

Toward clean, efficient passenger rail: A comparison of key indicators and policy milestones in China and the United States

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INTRODUCTION

In many countries, passenger rail is a backbone of mobility networks, efficiently connecting cities, rural areas, and regions. Passenger railway systems often offer a cost-effective, energy-efficient, low-carbon alternative for short- and medium-distance travel, while also reducing urban congestion. They can also play a critical role in decarbonizing the transportation sector.

China and the United States—two countries with significant populations, land areas, and economies—have developed extensive railway networks. China has more than 155,000 km of railway, with 60% of the network being double tracks. The United States has about 250,000 km of railway, most of it single track.¹ China's mainly state-owned railway network prioritizes passenger travel. The largely privately-owned and operated U.S. network is primarily for freight.

Both countries have invested in developing passenger rail but with different priorities and funding levels. Comparing their policies and passenger rail data can provide useful information for other regions interested in shaping their passenger railway

¹ Federal Railroad Administration, *Freight Rail Overview*, U.S. Department of Transportation, July 8, 2020, <https://railroads.dot.gov/rail-network-development/freight-rail-overview>; Ministry of Transport of the People's Republic of China, 交通概况 [Transportation overview], June 16, 2023, https://www.mot.gov.cn/jiaotonggaikuang/201804/t20180404_3006639.html. Trains sharing a single track must pull onto sidings to allow other trains to pass; a double track (one track in each direction) greatly increases capacity.

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systems. Accordingly, this paper compares representative indicators of the passenger railway systems in China and the United States, provides an overview of their main development milestones, and explores differences between the two systems. This analysis is based on publicly available sources in China and the United States, with a focus on the national, government-owned passenger rail systems only. In this case, the comparison is mainly between high-speed rail (HSR) operated by the China State Railway Group (China Railway) and the entire U.S. system operated by the National Railroad Passenger Corporation, known as Amtrak.²

PASSENGER RAIL IN CHINA AND THE UNITED STATES

This section briefly introduces the passenger railway systems in China and the United States and compares ridership, infrastructure, energy consumption and emissions, and costs.

CHINA'S PASSENGER RAILWAY SYSTEM

China Railway, a government-owned enterprise, has built, operated, and managed passenger rail since 2013, when it was split from the former Ministry of Railways.³ HSR planning can be traced back to 1990, to the *Beijing-Shanghai High-Speed Railway Route Planning Concept Report*.⁴ Since then, China has updated its HSR goals in the planning document every 5 years. HSR is a top priority in China; it has grown tremendously in recent years. China's *14th Five-Year Plan for the Development of a Modern Integrated Transportation System* set out a blueprint for "Eight Vertical and Eight Horizontal" HSR corridors, covering more than 95% of cities with populations of 500,000 or more with trains that run 250 kilometers per hour or faster by 2025.⁵

THE U.S. PASSENGER RAILWAY SYSTEM

Amtrak has operated the U.S. national passenger rail network since its creation in 1970 as the National Railroad Passenger Corporation. Freight railroads in the United States are privately owned, but Amtrak is a federally-chartered, for-profit, private corporation; its majority stockholder is the federal government. It currently runs routes in 46 states.⁶ Since it took over intercity passenger travel, Amtrak has launched projects to upgrade trains and routes. A major milestone was the electrification of routes between New Haven, Connecticut, and Boston, Massachusetts. Amtrak also inaugurated the first Acela Express high-speed train service between Washington and Boston with a top speed of about 150 miles per hour (242 km/h).⁷ In 2021, the Infrastructure Investment and Jobs Act authorized \$22 billion for Amtrak to repair and replace old, obsolete assets in its network, with an additional \$44 billion directed to the Federal Railroad Administration to support improvements.⁸

Although both are run by government-owned enterprises, the Chinese and U.S. railway systems have much different profiles. Figure 1 highlights selected indicators

2 This overview of China's system focuses mainly on HSR, because the regular rail system has a high share of mixed freight and passenger service.

3 Martha Lawrence, Richard Bullock, and Ziming Liu, *China's High-Speed Rail Development* (Washington, DC: World Bank Group, 2019), <https://documents1.worldbank.org/curated/en/933411559841476316/pdf/Chinas-High-Speed-Rail-Development.pdf>.

4 Lawrence, Bullock, and Liu, *China's High-Speed Rail Development*.

5 State Council of China, 国务院关于印发“十四五”现代综合交通运输体系发展规划的通知 [Notice of the State Council on issuing the Development Plan for the Modern Comprehensive Transportation System During the 14th Five-Year Plan], December 12, 2021, http://www.gov.cn/zhengce/content/2022-01/18/content_5669049.htm.

