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The Development of High Speed Rail in the United States: Issues and Recent Events

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Summary

The provision of $8 billion for intercity passenger rail projects in the 2009 American Recovery and Reinvestment Act (ARRA; P.L. 111-5) reinvigorated efforts to expand intercity passenger rail transportation in the United States. The Obama Administration subsequently announced that it would ask Congress to provide $1 billion annually for high speed rail (HSR) projects. This initiative was reflected in the President's budgets for FY2010 through FY2014. Congress approved $2.5 billion for high speed and intercity passenger rail in FY2010 (P.L. 111-117), but has provided no funding for the program since then, and in the FY2011 appropriations act rescinded $400 million from prior year unobligated balances of program funding.

There are two main approaches to building high speed rail: (1) improving existing tracks and signaling to allow trains to reach speeds of up to 110 miles per hour (mph), generally on track shared with freight trains; and (2) building new tracks dedicated exclusively to high speed passenger rail service, to allow trains to travel at speeds of 200 mph or more. The potential costs, and benefits, are relatively lower with the first approach and higher with the second approach.

Much of the federal funding for HSR to date has focused on improving existing lines in five corridors: Seattle-Portland; Chicago-St. Louis; Chicago-Detroit; the Northeast Corridor (NEC); and Charlotte-Washington, DC. Most of the rest of the money has been allocated to a largely new system dedicated to passenger trains between San Francisco and Los Angeles, on which speeds could reach 220 mph. Plans for HSR in some states were shelved by political leaders opposed to the substantial risks such projects entail, particularly the capital and operating costs; the federal funds allocated to those projects were subsequently redirected to other HSR projects. California's HSR plans are being challenged in court, and court decisions in the fall of 2013 have put its funding in question.

Estimates of the cost of constructing HSR vary according to train speed, the topography of the corridor, the cost of right-of-way, and other factors. Few if any HSR lines anywhere in the world have earned enough revenue to cover both their construction and operating costs, even where population density is far greater than anywhere in the United States. Typically, governments have paid the construction costs, and in many cases have subsidized the operating costs as well. These subsidies are often justified by the social benefits ascribed to HSR in relieving congestion, reducing pollution, increasing energy efficiency, and contributing to employment and economic development. It is unclear whether these potential social benefits are commensurate with the likely costs of constructing and operating HSR.

Lack of long-term funding represents a significant obstacle to HSR development in the United States. The federal government does not have a dedicated funding source for HSR, making projects that can take many years to build vulnerable to year-to-year changes in discretionary budget allocations.

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Introduction

The provision of $8 billion for intercity passenger rail projects in the 2009 American Recovery and Reinvestment Act (ARRA; P.L. 111-5) reinvigorated the development of high speed intercity passenger rail (HSR) transportation in the United States. While Congress has been interested in HSR since the 1960s, the ARRA funding represented an enormous appropriation in historical terms.[1] The $8 billion was included in ARRA largely at the behest of President Obama, and a subsequent announcement in April 2009 made it clear that the development of HSR is a priority of his Administration.[2] Another $2.5 billion was provided for high speed rail and intercity passenger rail projects in the Transportation, Housing, and Urban Development, and Related Agencies (THUD) Appropriations Act, 2010 (P.L. 111-117). Since then, no additional funding has been appropriated for this program. The FY2011 THUD appropriations act (P.L. 112-10) rescinded $400 million from prior year unobligated balances for high speed and intercity passenger rail projects.

Other than the rescinded amounts, virtually all of the federal HSR funding made available over the past few years has been obligated and various projects are proceeding. In most places, these projects entail upgrading existing lines owned and operated by freight railroads to allow somewhat faster passenger train speeds than are currently possible. On the Chicago-St. Louis line, for example, funding is being used to increase the maximum speed from 79 miles per hour (mph) to 110 mph.[3] Only the HSR project in California is using federal funds for tracks dedicated to passenger trains, on which speeds could reach 220 mph.

Plans for HSR in some states, including Florida, Wisconsin, and Ohio, were shelved by political leaders opposed to the substantial spending such projects entail, particularly for capital and operating costs. Some projects were stopped after federal funds were awarded; these funds were subsequently redirected to HSR projects in other states. Debate on the merits of HSR may continue where projects are ongoing because these projects are often only small steps along the way to providing much faster service in an entire corridor. A key aspect of the debate concerns prospects for the continued development of HSR if no more federal funds are forthcoming.

Federal Initiatives to Promote High Speed Rail

Congress has long been interested in the potential benefits of high speed rail. The first high speed rail act, in 1965, contributed to the establishment of the nation's fastest rail service, the Metroliner, on the Washington, DC, to New York City portion of the Northeast Corridor (NEC),

[1] As one observer has noted, "it is impossible to overstate how big a sea change this represents ... [the] $8 billion is seventeen times as much money as Congress has provided for these programs over the past 10 fiscal years." *Transportation Weekly*, "President to Sign Stimulus Bill Today," February 17, 2009, p. 5.

[2] At the April announcement, the President released a strategic plan for HSR, including a proposal for budgeting an additional $1 billion a year for five years. The plan identifies the funding as "a down payment to jump-start a potential world-class passenger rail system and sets the direction of transportation policy for the future." U.S. Department of Transportation, "President Obama, Vice President Biden, Secretary LaHood Call for U.S. High-Speed Passenger Trains," Press Release, Thursday April 16, 2009, DOT 51-09, http://www.fra.dot.gov/Downloads/RRdev/hsrpressrelease.pdf.

[3] Improvements on the Northeast Corridor between Washington and Boston will increase speeds on some stretches from 135 mph to 160 mph. See Department of Transportation, "Transportation U.S. Transportation Secretary LaHood Announces $2 Billion for High-Speed Intercity Rail Projects to Grow Jobs, Boost U.S. Manufacturing and Transform Travel in America," Press Release DOT 57-11, May 9, 2011, http://www.fra.dot.gov/roa/press_releases/fp_DOT_57-11.shtml.

when that line was still under private ownership. In the 1970s, ownership of the NEC was transferred from the bankrupt Penn Central to Amtrak, a government-controlled company. At the same time, Congress initiated the Northeast Corridor Improvement Program, which has funded major infrastructure improvements and, in the late 1990s, purchase of new high speed Acela trains for Amtrak.

Congress has also supported research into various high speed rail technologies and studies of potential high speed corridors outside of the NEC where speeds are currently slower (see **Table 1**). The Federal Railroad Administration (FRA) has calculated that Congress provided a total of $4.17 billion to various high speed rail projects between 1990 and 2007, an average of $232 million annually (not adjusted for inflation).[4] Most of that money went to improvements on the NEC.[5] There have also been state and private sector efforts to develop dedicated high speed rail lines without federal support. But it was only in February 2009, when Congress passed the American Recovery and Reinvestment Act (ARRA; P.L. 111-5), that the federal government dedicated large sums to a national high speed rail program.

Table 1. High Speed Rail Corridors in the United States

Corridor	Length (Miles)	Motive Power	Current Top Speed (mph)	Current Average Speed (mph)
Los Angeles–San Diego, CA	130	Diesel-electric	90	47
Chicago, IL–Detroit/Pontiac, MI	304	Diesel-electric	110	57
Chicago, IL-St. Louis, MO	284	Diesel-electric	110	53
New York City–Albany/Schenectady, NY	158	Diesel-electric	110	56
Philadelphia–Harrisburg, PA	104	Electric	110	64
Northeast Corridor (NEC)	454	Electric		
Boston, MA–New York City, NY, segment	229		150	62
New York, NY–Washington, DC, segment	225		135	79

Source: Adapted from Government Accountability Office, *High Speed Passenger Rail*, GAO-09-317. March 2009, Table 1; Average speeds calculated by CRS based on those corridors' fastest scheduled trips in December 2013.

Note: The top speeds listed for these corridors are currently attainable only on portions of the routes. For example, on the NEC the top speed of 150 mph is attainable on less than 10% of the total route. The New York-Albany trains rely on electric power while passing through a long tunnel departing New York City.

ARRA provided $8 billion specifically for intercity passenger rail projects, including high speed rail projects. Intercity passenger rail projects were also eligible uses for the $27 billion provided for highways (at the discretion of individual states) and for the $1.5 billion provided for discretionary grants for surface transportation projects "that will have a significant impact on the Nation, a metropolitan area, or a region." Another $90 million was provided for grants to states

[4] E-mail from Neil Moyer, Chief, Intercity Passenger Rail Analysis Division, FRA, February 1, 2008.

[5] U.S. Government Accountability Office, *High Speed Passenger Rail: Future Development Will Depend on Addressing Financial and Other Challenges and Establishing a Clear Federal Role*, GAO-09-317, March 2009, p. 10, http://www.gao.gov/new.items/d09317.pdf.

for intercity passenger rail projects in the FY2009 appropriations act (P.L. 111-8), following a $30 million appropriation for such purposes in the FY2008 appropriations act (P.L. 110-161).

In March 2009, the Obama Administration announced that it would ask Congress to provide $1 billion annually for high speed and intercity passenger rail projects. It has requested that much or more in its annual budget proposals. Congress approved $2.5 billion for high speed rail and intercity passenger rail in FY2010 (P.L. 111-117), but has provided no funding since then. In addition, the FY2011 appropriations act rescinded $400 million from prior year unobligated balances of program funding.

There have been several other recent congressional initiatives supporting high speed rail (see **Table 2**). The Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU; P.L. 109-59), as amended by the SAFETEA-LU Technical Corrections Act (P.L. 110-244), made $90 million available for maglev projects.[6] In the fall of 2008, Congress passed the Passenger Rail Investment and Improvement Act of 2008 (Division B of P.L. 110-432). Among other things, this act created a high speed rail development grant program with a total authorization of $1.5 billion over FY2009-FY2013. The act also authorized additional funding for Amtrak to address some of the backlog of maintenance needed to bring the Northeast Corridor up to a state of good repair. It included a provision directing the U.S. Department of Transportation (DOT) to seek private companies to build and operate one or more high speed lines.

In evaluating these efforts, it is important to note that there is no single definition of what constitutes high speed rail. The European Union defines HSR as

- separate lines built for speeds of 250 kilometers per hour (kph) (155 mph), or
- existing lines upgraded to speeds of 200 kph (124 mph), or
- upgraded lines whose speeds are constrained by circumstances such as topography or urban development.[7]

[6] "Maglev" stands for magnetic levitation, in which superconducting magnets levitate a train above a guide rail.

[7] International Union of Railways, "General Definitions of High speed," available at http://www.uic.asso.fr/gv/article.php3?id_article=14.

