High-Speed Rail: Costs and Best Practices

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Costs

Construction costs for HSR vary greatly between projects. This is studied by professionals (e.g. Beria, World Bank...).

HSR costs correlate with subway costs, but imperfectly.

Scope matters—some places are better than others at avoiding tunnels and viaducts. At-grade, HSR costs $30 million/km normally.

Best practices

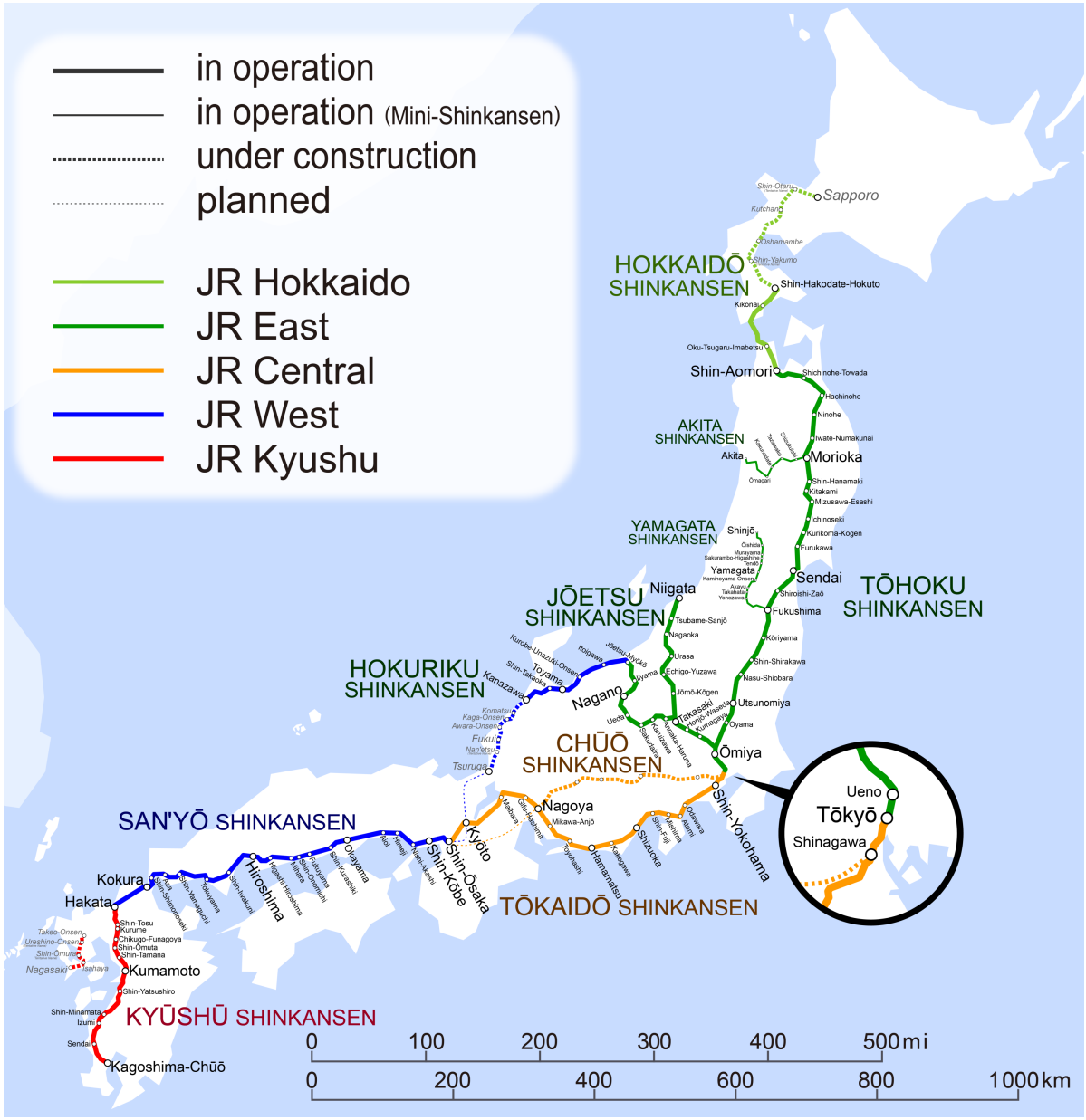
Costs are connected with practices—HSR projects vary in use, not just costs.

Q. Is there a global best practice for HSR?

A. No.

But there are aspects of different systems worth learning from.

