | | For Guangzhou, Shenzhen and Hong Kong link |

* For 3 classes train, 1st and 2nd classes are included in 1st class

*Source: International Union of Railways*

# 3.3 ROLLING STOCK

**700T**
*(China)*

| |
|---|
| T+3M+T+6M+T |
| Hitachi-Kawasaki Heavy Industries-Nippon Sharyo |
| THSRC |
| 2007 |
| No |
| 1,435 |
| 25 kV 60 Hz AC |
| 300 / 300 |
| 10,260 |
| Distributed traction |
| ATP |
| 34 |
| |
| 503 |
| 10.5 |
| 17.6 |
| 304 |
| 3.380 |
| |
| 66 |
| 923 |
| 989 |
| |
| Used in Chinese Taipei, not in the mainland of China |

**0**
*(Japan)*

| |
|---|
| 16 M |
| Hitachi-Kawasaki Heavy Ind.-Kinki Shayro-Nippon Sharyo-Tokyu Car Corp.-Kisha Seizo |
| JNR |
| 1964-2008 |
| No |
| 1,435 |
| 25 kV 60 Hz AC |
| 220 / 220 |
| 11,840 |
| Distributed traction |
| ATC |
| 0 |
| |
| 970 |
| 16 |
| 12.2 |
| 400.3 |
| 3.380 |
| |
| 68 |
| 1,323 |
| 1,391 |
| |
| First HS train in the world<br>Information data of original 16 cars train set<br>Initially 210 km/h maximum speed<br>Various train exists (16, 12, 6 and 4 cars)<br>Operation finished in 11/2008<br>3,216 cars were produced |

**100**
*(Japan)*

| |
|---|
| 12M + 4T |
| Hitachi-Kawasaki Heavy Industries-Kinki Shayro-Nippon Sharyo-Tokyu Car Corporation |
| JNR |
| 1985-2012 |
| No |
| 1,435 |
| 25 kV 60 Hz AC |
| 220 / 220 |
| 11,840 |
| Distributed traction |
| ATC |
| 0 |
| |
| 925 |
| 15 |
| 11.9 |
| 402.1 |
| 3.380 |
| |
| 168 |
| 1,153 |
| 1,321 |
| |
| Maximum speed was 230 km/h for V sets owned by JWR |

(1) M-Motor coach • T-Trailer coach• L-Locomotive
MB-Motor Bogie

AC – alternating current
DC – direct current

| General characteristics |
|---|
| (1) Composition |
| Suppliers |
| Owners or operators |
| Year in service |
| Articulated |
| Track gauge (mm) |
| Electrification voltage (kV) |
| Maximum train speed / operation speed (km/h) |
| Power (kW) |
| Traction |
| Signalling |
| Train sets currently used / planned |
| **Weight and dimensions** |
| Unladen weight in running order (t) |
| Maximum axle load (t) |
| Power weight ratio (kW/t) |
| Train length (m) |
| Train width (m) |
| **Seats** |
| 1st class seats* |
| 2nd class seats |
| Total seats |
| **Observations** |

* For 3 classes train, 1st and 2nd classes are included in 1st class

*Source: International Union of Railways*

# 3.4 ROLLING STOCK

(1) M-Motor coach • T-Trailer coach• L-Locomotive
MB-Motor Bogie

AC – alternating current
DC – direct current

| General characteristics | 200 *(Japan)* | 300 *(Japan)* | 400 *(Japan)* |
|---|---|---|---|
| (1) Composition | 10M | T+M+T+2M+T+2M+T+2M+T+2M+T+M | 4M+T+2M |
| Suppliers | Hitachi-Kawasaki Heavy Industries-Kinki Shayro-Nippon Sharyo-Tokyu Car Corporation | Hitachi-Kawasaki Heavy Industries-Kinki Shayro-Nippon Sharyo | Kawasaki Heavy Industries-Tokyu Car Corporation |
| Owners or operators | JRE | JRC / JRW | JRE |
| Year in service | 1982-2013 | 1992-2012 | 1992-2010 |
| Articulated | No | No | No |
| Track gauge (mm) | 1,435 | 1,435 | 1,435 |
| Electrification voltage (kV) | 25 kV 50 Hz AC | 25 kV 60 Hz AC | 25 kV 50 Hz AC / 20 kV 50 Hz AC |
| Maximum train speed / operation speed (km/h) | 240 / 240 | 270 / 270 | 240 / 240 |
| Power (kW) | 9,200 | 12,000 | 5,040 |
| Traction | Distributed traction | Distributed traction | Distributed traction |
| Signalling | ATC / DS-ATC | ATC / ATC-NS | ATC / DS-ATC / ATS-P |
| Train sets currently used / planned | 0 | 0 | 0 |
| **Weight and dimensions** | | | |
| Unladen weight in running order (t) | 583 | 711 | 318 |
| Maximum axle load (t) | 16.4 | 12 | 12.9 |
| Power weight ratio (kW/t) | 14.6 | 16.9 | 14.7 |
| Train length (m) | 250 | 402.1 | 149 |
| Train width (m) | 3.380 | 3.380 | 2.947 |
| **Seats** | | | |
| 1st class seats* | 52 | 200 | 20 |
| 2nd class seats | 710 | 1,123 | 379 |
| Total seats | 762 | 1,323 | 399 |
| **Observations** | | | |
| | It was 12 cars when introduced<br>A trainset was abandoned after the derailment at Chetsu earthquake | | For through operation b/w Shinkansen line and improved classical line (Yamagata line)<br>All 12 sets were replaced by E2-2000 |

* For 3 classes train, 1st and 2nd classes are included in 1st class

*Source: International Union of Railways*

# 3.4 ROLLING STOCK

| 500 *(Japan)* | |
|---|---|
| | |
| 16M | |
| Hitachi-Kawasaki Heavy Industries-<br>Kinki Shayro-Nippon Sharyo | |
| JRW | |
| 1996-2010 | |
| No | |
| 1,435 | |
| 25 kV 60 Hz AC | |
| 300 / 300 | |
| 18,240 or 17,600 | |
| Distributed traction | |
| ATC / ATC-NS | |
| 0 | |
| | |
| 688 (loaded) | |
| 11.7 | |
| 26.5 | |
| 404 | |
| 3.380 | |
| | |
| 200 | |
| 1,124 | |
| 1,324 | |
| | |
| 9 sets had existed | |

| 500-7000 *(Japan)* | |
|---|---|
| | |
| 8M | |
| Hitachi-Kawasaki Heavy Industries-<br>Kinki Shayro-Nippon Sharyo | |
| JRW | |
| 2008 | |
| No | |
| 1,435 | |
| 25 kV 60 Hz AC | |
| 285 / 285 | |
| 8,800 | |
| Distributed traction | |
| ATC-NS | |
| 6 | |
| | |
| 344 (loaded) | |
| 11 | |
| 25.6 | |
| 204 | |
| 3.380 | |
| | |
| - | |
| - | |
| 557 | |
| | |
| 8 sets were renovated from 16-car 500 | |

| 700 / 700-3000 *(Japan)* | |
|---|---|
| | |
| T+6M+2T+6M+T | |
| Hitachi-Kawasaki Heavy Industries-<br>Kinki Shayro-Nippon Sharyo | |
| JRC / JRW | |
| 1999 | |
| No | |
| 1,435 | |
| 25 kV 60 Hz AC | |
| 285 / 285 | |
| 13,200 | |
| Distributed traction | |
| ATC / ATC-NS | |
| 0 | |
| | |
| 708 | |
| 11.4 | |
| 18.6 | |
| 404.7 | |
| 3.380 | |
| | |
| 200 | |
| 1,123 | |
| 1,323 | |
| | |
| | |

(1) M-Motor coach • T-Trailer coach• L-Locomotive
MB-Motor Bogie

AC – alternating current
DC – direct current

| General characteristics |
|---|
| (1) Composition |
| Suppliers |
| Owners or operators |
| Year in service |
| Articulated |
| Track gauge (mm) |
| Electrification voltage (kV) |
| Maximum train speed / operation speed (km/h) |
| Power (kW) |
| Traction |
| Signalling |
| Train sets currently used / planned |
| **Weight and dimensions** |
| Unladen weight in running order (t) |
| Maximum axle load (t) |
| Power weight ratio (kW/t) |
| Train length (m) |
| Train width (m) |
| **Seats** |
| 1st class seats* |
| 2nd class seats |
| Total seats |
| **Observations** |

* For 3 classes train, 1st and 2nd classes are included in 1st class

*Source: International Union of Railways*

# 3.4 ROLLING STOCK

(1) M-Motor coach • T-Trailer coach• L-Locomotive
MB-Motor Bogie

AC – alternating current
DC – direct current

| General characteristics | 700-7000 *(Japan)* | N700 / N700A / N700-5000 / N700A-4000 *(Japan)* | N700-7000 / N700-8000 *(Japan)* |
|---|---|---|---|
| (1) Composition | T+6M+T | T+14M+T | 8M |
| Suppliers | Hitachi-Kawasaki Heavy Industries-<br>Kinki Shayro-Nippon Sharyo | Hitachi-Kawasaki Heavy Industries-<br>Kinki Shayro-Nippon Sharyo | Hitachi-Kawasaki Heavy Industries-<br>Kinki Shayro-Nippon Sharyo |
| Owners or operators | JRW | JRC / JRW | JRW / JRK |
| Year in service | 2000 | 2007 | 2011 |
| Articulated | No | No + Tilting | No+Tilting |
| Track gauge (mm) | 1,435 | 1,435 | 1,435 |
| Electrification voltage (kV) | 25 kV 60 Hz AC | 25 kV 60 Hz AC | 25 kV 60 Hz AC |
| Maximum train speed / operation speed (km/h) | 285 / 285 | 300 / 300 | 300 / 300 |
| Power (kW) | 6,600 | 17,080 | 9,760 |
| Traction | Distributed traction | Distributed traction | Distributed traction |
| Signalling | ATC-NS | ATC-NS | ATC-NS / KS-ATC |
| Train sets currently used / planned | 16 | 149 | 19 (JRW) - 11(JRK) |
| **Weight and dimensions** | | | |
| Unladen weight in running order (t) | 356 (loaded) | 715 (loaded) | 344 (loaded) |
| Maximum axle load (t) | 11.4 | 11.4 | - |
| Power weight ratio (kW/t) | 18.5 | 23.9 | 28.4 |
| Train length (m) | 204.7 | 404.7 | 204.7 |
| Train width (m) | 3.380 | 3.360 | 3.360 |
| **Seats** | | | |
| 1st class seats* | - | 200 | 24 |
| 2nd class seats | - | 1,123 | 522 |
| Total seats | 571 | 1,323 | 546 |
| **Observations** | | | |
| | | JRC: N700 58 sets / N700A 51 sets<br>JRW: N700-5000 16 sets N700A-4000 18 sets | JRW (N700-7000) 19 sets<br>JRK (N700-8000) 11 sets |