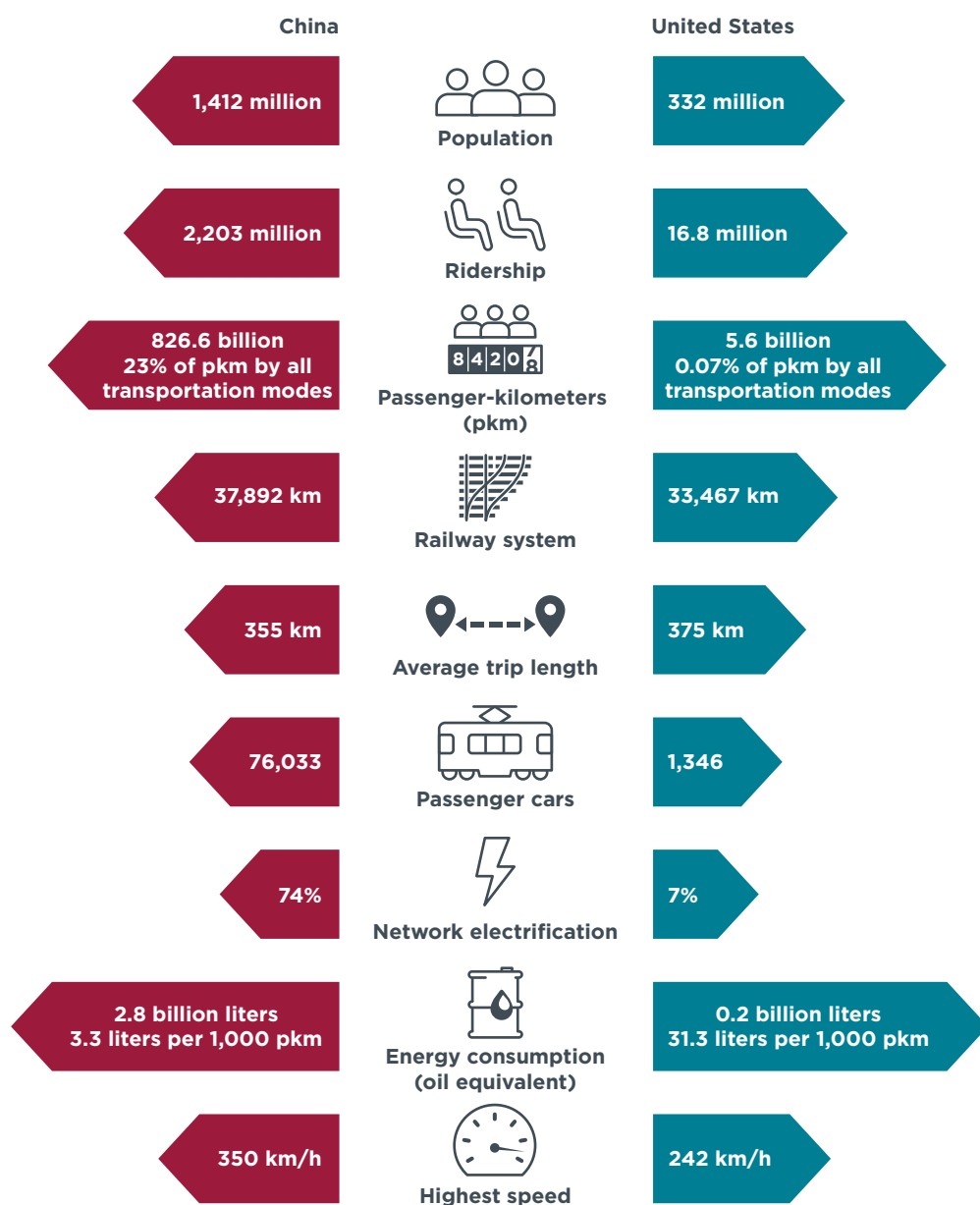
6 Amtrak, "Amtrak Facts," accessed October 2023, <https://www.amtrak.com/amtrak-facts>; the four states not served by Amtrak are Alaska, Hawaii, South Dakota, and Wyoming.

7 Amtrak, "2000s—America's Railroad," accessed October 2023, <https://history.amtrak.com/amtraks-history/2000s>.

8 Amtrak, "New Era of Rail," accessed October 2023, <https://www.amtrak.com/new-era-of-rail>.

representing railway performance, technology, and energy usage in both countries based on 2020 data. Overall, rail plays a more vital role in China, with higher speeds, greater ridership, and more volume in terms of passenger-kilometers (pkm) traveled. In addition, most of China's HSR is electrified, using much less energy per pkm.

Figure 1
Comparison of selected passenger railway transport indicators in China and the United States, 2020



Note: U.S. ridership and other data is for Amtrak's 2020 fiscal year.

Sources: National Bureau of Statistics of China, 中国统计年鉴 [China statistical yearbook 2021], 2021, <https://www.stats.gov.cn/sj/ndsj/2021/indexch.htm>; Amtrak, "FY 2020 Company Profile," 2021, <https://www.amtrak.com/content/dam/projects/dotcom/english/public/documents/corporate/nationalfactsheets/Amtrak-Company-Profile-FY2020-041921.pdf>.

PASSENGER TRAFFIC

Rail is a dominant transport mode in China; it enjoys high passenger demand. The railway share was almost 50% in 2019; that level fell to about 25% in 2020 because of

the pandemic.⁹ Nevertheless, in 2020, China's railways carried more than 2.2 billion passengers and reached more than 826.6 billion pkm, as shown in Figure 1.

U.S. passenger rail is more limited. In 2019, Amtrak carried about 32 million passengers, less than 1% of total pkm on all modes. In 2020, that level fell to about 17 million passengers, still less than 1% of total pkm.

China's passenger traffic and market share far exceed those of the United States. China's population is four times greater, which partly explains greater rail travel demand. However, China's rail ridership was more than 130 times U.S. ridership, while pkm on China's railways was nearly 150 times more. High ridership and market share reflect the critical role of rail in China's transportation system.

Even with these differences, average trip length was similar in both countries. This may be because they have similar total land area, kilometers of track, and numbers of stations.