Table 2. Recent Congressional Initiatives Related to High Speed Rail

Programs created and/or amended in the 109th–113th Congresses

Initiative	Source	Funding	Status
Maglev Deployment Program	Authorized in SAFETEA (§1307, P.L. 109-59) and SAFETEA Technical Corrections Act (P.L. 110-244)	$90 million over FY2008-FY2009. $45 million is for a line from Primm, NV, to Las Vegas; $45 million is for one or more of three eligible projects: the Pittsburgh area, from Baltimore to DC, and from Atlanta to Chattanooga.	Deadline for applications was February 13, 2009. All three eligible projects east of the Mississippi applied for funding. FRA selected the Pittsburgh and Georgia projects to receive funding, in addition to the Nevada project. As of 2013 the grantees have not used any of the grant funding.[a]
Amtrak Capital Grants	Passenger Rail Investment and Improvement Act of 2008 (PRIIA) (Division B of P.L. 110-432), §101(c)	$5.315 billion authorized over FY2009-FY2013.	$6 billion provided for capital grants and debt service FY2009-FY2013, including $1.3 billion provided in ARRA.
NEC High Speed Service Study	PRIIA §212(d)	Not specified.	Amtrak submitted an interim study to Congress on Oct. 21, 2009, and published two further studies, NEC Master Plan on June 4, 2010, and *A Vision for High-Speed Rail in the Northeast Corridor* on Sept. 27, 2010 (updated report published July 9, 2012).
Intercity Passenger Rail Service Corridor Capital Assistance Program	PRIIA §301 (49 U.S.C. §24402)	$1.9 billion authorized over FY2009-FY2013.	These three programs were provided a total of $8 billion in ARRA and $2.5 billion in the Consolidated Appropriations Act, 2010. The allocation of that funding among the programs is determined by DOT. No additional funding has been provided since FY2010.
High Speed Rail Corridor Development Program	PRIIA §501 (49 U.S.C. §26106)	$1.5 billion authorized over FY2009-FY2013.	
Congestion Grant Program (to alleviate congestion on passenger rail corridors)	PRIIA §302 (49 U.S.C. §24105)	$325 million authorized over FY2010-FY2013.	
Capital Assistance to States—Intercity Passenger Rail Service	DOT Appropriations Act, 2008 and 2009	$30 million provided in FY2008; $90 million provided in FY2009.	Funding awarded in several announcements.
Solicitation for new high speed intercity passenger rail system	PRIIA §502	$5 million authorized for planning and preliminary engineering activities for projects selected by DOT.	FRA issued a request for expressions of interest on Dec. 16, 2008. Deadline for response was Sept. 14, 2009. FRA received eight proposals; five were selected for further review. No decision has been announced.
Requirement for implementation of positive train control on main lines where passenger rail service is regularly provided by December 2015	Rail Safety Improvement Act of 2008 (Division A of P.L. 110-432), §104 (49 U.S.C. §20157)	$250 million authorized for grants over FY2009-FY2013.	It is not clear that rail operators will be able to meet the 2015 deadline.

Source: CRS.

Note: ARRA is the American Recovery and Reinvestment Act of 2009 (P.L. 111-5).

a. Sections 411(d) of P.L. 111-147 and 111(d) of P.L. 112-30 counted the funding the states received for this program (and several other discretionary SAFETEA programs) in determining their formula funding for FY2010 and FY2011.

The U.S. government also has several definitions of what constitutes high speed rail. FRA has defined high speed rail as service "that is time-competitive with air and/or auto for travel markets in the approximate range of 100 to 500 miles."[8] As FRA notes, this is a market-driven definition which recognizes that, in choosing a transportation mode, travelers are more interested in total trip time than in top speed, and that travelers evaluate transportation modes not in isolation, but by how those modes compare to each other.

Congress has, at different times, established high speed rail funding programs using different speed-based definitions and eligibility criteria (see **Table 3**).

Table 3. Statutory Definitions of High Speed Rail

Statute	Speed Component of Definition
High Speed Rail Assistance (enacted 1994)	"reasonably expected to reach sustained speeds of more than 125 miles per hour" (49 U.S.C. §26105)
High speed rail corridor development program (enacted 2008)	"reasonably expected to reach speeds of at least 110 miles per hour" (49 U.S.C. §26106(b)(4))
Railway-highway crossing hazard elimination in high speed rail corridors program (enacted 1991)	"where railroad speeds of 90 miles or more per hour are occurring or can reasonably be expected to occur in the future" (23 U.S.C. §104(d)(2)(C)

Source: CRS.

In its strategic plan for high speed rail, FRA defined three categories of high speed rail corridors. These categories differ in terms of top speeds, track characteristics, and service frequency (see **Table 4**). A map of the corridors defined by FRA appears in **Figure 1**.

Table 4. Categories of High Speed Rail in FRA's "Vision for High-Speed Rail in America"

Category	Speed Characteristics
Emerging High Speed Rail	Top speeds of 90-110 mph.
Regional High Speed Rail	Top speeds of 110-150 mph on grade-separated track.
Express High Speed Rail	Top speeds of at least 150 mph on grade-separated track dedicated to passenger service.

Source: Federal Railroad Administration, Vision for High-Speed Rail in America, April 2009, p. 2, http://www.fra.dot.gov/Downloads/Final%20FRA%20HSR%20Strat%20Plan.pdf.

As these various definitions show, discussions of high speed rail in the United States can refer to trains briefly reaching speeds of 90 mph on tracks shared with freight trains or trains traveling over 200 mph for sustained periods on dedicated track, or both. For clarity, in this report the term "higher speed rail" will refer to HSR on shared tracks with speeds up to 150 mph (encompassing both FRA's "Emerging HSR" and "Regional HSR" classifications), and "very high speed rail" will refer to HSR on dedicated tracks with speeds over 150 mph (equivalent to FRA's "Express HSR" classification).

[8] Department of Transportation, Federal Railroad Administration, *High-Speed Ground Transportation for America*, September 1997, p. 2-2.

High Speed Rail Project Grants

In response to the $8 billion that Congress provided for high speed and intercity passenger rail capital grants in ARRA, FRA received 45 applications, representing 24 states, requesting a total of approximately $50 billion.[9] Initial funding awards were announced on January 28, 2010, with the biggest awards going to California ($2.25 billion), Florida ($1.25 billion), Illinois ($1.1 billion), and Wisconsin ($810 million). Applications to FRA for the $2.5 billion appropriated in FY2010 numbered 132 and amounted to $8.8 billion. Awards for these funds were initially announced October 28, 2010. California received another $901 million and Florida another $800 million. Iowa received $230 million and Michigan $161 million in this second round of funding.[10]

Newly elected governors in some states, including Florida, Ohio, and Wisconsin, subsequently decided not to pursue the improvements for which their states had sought federal funds. Florida, for example, dropped plans to build a high speed rail line between Orlando and Tampa. As a result, these federal funds were reallocated to other projects.[11]

According to DOT, nearly 85% of the funding awarded over the past few years is concentrated in six corridors.[12] Investments in five of the corridors are aimed at upgrading existing lines. These five corridors are Seattle-Portland; Chicago-St. Louis; Chicago-Detroit; the Northeast Corridor (NEC); and Charlotte-Washington, DC. In the sixth corridor, Los Angeles-San Francisco, the plans are to build a new very high speed rail line that may allow trains to reach speeds of up to 220 mph. The remaining 15% or so of funding is going toward a multitude of smaller projects throughout the country, including planning studies and station and track improvements. **Table 5** shows obligated funding by state.

Some corridors have also received discretionary grants from the Transportation Investment Generating Economic Recovery (TIGER) program. A wide range of road, rail, transit, port, and intermodal projects are eligible for TIGER funding. Enacted initially as part of ARRA, the TIGER program has been funded in four subsequent appropriations bills.

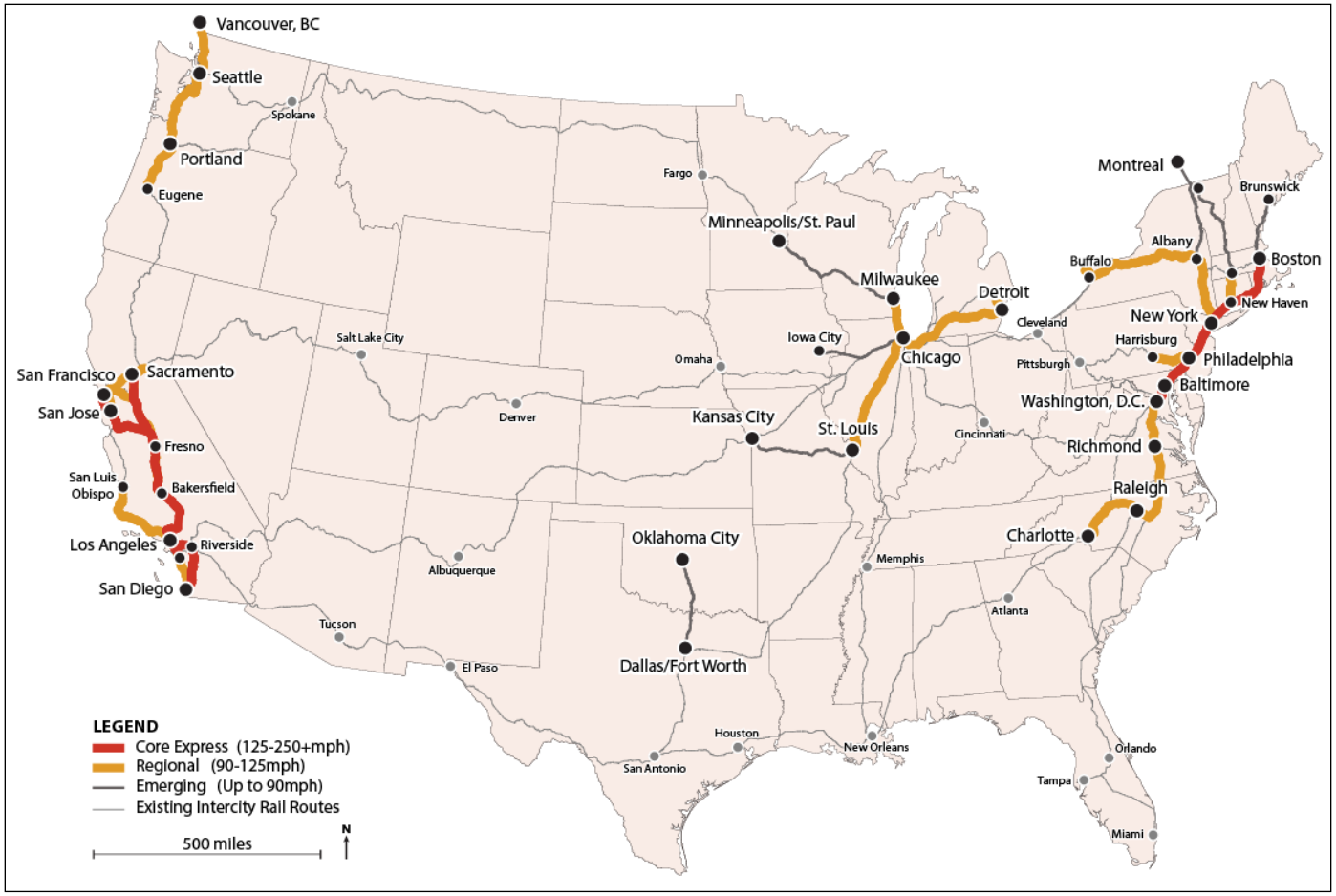
[9] Testimony of Joseph C. Szabo, Administrator, Federal Railroad Administration, U.S. Department of Transportation, before the U.S. Congress, House Committee on Transportation and Infrastructure, Subcommittee on Railroads, Pipelines and Hazardous Materials, *High-Speed Rail in the United States: Opportunities and Challenges*, 111th Cong., 1st sess., October 14, 2009, p. 9.

[10] Department of Transportation, Federal Railroad Administration, "U.S. Transportation Secretary Ray LaHood Announces $2.4 Billion for High Speed Rail Projects," Press Release, October 28, 2010, DOT 192-10, http://www.fra.dot.gov/Pages/press-releases/227.shtml.

