Byrne Seminar
The History and Future of High Speed Passenger Trains
Germany

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Germany High Speed Passenger Trains

Statistics

- Federal Republic of Germany
- Comparison with US

Item	*Germany*	*US*
Area	0.35 M km^2	9.8 M km^2
Driving side	right	right
GDP (nom)	\$ 3.9 T	\$ 22.3 T
GDP (PPP†)	\$ 4.4 T	\$ 22.3 T
Population	83 M	328 M

†Purchasing Power Parity

Germany High Speed Passenger Trains

History

- First railway line established in 1835 connecting Nuremberg and Fürth
- Steam powered locomotive (Adler) built in the United Kingdom
- First long distance railway line completed in 1839 connecting Leipzig and Dresden ($\approx$ 113 km)
- Rapid growth in railway lines from 2600 km in 1845 to more than 8000 km in 1855

Adler (replica)

Germany High Speed Passenger Trains

Unification of Germany

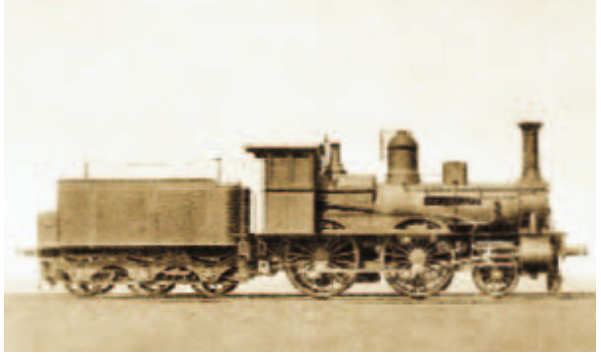
- Prior to 1871 the German Confederation was a loose association of sovereign states and the Holy Roman Empire
- The German Empire became a unified country with William I as German Emperor

German Empire (1871-1918)

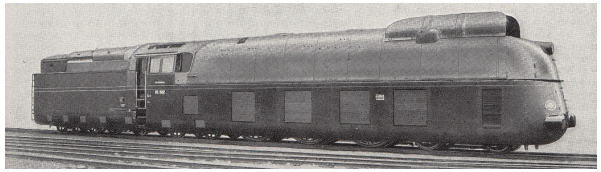
Germany High Speed Passenger Trains

History

- Following the Unification of Germany in 1871 there was a growth in railway lines in Germany
- By 1880 Germany had 9400 locomotives
- Following World War I the Deutsche Reichsbann was formed in 1920
- In 1936 a German steam locomotive set a world speed record of 200.4 km/hr



Borsig locomotive



DRG Class 006

- Following World War II, the West and East German governments separately assumed control of rail operations known as Deutsche Bundesbahn (DB) and Deutsche Reichsbahn (DR), respectively
- Deutsche Bundesbahn and Deutsche Reichsbahn consolidated in 1994 following reunification of Germany in 1990

Germany High Speed Passenger Trains

Deutsche Bundesbahn

- Deutsche Bundesbahn (Deutsche Bahn) is the state owned railway system in Germany
- It is a private joint-stock company (AG)
- The Federal Republic of Germany is the single shareholder
- Transports 2 B rail passengers annually
- Approximately 300,000 employees

Deutsche Bahn HQ
Potsdamer Plaza, Berlin

Germany High Speed Passenger Trains

Deutsche Bundesbahn

- Fernverkehr (long-distance trains)
  - ECE (EuroCity Express) for international high-speed rail services
  - ICE (Intercity-Express) for high-speed long-distance train services between major cities and regions
  - EC (EuroCity) for IC trains that cross borders, and connects Germany with other countries
  - IC (InterCity) for long-distance semi-high-speed services

ICE 3 train

ICE 4 train

Germany High Speed Passenger Trains

Deutsche Bundesbahn

- Nahverkehr (local trains)
  - IRE (Interregio-Express) longer distance RE trains
  - RE (Regional-Express) serves regions and connects cities
  - RB (Regionalbahn) stops at all stations on the route
  - S (S-Bahn) is rapid transit and most services stop at all stations

Interregio-Express train

Germany High Speed Passenger Trains

Intercity Express

- Intercity Express (ICE) is the main high speed rail system in Germany
- Tests began in 1985 with InterCityExperimental (ICE-V) train
- Set world speed record of 406.9 km/hr in 1988
- The ICE network was officially inaugurated on 29 May 1991

ICE-V train

Germany High Speed Passenger Trains

ICE 1

- First generation ICE railsets

Item	*Value*
Formation	12 or 14
Length	26.4 m (per car)
Width	3.02 m
Height	3.84 m
Electric system	15 kV, 16.7 Hz
Track gauge	standard
Passengers†	53 (1st class)
	71 (2nd class)
Maximum speed	280 km/hr

†Per car

ICE 1

ICE 1 commemerative stamp

Germany High Speed Passenger Trains

Hanover-Würzburg Line

- Construction began in 1973
- Designed for maximum 1.25% incline
- Length 327 km (120 km in tunnels!)
- Longest tunnel Landrücken (10.7 km)
- Second longest Münden (10.5 km)
- Operating speed 280 km/hr