RAILWAY INFRASTRUCTURE AND ROLLING STOCK

Different traffic demands in China and United States have led to differences in railway infrastructure (including tracks and stations) and rolling stock (locomotives and passenger cars). In 2020, the number of passenger rail cars in China exceeded 76,000; there were fewer than 1,500 in the United States. Since both countries have similar territorial area and almost the same number of provinces/states covered by railway operations, their overall passenger rail track length is also similar (about 30,000 km).¹⁰ Passenger cars for HSR in China are configured to accommodate more people, including those who purchase standing-only tickets, reflecting the combined impact of more frequent train service and better utilization of passenger car capacity.

Although China Railway operates both freight and passenger rail, passenger travel is a higher priority.¹¹ Nearly 10,000 high-speed train departures are made every day; this is possible because nearly 60% of the network is double-tracked and trains have a maximum operating speed of 350 km/h.¹²

Amtrak passenger trains run mostly on tracks leased from freight companies. Amtrak owns 3% of the tracks it uses, mostly in the busy Northeast Corridor.¹³ Although the maximum speed of Amtrak's only high-speed train service, the Acela, is designed to be up to 242 km/h, actual operating speeds over much of the route are only about half that because of track infrastructure and freight traffic. Severe delays often occur in Amtrak's network when passenger trains must wait for freight trains on tracks controlled by the freight railroads.¹⁴ In 2021, only one of Amtrak's 15 long-distance routes reached an on-time rate of 80%.¹⁵

9 Ministry of Transport of the People's Republic of China, 2019年交通运输行业发展统计公报 [2019 Transportation industry development statistical bulletin], May 12, 2020, http://www.gov.cn/xinwen/2020-05/12/content_5510817.htm.

10 The track length of regular railways used for mixed passenger and freight transportation is not counted, so the actual length of passenger railways in China is higher.

11 David Cole et al., *Freight Mobility and Intermodal Connectivity in China*, FHWA-PL-08-020 (Washington, DC: Federal Highway Administration, 2008), <https://international.fhwa.dot.gov/pubs/pl08020/pl08020.pdf>.

12 People's Daily, 上半年全国铁路发送旅客17.7亿人次 [In the first half of the year, China's railways carried 1.77 billion passengers], July 10, 2023, http://paper.people.com.cn/rmrb/html/2023-07/10/nw.D110000renmrb_20230710_6-06.htm.

13 Amtrak, "Amtrak Host Railroad Report Card: CY2022," 2023, <https://www.amtrak.com/content/dam/projects/dotcom/english/public/documents/corporate/HostRailroadReports/Amtrak-2022-Host-Railroad-Report-Card.pdf>.

14 Amtrak, "FY 2021 Company Profile," 2022, <https://www.amtrak.com/content/dam/projects/dotcom/english/public/documents/corporate/nationalfactsheets/Amtrak-Company-Profile-FY2021-030922.pdf>.

15 Rail Passenger Association, "Amtrak On-Time Performance," 2022, https://railpassengers.org/site/assets/files/25442/on-time_performance_2022_final.pdf.

ENERGY CONSUMPTION AND EMISSIONS

China's passenger trains have lower total energy consumption and emissions than U.S. trains. More than 70% of China's passenger rail network is electrified. Accordingly, China's passenger trains use one tenth of the energy used by Amtrak. Emissions related to train travel should continue to decrease in China with further rail electrification and decarbonization in the power generation sector. Conversely, more than 90% of Amtrak's locomotives are diesel, and the system lacks a clear pathway to fully phase in zero-emission technology even with the 2045 net-zero target.¹⁶

TRAVEL TIMES AND COSTS

Table 1 compares travel times and costs in China and the United States using representative short- and long-distance routes. The New York-Washington, D.C., and Chongqing-Chengdu routes were selected as the short-distance routes; both are southwest to northeast oriented. New York-Fort Hood, Texas, and Shanghai-Kunming were selected as long-distance routes; New York and Shanghai are economic centers. Ticket information was retrieved in May 2023 from Amtrak's website and China's ticketing website. The information shows that routes in China cost less and took half the time or less to travel similar distances. The short-distance U.S. ticket cost about 6 times more. For long-distance travel, China's HSR presents a more significant time-cost advantage at about one third of the U.S. ticket price and one fifth of the U.S. travel time. In addition, Table 1 also shows that costs per kilometer are relevantly consistent between short- and long-distance routes in China. In the United States, the long-distance cost per kilometer is less than half the short-distance cost.