[11] Department of Transportation, "U.S. Department of Transportation Redirects $1.195 Billion in High Speed Funds," Press Release, DOT 208-10, December 9, 2010, http://www.fra.dot.gov/Pages/press-releases/231.shtml; Department of Transportation, Federal Railroad Administration, High-Speed Intercity Passenger Rail (HSIPR) Program, 76 *Federal Register* 14443-14457, March 16, 2011, http://www.fra.dot.gov/rpd/downloads/March_2011_HSR_NOFA.pdf.

[12] Department of Transportation, Federal Railroad Administration, "High-Speed Intercity Passenger Rail Program: Federal Investment Highlights," February 3, 2012, http://www.fra.dot.gov/rpd/downloads/HSIPR_Federal_Investment_Highlights_20120203.pdf.

Figure 1. High Speed Rail Corridors by Proposed Type of Service



Source: Federal Railroad Administration, High Speed Intercity Passenger Rail Program: Federal Investment Highlights, http://www.fra.dot.gov/rpd/downloads/HSIPR_Federal_Investment_Highlights_20120203.pdf.

Notes: CRS modified the original map to highlight the different categories of high speed rail service. In this report the term "higher speed rail" refers to HSR on shared tracks with speeds up to 150 mph (encompassing both FRA's "Emerging HSR" and "Regional HSR" classifications), and "very high speed rail" refers to HSR on dedicated tracks with speeds over 150 mph (equivalent to FRA's "Express HSR" classification). There are no proposals for Alaska and Hawaii.

Table 5. High-Speed Intercity Passenger Rail Funding by State

State	Funds Obligated
California	$4,237,855,817
Illinois	$1,905,133,042
Washington	$794,850,538
North Carolina	$572,560,839
New York	$496,216,023
New Jersey	$488,444,000
Michigan	$400,732,552
Connecticut	$190,900,000
Massachusetts	$126,122,341
Virginia	$119,148,119
Maryland	$91,400,000
Indiana	$71,364,980
Pennsylvania	$66,400,000
Vermont	$53,222,258
Missouri	$49,754,545
Minnesota	$45,600,000
Maine	$38,985,495
Florida	$31,892,085
Rhode Island	$29,200,000
Wisconsin	$26,547,910
Texas	$24,067,877
Oregon	$19,496,630
Iowa	$18,709,080
Delaware	$13,750,000
District of Columbia	$7,170,500
Georgia	$4,848,467
Oklahoma	$3,157,184
New Hampshire	$2,000,000
Colorado	$1,377,848
West Virginia	$1,000,000
Nevada	$545,272
Kansas	$318,757
Idaho	$200,000
Alabama	$100,000
New Mexico	$100,000

Source: Federal Railroad Administration, HSPIR Project Funding, December 6, 2013, http://www.fra.dot.gov/Page/P0554.

As of December 2013, according to FRA, 99% of high speed and intercity passenger rail funding appropriated since FY2009 had been obligated (not including the $400 million rescinded in the FY2011 THUD appropriations bill). However, only about 17% of the total funds had been spent.[13] Progress on two of the largest HSR projects, in the Chicago-St. Louis and Los Angeles-San Francisco corridors, illustrates some of the possibilities and challenges with developing HSR.

Chicago-St. Louis Corridor

The 284-mile route used by Amtrak between Chicago and St. Louis is owned and operated by four different freight railroads. It consists mostly of one track with sidings to allow trains to pass. Although the long-term goal is to provide even faster service,[14] current funding is being used to upgrade the existing line to increase maximum passenger train speeds from 79 mph to 110 mph. Work includes track improvements, new sidings, new signals and warning systems, upgraded stations, and new passenger trains.

Illinois secured $1.1 billion in the initial round of ARRA funding and another $42 million in redirected ARRA funds to improve about 220 miles of the line from St. Louis to Dwight, IL (near Chicago), and to buy new locomotives and rail cars.[15] This is estimated to reduce trip times from 5 hours 30 minutes to between 4 and 5 hours. Illinois later received $186 million in FY2010 intercity passenger rail funding to improve about 40 miles of track between Dwight and Joliet, IL. This is estimated to save another 9 minutes from the overall trip time. Building out the whole route for 110 mph is projected to reduce trip times to 3 hours and 50 minutes. [16] Missouri also received $13.5 million in ARRA funding for rail improvements in the approach to St. Louis and several intermodal projects in the corridor have received $46 million in TIGER grant funding.[17] In addition to reduced travel time, the project is expected to provide improved travel time reliability, improved safety, and greater capacity.

Construction work in the Chicago-St. Louis corridor has been underway since 2010. According to the Illinois Department of Transportation, 110-mph service between Dwight and Pontiac, IL began revenue operation in November 2012. Speeds of 110 mph are expected on 75% of the approximately 240 miles between Joliet and Alton, IL, by 2015.[18]

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[13] Data provided to CRS by FRA, December 17, 2013.

[14] See Illinois Department of Transportation, "Illinois High Speed Rail: Chicago to St. Louis, Project Overview," http://www.idothsr.org/about/overview.aspx; and Illinois Department of Transportation, "Illinois High Speed Rail: Chicago to St. Louis, Fact Sheet Issue 2," May 7, 2011, http://www.idothsr.org/pdf/fact%20sheet%20-%20february%202011.pdf.

[15] Department of Transportation, Federal Railroad Administration, "FRA High-Speed Intercity Passenger Rail (HSIPR) Program Funding Selection Summary," http://www.fra.dot.gov/eLib/details/L02836.

[16] The application for supplemental projects in the Chicago-St. Louis corridor states that the first round of improvements, those based on the 2004 Record of Decision (ROD), will reduce one-way trip time from 5 hours and 30 minutes to 5 hours. The 2004 ROD states that trip times would be reduced to between 4 hours and 4 hours and 30 minutes. See Illinois Department of Transportation, *Il-Chicago-St. Louis Corridor Supplemental Projects: Service Development Plan*, April 4, 2011, pp. 21-22, http://www.idothsr.org/pdf/IL_Chicago_St_Louis_Supplement_SDP_COMBINED_APPLICATION_r2.pdf.

[17] Department of Transportation, Federal Railroad Administration, "Midwest Regional Investment Fact Sheet," July 11, 2013, http://www.fra.dot.gov/eLib/details/L04666; Department of Transportation, TIGER Grant Program, http://www.dot.gov/tiger.

[18] Illinois Department of Transportation, http://www.idothsr.org/about/overview.aspx; See also, Governor of Illinois, "Governor Quinn Announces High-Speed Rail Service for Thanksgiving Travelers on Chicago-St. Louis Corridor,"

California High Speed Rail

The California High Speed Rail Authority (CHSRA) is proposing to build a rail line that may allow trains to reach speeds up to 220 mph. In 2008, California voters approved the sale of $9 billion in bonds to partly finance such a system. The Los Angeles to San Francisco line is phase one of a two-phase project, with phase two involving extensions to San Diego and Sacramento. To date, the project has been awarded nearly $4 billion in federal funds..

Despite the California project's success in attracting federal funds, it remains controversial.[19] Among the main elements of controversy are the project's cost and its financing. In its 2009 business plan CHSRA estimated the cost of building phase one at $36.4 billion in 2010 dollars.[20] In its 2012 draft business plan, the cost of phase one was estimated for two different systems, a full high speed system and a blended system that would make some use of existing passenger rail infrastructure. The full high speed rail system was estimated to cost between $65.4 billion and $74.5 billion and the blended system between $54.9 billion and $66.3 billion (both in 2010 dollars).[21] CHSRA attributed about 80% to 85% of the cost increase since 2009 to the need for additional viaducts, tunnels, embankments, and retaining walls. The other 15% to 20% of the increase results from higher expected construction costs.[22]

The doubling or near doubling of estimated costs for phase one, depending on the proposed system, led to renewed calls for the project to be reexamined or abandoned.[23] Subsequently, a revised business plan, released April 2, 2012, dropped the full high speed rail system scenario as too costly. It provided a revised estimate for the blended system at between $53.4 billion and $62.3 billion (in 2011 dollars).[24]

The draft 2012 business plan proposed that nearly two-thirds of the construction funding would come from the federal government, although this share might be somewhat lower depending on the system built, the amount of private sector investment, and other variables.[25] A number of commentators, including California's Legislative Analyst Office (LAO) and the California High-Speed Rail Peer Review Group, have questioned this assumption and have contended that CHSRA's financial plan is highly uncertain.[26] The revised business plan continues to rely on the

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Press Release, November 22, 2012, http://www.idothsr.org/pdf/11%2022%2012%20thanksgiving%20hsr%20-%20release.pdf.

[19] For example, see U.S. Congress, House Committee on Transportation and Infrastructure, Subcommittee on Railroads, Pipelines, and Hazardous Materials, *California's High-Speed Rail Plan: Skyrocketing Costs & Project Concerns*, 112th Cong., 1st sess., December 15, 2011, http://transportation.house.gov/hearings/hearingdetail.aspx?NewsID=1475; Oversight of California High Speed Rail, 113th Cong., 1st sess., May 28, 2013, http://transportation.house.gov/calendar/eventsingle.aspx?EventID=351413.

[20] California High Speed Rail Authority, *California High Speed Rail Program Draft 2012 Business Plan*, November 1, 2011, p. 3-5, http://www.cahighspeedrail.ca.gov/assets/0/152/302/c7912c84-0180-4ded-b27e-d8e6aab2a9a1.pdf.

[21] Ibid., p. ES-7.

[22] Ibid., p. 3-6.

[23] See, for example, Dan Walters, "It's Time to Kill California's Bullet Train Boondoggle," *Sacramento Bee*, January 8, 2012, the http://www.sacbee.com/2012/01/08/4170890/dan-walters-its-time-to-kill-californias.html.

[24] California High Speed Rail Authority, *California High Speed Rail Program Draft Revised 2012 Business Plan*, April 2, 2012, p. 3-10, http://www.cahighspeedrail.ca.gov/uploadedFiles/Document_Repository/Business_Plans/Draft%20Revised%202012%20Business%20Plan(2).pdf. The costs are estimated at between $68 and $80 billion in year-of-expenditure-inflated dollars.

[25] California High Speed Rail Authority, *California High Speed Rail Program Draft 2012 Business Plan*, Chapter 8.

[26] Legislative Analyst's Office, *High Speed Rail Authority: The Draft 2012 Business Plan and Funding Plan*, November 29, 2011, p. 7, http://www.lao.ca.gov/handouts/transportation/2011/HSRA_Business_Funding_plan_11_29_11.pdf; California High-Speed Rail Peer Review Group, January 3, 2012, pp.

federal government for about two-thirds of the system's funding, but it states that revenue from California's quarterly auctions of greenhouse-gas emissions allowances, beginning November 2012, could be used instead if federal funding is not forthcoming.[27] In response, the LAO has called this plan "very speculative."[28]

Another element of controversy surrounds the choice of the section between Merced and Bakersfield in the Central Valley to be the first segment built. It appears that this section was chosen largely because it may face fewer challenges than other sections in the more heavily populated areas near San Francisco and Los Angeles, increasing the likelihood that California will be able to spend the ARRA money by the statutory deadline of September 30, 2017.[29] Critics, however, claim that this segment of the phase one project will have little utility if the rest of the system is not built.[30] The revised draft business plan commits to building an initial operating segment that connects the Central Valley to the Los Angeles Basin within 10 years.[31]

In late 2013 the project received several setbacks. A California state judge ruled that the state's approval to issue the bonds to fund the project had been made without complying with a requirement of state administrative law that evidence be placed in the record to support the decision, and that the CHSRA's funding plan does not satisfy certain of the conditions attached to use of Proposition 1A bond funds for the project. These conditions included a requirement that all environmental studies for an operable segment be completed, and all sources of funding for construction of an operable segment be identified, before a funding plan is approved and bond funding is made available.[32]

The initial operating segment identified by CHSRA is a 300-mile stretch from Merced south to the San Fernando Valley (a little north of Los Angeles). But the plan foresees completion of that segment by 2021, four years after the deadline for expending the federal funding already granted to the project. The plan assumes that CHSRA will receive roughly $20 billion in additional federal funds to build the initial operating segment, although Congress has not provided any additional funding for high speed rail grants since FY2010. CHSRA proposes to complete the first construction portion of the initial operating segment (130 miles) by 2017, and the remaining 170 miles by 2021 (see **Table 6**).