* For 3 classes train, 1st and 2nd classes are included in 1st class

*Source: International Union of Railways*

**N700S**
*(Japan)*

| |
|---|
| 14M + 2T |
| Hitachi-Nippon Sharyo |
| JRC-JRW |
| 2020 |
| No+Tilting |
| 1,435 |
| 25 kV 60 Hz AC |
| 300 / 300 |
| 17,080 |
| Distributed traction |
| ATC-NS |
| 27 |
| |
| - |
| - |
| - |
| 404.7 |
| 3.360 |
| |
| 200 |
| 1,123 |
| 1,323 |
| |
| |

**800**
*(Japan)*

| |
|---|
| 6M |
| Hitachi |
| JRK |
| 2004 |
| No |
| 1,435 |
| 25 kV 60 Hz AC |
| 260 / 260 |
| 6,600 |
| Distributed traction |
| ATC / KS-ATC |
| 5 |
| |
| 276 (loaded) |
| 11.4 |
| 23.9 |
| 154.7 |
| 3.380 |
| |
| - |
| 378 |
| 378 |
| |
| |

**800-1000 / 800-2000**
*(Japan)*

| |
|---|
| 6M |
| Hitachi |
| JRK |
| 2009 |
| No |
| 1,435 |
| 25 kV 60 Hz AC |
| 260 / 260 |
| 6,600 |
| Distributed traction |
| ATC / KS-ATC |
| 3 |
| |
| 276 (loaded) |
| 11.4 |
| 23.9 |
| 154.7 |
| 3.380 |
| |
| - |
| 378 |
| 378 |
| |
| 2 sets: 800-1000, track inspection is capable<br>1 set: 800-2000, catenary, signalling and communication inspection are capable |

(1) M-Motor coach • T-Trailer coach• L-Locomotive
MB-Motor Bogie

AC – alternating current
DC – direct current

| General characteristics |
|---|
| (1) Composition |
| Suppliers |
| Owners or operators |
| Year in service |
| Articulated |
| Track gauge (mm) |
| Electrification voltage (kV) |
| Maximum train speed / operation speed (km/h) |
| Power (kW) |
| Traction |
| Signalling |
| Train sets currently used / planned |
| **Weight and dimensions** |
| Unladen weight in running order (t) |
| Maximum axle load (t) |
| Power weight ratio (kW/t) |
| Train length (m) |
| Train width (m) |
| **Seats** |
| 1st class seats* |
| 2nd class seats |
| Total seats |
| **Observations** |

* For 3 classes train, 1st and 2nd classes are included in 1st class

*Source: International Union of Railways*

# 3.4 ROLLING STOCK

(1) M-Motor coach • T-Trailer coach• L-Locomotive
MB-Motor Bogie

AC – alternating current
DC – direct current

| General characteristics | E1 *(Japan)* | E2 *(Japan)* | E2-1000 *(Japan)* |
|---|---|---|---|
| (1) Composition | T+2M+2T+2M+2T+2M+T | T+6M+T | T+8M+T |
| Suppliers | Hitachi-Kawasaki Heavy Industries | Hitachi-Kawasaki Heavy Industries-Nippon Sharyo-Tokyu Car Corporation | Hitachi-Kawasaki Heavy Industries-Nippon Sharyo-Tokyu Car Corporation |
| Owners or operators | JRE | JRE | JRE |
| Year in service | 1994-2012 | 1997 | 2002 |
| Articulated | No+Double Decker | No | No |
| Track gauge (mm) | 1,435 | 1,435 | 1,435 |
| Electrification voltage (kV) | 25 kV 50 Hz AC | 25 kV 50 Hz AC / 25 kV 60 Hz AC | 25 kV 50 Hz AC |
| Maximum train speed / operation speed (km/h) | 240 / 240 | 275 / 275 | 275 / 275 |
| Power (kW) | 9,840 | 7,200 | 9,600 |
| Traction | Distributed traction | Distributed traction | Distributed traction |
| Signalling | ATC / DS-ATC | DS-ATC | DS-ATC |
| Train sets currently used / planned | 0 | 0 | 24 |
| **Weight and dimensions** | | | |
| Unladen weight in running order (t) | 693 | 349 | 442 |
| Maximum axle load (t) | 17 | 13 | 13 |
| Power weight ratio (kW/t) | 12.8 | 18.6 | 19.6 |
| Train length (m) | 302 | 201.4 | 251.4 |
| Train width (m) | 3.380 | 3.380 | 3.380 |
| **Seats** | | | |
| 1st class seats* | 102 | 51 | 51 |
| 2nd class seats | 1,133 | 579 | 763 |
| Total seats | 1,235 | 630 | 814 |
| **Observations** | | | |
| | | | For Tohoku and Joetsu line<br>7 sets were lengthened from 8-car E2<br>25 sets are original E2-1000 |

* For 3 classes train, 1st and 2nd classes are included in 1st class

*Source: International Union of Railways*

# 3.4 ROLLING STOCK

**E3**
*(Japan)*

| | |
|---|---|
| (1) Composition | 2M+2T+2M |
| Suppliers | Kawasaki Heavy Industries-Tokyu Car Corporation |
| Owners or operators | JRE |
| Year in service | 1997 |
| Articulated | No |
| Track gauge (mm) | 1,435 |
| Electrification voltage (kV) | 25 kV 50 Hz AC / 20 kV 50 Hz AC |
| Maximum train speed / operation speed (km/h) | 275 / 275 |
| Power (kW) | 4,800 |
| Traction | Distributed traction |
| Signalling | ATC / DS-ATC / ATS-P |
| Train sets currently used / planned | 2 |
| **Weight and dimensions** | |
| Unladen weight in running order (t) | 258 |
| Maximum axle load (t) | 12.3 |
| Power weight ratio (kW/t) | 17.2 |
| Train length (m) | 128.2 |
| Train width (m) | 2.945 |
| **Seats** | |
| 1st class seats* | 23 |
| 2nd class seats | 315 |
| Total seats | 338 |
| **Observations** | |
| | For Tohoku line, coverted from through operation b/w Akita Shinkansen in 2014 |

**E3-700**
*(Japan)*

| | |
|---|---|
| (1) Composition | T+6M+T |
| Suppliers | Kawasaki Heavy Industries |
| Owners or operators | JRE |
| Year in service | 2014 |
| Articulated | No |
| Track gauge (mm) | 1,435 |
| Electrification voltage (kV) | 25 kV 50 Hz AC / 20 kV 50 Hz AC |
| Maximum train speed / operation speed (km/h) | 275 / 275 |
| Power (kW) | 4,800 |
| Traction | Distributed traction |
| Signalling | ATC / DS-ATC / ATS-P |
| Train sets currently used / planned | 1 |
| **Weight and dimensions** | |
| Unladen weight in running order (t) | 258 |
| Maximum axle load (t) | 12.3 |
| Power weight ratio (kW/t) | 18 |
| Train length (m) | 128.2 |
| Train width (m) | 2.945 |
| **Seats** | |
| 1st class seats* | - |
| 2nd class seats | - |
| Total seats | 143 |
| **Observations** | |
| | A luxury train for tourist-oriented services,"Toreiyu", on Yamagata-Shinkansen line (the regauged section) It was convered from E3 on 2014 |

**E3-700**
*(Japan)*

| | |
|---|---|
| (1) Composition | T+6M+T |
| Suppliers | Kawasaki Heavy Industries |
| Owners or operators | JRE |
| Year in service | 2016 |
| Articulated | No |
| Track gauge (mm) | 1,435 |
| Electrification voltage (kV) | 25 kV 50 Hz AC / 20 kV 50 Hz AC |
| Maximum train speed / operation speed (km/h) | 275 / 275 |
| Power (kW) | 4,800 |
| Traction | Distributed traction |
| Signalling | ATC / DS-ATC / ATS-P |
| Train sets currently used / planned | 1 |
| **Weight and dimensions** | |
| Unladen weight in running order (t) | 258 |
| Maximum axle load (t) | 12.3 |
| Power weight ratio (kW/t) | 18 |
| Train length (m) | 128.2 |
| Train width (m) | 2.945 |
| **Seats** | |
| 1st class seats* | - |
| 2nd class seats | - |
| Total seats | 143 |
| **Observations** | |
| | A luxury train for tourist-oriented services,"Genbi-Shinkansen", on Joetsu-Shinkansen line It was convered from E3 on 2015 |

(1) M-Motor coach • T-Trailer coach• L-Locomotive
MB-Motor Bogie

AC – alternating current
DC – direct current

| General characteristics |
|---|
| (1) Composition |
| Suppliers |
| Owners or operators |
| Year in service |
| Articulated |
| Track gauge (mm) |
| Electrification voltage (kV) |
| Maximum train speed / operation speed (km/h) |
| Power (kW) |
| Traction |
| Signalling |
| Train sets currently used / planned |
| **Weight and dimensions** |
| Unladen weight in running order (t) |
| Maximum axle load (t) |
| Power weight ratio (kW/t) |
| Train length (m) |
| Train width (m) |
| **Seats** |
| 1st class seats* |
| 2nd class seats |
| Total seats |
| **Observations** |

* For 3 classes train, 1st and 2nd classes are included in 1st class

*Source: International Union of Railways*

# 3.4 ROLLING STOCK

(1) M-Motor coach • T-Trailer coach• L-Locomotive
MB-Motor Bogie

AC – alternating current
DC – direct current

| General characteristics | E3-1000 *(Japan)* | E3-2000 *(Japan)* | E4 *(Japan)* |
|---|---|---|---|
| (1) Composition | 2M+T+M+T+2M | 2M+T+M+T+2M | T+2M+2T+2M+T |
| Suppliers | Kawasaki Heavy Industries-Tokyu Car Corporation | Kawasaki Heavy Industries-Tokyu Car Corporation | Hitachi-Kawasaki Heavy Industries |
| Owners or operators | JRE | JRE | JRE |
| Year in service | 1999-2014 | 2008 | 1997 |
| Articulated | No | No | No+Double Decker |
| Track gauge (mm) | 1,435 | 1,435 | 1,435 |
| Electrification voltage (kV) | 25 kV 50 Hz AC / 20 kV 50 Hz AC | 25 kV 50 Hz AC / 20 kV 50 Hz AC | 25 kV 50 Hz AC |
| Maximum train speed / operation speed (km/h) | 275 / 275 | 275 / 275 | 240 / 240 |
| Power (kW) | 6,000 | 6,000 | 6,720 |
| Traction | Distributed traction | Distributed traction | Distributed traction |
| Signalling | ATC / DS-ATC / ATS-P | ATC / DS-ATC / ATS-P | DS-ATC |
| Train sets currently used / planned | 3 | 12 | 16 |
| **Weight and dimensions** | | | |
| Unladen weight in running order (t) | 311 | 307 | 428 |
| Maximum axle load (t) | 12.2 | 12.5 | 16 |
| Power weight ratio (kW/t) | 17.9 | 18.1 | 14.1 |
| Train length (m) | 148.7 | 148.7 | 201.4 |
| Train width (m) | 2.945 | 2.945 | 3.380 |
| **Seats** | | | |
| 1st class seats* | 23 | 23 | 54 |
| 2nd class seats | 379 | 371 | 763 |
| Total seats | 402 | 394 | 817 |
| **Observations** | | | |
| | For through operation b/w Shinkansen line and improved classical line (Yamagata Shinkansen line)<br>1 additional train set was convered from E3 of 2 train sets on 2014 | All sets had replaced Series 400 | |