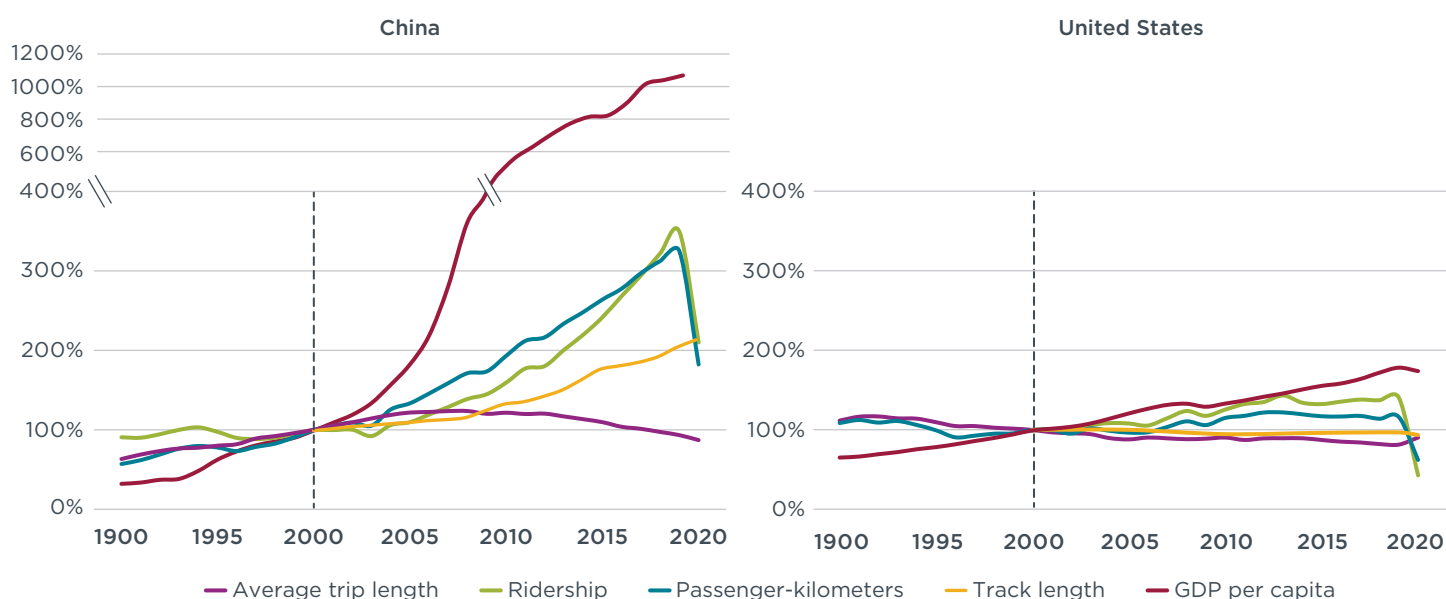
Table 1
Comparison of routes, distances, travel times and ticket prices in China and the United States

Routes	Chongqing-Chengdu	New York-Washington, D.C.	Shanghai-Kunming	New York-Fort Hood, Texas
Distance (km)	302	354	2,322	2,505
Time	1h 45min	3h 20min	11h 52min	56h 27min
Cost (coach)	¥138 (\$19.40)	¥818 (\$115)	¥879 (\$123)	¥2,408 (\$337)
Cost per km	¥0.46 (\$0.06)	¥2.31 (\$0.32)	¥0.39 (\$0.05)	¥0.96 (\$0.13)

DEVELOPMENT TRENDS

Modern railway systems are the result of longterm economic development and infrastructure investment. Figure 2 compares key development trends for passenger railways in China and the United States using per capita disposable income, passenger traffic or ridership, pkm, system track length, and average travel distances. Due to limited data availability, only high-level domestic travel comparisons were conducted. The year 2000 was selected as the baseline, given this is when HSR investment and development in China started.

¹⁶ Amtrak, "Amtrak's Five Strategies to Lead Sustainable Mobility," accessed January 2024, <https://www.amtrak.com/climate-commitment>.

Figure 2**Percentage change in passenger rail indicators in China and the United States, using 2000 as the baseline year**

Note: Track length in China covers only HSR, as China's regular railway network has a high share of mixed passenger and freight transportation.

Sources: National Bureau of Statistics of China, 中国统计年鉴 [China statistical yearbook 2021], 2021, <https://www.stats.gov.cn/sj/ndsj/2021/indexch.htm>; Amtrak, "FY 2020 Company Profile," 2021, <https://www.amtrak.com/content/dam/projects/dotcom/english/public/documents/corporate/nationalfactsheets/Amtrak-Company-Profile-FY2020-041921.pdf>.

With China's rapid economic development and continuously increasing per capita disposable income, passenger rail demand (both ridership and pkm) grew tremendously from 1990–2020. Ridership increased from 1 billion passengers in 2000 to 3.6 billion in 2019, with an average annual growth rate of 6.8%. Although passenger traffic dropped to 2.2 billion in 2020, it was still double the 2000 rate.¹⁷ Growth in pkm is slightly higher, indicating total trip length also grew over time.

The average annual growth of U.S. ridership was 1.9% from 2000–2019. U.S. economic growth was also slower, as measured by per capita GDP, during this time. Railway ridership has been steady in recent years and is consistent with pkm growth. In 2020, because of the pandemic, ridership and pkm were lower than in 2000.

The average passenger rail trip length in China has gradually declined since its 2008 peak, even with continuous pkm growth. One reason is that the network's expansion—as guided by planning documents—has led to improved access, particularly for small cities and rural areas. This has resulted in shorter-distance train rides to nearby regions. For example, the *Medium- and Long-Term Railway Network Plan* (revised in 2008) details the building and operation of the many railway routes connecting major cities with high population densities (often called intercity railways). Improved network coverage also makes passenger rail the preferred travel mode for more people. Another reason for the reduction: data collected for average trip length were based on information from train tickets that indicate neither whether passengers transferred to other trains to continue their journeys, nor the cumulative length of transfers. Thus, average trip length shows a decline in China, with more demand for intercity travel of shorter distances being met by the HSR network.

17 Ministry of Transport of the People's Republic of China, 2020 年交通运输行业发展统计公报 [2020 Transportation industry development statistical bulletin], May 19, 2021, https://www.gov.cn/xinwen/2021-05/19/content_5608523.htm.