3-4, http://www.cahsrprg.com/files/CommentsonCHSRA2010FundingPlan.pdf.

[27] California High Speed Rail Authority, *California High Speed Rail Program Draft Revised 2012 Business Plan*, Chapter 7.

[28] Mac Taylor, *The 2012-13 Budget: Funding Requests for High-Speed Rail*, Legislative Analyst's Office, April 17, 2012, http://www.lao.ca.gov/analysis/2012/transportation/high-speed-rail-041712.pdf.

[29] U.S. Department of Transportation, Letter from John D. Porcari, Deputy Secretary of Transportation, to Roelef van Ark, Chief Executive Officer, California High Speed Rail Authority, January 3, 2012, http://www.cahighspeedrail.ca.gov/assets/0/152/302/9f61175c-f0a9-4bc6-87bd-4e541d558038.pdf.

[30] Richard White, "Fast Train to Nowhere," *New York Times*, April 24, 2011, http://www.nytimes.com/2011/04/24/opinion/24white.html; "California's High Speed Rail System is Going Nowhere Fast," Editorial, *The Washington Post*, November 13, 2011, http://www.washingtonpost.com/opinions/californias-high-speed-rail-system-is-going-nowhere-fast/2011/11/08/gIQAKni2IN_story.html. See also the California High-Speed Rail Peer Review Group, p. 6.

[31] California High Speed Rail Authority, *California High Speed Rail Program Draft Revised 2012 Business Plan*, p. ES-2.

[32] See http://www.saccourt.ca.gov/general/media/docs/tos-v-ca-high-speed-rail-authority-ruling.pdf and http://www.saccourt.ca.gov/general/media/docs/tos-v-ca-high-speed-rail-authority-ruling2-112513.pdf.

Table 6. CHSRA Funding Plan for Construction of the Initial Operating Segment of the High Speed Rail Project

($ billions)

	Bakersfield-Fresno Segment (completion 2017)	Remainder, Initial Operating Segment (completion 2021)	Total, Initial Operating Segment
Length	130 miles	170 miles	300 miles
Funding Sources			
Federal	$3.3	$20.3	$23.6
State high-speed rail bond	2.7	4.4	7.1
Locally generated	0	0.7	0.7
Total	$6.0	$25.3	$31.3

Source: California High Speed Rail Authority, Revised 2012 Business Plan, Exhibits 7-9 and 7-10. Numbers may not add due to rounding.

Also, the U.S. Surface Transportation Board (STB) issued a decision that complicates the path for the project. The STB had previously approved construction for a 65-mile portion of the first construction segment. CHSRA has issued a contract for 29 miles of the first construction portion, including five miles outside the 65-mile portion already approved by the STB. CHSRA asked STB to conditionally approve construction on the remainder of the first construction portion, pending future environmental clearances. STB declined to issue the exemption, meaning that environmental review will have to be completed before construction can begin on that five-mile stretch included in the initial construction contract.[33]

Options for Building High Speed Rail

There are two options for developing high speed rail service; the option chosen determines the level of high speed service that can be attained:

- upgrading existing track, signaling systems, and equipment (e.g., tilting trains) to enable trains to travel somewhat faster over the existing rail network, or
- building new rail lines for the exclusive use of passenger trains enabling trains to travel at much higher speeds than are possible over the existing rail network, which is shared with freight rail.[34]

The advantage of upgrading existing track is its lower cost; a 2007 estimate put the average cost of such upgrades at around $7 million per mile.[35] In the 1990s Amtrak (and commuter railroads)[36]

[33] Surface Transportation Board, Decision, FD 35724, 12/3/2013, http://www.stb.dot.gov/decisions/readingroom.nsf/fc695db5bc7ebe2c852572b80040c45f/dace3d538024c4c585257c370051ecf0?OpenDocument.

[34] Either option could entail gaining access to privately owned freight railroad rights-of-way. See CRS Report R42512, *Passenger Train Access to Freight Railroad Track*, by John Frittelli.

[35] Passenger Rail Working Group of the National Surface Transportation Policy and Revenue Study Commission, *Vision for the Future: U.S. Intercity Passenger Rail Network Through 2050*, December 6, 2007, p. 31.

[36] Amtrak owns only 363 of the 457 miles of the Northeast Corridor; the remainder is owned by a number of states and commuter rail agencies. Douglas John Bowen, "Amtrak's NEC: healthy hybrid: the Western Hemisphere's busiest passenger rail route delivers a dazzling array of service unequalled by more glamorous global counterparts," *Railway*

spent around $2 billion—an average of around $9 million per mile, in 2003 dollars—to upgrade the 229-mile north end of the Northeast Corridor (connecting Boston to New York City), including electrifying the route and replacing a bridge.[37] This reduced rail travel time between Boston and New York City from 4 hours to 3 hours and 24 minutes—an increase in average speed over the route from 57 mph to 68 mph. However, track upgrades also have important limitations. One is that many aspects of the rail infrastructure, such as curves and at-grade road crossings, limit the potential speed improvements. Another is that almost all existing track is used for freight trains that operate at slower speeds than passenger trains. Freight traffic may constrain the speed of passenger trains, and FRA regulations limit train speeds on routes that handle both freight and passenger traffic.

Conversely, building new rail lines, including the train, the track, and the signal and communications network, makes much higher speeds possible. One limitation of that approach is the cost, which is estimated to average $35 million per mile,[38] or more in densely populated areas or difficult terrain. In order to attain such high speeds, freight trains would have to be prohibited from using the track—which also means that freight operators would not be contributing to the construction or maintenance costs. New lines can use either conventional steel wheel on steel rail technology or magnetic levitation (maglev), in which superconducting magnets levitate a train above a guide rail.

Conventional High Speed Rail

With one minor exception, all current high speed rail systems use conventional steel wheel on steel rail technology. At speeds up to around 125 mph, these trains can be pulled by diesel-electric locomotives. For higher speeds, trains powered by externally supplied electricity become necessary. These trains' engines draw power from overhead wires (catenaries). This technology allows for lighter-weight trains, in part because they do not have to carry fuel. Because of their lighter weight, electric trains can stop and start more quickly and cause less wear on the track. These trains can operate at very high speeds: in 2007 a French electric-powered train on conventional tracks reached 357 mph.[39] However, because of the greater costs and diminishing benefits[40] of operating at extremely high speeds, the top operating speed of high speed trains in most countries is around 210 mph.

There are two main reasons why such trains are not widely available in the United States. First, only a small portion of the U.S. rail network is electrified, so most passenger trains must use diesel-electric locomotives.[41] Second, because passenger trains typically use the same tracks as freight trains (and neither generally uses the most advanced collision avoidance systems), federal

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Age, August 2008.

[37] Government Accountability Office, *Intercity Passenger Rail: Amtrak's Management of Northeast Corridor Improvements Demonstrates Need for Applying Best Practices*, GAO-04-94, February 27, 2004, pp. 19-20.

[38] Passenger Rail Working Group, op. cit., p 31.

[39] Ariane Bernard, "French Train Breaks Rail Speed Record," *New York Times*, April 4, 2007.

[40] As train speeds increase, the benefit of even greater speeds diminishes. For example, increasing the average speed on a 240-mile route from 60 mph to 120 mph reduces the trip time by two hours, from four hours to two; the next 60-mph increase, from 120 mph to 180 mph, only reduces the trip time by 40 minutes; the next 60 mph increase beyond that, from 180 mph to 240 mph, would reduce the trip time by only 20 minutes.

[41] Freight railroads in the United States commonly operate "double stack" trains hauling containers. These have a relatively high elevation, which would interfere with overhead electric catenary systems such as those used on the NEC and in many other countries. Most countries that use overhead catenaries to power trains do not allow double-stack freight traffic on such lines.

regulations require that passenger trains have a variety of design features to protect passengers in the event of a train crash. This results in relatively heavy passenger trains, which are thus slower to get up to speed and take longer to stop.[42]

Track

To make very high speed operation possible, rail track must be substantially flat and straight, with shallow curves and gentle changes in elevation. As train speeds increase, the risk of crashes where roads cross the rail line ("at-grade crossings") increases, so safety dictates that high speed tracks not have any at-grade crossings.[43] This is the standard to which new very high speed lines in other countries are usually built. The result is the rail equivalent of the Interstate Highway System, allowing trains to operate at high average speeds without risk from crossing traffic.

A high speed rail system using dedicated track can handle many trains at one time without compromising safety. For example, the Japanese high speed rail network, which began operation in 1964, now has trains running at speeds up to 200 mph, with as little as three minutes of headway (the time separating trains operating on the same track) during peak periods. In almost 50 years of operation, there has never been a fatality due to a train crash on the Japanese high speed network.[44]

Signal and Communications Networks

The prevailing train control system on the U.S. rail network relies on dispatchers at central locations who track the location of trains and signal to train operators when it is safe to proceed onto a stretch of track. This system is somewhat analogous to the air traffic control system, in that the dispatchers can see the location of trains but cannot directly control those trains. Thus, when a train operator does not respond correctly to an operational signal, a collision may occur.

Very high speed rail networks use electronic train control systems (often referred to as "positive train control," or PTC). PTC uses communications systems, global positioning systems, on-board computers with digitized maps, and central control system computers to monitor and control train movements. This technology is intended to improve efficiency and safety through better communication and reducing the threat of human error in the operation of trains. Outside of the NEC, almost none of the nation's rail network is equipped with positive train control. However, the Rail Safety Improvement Act of 2008 requires that rail carriers implement positive train control by December 31, 2015, on main lines over which passengers or poison- or toxic-by-inhalation hazardous materials are transported.[45] Implementation is underway, though there are proposals to extend the deadline.[46]

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[42] In light of a recommendation from its Rail Safety Advisory Committee, FRA has said it intends to propose changes to these regulations; the changes would more closely reflect European design standards, improving the crashworthiness of rail cars while making them lighter. See http://www.fra.dot.gov/eLib/details/L04638.

[43] Federal Railway Administration regulations require that rail lines rated for speeds above 150 mph have no at-grade crossings. 49 C.F.R. 213.347(a).

[44] David Barboza and Sharon LaFraniere, "Crash Raises Questions on China's Push to Build High-Speed Passenger Rail Lines," *New York Times*, July 26, 2011; American Association of State Highway And Transportation Officials (AASHTO), "Basic Facts About High Speed/Intercity Passenger Rail," Updated September 7, 2011, http://www.highspeed-rail.org/Pages/BasicFacts.aspx.

[45] P.L. 110-432, Division A, §104.