* For 3 classes train, 1st and 2nd classes are included in 1st class

*Source: International Union of Railways*

**E5**
*(Japan)*

| |
|---|
| T+6M+T |
| Hitachi-Kawasaki Heavy Industries |
| JRE |
| 2011 |
| No+Tilting |
| 1,435 |
| 25 kV 50 Hz AC |
| 320 / 320 (300 until 2012) |
| 9,600 |
| Distributed traction |
| DS-ATC |
| 46 |
| |
| 453.5 |
| 13 |
| 19.3 |
| 253 |
| 3.350 |
| |
| 18 / 55 |
| 650 |
| 723 |
| |
| 3 classes, for Hokkaido-Shinkansen, through operation between JR East and JR Hokkaido |

**H5**
*(Japan)*

| |
|---|
| T+6M+T |
| Hitachi-Kawasaki Heavy Industries |
| JRH |
| 2016 |
| No+Tilting |
| 1,435 |
| 25 kV 50 Hz AC |
| 320 / 320 |
| 9,600 |
| Distributed traction |
| DS-ATC |
| 4 |
| |
| 453.5 |
| 13 |
| 19.3 |
| 253 |
| 3.350 |
| |
| 18 / 55 |
| 650 |
| 723 |
| |
| 3 classes, for Hokkaido-Shinkansen, through operation between JR East and JR Hokkaido |

**E6**
*(Japan)*

| |
|---|
| M+T+3M+T+M |
| Hitachi-Kawasaki Heavy Industries |
| JRE |
| 2013 |
| No+Tilting |
| 1,435 |
| 25 kV 50 Hz AC / 20 kV 50 Hz AC |
| 320 / 320 (300 until 2012) |
| 6,000 |
| Distributed traction |
| DS-ATC / ATS-P |
| 24 |
| |
| 306.5 |
| 10.9 |
| 18.4 |
| 148.7 |
| 2.945 |
| |
| 22 |
| 310 |
| 332 |
| |
| For through operation b/w Shinkansen line and improved classical line (Akita Shinkasen line) |

(1) M-Motor coach • T-Trailer coach• L-Locomotive
MB-Motor Bogie

AC – alternating current
DC – direct current

| General characteristics |
|---|
| (1) Composition |
| Suppliers |
| Owners or operators |
| Year in service |
| Articulated |
| Track gauge (mm) |
| Electrification voltage (kV) |
| Maximum train speed / operation speed (km/h) |
| Power (kW) |
| Traction |
| Signalling |
| Train sets currently used / planned |
| **Weight and dimensions** |
| Unladen weight in running order (t) |
| Maximum axle load (t) |
| Power weight ratio (kW/t) |
| Train length (m) |
| Train width (m) |
| **Seats** |
| 1st class seats* |
| 2nd class seats |
| Total seats |
| **Observations** |

* For 3 classes train, 1st and 2nd classes are included in 1st class

*Source: International Union of Railways*

# 3.4 ROLLING STOCK

(1) M-Motor coach • T-Trailer coach• L-Locomotive
MB-Motor Bogie

AC – alternating current
DC – direct current

| General characteristics | E7 / W7 *(Japan)* | KTX *(South Korea)* | KTX-Sancheon *(South Korea)* |
|---|---|---|---|
| (1) Composition | T+10M+T | L+18T+L (+2MB) | L+8T+L |
| Suppliers | Hitachi-Kawasaki Heavy Industries-Kinki Sharyo-J-TREC | Alstom-Hyundai Rotem | Hyundai Rotem |
| Owners or operators | JRE / JRW | KORAIL | KORAIL |
| Year in service | 2014 | 2004 | 2010 |
| Articulated | No | Yes | Yes |
| Track gauge (mm) | 1,435 | 1,435 | 1,435 |
| Electrification voltage (kV) | 25 kV 50 Hz AC / 25 kV 60 Hz AC | 25 kV 60 Hz AC | 25 kV 60 Hz AC |
| Maximum train speed / operation speed (km/h) | 275 / 260 | 300 / 300 | 330 / 300 |
| Power (kW) | 12,000 | 13,560 | 8,800 |
| Traction | Distributed traction | Concentrated traction | Concentrated traction |
| Signalling | DS-ATC | ATC (TVM) / ATS | ATC (TVM) / ATS / ATP |
| Train sets currently used / planned | 19 (JRE) - 11 (JRW) | 46 | 24 |
| **Weight and dimensions** | | | |
| Unladen weight in running order (t) | 540 | 701 | 434 |
| Maximum axle load (t) | 11.3 | 17 | 25.5 |
| Power weight ratio (kW/t) | 20.1 | 17.5 | 19 |
| Train length (m) | 302 | 388 | 201 |
| Train width (m) | 3.380 | 2.904 | 2.970 |
| **Seats** | | | |
| 1st class seats* | 18 / 63 | 127 | 30 |
| 2nd class seats | 831 | 808 | 333 |
| Total seats | 912 | 935 | 363 |
| **Observations** | | | |
| | 3 classes, JRE (E7) 17 sets, JRW (W7) 11 sets for Hokuriku-Shinkansen, operating from 2014 | | "Sancheon" |

* For 3 classes train, 1st and 2nd classes are included in 1st class

*Source: International Union of Railways*

# 3.4 ROLLING STOCK

## KTX-Sancheon 2
*(South Korea)*

## KTX-EUM
*(South Korea)*

## SRT-Suseo
*(South Korea)*

(1) M-Motor coach • T-Trailer coach• L-Locomotive
MB-Motor Bogie

AC – alternating current
DC – direct current

| General characteristics | KTX-Sancheon 2 | KTX-EUM | SRT-Suseo |
|---|---|---|---|
| (1) Composition | L+8T+L | T+4M+T | L+8T+L |
| Suppliers | Hyundai Rotem | Hyundai Rotem | Hyundai Rotem |
| Owners or operators | KORAIL | KORAIL | SR |
| Year in service | 2017 | 2021 | 2016 |
| Articulated | Yes | No | Yes |
| Track gauge (mm) | 1,435 | 1,435 | 1,435 |
| Electrification voltage (kV) | 25 kV 60 Hz AC | 25 kV 60 Hz AC | 25 kV 60 Hz AC |
| Maximum train speed / operation speed (km/h) | 330 / 300 | nd / 260 | 330 / 300 |
| Power (kW) | 8,800 | - | 8,800 |
| Traction | Concentrated traction | Distributed traction | Concentrated traction |
| Signalling | ATC (TVM) / ATS / ATP | ATC (TVM) / ATS / ATP / ETCS | ATC (TVM) / ATS / ATP |
| Train sets currently used / planned | 15 | 19 / 24 | 12 |
| **Weight and dimensions** | | | |
| Unladen weight in running order (t) | 434 | 312 | 434 |
| Maximum axle load (t) | 25.5 | - | 25.5 |
| Power weight ratio (kW/t) | 20.3 | - | 18.9 |
| Train length (m) | 201 | 150.5 | 201 |
| Train width (m) | 2.970 | 3.150 | 2.970 |
| **Seats** | | | |
| 1st class seats* | 33 | 46 | 33 |
| 2nd class seats | 377 | 335 | 377 |
| Total seats | 410 | 381 | 410 |
| **Observations** | | | |
| | "Wongang"<br>For Wonju - Gangneung | | "Suseo"<br>SR is on of the High Speed train operation company in South Korea |

* For 3 classes train, 1st and 2nd classes are included in 1st class

*Source: International Union of Railways*


INTERNATIONAL UNION
OF RAILWAYS

# 4.1 HIGH-SPEED RAIL NETWORK

## EGYPT

### *High-speed lines planned in Egypt*

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| Cairo - Alexandria | 320 | 2024 | 210 |
| Cairo - Aswan | 320 | 2024 | 700 |
| El Alamein - Ain Sokhna | 250 | 2025 | 460 |
| El Alamein - Marsa Matrouh | 250 | 2025 | 200 |
| | | | **Total km = 1,570** |

### *High-speed lines with long-term planning in Egypt*

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| Ain Sokhna - Hurghada | 250 | 2030 | 320 |
| Hurghada - Luxor | 250 | - | 285 |
| 6th October City - Luxor | 250 | - | 640 |
| Luxor - Aswan | 250 | - | 210 |
| Safaga - Barnis | 250 | - | 350 |
| | | | **Total km = 1,805** |

*Source: compiled by authors based on International Union of Railways, 2021*

# 4.1 HIGH-SPEED RAIL NETWORK

## *High-speed lines in Egypt*


*Source: compiled by authors based on International Union of Railways, 2021*

## MOROCCO

### *High-speed lines in commercial operation in Morocco*

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| Tanger - Kenitra | 320 | 2018 | 186 |
| | | | **Total km = 186** |

### *High-speed lines planned in Morocco*

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| Kenitra - Rabat | 320 | 2027 | 55 |
| Casablanca - Marrakech | 320 | 2028 | 240 |
| Rabat - Casablanca | 320 | 2029 | 105 |
| Marrakech - Agadir | 250 | - | 240 |
| | | | **Total km = 640** |