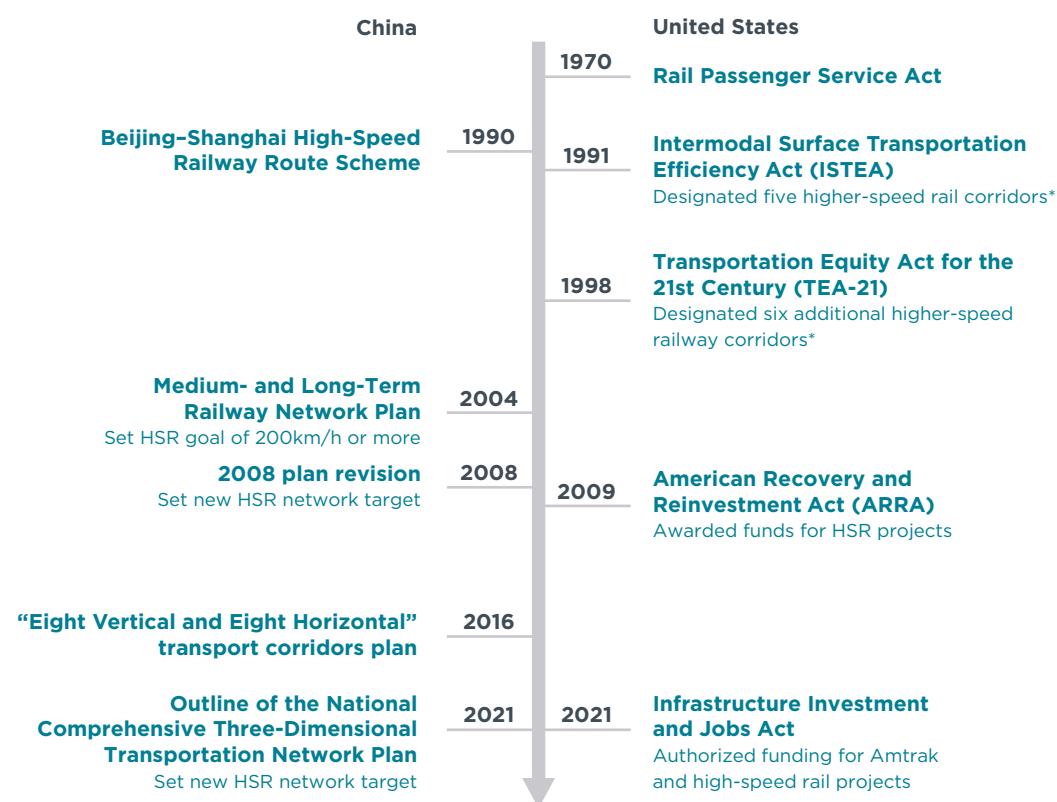
The average U.S. travel distance declined only slightly. Most of Amtrak’s ridership historically has been concentrated on short-distance Northeast routes.

The rapid development of passenger railways in China has depended on the rapid expansion of HSRs. The growth in HSR track has accelerated since 2008 with substantial government funding; HSR now accounts for 27% of railway track length, including both passenger and freight.¹⁸ Meanwhile, the number of kilometers of track used by Amtrak has remained almost unchanged for many years.

PASSENGER RAIL POLICY

China and the United States began to develop HSR around the same time, but their progress has differed. China’s first HSR was the Qinhuangdao-Shenyang route, which started operation in 2003.¹⁹ The first U.S. HSR was the Northeast Corridor Acela, which started in 2000.²⁰ Figure 3 outlines major policy milestones.

Figure 3
Major passenger rail policy milestones in China and the United States



* Higher-speed railway refers to a system with a designed maximum speed of up to 200 km/h.

POLICY AND PLANNING IN CHINA

China’s HSR development was officially proposed in a high-level policy document, the *Beijing-Shanghai High-Speed Railway Route Planning Concept Report* in 1990.²¹ In

18 Ministry of Transport, “Transportation overview.”

19 Lawrence, Bullock, and Liu, *China’s High-Speed Rail Development*.

20 Amtrak, “2000s–America’s Railroad.”

21 Xinhua Net, 《京沪高铁演绎的传奇》[The legendary Beijing-Shanghai high-speed railway], January 8, 2016, http://www.xinhuanet.com/politics/2016-01/08/c_1117718883.htm.

1994, the Guangzhou-Shenzhen HSR reached a maximum speed of 160 km/h.²² China then launched the first official HSR to connect Qinhuangdao and Shenyang with a total track length of 404 km. The Qinhuangdao–Shenyang HSR started construction in 1999 and went into full operation in 2003.²³

In the late 1990s, the former Ministry of Railways enacted the *Railway Speed Improvement Plan during the Tenth Five-Year Plan*.²⁴ The Tenth Five-Year Plan (2001–2005) proposed a national HSR network connecting major cities, including Beijing, Shanghai, and Guangzhou, by the end of the plan term. The plan also started separating passenger and freight travel, reserving some busy HSR tracks only for passenger trains.