[46] See CRS Report R42637, *Positive Train Control (PTC): Overview and Policy Issues*, by John Frittelli.

Magnetic Levitation (Maglev)

Maglev train technology was developed in the United States in the 1960s. It uses electromagnets to suspend (levitate) the train above a guideway, as well as to propel the train. The lack of direct contact (and hence friction) between the train and the guideway allows maglev trains to go very fast. Maglev trains and tracks are expected to experience relatively little wear and tear and hence to have low maintenance costs, although there is not enough experience with maglev in commercial operations to verify this.

Many maglev lines have been proposed, but the few that have been constructed, notably a 19-mile line completed in 2004 connecting a Shanghai subway station to Pudong International Airport, have been relatively short. As a consequence, the costs of constructing and maintaining an intercity maglev line are unclear. It is generally believed that such projects are very expensive, in part because the need for a relatively straight guideway may require costly land acquisition and tunneling. Japan and Germany have operated maglev test tracks since the 1970s and 1980s, respectively, but neither country has gone on to build the commercial maglev lines that were envisioned. Congress established a program to promote maglev in the United States in the 1990s, but none of the projects that received federal support have advanced beyond the planning stage.

Because conventional train technology is capable of speeds comparable to maglev technology, and the costs of maglev implementation are probably very high, there is little impetus to adopt maglev technology. Moreover, maglev trains could not operate over the existing rail network, but would require an entirely separate network. China reportedly built the Shanghai line in part to examine maglev technology as a candidate for high speed lines it planned; it subsequently chose conventional train technology for its high speed rail network.

The Central Japan Railway Company (JR Central) has announced that it will deal with capacity limitations on its high speed line between Tokyo and Osaka, the most heavily traveled intercity rail segment in the world, by building a maglev line roughly parallel to the existing line. The planned train would travel at 300 mph over the 175 miles between Tokyo and Nagoya and would eventually be extended to Osaka. Due in part to the geographic constraints—as the line would pass through mountainous areas, as well as densely populated areas, about 80% of the track would be located on viaducts or in tunnels—JR Central has estimated the cost of building the Tokyo-Nagoya segment at 5.1 trillion yen (around $60 billion), or a little less than $350 million per mile.[47] The full line is estimated to cost 9 trillion yen (about $110 billion).[48] Although the Japanese government has approved the project it is not certain that the line will be built; estimated costs have risen, and the need is unclear given Japan's population decline.

Cost Issues

The costs of HSR can be divided into two general categories: infrastructure costs, including the costs of building the line and maintaining it, and operating costs, such as labor and fuel, which tend to vary according to the amount of train service offered. Of the many high speed routes in

[47] Philip Brasor, "Japan's maglev on track for financial crash," *The Japan Times Online*, July 26, 2009, http://www.japantimes.co.jp/text/fd20090726pb.html.

[48] *The Japan Times Online*, "Tokyo-Osaka Maglev Gets State OK," May 28, 2011, http://www.japantimes.co.jp/text/nn20110528a8.html.

the world, it is thought that only two have earned enough revenue to cover both their infrastructure and operating costs.[49]

Infrastructure Costs

High speed rail requires a significant up-front capital outlay for development of the fixed infrastructure (right-of-way, track, signals, and stations) and for its upkeep. However, system costs are highly site- and project-specific. A leading determinant of cost is whether a new right-of-way is planned or if an existing railroad right-of-way is going to be improved. Another key cost determinant is speed. Generally, as speed increases, the cost of providing the infrastructure to attain that speed rises at an increasing rate. The highest speeds will require grade-separated corridors, limited curvature, and modest gradients so that passengers do not experience extreme discomfort at high speeds. As speed increases, the signaling and communications system must be more advanced (and costly) to ensure safe operations. Building a route through mountainous terrain is more costly than construction on level terrain, and building a route through an urban area is generally costlier than construction in a rural area.

These drivers of cost are evident in the various projects to build higher speed or very high speed rail in the United States. For instance, a proposed route between Los Angeles (Anaheim) and Las Vegas would utilize maglev technology, with a top speed of 311 mph, at an estimated cost of nearly $12 billion, or $48 million per route mile. A proposed alternative would use conventional steel rail, with a top speed of 150 mph, and, rather than beginning in Anaheim, would start in Victorville, CA, which is beyond the mountains to the north of Los Angeles. The estimated cost of this alternative is nearly $4 billion or $22 million per route mile. Much of the decrease in estimated cost is due to not bringing the line through the mountains into the Los Angeles area, which in turn may lower its attractiveness to potential riders.[50]

In contrast to these projects involving acquisition of new rights-of-way, a project to increase train speeds between Chicago and other Midwest cities would involve improvements to approximately 3,000 miles of existing track at an estimated cost of $7.7 billion, or about $2.5 million per route mile. A Government Accountability Office (GAO) review of six projects involving incremental track improvements found that per-mile costs ranged from $4.1 million to $11.4 million.[51] The DOT Inspector General has estimated that reducing travel time between Washington, DC, and New York City and between New York City and Boston by a half hour would require corridor improvements totaling $14 billion (or about $31 million per route mile).[52]

Since the objective of building or improving a rail line is passenger mobility, rail project costs could be compared with the costs of alternative methods of increasing mobility, such as expanding a highway or an airport. The cost of highway or airport expansion is also highly project- and site-specific. Comparing costs on a per-mile basis is not as useful as comparing costs on a per passenger-mile basis (the cost of moving one passenger one mile) or comparing the reductions in total travel time across alternative modal projects. These measures incorporate the

[49] They are Japan's Tokyo-Osaka route and France's Paris-Lyon route, cited by Iñaki Barrón de Angoiti, director of high-speed rail at the International Union of Railways, in Victoria Burnett, "Spain's High-Speed Rail Offers Guideposts for U.S.," *The New York Times On the Web*, May 30, 2009.

[50] GAO, *High Speed Passenger Rail: Future Development Will Depend on Addressing Financial and Other Challenges and Establishing a Clear Federal Role*, March 2009, GAO-09-317, p. 24.

[51] Ibid., p. 25.

[52] DOT Inspector General, *Analysis of the Benefits of High-Speed Rail on the Northeast Corridor*, Report CC-2008-091, June 26, 2008.

improvement in passenger throughput expected from the construction project. However, comparing costs and benefits of modal options in this manner is not common because of institutional and organizational obstacles.[53] These include a federal DOT that is organized by modal segments, congressional authorizing committees organized by mode, earmarking of projects, prohibitions in state trust fund and federal trust fund financing, and industry advocacy that is largely organized by mode.[54]

In addition, there is evidence that transportation project costs are routinely underestimated. One study examined 258 transportation infrastructure projects around the world and found that in almost 90% of the cases costs were underestimated, that actual costs on average were 28% higher than estimated, and that rail projects in particular were the most severely underestimated, costing on average 45% more than estimated.[55]

Most U.S. railroad track is owned and maintained by private freight railroad companies whose trains operate more economically at slower speeds. Improving the quality of this track to allow for higher speed passenger trains could involve rebuilding track substructure, such as replacing the ballast, improving drainage, or replacing wood ties with concrete ties, as well as upgrading signaling and communications systems. Although the host freight railroads might gain some benefit from such improvements, they may be reluctant to fund them, as they may gain little advantage from being able to operate freight trains at higher speeds.

More importantly, because intercity passenger and freight trains, as well as commuter trains, share the track in many corridors where higher speed service is proposed, it will be necessary to increase capacity on these routes to avoid delays caused by interference from other trains. For example, Amtrak's on-time performance on the NEC,[56] which has multiple tracks and on which Amtrak controls the dispatching, was around 86% in FY2013, but its on-time performance outside the NEC,[57] where there is often only a single track and where dispatching is controlled by freight rail companies, was 82% for short-distance trains and 72% for long-distance trains.[58] According to Amtrak, many delays are due to interference from freight trains, and to a lesser extent, commuter trains. The simplest way to increase capacity is to add sidings to allow slower trains to make way for faster trains to pass, but significant improvements in speed and reliability may require installing a second track with high-speed crossovers so trains can shift from one track to the other, a layout which more than doubles route capacity.[59]

Operating Costs and Revenues

Once a higher speed or very high speed infrastructure has been completed, operating costs can be a significant public expense if the train operator cannot generate sufficient revenue from passenger fares. Operating costs include labor, fuel or electric power, equipment and track

[53] For further discussion of this issue, see Transportation Research Board, *Multimodal Aspects of Statewide Transportation Planning*, NCHRP Synthesis 286, 2000, http://ntl.bts.gov/lib/17000/17600/17654/PB2001102765.pdf; and GAO, *Surface Transportation: Many Factors Affect Investment Decisions*, GAO-04-744, June 2004.

[54] NCHRP Synthesis 286, p. 1.

[55] Bent Flyvbjerg, Mette Skamris Holm, and Soren Buhl, "Underestimating Costs in Public Works Projects: Error or Lie?," *Journal of the American Planning Association*, Summer 2002, vol. 68, no. 3. Rail projects in this study included high speed and conventional intercity rail projects as well as rail transit projects.

[56] Defined as arriving within 10 minutes of the scheduled arrival time.

[57] Defined as arriving within 20 minutes of the scheduled arrival time.

[58] Amtrak, Monthly Performance Report for September 2013, p. E-7, http://www.amtrak.com/ccurl/931/771/Amtrak-Monthly-Performance-Report-September-2013.pdf.

[59] Andrew Nash, "Best Practices in Shared-Use High-Speed Rail Systems," Mineta Transportation Institute, June 2003.

maintenance, track access charges, and other costs that vary depending on the number of trains that are operated. In the United States, all intercity passenger operations except Amtrak's Acela service are subsidized, in the sense that federal and state governments supplement revenues from ticket sales, as these are insufficient to cover the costs of operating the trains plus a portion of general administrative expenses. Few if any passenger rail operations anywhere in the world generate sufficient revenue to cover all capital as well as operating costs.

Some high speed rail project sponsors have estimated that their services would be able to operate without public subsidies once construction is complete. Additionally, some supporters of high speed rail projects have asserted that profit-maximizing private companies could operate rail services without subsidy, especially in corridors where air and highway congestion are extreme.

The organizational structure of passenger rail is not conducive to a market environment in which competition among carriers exerts downward pressure on operating costs. The "low-cost carrier" phenomenon in the airline and intercity bus industries, in which multiple carriers compete with one another over the same infrastructure, is not practicable in the passenger rail industry.

Airlines and bus lines operate using publicly owned infrastructure to which all carriers have access on similar terms. Most track suitable for passenger service in the United States, on the other hand, is controlled by railroads whose main business is operating freight trains rather than accommodating passenger operations. Indeed, under federal law freight railroads are not obligated to carry trains of passenger operators other than Amtrak.[60] The freight railroads have little incentive to negotiate access charges favorable to potential passenger operators, especially where their trains would interfere with freight operations or would necessitate a higher level of track maintenance. This poses a considerable obstacle to state governments or private companies seeking to operate high-speed passenger trains in competition with Amtrak or on routes Amtrak does not serve.[61]

Operating costs aside, the other key determinant of whether high speed rail can be profitable without subsidies is fare revenue, which is dependent on ridership levels and how much riders would be willing to pay for the service.[62] The cost-effectiveness of higher speed and very high speed rail depends on achieving high ridership levels. Estimates of the level of ridership needed to justify the cost of a high speed line similar to those in other countries range from 6 million to 9 million riders in the first year.[63] To put that figure in context, Amtrak's current high speed service, the Acela, which began operating in 2000 in the most densely populated corridor in the United States, carried 3.3 million passengers in FY2013.[64]

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[60] See CRS Report R42512, *Passenger Train Access to Freight Railroad Track*, by John Frittelli.