Japan

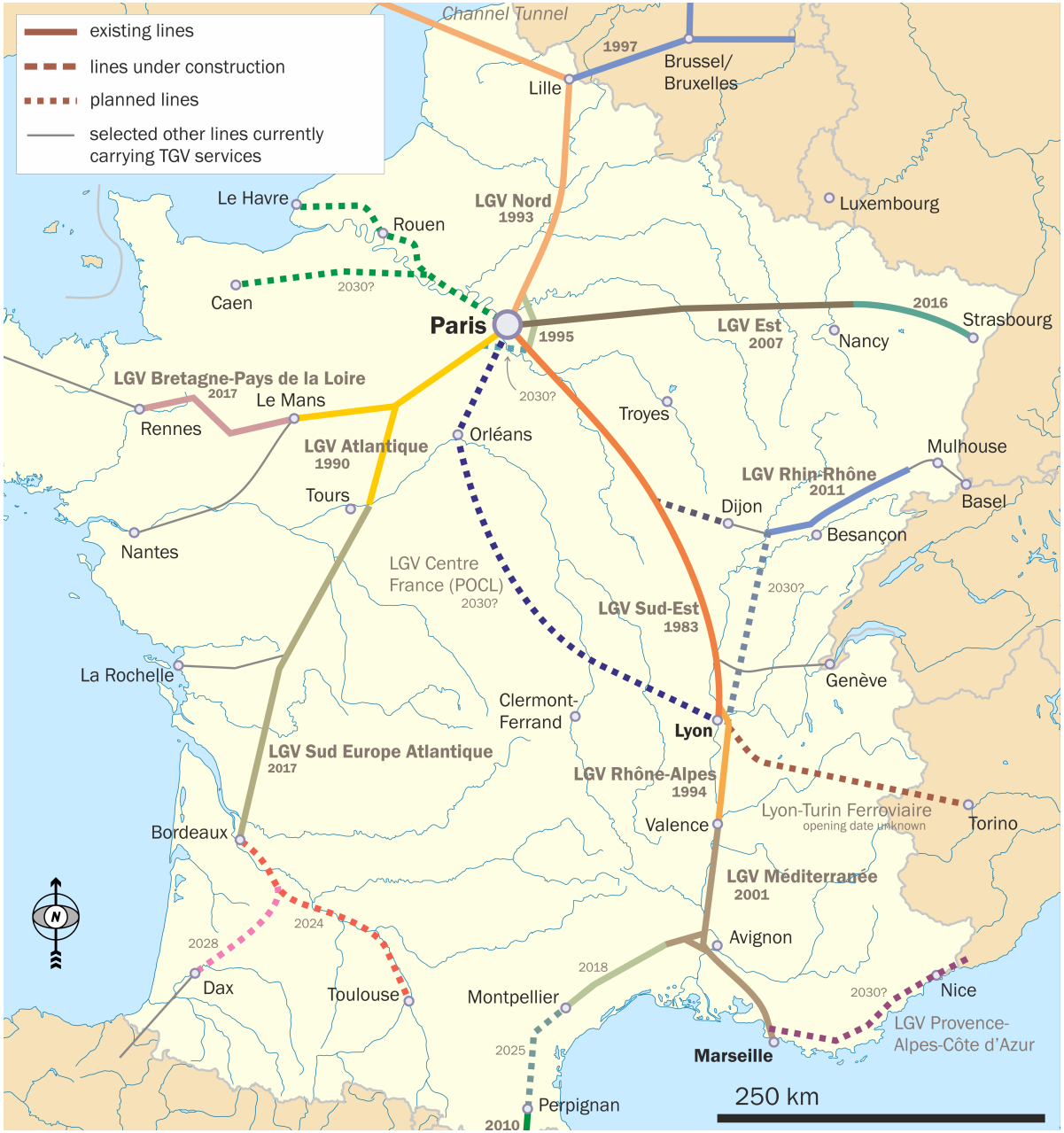

in operation
in operation (Mini-Shinkansen)
under construction
planned
JR Hokkaido
JR East
JR Central
JR West
JR Kyushu
HOKKAIDŌ SHINKANSEN
Sapporo
Shin-Hakodate-Hokuto
Shin-Aomori
AKITA SHINKANSEN
Morioka
YAMAGATA SHINKANSEN
Shinjō
Yamagata
Sendai
TŌHOKU SHINKANSEN
JŌETSU SHINKANSEN
Niigata
HOKURIKU SHINKANSEN
Kanazawa
Nagano
Utsunomiya
Fukushima
CHŪŌ SHINKANSEN
Ōmiya
Nagoya
Shin-Yokohama
Ueno
Tōkyō
Shinagawa
SAN'YŌ SHINKANSEN
Kyōto
Shin-Ōsaka
Shin-Kōbe
Hiroshima
Okayama
Kokura
Hakata
TŌKAIDŌ SHINKANSEN
Kumamoto
Kagoshima-Chūō
KYŪSHŪ SHINKANSEN
0 100 200 300 400 500 mi
0 200 400 600 800 1000 km

Japan, ctd.