In 2004, the first *Medium- and Long-Term Railway Network Plan* announced the planning and construction of dedicated high-speed passenger railways with more than 12,000 km of track and a maximum speed of more than 200 km/h.²⁵ In 2008, the government released a revised plan that called for the planning and construction of “Four Vertical and Four Horizontal” corridors with more than 16,000 km of dedicated passenger HSR tracks.²⁶

Targets for rail announced in the 13th Five-Year Plan (2016–2020) included reaching a total track length of 150,000 km (including 30,000 km of HSR), 4 billion passengers, and 1.6 trillion pkm by 2020. The 2016 *Medium- and Long-Term Railway Network Plan* proposed the “Eight Vertical and Eight Horizontal” corridors, scoped HSR for regional connectivity, and required the development of intercity passenger railways. Total HSR track length in China reached 37,900 km by the end of 2020, covering more than 80% of major cities. Additional targets called for reaching 45,000 km in HSR track length by 2025 and 70,000 km by 2035. HSR connectivity in provincial capitals, rapid access to prefectural and municipal cities, and basic coverage of county areas are to be established by 2030.²⁷

The *Outline of Building National Strength in Transportation*, issued by the CPC Central Committee and the State Council in September 2019, aimed to “promote the integrated development of trunk railways, intercity railways, urban (suburban) railways, and urban rail transit.”²⁸

The 14th Five-Year Plan (2021–2025) upped the HSR track target to 50,000 km by 2025. In February 2021, the *Outline of the National Comprehensive Three-Dimensional Transportation Network Plan* raised that goal, requiring the track length of the entire

22 Shenzhen Urban Transportation Planning Center, 《从铁路末端 城市到国家铁路枢纽》[From railway terminal city to national railway hub], September 23, 2020, <http://www.sutpc.com/news/jishufenxiang/626.html>.

23 National Railway Administration of the People's Republic of China, 中国高速铁路发展里程 [The development history of China's high-speed railway], March 11, 2014, https://www.nra.gov.cn/ztlz/hy/gsgt/zgtl/fzlc/201602/t20160216_146042.shtml.

24 State Planning Commission (now National Development and Reform Commission), 国家计委关于印发国民经济和社会发展第十个五年计划综合交通体系发展重点专项规划的通知 [Notice of the State Planning Commission on issuing the Key Special Plan for the Development of Comprehensive Transportation System in the Tenth Five-Year Plan for National Economic and Social Development], May 25, 2001, https://www.gov.cn/gongbao/content/2002/content_61816.htm.

25 National Development and Reform Commission, 国家《中长期铁路网规划》内容简介 [Brief introduction to the content of the National Medium and Long-Term Railway Network Plan], September 16, 2005, https://www.gov.cn/ztlz/2005-09/16/content_64413.htm.

26 National Development and Reform Commission, 国家发展改革委批准《中长期铁路网规划（2008年调整）》 [The National Development and Reform Commission approved the Medium- and Long-Term Railway Network Plan (2008 adjustment)], October 8, 2008, https://www.ndrc.gov.cn/xxgk/zcfb/qt/200906/t20090605_967738.html.

27 National Development and Reform Commission, 发展改革委印发《中长期铁路网规划》 [The National Development and Reform Commission issued the Medium- and Long-Term Railway Network Plan], July 13, 2016, https://www.gov.cn/xinwen/2016-07/20/content_5093165.htm.

28 State Council, 中共中央 国务院印发《交通强国建设纲要》 [The Central Committee of the Communist Party of China and the State Council issued the Outline for Building a Powerful Transportation Country], September 19, 2019, https://www.gov.cn/gongbao/content/2019/content_5437132.htm.

network to reach 200,000 km with 70,000 km being HSRs (including some intercity railways).²⁹ The HSR network included in the *Outline* must be efficient, modern, and cover the “Eight Vertical and Eight Horizontal” routes and regional corridors.

POLICY AND PLANNING IN THE UNITED STATES

The United States has explored the potential of introducing HSR since 1964, with several federal plans and fiscal investments, but progress has been limited.³⁰ In 1970, Congress passed the Rail Passenger Service Act with the aim of preserving intercity passenger train service. The law established the National Railroad Passenger Corporation, later known as Amtrak, to take over all intercity railway passenger services (with few exceptions) in the continental United States previously provided by private railroads.

Since then, the federal government has supported research and infrastructure upgrade projects to enable HSR. The Intermodal Surface Transportation Efficiency Act (ISTEA) and the Transportation Equity Act for the 21st Century (TEA-21), in 1991 and 1998 respectively, designated 11 HSR corridors and provided funds through the Federal Railroad Administration.³¹ In 2009, Congress approved the American Recovery and Reinvestment Act (ARRA), which provided \$8 billion to jump-start multiple HSR projects. The High Speed Intercity Passenger Rail program (HSIPR) also provided grants to upgrade rail corridors, including improvements that could allow for higher speeds, though not true high-speed rail. After the initial infusion of money, Congress stopped funding the HSIPR program.

In 2021, the Infrastructure Investment and Jobs Act, also known as the Bipartisan Infrastructure Law, authorized \$66 billion for railway infrastructure.³² The funding aims to improve and extend existing railway corridors—including modernizing and upgrading the Northeast Corridor—and establish a safe, efficient, and climate-friendly railway transportation system.³³ In late 2023, President Biden announced that \$8.2 billion from the law would support 10 passenger rail projects across the country, including advancing two HSR corridors.³⁴

TECHNOLOGY INVESTMENTS AND CONSTRUCTION UPGRADES

Technology investment in HSRs has always been a high priority in China’s planning and development documents. The *Railway Speed Improvement Plan during the Tenth Five-Year Plan*, enacted in the late 1990s, required a study on AC electric drive and multiple-unit technologies of HSR trains and the development of a 270 km/h high-speed motor train unit. The *Medium- and Long-Term Railway Network Plan* in 2004 contributed to innovation in wheel-rail technology on the Beijing–Shanghai HSR and three other north-south HSR routes, which paved the way for the rapid construction of HSR in China.