[61] One freight operator, Florida East Coast Railway, has proposed to operate its own passenger service over track it owns or would build. See http://www.allaboardflorida.com/.

[62] For further information and analysis on economic viability, see DOT IG, *FRA Needs to Expand Its Guidance on High Speed Rail Project Viability Assessments*, Report no. CR-2012-083, March 28, 2012.

[63] Ginés de Rus and Gustavo Nombela, "Is Investment in High Speed Rail Socially Profitable?," *Journal of Transport Economics and Policy*, vol. 41, no. 1 (January 2007), p. 15; Ginés de Rus and Chris Nash, "In What Circumstances is Investment in HSR Worthwhile?," chapter 3 of *Economic Analysis of High Speed Rail In Europe*, Ginés de Rus (ed.), Bilbao, 2009, p. 70.

[64] Amtrak, *Monthly Performance Report for September 2013*, November 8, 2013, p. A-3.5, http://www/amtrak.com/ccurl/931/771/Amtrak-Monthly-Performance-Report-September-2013.pdf. Amtrak's slower service in the Northeast Corridor, the Northeast Regional, carried 8.0 million passengers; fares for the Northeast Regional Service are less than half those charged for Acela service. Only five other Amtrak routes nationwide carried more than 1 million passengers in FY2013.

Ridership, of course, will depend heavily on the fares charged. Most plans for very high speed systems are premised on their ability to attract business customers who currently travel by air, as these are the travelers most willing to pay high fares for premium service. Despite an airplane's speed advantage, HSR can be time-competitive with airplanes if distances between cities are less than about 400-500 miles, given that security screening and pre-boarding wait times generally are significantly longer for air travelers than they are for train riders. Amtrak has been competitive with the airlines between certain cities along the Northeast Corridor. It captures 77% of the air/rail market share between Washington, DC, and New York City and 54% of the air/rail market share between New York City and Boston.[65] However, Amtrak only captures about 5% of the air/rail market share for trips from Washington, DC, to Boston, a distance of about 440 miles, which takes nearly seven hours even on the Acela.

It is more difficult for rail to compete with automobile transportation. If a traveler needs to make multiple stops en route to or around the destination city, a car may be more convenient, especially if the destination city lacks an extensive mass transit system. Driving is likely to be less expensive than rail if two or more people are traveling together, since the added cost of each additional traveler is virtually zero for passenger cars, and if tolls and parking fees are low. People traveling for leisure or personal reasons are likely to be more price-sensitive than business travelers, and their willingness to use the train instead of a personal car may depend in good part on the availability of low-cost fares.

High speed trains are not expected to compete well against intercity buses in many instances because bus travelers are more concerned about price than about travel time or comfort. Recent improvements in intercity bus service quality and frequency may reduce demand for high speed rail in some markets.

Trains depend on population density to operate efficiently. To compete with the airlines, trains must depart frequently but they also must fill a large proportion of their seats to generate sufficient ticket revenue if they hope to cover their operating costs. Not only is the population size of a city important but also the concentration of economic activity in the central business district or otherwise near the train station(s). Although the nation as a whole is becoming more urbanized, trends show that employment is steadily decentralizing in almost all U.S. cities, which may raise questions about the viability of high speed rail as a transportation alternative for many business travelers.[66] It is worth noting that tickets to or from New York City accounted for 30% of Amtrak's total ridership in 2012.[67] New York has an extremely high population density, has a large concentration of businesses within walking distance of the train station, and is the only city in the country where more residents (55%) do not own an automobile than do.[68]

Potential Benefits of High Speed Passenger Rail

With decades of experience from around the world, conventional HSR can be considered a proven technology that potentially offers a convenient and comfortable way to travel between major urban centers. However, HSR has come in for criticism based on concerns about its cost-

[65] Based on FY2011, 3rd quarter data. Amtrak Government Affairs Department, "Amtrak's Northeast Corridor: FY2011," June 2012, http://www.amtrak.com/ccurl/193/174/Amtrak-Northeast-Corridor-2011.pdf.

[66] Ibid., pp. 10-14.

[67] Amtrak, *National Fact Sheet: FY2012*, http://www.amtrak.com/ccurl/355/968/Amtrak-National-Fact-Sheet-FY2012.pdf.

[68] U.S. Census, *County and City Data Book: 2007*, 14th edition (latest edition available). The only other cities with at least a third of households not having a vehicle are also in the Northeast Corridor: Washington, DC, Boston, and Philadelphia.

effectiveness compared to travel by air or highway. Assessments of cost-effectiveness are likely to depend, in part, on the ability of HSR to provide various social goods whose benefits will not be reflected in passenger revenues.

Alleviating Highway and Airport Congestion

In heavily traveled and congested corridors, HSR has the potential to relieve highway and air traffic congestion, and thereby to reduce the need to pay for capacity expansions of roads and airports.[69]

With respect to highway congestion relief, many studies estimate that HSR will have little positive effect because most highway traffic is local and the diversion of intercity trips from highway to rail will be small. In a 1997 study, FRA estimated that in most cases rail improvements would divert only 3%-6% of intercity automobile trips, and even less in corridors with average trip lengths under 150 miles.[70] DOT's Inspector General (IG) found much the same thing in a more recent analysis of HSR in the Northeast Corridor, estimating that reductions of one hour in rail trip times from Boston to New York and from New York to Washington would reduce automobile ridership along the NEC by less than 1%.[71] Planners of a high speed rail link in Florida between Orlando and Tampa, a distance of about 84 miles, estimated that it would shift 11% of those driving between the two cities to the train, but because most of the traffic on the main highway linking the two cities, Interstate 4, is not travelling between Orlando and Tampa, the HSR project was estimated to reduce traffic on the busiest sections of I-4 by less than 2%.[72]

Since HSR is more comparable to commercial air travel than to automobile travel, it is likely that in the right circumstances a significant share of air travelers would switch to HSR. The IG's study of the NEC estimated that 11%-20% would divert to HSR from air, depending upon train speeds, concluding that "this would provide congestion relief at NEC airports and in NEC airspace."[73]

Such high diversion rates would not necessarily reduce airport congestion. Airlines might substitute smaller aircraft for larger ones, or replace flights to locations accessible by rail with flights to and from other locations. The net effects of such changes may be positive, as they may improve intercity transport links overall. However, it is possible that a smaller airport in a community served by HSR could suffer a disproportionate loss of its air service.[74] Even in heavily congested areas, HSR may be a more costly way of relieving air traffic congestion on a per-passenger basis than some combination of measures such as expanding airport capacity,

[69] For an argument on this point, see California High Speed Rail Authority, "Moving California Forward: California's High-Speed Train System," http://www.cahighspeedrail.ca.gov/news/MOBILITY_lr.pdf.

[70] U.S. Department of Transportation, Federal Railroad Administration, *High-Speed Ground Transportation for America*, Washington, DC, September 1997, p. 7-8, http://www.fra.dot.gov/Downloads/RRDev/cfs0997all2.pdf.

[71] U.S. Department of Transportation, Office of the Secretary of Transportation, Office of the Inspector General, *Analysis of the Benefits of High Speed Rail on the Northeast Corridor*, Washington, DC, June 26, 2008, http://www.oig.dot.gov/sites/dot/files/pdfdocs/HSR_Final_7-1-08.pdf.

[72] U.S. Department of Transportation, Federal Railroad Administration and Florida High Speed Rail Authority, *Final Environmental Impact Statement: Florida High Speed Rail, Tampa to Orlando*, May 2005, p. 1-7, 4-119, http://www.fra.dot.gov/downloads/RRDev/florida_tampa-orlando_feis.pdf.

[73] IG, 2008, p. 3.

[74] Randal O' Toole, *High-Speed Rail: the Wrong Road for America*, Cato Institute, Policy Analysis, No. 625, October 31, 2008, p. 8, http://www.cato.org/pubs/pas/pa-625.pdf.

applying congestion pricing to takeoff and landing slots, and implementing an enhanced air traffic control system.[75]

Alleviating Pollution and Reducing Energy Consumption

Another major benefit claimed for HSR is that it uses less energy and is relatively less polluting than other modes of intercity transportation.[76] While the physics of rail do generally provide favorable energy intensity and carbon emission attributes in comparison with highway and air travel, such claims tend to rest heavily on assumed high passenger loads and the use of clean sources of electricity generation to power the trains. Moreover, they tend to ignore the energy and carbon emission of building, maintaining, and rebuilding the infrastructure that supports each mode, and they tend to assume automotive and airplane engine technology will not become more energy efficient in the future.

Completed as part of a wide-ranging review of transportation policy in the United Kingdom, an analysis of building a high speed rail system connecting London with Glasgow and Edinburgh (distances of approximately 350 miles and 330 miles, respectively), including its energy use and carbon emissions profile, concluded:

> high level analysis of the potential carbon benefits from modal shift from air to high speed rail suggests that these benefits would be small relative to the very high cost of constructing and operating such a scheme, and that under current assumptions a high speed line connecting London to Scotland is unlikely to be a cost-effective policy for achieving reductions in carbon emissions compared to other policy measures.[77]

Because HSR will only capture a relatively small share of total passenger trips, it is also unlikely to make much difference in achieving greenhouse gas reduction targets and in reducing petroleum consumption. A study of the potential benefits of HSR in Sweden concluded that investment in rail networks is a less cost-effective climate policy instrument than general policies, such as increased fuel taxes.[78] Similarly, analysis of a proposed line from London to Scotland estimated carbon savings would be 0.2% of the UK's current emissions, assuming that all flyers take the train and HSR emits no greenhouse gases.[79]

Promoting Economic Development

There is no doubt that HSR projects create employment in planning, design, and construction. Research shows that infrastructure spending tends to create more jobs than other types of

[75] See, for example, the cost estimates for NextGen in Government Accountability Office, Next Generation Air Transportation System: Status of Systems Acquisition and the Transition to the Next Generation Air Transportation System, GAO-08-1078, Washington, DC, September 2008, p.7, http://www.gao.gov/new.items/d081078.pdf.

[76] See, for example, Center for Clean Air Policy and Center for Neighborhood Technology, *High Speed Rail and Greenhouse Gas Emissions in the U.S.*, January 2006, http://www.cnt.org/repository/HighSpeedRailEmissions.pdf, and California High Speed Rail Authority, "California High-Speed Train System Environmental Protection," http://www.cahighspeedrail.ca.gov/news/Factsheetenviro.pdf.

[77] HM Treasury and Department for Transport, *The Eddington Transport Study: Main Report, Volume 3*, London, 2006, p. 213, http://www.dft.gov.uk/about/strategy/transportstrategy/eddingtonstudy/.

[78] Jan-Eric Nilsson and Roger Pyddoke, *High-Speed Railways—A Climate Policy Sidetrack*. VTI (Swedish National Road and Transport Research) #655, 2009, p. 13, http://www.vti.se/en/publications/high-speed-railways--a-climate-policy-sidetrack/.