*Source: compiled by authors based on International Union of Railways, 2021*

# 4.1 HIGH-SPEED RAIL NETWORK

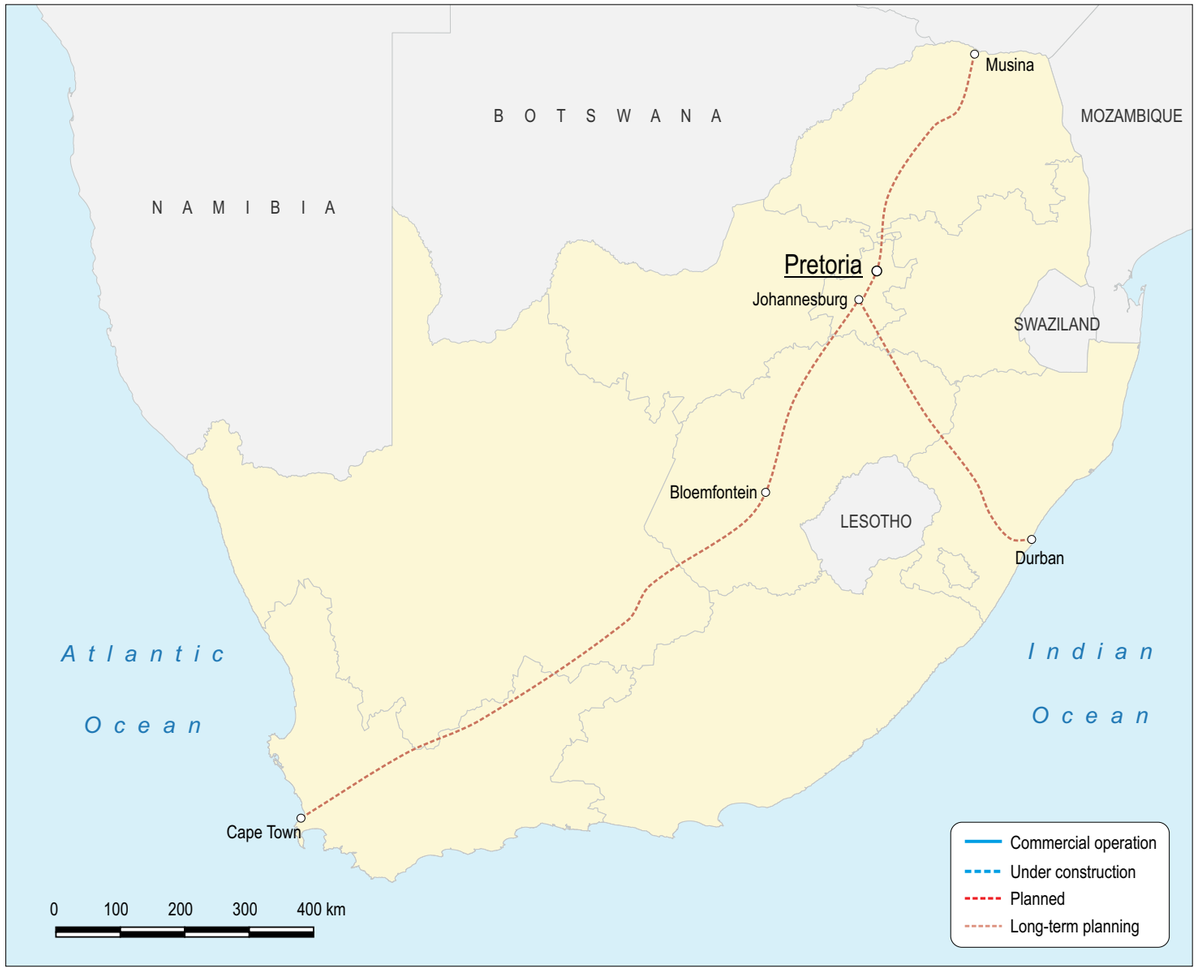
***High-speed lines in Morocco***


*Source: compiled by authors based on International Union of Railways, 2021*

## SOUTH AFRICA

*High-speed lines with long-term planning in South Africa*

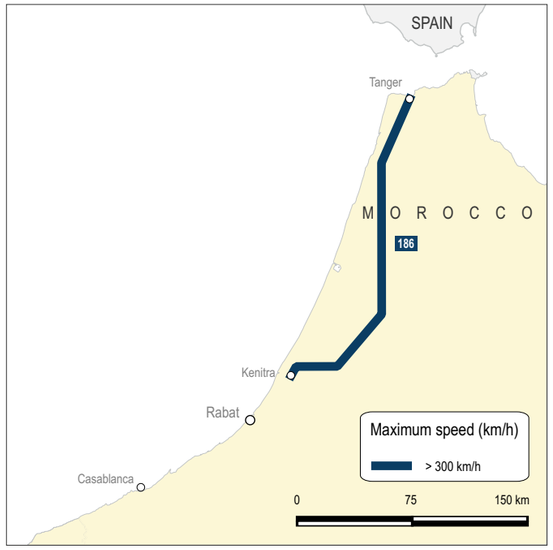
| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| Johannesburg - Durban | 300 | - | 610 |
| Johannesburg - Musina | 300 | - | 480 |
| Johannesburg - Cape Town | 300 | - | 1,300 |
| | | | **Total km = 2,390** |



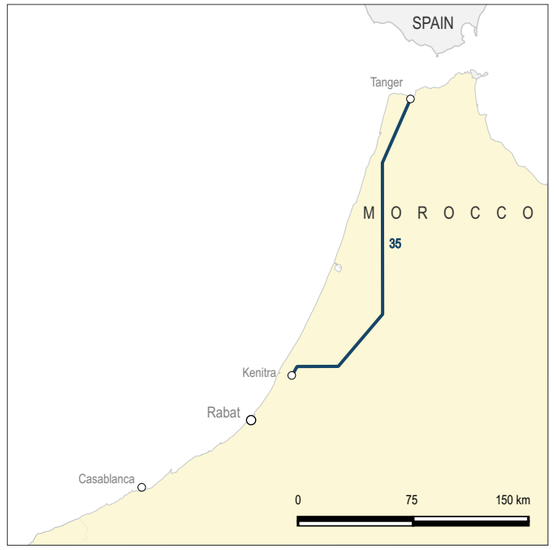

*Source: compiled by authors based on International Union of Railways, 2021*

# 4.2 CHARACTERISTICS AND EQUIPMENT

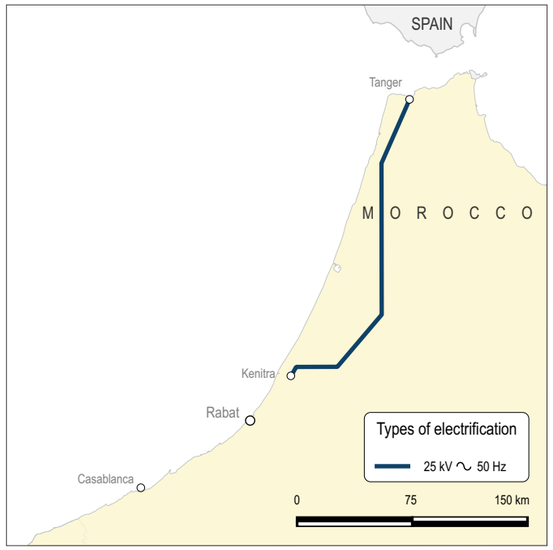
### *Maximum com. speed and distance (km)*



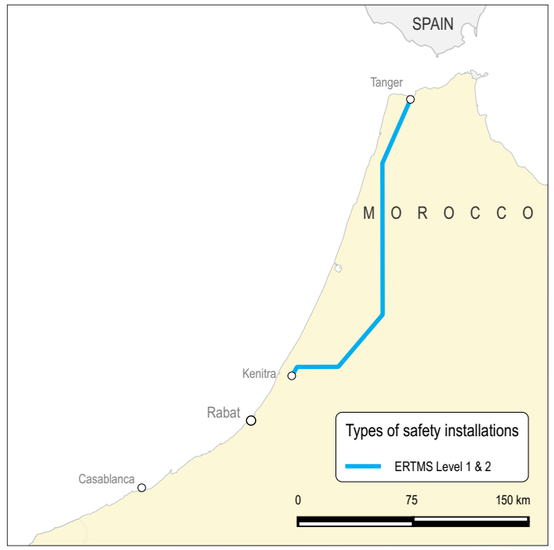

### *Maximum slope (‰)*




### *Electrification*



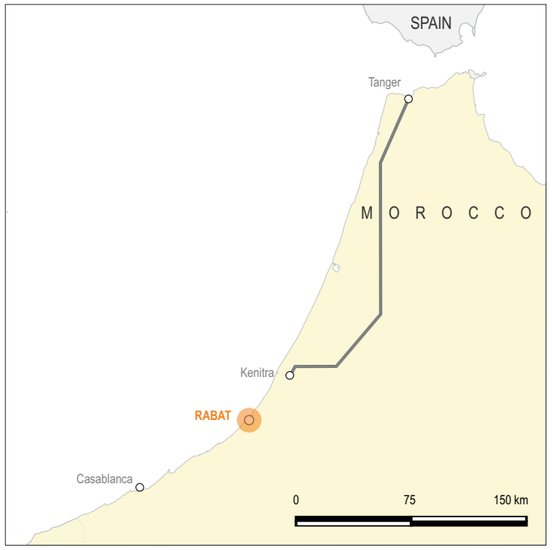

### *Signalling*



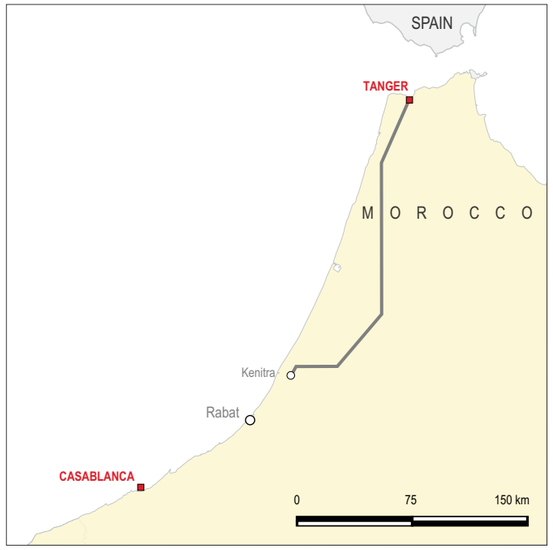

*Source: compiled by authors based on International Union of Railways, 2021*

# 4.2 CHARACTERISTICS AND EQUIPMENT

### *Centralized Traffic Control (CTC)*

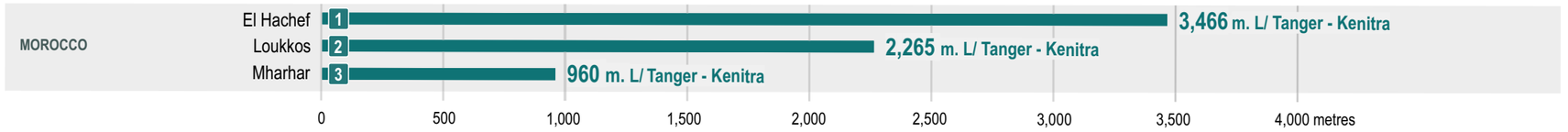



### *High-speed rolling stock workshops*




### *Longest viaducts*


### *Longest viaducts of the high-speed rail network in Africa*




*Source: compiled by authors based on International Union of Railways, 2021*

# 4.3 ROLLING STOCK

## RGV-M
*(Morocco)*

| | |
|---|---|
| (1) Composition | L+8T+L |
| Suppliers | Alstom |
| Owners or operators | ONCF |
| Year in service | 2018 |
| Articulated | Yes + Double Decker |
| Track gauge (mm) | 1,435 |
| Electrification voltage (kV) | 25 kV 50 Hz AC / 3 kV DC |
| Maximum train speed / operation speed (km/h) | 320 / 300 |
| Power (kW) | - |
| Traction | Concentrated traction |
| Signalling | ETCS |
| Train sets currently used / planned | 12 |
| **Weight and dimensions** | |
| Unladen weight in running order (t) | - |
| Maximum axle load (t) | - |
| Power weight ratio (kW/t) | - |
| Train length (m) | 200 |
| Train width (m) | 2.896 |
| **Seats** | |
| 1st class seats* | - |
| 2nd class seats | - |
| Total seats | 533 |
| **Observations** | |
| | No. 1201-1212 |

(1) M-Motor coach • T-Trailer coach• L-Locomotive
MB-Motor Bogie

AC – alternating current
DC – direct current

*Source: International Union of Railways*

* For 3 classes train, 1st and 2nd classes are included in 1st class


INTERNATIONAL UNION
OF RAILWAYS

# 5.1 HIGH-SPEED RAIL NETWORK

**CANADA**
**USA**
**MEXICO**

### *High-speed lines with long-term planning in Canada*

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| Quebec - Windsor | 300 | - | 1,229 |
| Calgary - Edmonton | 300 | - | 294 |
| | | | **Total km = 1,523** |