29 State Council, 中共中央 国务院印发《国家综合立体交通网规划纲要》 [The Central Committee of the Communist Party of China and the State Council issued the National Comprehensive Three-Dimensional Transportation Network Planning Outline], February 24, 2021, https://www.gov.cn/gongbao/content/2021/content_5593440.htm.

30 Federal Railroad Administration, “High-Speed Rail Timeline,” last modified December 5, 2019, <https://railroads.dot.gov/passenger-rail/high-speed-rail/high-speed-rail-timeline>.

31 Federal Railroad Administration, “High-Speed Rail Timeline.”

32 Amtrak, “New Era of Rail.”

33 Siyue Zhang and Lin, 美国《基础设施投资和就业法案》概况、进展及影响 [The Infrastructure Investment and Jobs Act of the United States: Background, overview and impact], *Advances in Social Sciences* 11(5) (May 2022): 1580-1586, https://pdf.hanspub.org/ASS20220500000_56297148.pdf.

34 The White House, “Fact sheet: President Biden Announces Billions To Deliver World-Class High-Speed Rail and Launch New Passenger Rail Corridors Across the Country,” December 8, 2023, <https://www.whitehouse.gov/briefing-room/statements-releases/2023/12/08/fact-sheet-president-biden-announces-billions-to-deliver-world-class-high-speed-rail-and-launch-new-passenger-rail-corridors-across-the-country/>.

The Ministry of Science and Technology and the Ministry of Railways jointly signed the *Joint Action Plan for Independent Innovation of High-Speed Trains* in China in 2008, which further increased independent efforts to develop a new generation of high-speed trains with speeds of 350 km/h or more.³⁵ The plan also stated that China would establish independent intellectual property rights and increase its international competitiveness in the high-speed train market.

Amtrak has also laid out plans for enhancing service and improving speeds. A new fleet of Acela trains, with top speeds of 258 km/h, is scheduled to start operating in the Northeast Corridor in 2024.³⁶ As part of its fleet modernization program, Amtrak is also upgrading its long-distance trains to be cleaner, faster, and more efficient.³⁷ The Bipartisan Infrastructure Law is funding studies on ways to increase speed and improve capacity in the Northeast Corridor.

SUMMARY

Passenger rail transportation in China and the United States present different key indicators for capacity, operational efficiency, and electrification level. Although passenger rail development started relatively late in China, the country has experienced substantial growth in the past two decades; it now has one of the world's largest railway networks. Train speed rose every 5 years after China committed to HSR development. The U.S. passenger rail system has less equipment, smaller ridership, and lower train speeds, and still has significant room for improvement in clean emissions compared to China.

The development of China's passenger railways features intensive planning, fast construction, high operational capacity, high energy efficiency, low energy consumption, and low fares. The passenger rail sector has also continuously innovated its services (see Appendix), making it a key part of the country's entire transportation system in addition to providing China with a greener, more efficient way to travel.

³⁵ Ministry of Railways, 铁道部科技部联合深化时速350公里列车自主创新 [The Ministry of Railways and the Ministry of Science and Technology jointly deepen independent innovation of 350 kilometers-per-hour trains], February 29, 2008, https://www.gov.cn/govweb/gzdt/2008-02/29/content_905588.htm.

³⁶ Amtrak, "Next-Generation of Acela," May 19, 2022, <https://www.amtrak.com/content/dam/projects/dotcom/english/public/documents/corporate/for-acela-next-gen--sheet-051922.pdf>

³⁷ Amtrak, "Article: Introducing a New Era of Rail in America," May 25, 2023, <https://media.amtrak.com/2023/05/article-introducing-a-new-era-of-rail-in-america/>.