[79] Eddington Transport Study, 2006, p. 211.

spending.[80] The California High Speed Rail Authority claims that its planned HSR system will create 100,000 construction-related jobs each year during the building phase.[81]

The longer-term impact of HSR in spurring economic development and encouraging potentially beneficial changes in land use around high speed rail stations, by contrast, is disputed. CHSRA claims that high speed rail in California will create 450,000 permanent jobs due to faster economic growth.[82] Looking at the experience of HSR in Japan, one study argues "the claims that a multiplier effect (or economic development effect) of 450,000 jobs as a result of the introduction of CHSR [California HSR] are not likely to be realized."[83] Moreover, GAO pointed out in 2009 that "while benefits such as improvements in economic development and employment may represent real benefits for the jurisdiction in which a new high speed rail service is located, from another jurisdiction's perspective or from a national view they may represent a transfer or relocation of benefits."[84] On the question of whether HSR can provide broader economic benefits by allowing workers greater access to jobs and improving business travel, the UK study discussed earlier found that "such effects are quite limited in mature economies with well developed infrastructure."[85]

Improving Transportation Safety

Despite several serious accidents, HSR in other countries generally has a very good safety record. France's TGV, for example, boasts that it has never had a single on-board fatality running at high speed in over two decades of operation. However, it is unlikely that HSR will significantly reduce the number of transportation-related deaths and injuries in the United States. Autos are by far the most dangerous form of passenger travel, in terms of fatalities per passenger-mile, and, as noted above, the ability of HSR to divert highway travelers to rail is likely to be limited. The diversion of flyers to trains would make little difference in terms of passenger safety because air transportation is also very safe.

Providing Travelers a Choice of Modes

There is some value in providing travelers with a choice of modes, particularly for those unable or unwilling to fly or drive. In congested corridors, frequent and reliable HSR could provide travelers an attractive alternative to dealing with the frustrations of traffic bottlenecks and airline delays. Intercity rail can also be a relatively comfortable way to travel, affording travelers more seating room than airplanes or buses and greater opportunity to walk around. However, while these benefits accrue to individual users of HSR, it is not apparent that greater comfort and convenience bring social benefits that would justify public subsidies.

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[80] CRS Report R40104, *Economic Stimulus: Issues and Policies*, by Jane G. Gravelle, Thomas L. Hungerford, and Marc Labonte.

[81] California High Speed Rail Authority, "Project Vision and Scope," http://www.cahighspeedrail.ca.gov/project_vision.aspx.

[82] Ibid.

[83] Jerry Nickelsburg and Saurabh Ahluwalia, "California High-Speed Rail and Economic Development: Lessons from Japan," *UCLA Anderson Forecast*, June 2012, p. 107, http://www.anderson.ucla.edu/documents/areas/ctr/forecast/UCLAForecast_June2012_HSR.pdf.

[84] U.S. Government Accountability Office, *High Speed Passenger Rail*, GAO-09-317, March 2009, Washington, DC, p. 29, http://www.gao.gov/new.items/d09317.pdf.

[85] Eddington Transport Study, 2006, p. 208.

Making the Transportation System More Reliable

Many different types of events can dramatically disrupt a transportation system. These include floods, snowstorms, hurricanes, earthquakes, fires, and terrorism. During such events, it can be very valuable to have extra capacity to handle extra demand or an alternative means of travel when other means fail. For example, rail service often continues when bad weather grounds air service.[86] Building in redundancy to any system entails added costs, but the availability of alternatives tends to make the system as a whole more reliable during unusual events and emergencies.[87]

High Speed Rail Funding Considerations

The demand for HSR funding is potentially very great. There are many potential projects, and if currently funded projects result in significantly increased train usage, additional projects are likely to be put forward. For example, work now underway to improve service between Chicago and St. Louis may be followed by proposals to double-track the existing line at additional cost, and there have been studies for a future 220 mph line between the two cities at an estimated cost of $12.6 billion (in 2012 dollars).[88] As noted earlier, the most recent cost estimate for Phase 1 of the California HSR is now itself around $60 billion.

In 2009, the House Transportation and Infrastructure (T&I) Committee's proposal for surface transportation authorization included $50 billion over six years for high speed rail development, an average of $8.3 billion annually.[89] However, the House T&I proposal for high speed rail did not include a dedicated revenue source. Given that HSR projects can require 10 years or more to develop, funding projects in the face of changing political priorities will be difficult without a dedicated funding source.[90] Otherwise, rail projects must compete with the programs for limited discretionary funding. Only about $15 billion of DOT's funding came from the general fund in FY2012, with the balance coming from motor fuel taxes dedicated to the highway trust fund. Providing another $1 billion in general fund money for high speed rail each year, let alone $8.3 billion, would require a significant increase in DOT's General Fund appropriation.

Several options have been advanced to fund a high speed intercity passenger rail development program:

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[86] See, for example, U.S. Department of Transportation, Bureau of Transportation Statistics, *Transportation Statistics Annual Report 1997*, Washington, DC, 1997, pp. 22-23, http://www.bts.gov/publications/transportation_statistics_annual_report/1997/pdf/report.pdf.

[87] See, for example, U.S. Department of Transportation, Research and Special Programs Administration, Effects of Catastrophic Events on Transportation System Management and Operations: Cross Cutting Study, January 2003, http://www.itsdocs.fhwa.dot.gov//JPODOCS/REPTS_TE//13780_files/13780.pdf.

[88] TranSystems, *Chicago to St. Louis 220 mph High Speed Rail Alternative Corridor Study*, October 8, 2008, http://www.midwesthsr.org/sites/default/files/pdf/MHSRA_Chicago_StLouis_HSR_Corridor_Study.pdf.

[89] U.S. Congress, House Committee on Transportation and Infrastructure, *The Surface Transportation Authorization Act of 2009: A Blueprint for Investment and Reform*, Executive Summary, 111th Cong., 1st sess., June 18, 2009, p. 4, available at http://transportation.house.gov/Media/file/Highways/HPP/Surface%20Transportation%20Blueprint%20Executive%20Summary.pdf.

[90] As noted earlier, congressional support for HSR changed significantly as a result of the 2010 midterm election; in the two years prior to that election, Congress had appropriated $10.5 billion for passenger rail, including HSR; in the year after that election, Congress provided no additional funding, and cut $400 million of the funding already appropriated.

- Dedicating a portion of the highway trust fund's revenues. This approach is not promising, as the highway trust fund's outlays for highway and transit currently exceed its revenues.
- Adding a tax onto the tickets of intercity rail passengers, just as the airport and airway trust fund is funded in part by a tax on airline tickets. In addition to raising the price of the rail travel it is meant to support, this proposal would produce relatively small amounts of revenue: a 10% tax on Amtrak tickets in FY2011 would have raised $189 million, assuming that ridership would not have declined as a result of the price increase.
- Dedicating a portion of the revenues from proposed greenhouse gas emissions reduction programs to a rail trust fund. To date, however, Congress has not established greenhouse gas control programs that would raise significant sums.
- Using bonds, including tax-exempt bonds and tax-credit bonds, to fund development of high speed rail lines. Based on the revenue experience of high speed lines in other countries, it appears likely that the bonds would have to be repaid primarily by the federal or state governments, or both.
- Obtaining funding from the private sector. The United States has not seen private investment in high speed passenger rail infrastructure in many decades; the most notable proposal now pending, for a privately owned line between Victorville, CA, and Las Vegas, is dependent upon a $4.9 billion federal loan, meaning that taxpayers could be at risk if the project fails to generate sufficient revenue.[91]

High Speed Rail In Other Countries

Proponents of HSR often cite the networks in Japan, France, and other countries, with the implication that their adoption of HSR demonstrates the feasibility and desirability of building HSR lines in the United States. This conclusion may not be warranted. The motives that led other countries to implement very high speed rail lines are varied. Some, like Japan and China, did so originally in part to meet the demand on already overcrowded conventional rail lines. Others did so to promote economic development in certain locations or encourage rail travel in the face of the growing role of car and air travel.

In Europe and Japan, HSR has succeeded in capturing market share from commercial aviation. For example, rail has captured 85% of the air/rail market between Tokyo and Osaka (a distance of 320 miles, with a fastest scheduled rail travel time of 2 hours 25 minutes), and 74% of the air/rail market between Rome and Bologna (a distance of 222 miles, with a fastest scheduled rail travel time of 2 hours 44 minutes).[92]

The relative efficiency of HSR as a transportation investment varies among countries, depending upon the interplay of many factors, including geography, economics, and government policies. For example, compared to the United States, countries with HSR have higher population

[91] This would be a grade separated, dedicated double-tracked passenger-only line of approximately 200 miles that would generally follow the I-15 corridor. The developer, DesertXpress Enterprises, describes the project as a public/private partnership, since it hopes to use public right-of-way (http://www.desertxpress.com/economics.php). DesertXpress has applied for a $4.9 billion loan from the Railroad Rehabilitation and Improvement Financing Program to help finance the $6 billion project. See "DesertXpress hopes for federal loan, aims for 2012 start on work," *Las Vegas Sun*, October 10, 2011. DOT suspended review of the loan request in summer 2013; see "Feds: XpressWest failed to meet 'Buy America' rules for high-speed train," *Las Vegas Review-Journal*, July 16, 2013.

[92] Prospects for High Speed Rail in the U.S., presentation prepared by Mercer Management Consulting before the House Committee on Transportation and Infrastructure, March 20, 2007.

densities, smaller land areas, lower per capita levels of car ownership, higher gasoline prices, lower levels of car use (measured both by number of trips per day and average distance per trip), and higher levels of public transportation availability and use.

Also, there is a significant difference in the structure of the rail industry in countries with HSR compared to the United States. In most of those countries, high speed rail was implemented by state-owned or state-supported rail infrastructure companies and is operated by state-owned rail companies whose principal business is passenger, rather than freight, transportation. By contrast, in the United States the rail network is almost entirely owned by private companies specializing in freight transportation.

The history of HSR development in other countries reveals a recurring tension between economic analysis and political pressure in HSR development. A country's initial HSR line is usually built in a location where the investment makes the most sense economically, in terms of population density and travel demand. Once that line is built, and if it is considered successful, the desire for similar benefits in other parts of the country can result in political pressure to build additional lines, even if economic analysis indicates that these are unlikely to be as successful as the initial line. Japan is perhaps the best example, in part because it has been building HSR lines for the longest time: its first HSR line was the most successful the world has seen, but subsequent lines have carried fewer passengers and had weaker financial performance.

For more information on the development of HSR in other countries see the **Appendix**.

Considerations for Congress

In considering further initiatives regarding HSR, there are a number of issues Congress may wish to examine. The first of these is the rationale for building HSR. Proponents of HSR contend that it provides a number of direct and indirect benefits to travelers and the general public, some of which may not be apparent until far into the future. The extent of those benefits would depend largely on the level of ridership, which is difficult to forecast accurately and is likely to be influenced by the adoption or rejection of policies that would encourage people to use high speed rail. Other countries with high speed rail systems support HSR use through both incentives (e.g., widespread provision of a complementary mode, public transit) and disincentives (e.g., high road tolls and high taxes on motor fuel to make automobile use more expensive). Without similar policies in place, HSR ridership in the United States may not fulfill expectations based on the experiences of other countries.

Many of the benefits ascribed to HSR, such as improved mobility, reductions in imported energy, reduced greenhouse gas emissions, and so forth, would come from very high speed rail lines. Yet very high speed lines are expensive and potentially risky investments. Very high speed rail competes primarily with commercial aviation, which receives relatively little support from general Treasury funds compared to the level of funding which would likely be required to develop and operate a high speed rail network. And while very high speed rail might help to relieve airport congestion, Congress is supporting improvements which are expected to significantly expand the aviation system's capacity.