### *High-speed lines in commercial operation in USA*

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| NE Corridor (Boston - New York - Washington DC) | 240 | 2000 | 735 |
| | | | **Total km = 735** |

### *High-speed lines under construction in USA*

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| Madera - Fresno - Bakersfield | 320 | 2029 | 192 |
| San Francisco - San Jose | 320 | 2033 | 82 |
| | | | **Total km = 274** |

### *High-speed lines planned in USA*

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| Las Vegas - Victorville | 320 | 2023 | 270 |
| Houston - Dallas | 330 | 2026 | 385 |
| San Jose - Madera | 320 | 2033 | 204 |
| Bakersfield - Anaheim | 350 | 2033 | 269 |
| Victorville - Los Angeles | 320 | - | 150 |
| | | | **Total km = 1,278** |

*Source: compiled by authors based on International Union of Railways, 2021*

# 5.1 HIGH-SPEED RAIL NETWORK

### *High-speed lines with long-term planning in USA*

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| NEC Future (Boston - New York - Washington DC) | 350 | 2040 | 735 |
| Merced - Sacramento | - | - | 180 |
| Los Angeles - San Diego | - | - | 269 |
| Vancouver (Canada) - Seattle - Portland | - | - | 509 |
| Chicago - Milwaukee | - | - | 149 |
| Atlanta - Charlotte | - | - | 370 |
| Chicago - St. Louis | - | - | 420 |
| Chicago - Detroit | - | - | 455 |
| Kansas City - St. Louis | - | - | 399 |
| Chicago - Indianapolis | - | - | 298 |
| | | | **Total km = 3,784** |

### *High-speed lines planned in Mexico*

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| Mexico D.F. - Querétaro | 300 | - | 210 |
| | | | **Total km = 210** |

*Source: compiled by authors based on International Union of Railways, 2021*

# 5.1 HIGH-SPEED RAIL NETWORK

## *High-speed lines in Canada and USA*


*Source: compiled by authors based on International Union of Railways, 2021*

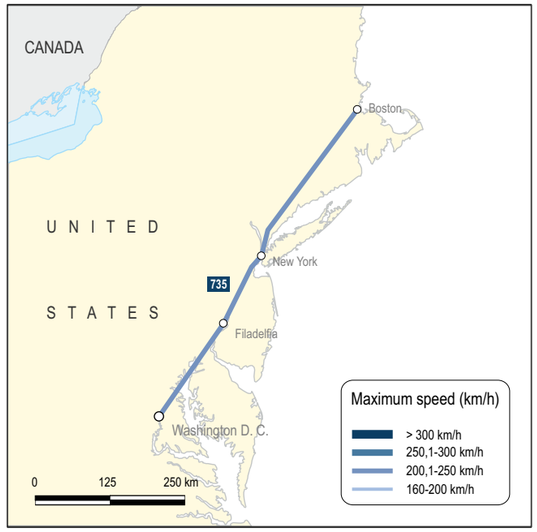
# 5.1 HIGH-SPEED RAIL NETWORK

***High-speed lines in Mexico***


*Source: compiled by authors based on International Union of Railways, 2021*

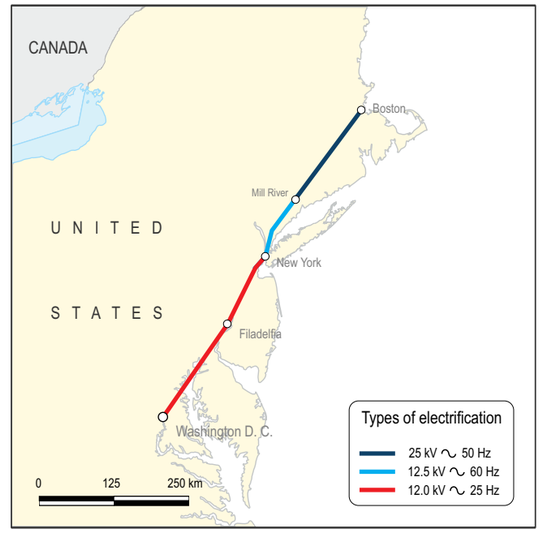
# 5.2 CHARACTERISTICS AND EQUIPMENT

### *Maximum com. speed and distance (km)*

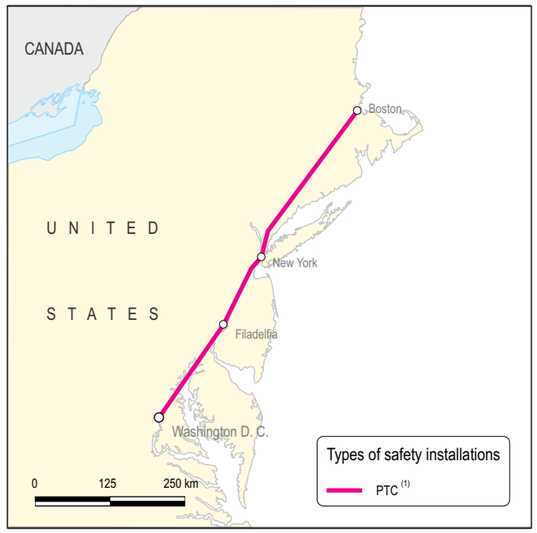



### *Maximum slope (‰)*

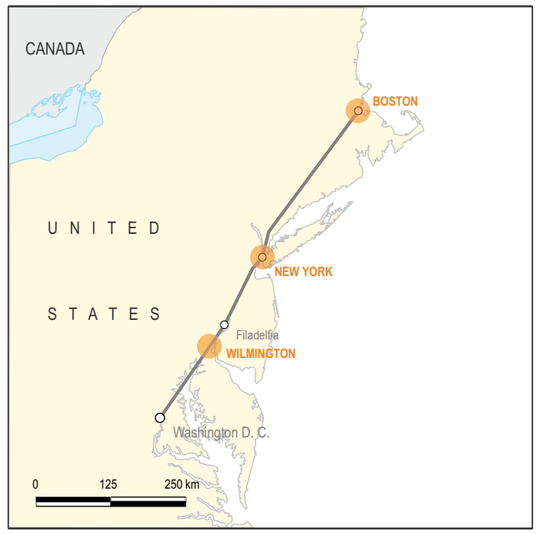

### *Electrification*




### *Signalling*




### *Centralized Traffic Control (CTC)*




### *High-speed rolling stock workshops*


*Note:*
*(1): Positive Train Control*

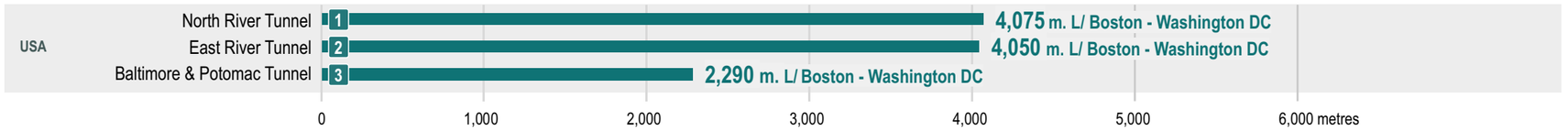
*Source: compiled by authors based on International Union of Railways, 2021*

# 5.2 CHARACTERISTICS AND EQUIPMENT

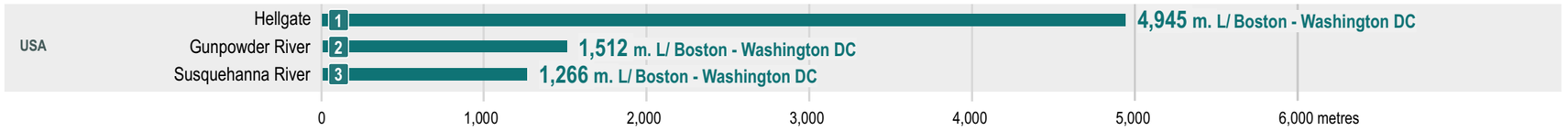
### *Longest tunnels*


### *Longest viaducts*


### *Longest tunnels of the high-speed rail network in North America*




### *Longest viaducts of the high-speed rail network in North America*




*Source: compiled by authors based on International Union of Railways, 2021*

# 5.3 SPEED AND TRAVEL TIMES

***Evolution of average speed on American high-speed lines***


*Source: International Union of Railways*

# 5.4. ROLLING STOCK

(1) M-Motor coach • T-Trailer coach• L-Locomotive
MB-Motor Bogie

AC – alternating current
DC – direct current

| | Acela *(USA)* | Acela II *(USA)* |
|---|---|---|
| **General characteristics** | | |
| (1) Composition | L+6T+L | L+10T+L |
| Suppliers | Bombardier-Alstom | Alstom |
| Owners or operators | Amtrak | Amtrak |
| Year in service | 2000 | 2021-2022 |
| Articulated | No | No + Tilting |
| Track gauge (mm) | 1,435 | 1,435 |
| Electrification voltage (kV) | 25 kV 60 Hz AC / 12.5 kV 60 Hz AC / 12 kV 25 Hz AC | 25 kV 60 Hz AC / 12.5 kV 60 Hz AC / 12 kV 25 Hz AC |
| Maximum train speed / operation speed (km/h) | 241 / 241 | 300 / 257 |
| Power (kW) | 9,200 | 7,000 |
| Traction | Concentrated traction | Concentrated traction |
| Signalling | ATP | ATP |
| Train sets currently used / planned | 20 | 0 / 28 |
| **Weight and dimensions** | | |
| Unladen weight in running order (t) | 566 | - |
| Maximum axle load (t) | 23 | - |
| Power weight ratio (kW/t) | 15.6 | - |
| Train length (m) | 203 | 212 |
| Train width (m) | 3.175 | - |
| **Seats** | | |
| 1st class seats* | 44 | |
| 2nd class seats | 260 | |
| Total seats | 304 | 512 |
| **Observations** | | |

* For 3 classes train, 1st and 2nd classes are included in 1st class

*Source: International Union of Railways*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# 6.1 HIGH-SPEED RAIL NETWORK

**BAHRAIN AND QATAR**
**IRAN**
**ISRAEL**
**SAUDI ARABIA**
**TURKEY**

### *High-speed lines with long-term planning in Bahrain and Qatar*

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| Doha - Manama | 350 | - | 180 |
| | | | **Total km = 180** |

### *High-speed lines under construction in Iran*

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| Tehran - Qom - Esfahan | 250 | 2023 / 2024 | 410 |
| | | | **Total km = 410** |

### *High-speed lines planned in Iran*

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| Tehran - Mashhad | 200 | 2025 | 926 |
| Qom - Arak | 250 | 2025 | 117 |
| | | | **Total km = 1,043** |

### *High-speed lines with long-term planning in Iran*

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| Tehran - Hamedan | - | - | 284 |
| Tehran - Zanjan - Tabriz | - | - | 613 |
| Esfahan - Shiraz | - | - | 470 |
| Esfahan - Yazd | - | - | 284 |
| | | | **Total km = 1,651** |

### *High-speed lines planned in Israel*

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| Tel Aviv - Haifa | 250 | - | 85 |
| | | | **Total km = 85** |

