



Intercity high-speed railway systems

High-speed railway explained

Definitions of a high-speed railway system vary, but a common one is a rail system designed for maximum train speeds that exceed 200 km per hour for upgraded tracks and 250 km per hour for new tracks. High-speed rail is generally used for intercity transport rather than urban transport.

Performance, evaluated

Capacity	Approximately 1,000 persons per vehicle. Double-decker trains increase the capacity but also increase drag, and thus increase the amount of energy needed.
Geographical range	There is no limit in expanding the line, as long as the demand is high. Generally, high-speed rail can compete with airplane trips of 300–600 km and car trips of up to 300 km. ¹
Implementing cost	Infrastructure costs are highly variable and very dependent on a number of site-specific factors. Excluding planning fees, the cost can range from 9 million to 40 million euros per kilometre in Europe. There is an additional 30,000 euros per kilometre in track maintenance costs as well as 77,000–145,000 euros per seat in rolling stock (train) operations and maintenance costs. ² Costs in Asia are likely somewhat lower due to lower construction and labour costs.
Payback period	The length of the payback period depends not only on the cost of the project but also on ridership per year and the level of passenger charges. European studies have shown break-even ridership to be 3 million to 17 million passengers per year. ³ Most systems take in more revenue than annual operating costs but do not come close to recouping the infrastructure investment costs.
Example	Shinkansen in Japan, High-speed rail in China, Korean Train eXpress in Republic of Korea

Strengths of the high-speed railway

- Long-term and durable infrastructure
- High carrying capacity
- Relatively safe (fewer traffic casualties compared to road-based transport)
- Efficient land use (road-based transport occupies more space with multiple lanes and parking lots)
- Faster, more reliable transportation times

¹ Gines De Rus, "The economic effects of high-speed rail investment", Discussion paper No. 2008-16 prepared for the Round Table on Airline Competition, Systems of Airports and Intermodal Connections, Paris, 2-3 October 2008. Available from www.internationaltransportforum.org/jtrc/discussionpapers/dp200816.pdf (accessed 21 February, 2012).

² *ibid.*

³ Chris Nash, "Enhancing the Cost Benefit Analysis of High Speed Rail", *California Connect*, February 22, 2011. Available from <http://californiaconnect.com/research/view/enhancing-the-cost-benefit-analysis-of-high-speed-rail> (accessed 26 September 2011).

If designed well, high-speed railway systems contribute towards:

- Improved air quality and lower greenhouse gas emissions⁴
- Economic growth and increased employment

Challenges to using high-speed railway

- Estimating annual ridership during feasibility stage analysis (and thus returns, including greenhouse gas reduction) can be difficult, especially when developments in other transportation modes (air and automobile) are uncertain
- High investment costs for buying the needed land and building the lines and trains
- Long period of construction time and for reaping payback

Limitations

- High-speed rail lines, once built, are very inflexible. Corridors to be developed must be heavily studied to determine if the return is likely to be eco-efficient.
- Increasing train speed requires considerably more electricity. If power is sourced from polluting technologies and/or if load factors are low, high-speed rail can actually exacerbate rather than mitigate greenhouse gas emissions.
- The possible positive ecological impacts are largely dependent on a modal shift – more passengers must choose high-speed rail links over driving or flying.
- To maintain the high speed and financial viability of the system, the service should be supplemented with intermodal transport that will improve the connectivity and sense of door-to-door service.
- Construction on soft ground is technically difficult. The difficult terrain and travel through high-density cities are the main reasons for the higher construction costs.

Implementing strategies

- **Financial support from public sector:** Securing and allocating government revenue for high-speed rail investments over multiple years is a necessary first step to allow for the required years of planning and construction of a new high-speed rail project. Long-term revenue could come from a transportation tax.⁵ Publically chartered infrastructure corporations can foster public-private partnerships and alleviate planning difficulties for lines that cross administrative boundaries of provinces or even national borders.⁶ A high-speed railway should be promoted alongside renewable energy-promoting policies in order to have positive climate change mitigation impacts.
- **Coordination with feeder transportation:** Because a high-speed railway is usually operated for passenger transport, the service should be linked to other more flexible feeder transportation in order to improve the connectivity.
- **Strategic design of networks:** Because demand for rail services needs to be quite high for investment in high-speed rail to be worthwhile, it is significantly important that a high-speed rail system be used to link sizeable population centres that expecting increased travel capacity between them

⁴ To be environmentally beneficial, a high-speed railway system must capture the market share of passengers who would otherwise use cars or airplanes. The final environmental impact depends on (inter alia): Load factor (CO₂ emissions per passenger mile decrease as passengers increase); Electricity CO₂ factor (generation mix and associated emissions); Changes in competing modes (emissions for air and road transportation).

⁵ Petra Todorovich, Daniel Schned and Robert Lane, *High-Speed Rail: International Lessons for U.S. Policy Makers* (Cambridge, MA, Lincoln Institute of Land Policy, 2011).

⁶ Petra Todorovich, Daniel Schned and Robert Lane, *High-Speed Rail: International Lessons for U.S. Policy Makers* (Cambridge, MA, Lincoln Institute of Land Policy, 2011). Available from www.lincolnst.edu/pubs/download.asp?doc_id=1268&pub_id=1948 (accessed 26 September 2011).

Further reading

High Speed and the City, by International Union of Railways (Paris, 2010a). Available from www.uic.org/download.php/publication/518E.pdf

High Speed Rail, by International Union of Railways (Paris, 2010b). Available from www.uic.org/download.php/publication/521E.pdf