Should Congress decide to continue federal support for HSR, it would need to address a number of issues related to program financing:

- Should overall transportation funding be increased to include funding for HSR, or should some funding from existing highway and transit programs be redirected to HSR?

- What is the desirable allocation of the costs of high speed rail development among federal, state, and local governments and the private sector? Congress specified that the $8 billion provided in ARRA would be provided without requiring any local matching funds, but the HSR development program authorized in the Passenger Rail Investment and Improvement Act of 2008 (PRIIA) provided that the federal share of grants under that program should not exceed 80%. Most highway construction receives an 80% federal match, but the federal share of most rail transit projects is less.[93]
- How should federal funds be allocated among types of HSR? One or two successful very HSR projects might demonstrate HSR's potential and build public support, but they could also consume large amounts of funding. Incremental improvements to passenger routes in many parts of the country might bring better rail service to more people, but would probably not achieve the high density, very high speed operations generally associated with the concept of HSR.
- Which HSR projects should receive funding? In the HSR development program, Congress required that projects be part of a state rail plan or the national rail plan in order to receive funding. The FRA is currently developing a national rail plan,[94] but high speed rail development grants have been awarded prior to the completion of the plan. The basis FRA has used for selecting projects to be funded is not always clear. Nor is it clear whether FRA's national rail plan will reflect the rail plans of the states or will lay out a national rail vision that may not coincide with individual states' priorities.

Beyond the development costs, Congress may wish to consider how to pay for maintaining and operating an HSR system over the long term. Passenger revenues may not be sufficient to cover the operating costs of high speed lines, including the maintenance of the new HSR infrastructure. The federal government has not assumed long-term responsibility for infrastructure, other than that owned by Amtrak, and has not supported train operations other than those deemed to be part of Amtrak's national network. Measures to ensure adequate funding for train operations and infrastructure maintenance may be desirable to protect the federal investment in HSR.

[93] While the federal share for new rail transit projects receiving funding through the Federal Transit Administration's New Starts program can, by statute, be up to 80%; in practice the average federal share is lower; FTA has encouraged applicants to provide a local match of more than 20%, and since FY2002 the Senate Committee on Appropriations has directed FTA not to provide more than a 60% federal match.

[94] FRA has published a Preliminary National Rail Plan and a National Rail Plan Progress Report. The preliminary plan is described as setting forth FRA's proposed approach to developing the long-range National Rail Plan, including providing background information and identifying issues that FRA believes should be considered in developing National Rail Plan. Federal Railroad Administration, *Preliminary National Rail Plan: The Groundwork for Developing Policies to Improve the United States Transportation System*, October 15, 2009, http://www.fra.dot.gov/Downloads/RailPlanPrelim10-15.pdf. The progress report is a product of 15 months of study and discussions with partners in the rail industry. Federal Railroad Administration, National Rail Plan: Moving Forward, A Progress Report, September 2010, http://www.fra.dot.gov/downloads/NRP_Sept2010_WEB.pdf.

Appendix. Experience with HSR in Other Countries

Following are brief accounts of high speed rail networks in selected countries. Except where otherwise indicated, these countries have lines currently operating at speeds of 186 mph or more.

Japan

Japan may be the ideal country, geographically, for high speed rail; its main island is relatively long and narrow, so that its relatively large population is concentrated in cities arrayed along a corridor. Japan opened its first high speed rail line, between Tokyo and Osaka, in 1964.[95] That line was built to expand capacity in an overcrowded rail corridor. From its inception it earned enough revenue to cover its operating costs, and reportedly earned enough money within its first few years to pay back its construction costs. The success of the Tokyo-Osaka line encouraged expansion, and the Japanese government has supported construction of other high speed lines. As of 2011, the high speed rail network was 1,665 miles in length, with more under construction.[96] Currently, new lines are funded by public-private partnerships, with part of the funding coming from the now-privatized regional rail companies, and the rest from the national and local governments.

Since 1987, when the government began the privatization of Japan National Railways, all high speed lines have been operated by private companies. Current information on the profitability of individual high speed lines is not available, but all of the more recent lines have much lower ridership than the heavily traveled Tokyo-Osaka line.

France

France opened its first high speed rail line in 1981, between Paris and Lyon. Its high speed trains are referred to as TGVs (*Trains à Grande Vitesse*). As of 2013, the system has approximately 1,185 miles of high speed rail line, with more under construction.[97] Because of the relatively low population density of France and the central role of Paris (the nation's capital and largest population center), the French high speed rail network has been developed as spokes radiating outward from Paris. Regional governments are responsible for a significant share of construction costs. The state-owned rail operating company, SNCF, reports that its TGVs have taken the dominant share of the air-rail travel market in several of the high speed corridors, taking over 90% in the Paris-Lyon market (with a TGV travel time of less than two hours) and about 60% in corridors where the TGV travel time is around three hours.[98]

[95] In Japan, high speed rail is referred to as *Shinkansen* (literally, "New Trunk Line"), although the term is often used to refer to trains as well as the railway. The trains are often called "bullet trains" because of their shape and speed.

[96] International Union of Railways, *High-Speed Rail Lines in the World, Updated 1st November, 2011*, http://www.uic.org/spip.php?article573.

[97] Réseau Ferré de France, *[Rail] Network Inventory*, http://www.rff.fr/pages/reseau/inventaire_reseau.asp?lg=en.

[98] U.S. Congress, House Committee on Transportation and Infrastructure, Subcommittee on Railroads, Pipelines, and Hazardous Materials, Testimony of Jean Marie Metzler, French National Railroads, 110th Cong., 1st sess., April 19, 2007, http://republicans.transportation.house.gov/Media/File/Testimony/Rail/4-19-07-Metzler.pdf.

Germany

Article 87 of the German Constitution makes rail transport a government responsibility.[99] Germany opened its first high speed rail line in 1991. Its high speed trains are called InterCityExpress (ICE).

Germany's network varies significantly from that of its neighbor, France. Due in part to the more geographically distributed political demands of a federal system of government and in part to a denser and more evenly distributed population, Germany's high speed rail service has been developed to connect many hubs rather than centering on a single city. Germany's high speed trains also have more stops than those of France, whose system emphasizes connecting distant city pairs with few intermediate stops. These considerations have led Germany to put more emphasis on upgrading existing rail lines to accommodate higher speed service, and less emphasis on building entirely new high speed lines. One result is that Germany's high speed trains have longer average trip times than do those of France over comparable distances.

Spain

Spain opened its first high speed rail line in 1992. Like France, its population density is relatively low by European standards, and, except for Madrid, the capital and largest city, which is located in the center of the country, the population is largely concentrated near the coasts. Spain's conventional rail network was built using a wider gauge (i.e., the distance between the two parallel rails) than the international standard. Its high speed rail network is being built to the international standard, producing two separate rail networks. Many trains have special equipment to allow them to operate on both networks. As of 2013, Spain had more than 1,900 miles of high speed track in service.[100]

Government spending on rail infrastructure (both high speed and conventional) surpassed spending on roads in 2003. The Spanish government's Ministry of Public Works issued a Strategic Plan for Infrastructure and Transport for the period 2005-2020, which called for increasing the size of the high speed rail network to 6,200 miles by the year 2020. However, economic and financial issues have led to reconsideration or postponement of some of the projects in the plan.

China

China is developing an extensive high speed rail system in part to relieve the pressure of both passenger and freight demand on its overcrowded existing rail system,[101] in part to improve transportation connections between its different regions, and in part to promote the economy of less developed regions. China is upgrading parts of its existing rail network to achieve speeds of 120-150 mph, and is building new dedicated electrified lines to enable speeds of 180 mph or more. The national government has announced plans to have approximately 10,000 miles of high speed lines (including both upgraded existing lines and new dedicated electrified lines) in

[99] Heike Link, "German Railway Reform: Chances and Risks," *Japan Railway & Transport Review*, June 1994, p. 22.

[100] http://www.adif.es/es_ES/infraestructuras/lineas_de_alta_velocidad/lineas_de_alta_velocidad.shtml.

[101] Though its population is approximately four times larger than that of the United States, China's railway network is less than half the size of the U.S. rail network (the same is true of its highway network). *EU Energy and Transport in Figures 2009*, p. 105, http://ec.europa.eu/energy/publications/statistics/doc/2009_energy_transport_figures.pdf.

operation by 2020.[102] China accelerated its HSR construction schedule in 2008-2010, in part to stimulate the economy. But in the wake of a high-profile collision between two high-speed trains that killed 40 people in the summer of 2011, China acknowledged that it expanded the network too quickly, and slowed the pace of its HSR construction.[103]

Taiwan

Taiwan is an island nation slightly smaller than Maryland and Delaware combined, with a population estimated at around 23 million. The high speed line runs 214 miles north to south along the western side of the country. Upon completion of its first segment in 2007, it cut end-to-end travel times from 4.5 hours to 90 minutes. The Taiwanese government executed a build-operate-transfer contract with a private consortium, the Taiwan High Speed Rail Corporation, to develop the line at a cost of approximately $15 billion. Some 87% of the line had to be placed either in tunnels or on viaducts.[104] Initial ridership projections were around 65 million passengers annually. However, subsequent economic difficulties resulted in airline ridership dropping to 9 million in 2005, and the opening of a new highway also increased the attractiveness of highway travel.[105] In 2009, the Taiwanese government took control of the Taiwan High Speed Rail Corporation, which was on the brink of bankruptcy.[106] In 2012, the corporation reported a profit, and said ridership totaled 44.5 million passengers.[107]

South Korea

The Republic of Korea is slightly larger in area than the state of Indiana, with a population estimated at 49 million people. Korea began construction of a 255-mile high speed line in 1992, connecting its capital, Seoul (population 10 million), with its main port, Busan (population 3 million). This corridor serves 70% of the nation's population, and was previously serviced by a conventional line. The project was substantially completed in 2010, with a small amount of new track in central cities yet to be built. End-to-end travel time was cut from 4 hours to around 2 hours and 20 minutes, and ridership was reported to be 140,000 passengers a day in 2011 (about 51 million passengers, annually).[108] Initial cost estimates were around $5 billion, but the ultimate project cost was around $20 billion.[109] The project was costly in part due to the challenging terrain; nearly half the line is in tunnels and another quarter on viaducts, with only a quarter at grade.[110]

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[102] Keith Bradsher, "High Speed Rail Poised to Alter China," *New York Times*, June 22, 2011.

[103] *Wall Street Journal*, "Rail Line Collapses in China," March 13, 2012, http://online.wsj.com/article/SB10001424052702304537904577277200065540834.html.

[104] http://www.railway-technology.com/projects/taiwan/.

[105] Shima, Takashi, "Taiwan High Speed Rail," *Japan Railway and Transport Review* 48, August 2007, p. 45, http://www.jrtr.net/jrtr48/pdf/f40_Shi.pdf.

[106] "Government Takes Over to Keep High Speed Rail on Track," September 28, 2009, http://www.cens.com/cens/html/en/news/news_inner_29333.html.

[107] Taiwan High Speed Rail, *2012 Annual* Report, http://www5.thsrc.com.tw/download/en/01/thsrc_f_2012.pdf.

[108] Ahn B.O., Korail director of International Affairs, quoted in "High Speed Rail Boosts South Korea's Business," *ABC News*, November 15, 2011, http://abclocal.go.com/kgo/story?section=news/assignment_7&id=8433340.

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