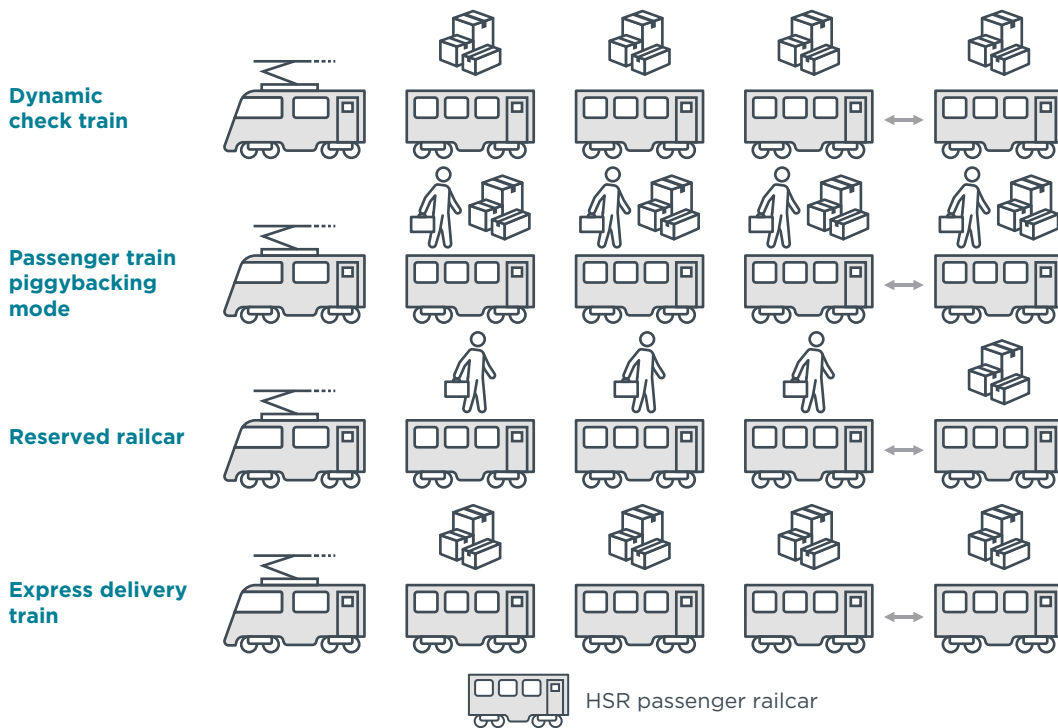
APPENDIX

CHINA'S PASSENGER RAILWAY FREIGHT SERVICES

China's railway sector has continuously innovated to use its HSR network for transporting high-value goods. The passenger railway sector has worked with the delivery and logistics company SF Express to provide express shipping for e-commerce since 2018.³⁸ Shipping freight by high speed rail is a way to both optimize track and train capacity while taking advantage of China's fast and efficient transportation network. Up to three layers of cargo boxes can be loaded in railcars without any passenger seating and with protection installed on both sides of the cars to ensure minimal movement of freight during transit.

HSR service for freight has four shipping modes, as shown in Figure A1. The four modes use different combinations of train sets with and without passengers to ship freight on the HSR network.

Figure A1
Four freight shipping modes using HSR



Source: Yuting Yang, “考虑客运能力影响的高铁快递运输组织优化” [Optimization of high-speed rail express transportation organization considering the impact of passenger capacity] (Master's thesis, Beijing Transportation University, 2023).

Dynamic check train mode: This shipping method takes advantage of special multiple-car trains that are dispatched, without passengers, by the railway operator to check the safety status of the HSR system. Inspection is usually performed early each day before regular passenger service starts. However, express freight can be delivered only to stations along the route.

Passenger train piggybacking mode: Extra space in partly-filled passenger cars is used for express packages. Goods are transported within passenger trains, and the

³⁸ China Railway, 中铁顺丰国际快运有限公司简介 [Introduction of CR-SF International Express], December 26, 2018. http://wap.china-railway.com.cn/zyyw/dyjy/tlhg/201812/t20181228_92062.html.

loading plan ensures that packages can be loaded and unloaded within the time scheduled for each stop.³⁹

Reserved rail car mode: Shippers use reserved rail cars with all passenger seats removed. These cars are then attached to passenger cars in the train set.

Express delivery train mode: Multi-unit trains like passenger trains are dispatched, but all cars are for freight only. This represents a maturing of the market for shipping express freight by high-speed rail. The first pilot runs of express freight trains were conducted between Kunming and Chengdu in July 2023, following the completion of cargo transfer facilities at the rail stations.⁴⁰

High-speed rail offers various service options for freight and package-delivery customers with different timelines and costs, as shown in Table A1.

- » Same-day delivery generally applies to products that require fast delivery but have lower price sensitivity, such as commercial contracts and certificates. The passenger piggybacking mode often delivers these small packages, and service is only available for destinations along the HSR route. Demand for same-day delivery is limited.
- » Next-morning delivery applies to products such as letters and high-grade fresh food. More services are available for next-morning delivery than for same-day delivery. Both passenger piggybacking mode trains and daily dynamic check trains are used for delivering packages and freight before 11 a.m. the following day.
- » Next-day delivery is cheaper than next-morning delivery, with goods being delivered before 6 p.m. the following day. This service covers most cities.
- » Third-day delivery is mainly designed for goods that require fast shipping but are less time-sensitive than other products. It is aimed at the express delivery market, which has been dominated by the trucking industry. Third-day delivery provides a more cost-effective option and a broader service radius than next-morning delivery.

Table A1
Delivery speeds and costs for HSR for freight services

	Same-day delivery	Next-morning delivery	Next-day delivery	Third-day delivery
Cutoff time	Same day 12:00	Previous day 12:00	Previous day 22:00	3 days previous 22:00
Promised delivery time limit	Same day by 22:00	Next day by 11:00	Next day by 18:00	Third day by 18:00
Preset weight rate	¥130/kg (\$18.00/kg)	¥30/kg (\$4.20/kg)	¥17/kg (\$2.40/kg)	¥15/kg (\$2.10/kg)
Extra weight rate	¥25/kg (\$3.50/kg)	¥15/kg (\$2.10/kg)	¥10/kg (\$1.40/kg)	¥6/kg (\$0.80/kg)

Source: China Railway Express, 产品服务 [Product service], October 2023, https://www.95572.com/cpfw_88/.

HSR provides a fast, safe, environmentally friendly option for freight transportation with high punctuality and stable freight rates. By utilizing extra rail capacity for cargo, express freight service could alleviate pressure on roads and trucking while improving transportation efficiency.

³⁹ The stopping time at the station for HSR is normally 2-3 minutes.

⁴⁰ China Railway, 整列高铁快运动车组列车, 试点开行! [The entire high-speed unit train is launched on pilot!], July 12, 2023, http://www.cr-sf.com.cn/news/news037/news_037.html.



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