German high speed rail network

Germany High Speed Passenger Trains

ICE 2

- Second generation ICE railsets

Item	*Value*
Formation	8 cars
Electric system	15 kV, 16.7 Hz
Track gauge	standard
Passengers	391
Maximum speed	280 km/hr

ICE 2

- Lighter weight cars compared to ICE 1
- Air suspension system

Germany High Speed Passenger Trains

ICE 3

- Third generation ICE railsets

Item	*Value*
Formation	8 or 16
Length†	200.8 m
Width	2.95 m
Height	3.89 m
Electric systems	15 kV, 16.7 Hz
	25 kV, 50 Hz
Track gauge	standard
Passengers†	430 to 460
Maximum speed	320 km/hr

†Formation of 8 cars

ICE 3

Germany High Speed Passenger Trains

Frankfurt-Cologne Line

- Completed in 2002
- length 180 km
- Route mostly follows Bundesautobahn 3
- Travel time 62 minutes
- Maximum 4% grade
- Total cost 6 B euro

German high speed rail network

Germany High Speed Passenger Trains

ICE 4

- Fourth generation ICE railsets
- Replacement for ICE 1 and ICE 2

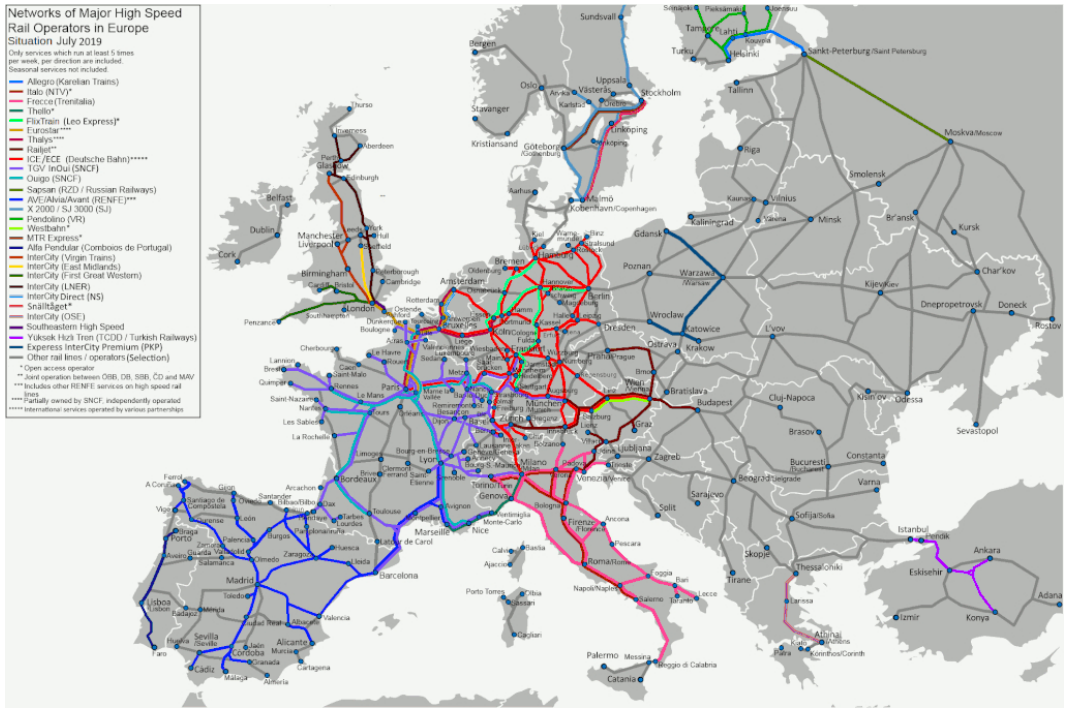
Item	*Value*
Formation	7 or 12
Length	202 m to 288 m
Width	2.6 m to 2.8 m
Electric system	15 kV, 16.7 Hz
Track gauge	standard
Passengers	499 to 830
Maximum speed	250 km/hr

ICE 4

Germany High Speed Passenger Trains

Europe High Speed Rail System

- ICE is part of European High Speed Rail System



Germany High Speed Passenger Trains

ICE Connections

- Examples of inter-country ICE trains
  - Duisburg Hbf to Amsterdam Centraal (Netherlands)
  - Köln Hbf via Aachen Hbf and Liège-Guillemins to Bruxelles-Midi/Brussel-Zuid (Belgium)
  - Saarbrücken Hbf to Paris Est (France)
  - Basel SBB to Interlaken Ost (Switzerland)
  - Basel SBB to Zürich HB (Switzerland)
  - München Hbf via Kufstein to Innsbruck Hbf (Austria)
  - Passau Hbf via Linz Hbf to Wien Westbf (Austria)

ICE train at Amsterdam Central

ICE train at St Pancras (London)

Germany High Speed Passenger Trains

ICE Performance

- Annual passengers

Year	*Passengers (M)*
1991	5.1
1992	10.2
1993	14.6
1994	21.3
1995	27.2
2000	41.6
2005	66.8
2010	77.8
2015	80
2018	94
2019	99.2

ICE trains