*Source: compiled by authors based on International Union of Railways, 2021*

# 6.1 HIGH-SPEED RAIL NETWORK

### *High-speed lines in commercial operation in Saudi Arabia*

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| Medina - Jeddah - Mecca | 300 | 2018 | 449 |
| | | | **Total km = 449** |

### *High-speed lines in commercial operation in Turkey*

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| Ankara - Eskisehir | 250 | 2009 | 245 |
| (Ankara) Polatlı - Konya | 250 | 2011 | 212 |
| Eskisehir - İzmit - Pendik (Istanbul) | 250 | 2014 | 257 |
| Kayseri North Passage | 160 | 2016 | 23 |
| Balışeyh (Kırıkkale) - Sivas | 300 | 2021 | 315 |
| | | | **Total km = 1,052** |

### *High-speed lines under construction in Turkey*

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| (Ankara) Kayaş - Balışeyh (Kırıkkale) | 300 | 2023 | 78 |
| Bursa - Osmaneli | 200 | 2024 | 106 |
| Mersin - Adana - Gaziantep | 200 | 2025 | 313 |
| (Ankara) Polatlı - Menemen (Izmir) | 250 | 2025 | 508 |
| Halkalı - Ispartakule | 200 | 2025 | 9 |
| Aksaray - Ulukışla - Yenice | 200 | 2025 | 192 |
| Konya - Karaman - Ulukışla | 200 | - | 237 |
| Çerkezköy - Kapıkule (Bulgarian border) | 200 | - | 153 |
| | | | **Total km = 1,596** |

### *High-speed lines planned in Turkey*

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| Ispartakule - Çerkezköy | 200 | 2025 | 67 |
| Eskişehir - Antalya | 200 | - | 428 |
| Delice (Kırıkkale) - Samsun | 200 | - | 293 |
| Erzincan - Kars | 200 | - | 382 |
| Kayseri - Antalya | 200 | - | 541 |
| Gaziantep - Mardin | 200 | - | 300 |
| | | | **Total km = 2,011** |

*Source: compiled by authors based on International Union of Railways, 2021*

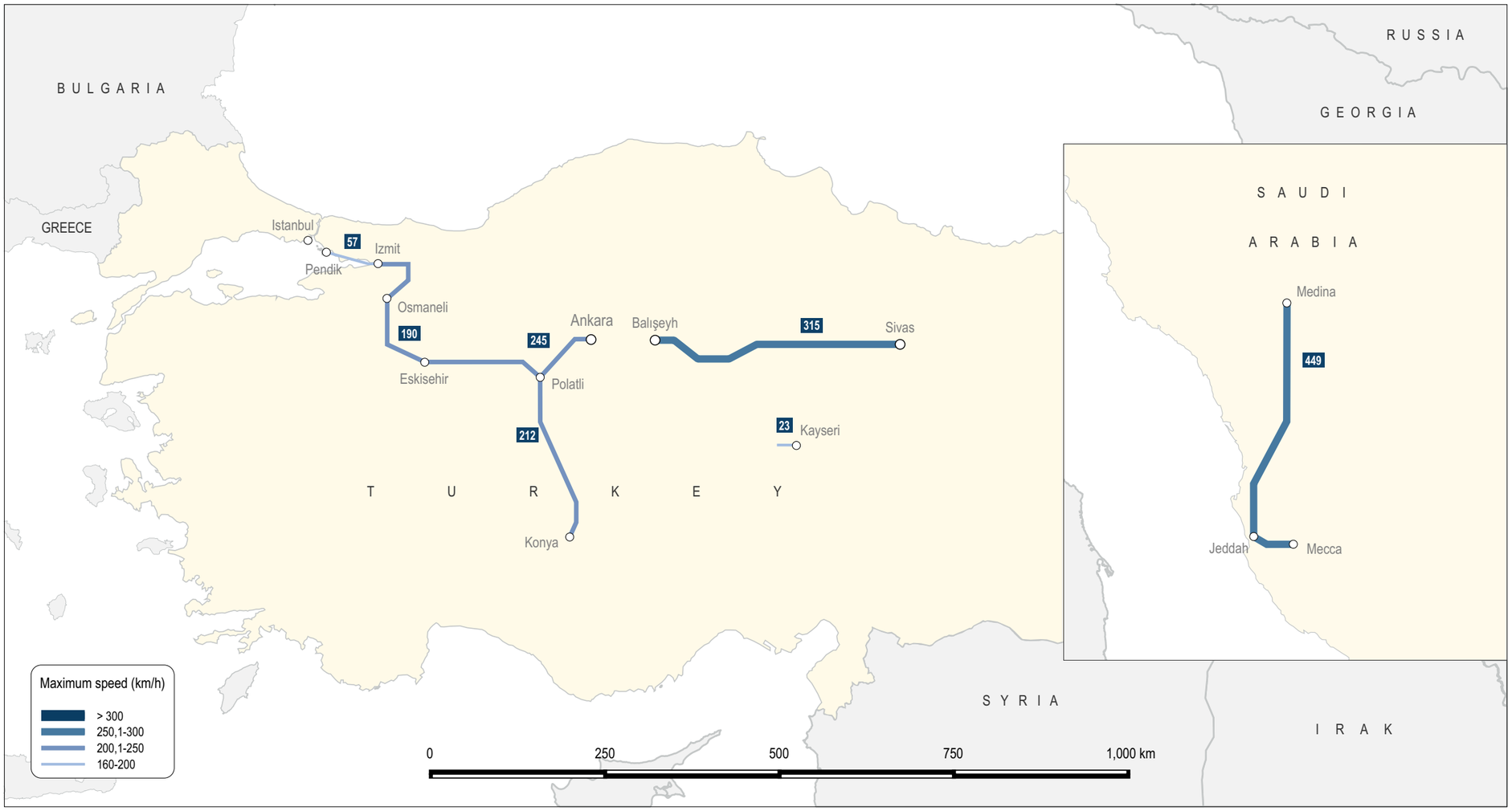
# 6.1 HIGH-SPEED RAIL NETWORK

## *High-speed lines in Middle East*


*Source: compiled by authors based on International Union of Railways, 2021*

# 6.2 CHARACTERISTICS AND EQUIPMENT

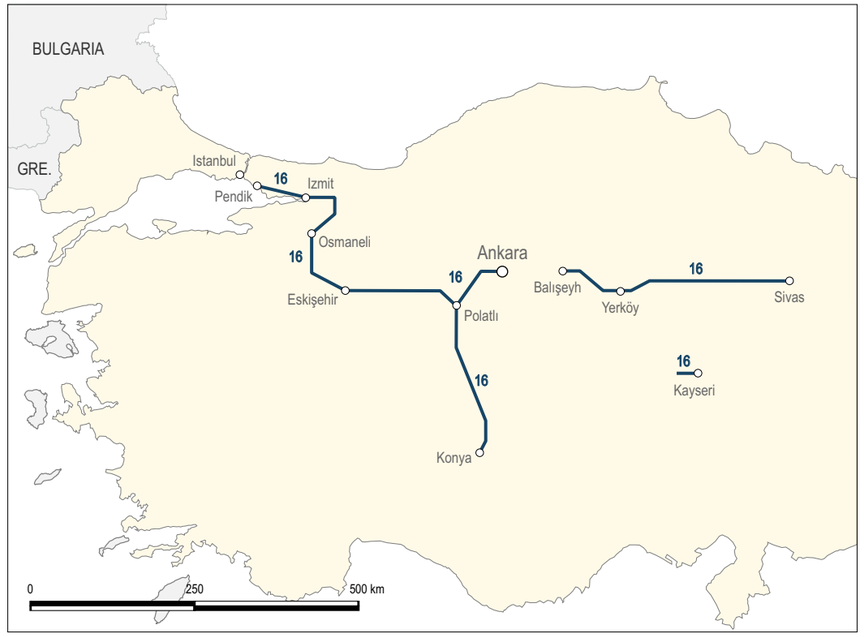
### *Maximum commercial speed and Distances (km)*