The Shinkansen runs like a **subway** but between cities.

- There is very little track-sharing.
- Stopping patterns are fairly consistent (local, semi-express, express).
- Fares are consistent.
- Trains run mostly on viaduct, so construction costs are high.
- Average speed is high, around 220-230 km/h on express trains.

France


existing lines
lines under construction
planned lines
selected other lines currently carrying TGV services
Channel Tunnel
1997
Brussel/ Bruxelles
Lille
Le Havre
Rouen
LGV Nord 1993
Luxembourg
Caen
2030?
Paris
1995
LGV Est 2007
2016
Strasbourg
Nancy
LGV Bretagne-Pays de la Loire
2017
Le Mans
Rennes
2030?
Troyes
Orléans
LGV Atlantique 1990
Mulhouse
LGV Rhin-Rhône 2011
Tours
Dijon
Basel
Besançon
Nantes
LGV Centre France (POCL)
2030?
2030?
LGV Sud-Est 1983
La Rochelle
Genève
Clermont-Ferrand
Lyon
LGV Sud Europe Atlantique 2017
LGV Rhône-Alpes 1994
Lyon-Turin Ferroviaire
opening date unknown
Torino
Valence
Bordeaux
LGV Méditerranée 2001
2024
2028
Avignon
2018
Dax
Toulouse
Montpellier
2030?
Nice
LGV Provence-Alpes-Côte d'Azur
2025
Marseille
Perpignan
2010
250 km

France, ctd.

The TGV runs like an **airline** at ground level.

- Trains run point-to-point, usually nonstop. Paris-Marseille trains skip Lyon.
- Trains have infrequent one-seat rides to medium-size cities off the high-speed network ("LGV").
- Fares use airline-style yield management.
- There's extensive imitation of LCCs, with separate train stations for cheaper trains.
- Trains run mostly at-grade, with low construction costs.
- Average speed is high, around 220-260 km/h.

Germany


Kiel
Rostock
Binz
Lübeck
Hamburg
Bremen
Oldenburg
Hannover
Berlin
Münster
Magdeburg
Duisburg
Dortmund
Göttingen
Leipzig
Kassel
Erfurt
Dresden
Köln
Jena
Aachen
Frankfurt
Würzburg
Saarbrücken
Mannheim
Nürnberg
Stuttgart
Passau
Augsburg
München
Basel

Germany, ctd.

The ICE runs like a **conventional railway** but faster.

- HSR lines are bypasses of slow or congested areas—every train runs on slow tracks extensively.
- Trains run on a regular hourly clockface schedule ("Takt"), with timed connections.
- Fares are midway between France and Japan in complexity.
- Most lines are mixed with freight (but freight often doesn't even use them), leading to more tunnels and high costs.
- Average speed is low, at best around 170 km/h.

Mixing and matching

Q. Is it possible to mix and match the traditions for what they do best?

A. Yes! Germany is slowly building more lines to fill in network gaps. Spain has a very TGV-like network but understands the drawbacks and seeks to do better.

The exact mix of the traditions sometimes depends on local circumstances and sometimes doesn't:

- France excels at NIMBY suppression in general.
- Timetabling should look more like Japan with big cities and more like Germany with small ones.
- German rail integration is more important when there's a legacy commuter network that trains need to share track with.
- Japan makes more efficient use of platforms than Europe—this is important in constrained places (e.g. UK).

Where is the US?

The US is the worst industry practice. What each of the above three traditions does worst, the US does even worse.

- Frequency is inconsistent and trains are broken between Regionals and Acelas—worse than TGVs.
- Integration with conventional rail is worse than in France.
- Construction plans (e.g. California HSR) are more overbuilt than Japan, at very high costs.
- Average speed is worse than in Germany.

The current Northeast Corridor plan is to spend $117 billion to get average speeds of around 140 km/h, worse than half-fast, half-legacy German lines.

Can the US do better?

Yes.

But it requires letting go of the entirety of accumulated American railroader culture and traditions. The Northeast Corridor needs the following paradigm:

- Integrated takt timetable planning between intercity and commuter rail, with takts, timed overtakes, timed connections, etc.
- Infrastructure-timetable-rolling stock integration: capital investments should be planned together with the schedule.
- Electronics before concrete: it's cheaper to electrify, improve signaling, upgrade platforms, etc. than to pour concrete.
- ...but not instead of concrete: you should actually build those HSR bypasses!