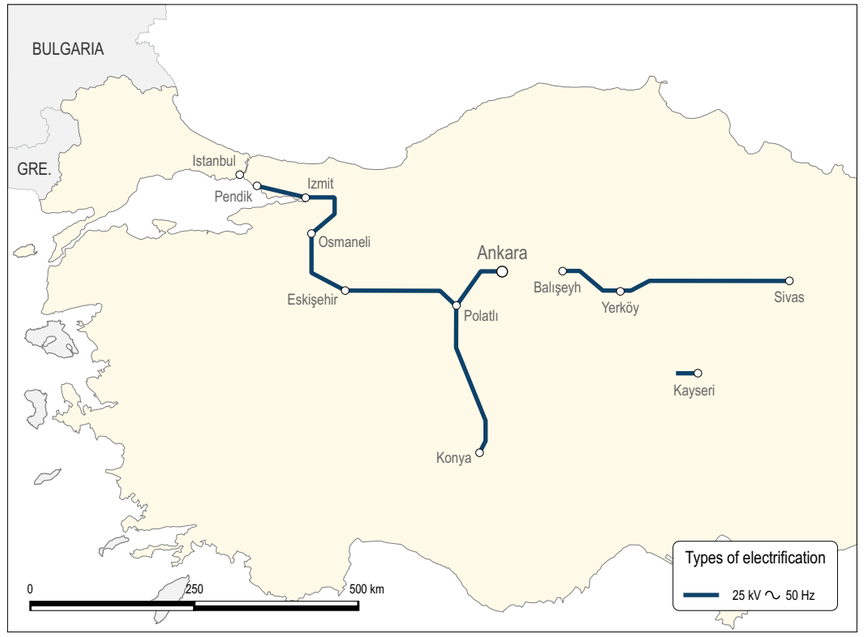

*Source: compiled by authors based on International Union of Railways, 2021*

# 6.2 CHARACTERISTICS AND EQUIPMENT (Turkey)

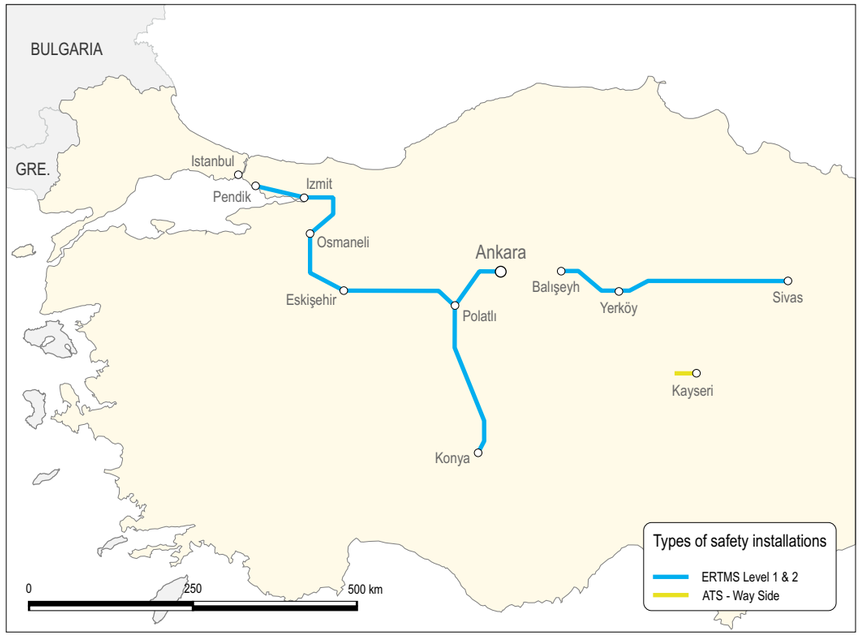
### *Maximum slope (‰)*




### *Electrification*



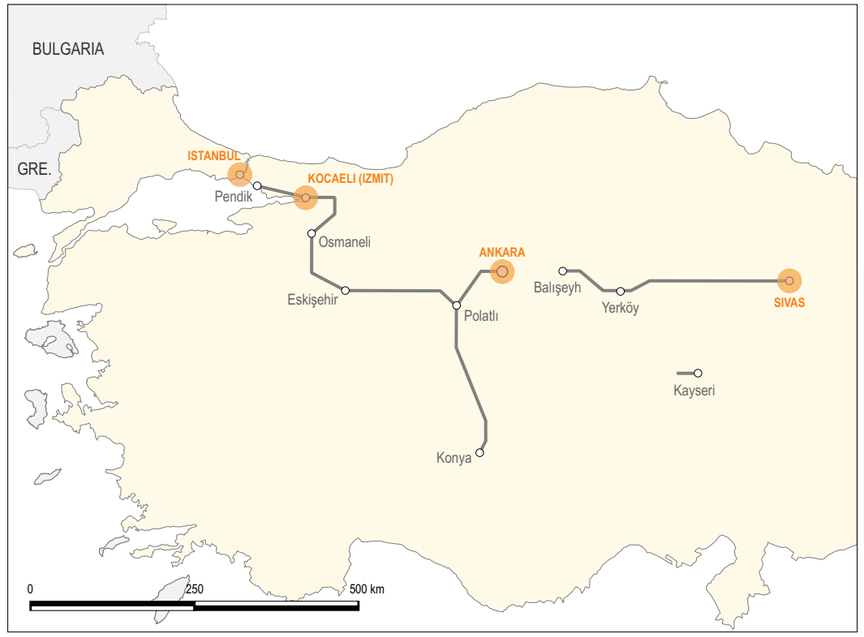

### *Signalling*



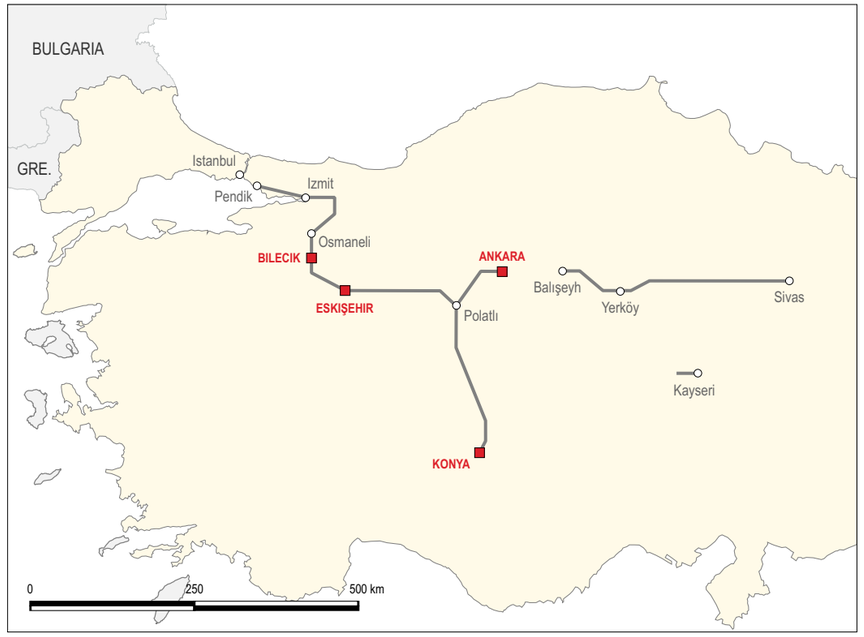

*Source: compiled by authors based on International Union of Railways, 2021*

# 6.2 CHARACTERISTICS AND EQUIPMENT (Turkey)

### *Centralized Traffic Control (CTC)*



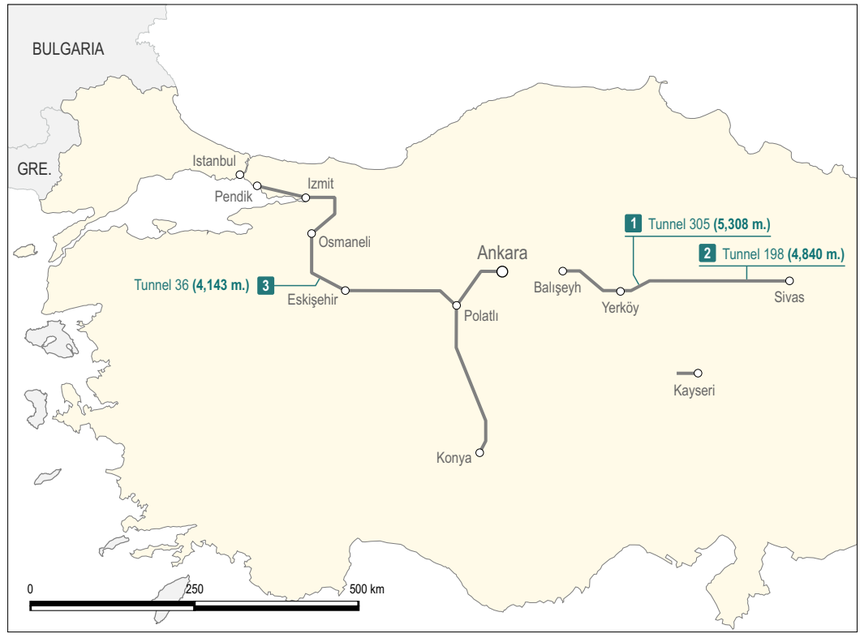

### *High-speed rolling stock workshops*



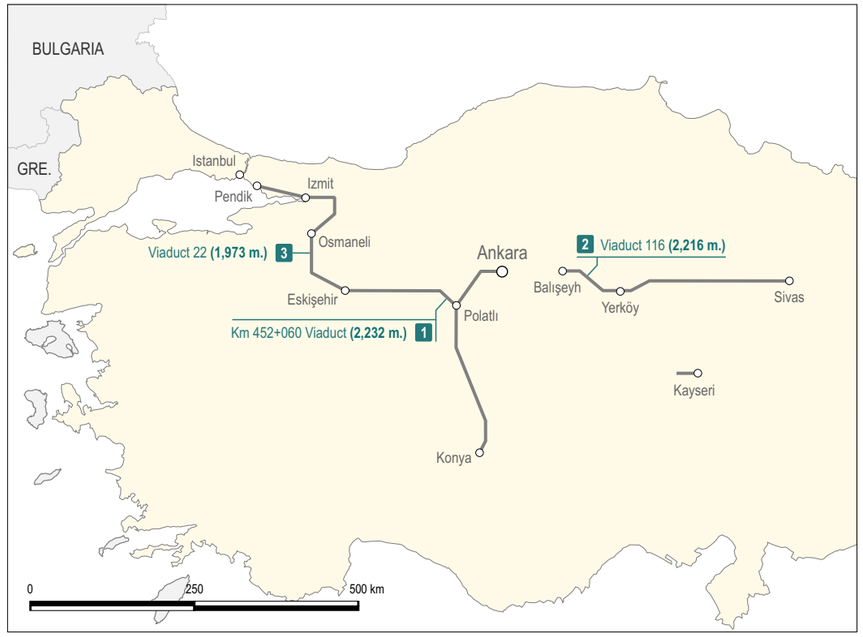

*Source: compiled by authors based on International Union of Railways, 2021*

# 6.2 CHARACTERISTICS AND EQUIPMENT (Turkey)

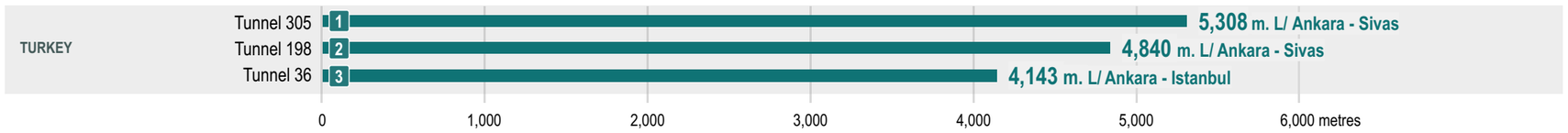
### *Longest tunnels*




### *Longest viaducts*




### *Longest tunnels of the high-speed rail network in Turkey*

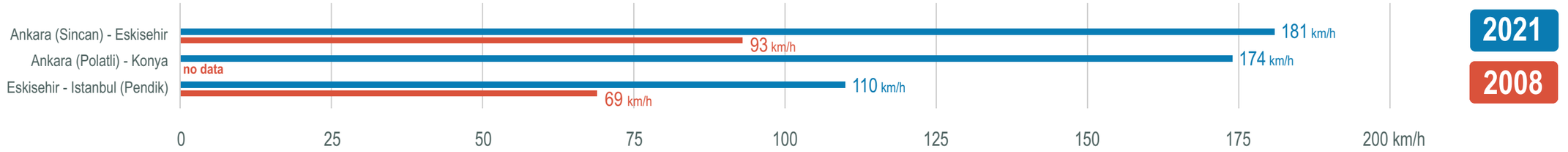



### *Longest viaducts of the high-speed rail network in Turkey*


*Source: compiled by authors based on International Union of Railways, 2021*

# 6.3 SPEED AND TRAVEL TIME

***Evolution of average speed on Turkish high-speed lines***




*Source: compiled by authors based on International Union of Railways, 2021*

# 6.4 ROLLING STOCK

(1) M-Motor coach • T-Trailer coach• L-Locomotive
MB-Motor Bogie

AC – alternating current
DC – direct current

| General characteristics | HT65000 *(Turkey)* | HT80000 *(Turkey)* | HT80100 *(Turkey)* |
|---|---|---|---|
| (1) Composition | T+4M+T | M+T+M+2T+M+T+M | M+T+M+2T+M+T+M |
| Suppliers | CAF | Siemens | Siemens |
| Owners or operators | TCDD Transportation | TCDD Transportation | TCDD Transportation |
| Year in service | 2009 | 2015 | 2016 |
| Articulated | No | No | No |
| Track gauge (mm) | 1,435 | 1,435 | 1,435 |
| Electrification voltage (kV) | 25 kV 50 Hz AC | 25 kV 50 Hz AC | 25 kV 50 Hz AC |
| Maximum train speed / operation speed (km/h) | 250 / 250 | 320 / 300 | 300 / 300 |
| Power (kW) | 4,800 | 8,000 | 8,000 |
| Traction | Distributed traction | Distributed traction | Distributed traction |
| Signalling | ETCS / ATS | ETCS / ATS | ETCS / ATS |
| Train sets currently used / planned | 12 | 17 | 12 |
| **Weight and dimensions** | | | |
| Unladen weight in running order (t) | 297.25 | 456.47 | 456.47 |
| Maximum axle load (t) | <17 | <17 | <17 |
| Power weight ratio (kW/t) | 12.7 | 14.7 | 14.7 |
| Train length (m) | 158.9 | 200.7 | 200.7 |
| Train width (m) | 2.920 | 2.924 | 2.924 |
| **Seats** | | | |
| 1st class seats* | 55 | 111 | 57 |
| 2nd class seats | 364 (8 bistro + 2 hp) | 351 (16 bistro + 2 hp) | 462 (36 bistro + 2 hp) |
| Total seats | 419 | 462 | 519 |
| **Observations** | | | |
| | | Siemens Velaro D series | Siemens Velaro Turkey series<br>Five new trainsets put into operation as of 2021. |

* For 3 classes train, 1st and 2nd classes are included in 1st class

*Source: International Union of Railways and miscellaneous data sources*

## Talgo 350
*(Saudi Arabia)*

| General characteristics | |
|---|---|
| (1) Composition | L+13T+L |
| Suppliers | Talgo |
| Owners or operators | Haramain HSR |
| Year in service | 2017 |
| Articulated | Yes |
| Track Gauge (mm) | 1,435 |
| Electrification voltage (kV) | 25 kV 60 Hz AC |
| Maximum train speed / operation speed (km/h) | 350 / 300 |
| Power (kW) | 8,000 |
| Traction | Concentrated traction |
| Signalling | ETCS |
| Train sets currently used / planned | 8 / 36 |
| **Weight and dimensions** | |
| Unladen weight in running order (t) | 373,9 |
| Maximum axle load (t) | 16.9 |
| Power weight ratio (kW/t) | 21.4 |
| Train length (m) | 215 |
| Train width (m) | 2.960 (locom.) / 2.942 (coach) |
| **Seats** | |
| 1st class seats* | 100 |
| 2nd class seats | 304 |
| Total seats | 404 |
| **Observations** | |

(1) M-Motor coach • T-Trailer coach• L-Locomotive
MB-Motor Bogie

AC – alternating current
DC – direct current

* For 3 classes train, 1st and 2nd classes are included in 1st class

*Source: International Union of Railways*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# 7.1 HIGH-SPEED RAIL NETWORK

## BRAZIL

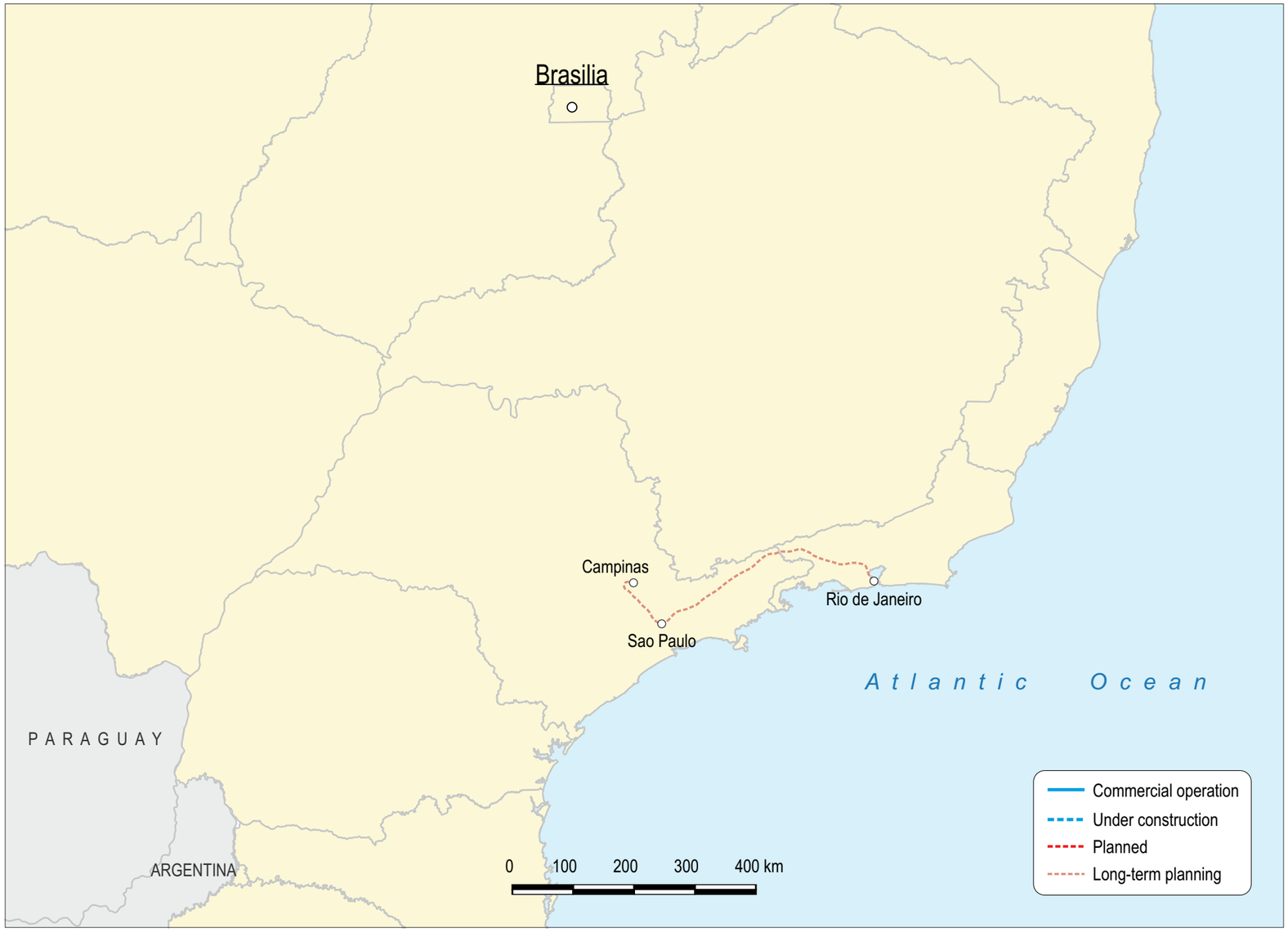
***High-speed lines with long-term planning in Brazil***

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| Rio de Janeiro - São Paulo - Campinas | 300 | - | 511 |
| | | | **Total km = 511** |

*Source: miscellaneous data sources*

# 7.1 HIGH-SPEED RAIL NETWORK

***High-speed lines with long-term planning in Brazil***




*Source: miscellaneous data sources, 2021*

# 7.1 HIGH-SPEED RAIL NETWORK

## CHILE

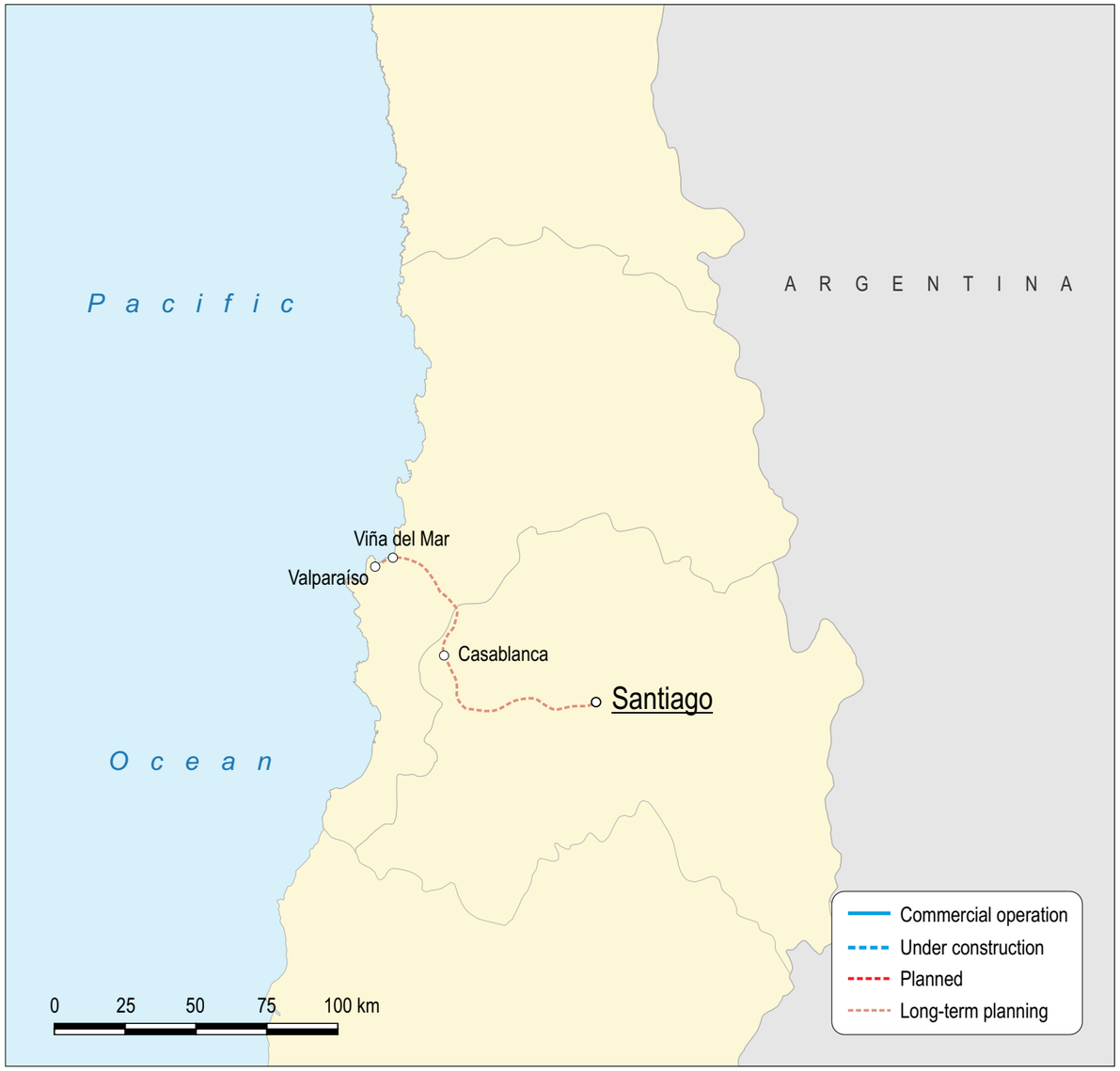
***High-speed lines with long-term planning in Chile***

| LINE | MAXIMUM SPEED (km/h) | YEAR | DISTANCE (KILOMETRES) |
|---|---|---|---|
| Santiago - Valparaíso | 220 | - | 127 |
| | | | **Total km = 127** |

*Source: miscellaneous data sources*

# 7.1 HIGH-SPEED RAIL NETWORK

***High-speed lines with long-term planning in Chile***




*Source: miscellaneous data sources, 2021*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# INDEX OF COUNTRIES

# INDEX OF COUNTRIES. HIGH-SPEED RAIL NETWORK

*Index of countries (I)*

*Index of countries (II)*


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March 2022

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