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March 2009

# HIGH SPEED PASSENGER RAIL

Future Development  
Will Depend on  
Addressing Financial  
and Other Challenges  
and Establishing a  
Clear Federal Role





Highlights of GAO-09-317, a report to congressional requesters

March 2009

## HIGH SPEED PASSENGER RAIL

### Future Development Will Depend on Addressing Financial and Other Challenges and Establishing a Clear Federal Role

#### Why GAO Did This Study

Federal and other decision makers have had a renewed interest in how high speed rail might fit into the national transportation system and address increasing mobility constraints on highways and at airports due to congestion. GAO was asked to review (1) the factors affecting the economic viability—meaning whether total social benefits offset or justify total social costs—of high speed rail projects, including difficulties in determining the economic viability of proposed projects; (2) the challenges in developing and financing high speed rail systems; and (3) the federal role in the potential development of U.S. high speed rail systems. GAO reviewed federal legislation; interviewed federal, state, local, and private sector officials, as well as U.S. project sponsors; and reviewed high speed rail development in France, Japan, and Spain.

#### What GAO Recommends

GAO recommends that the Secretary of Transportation develop a strategic vision of how high speed passenger rail systems fit into the national transportation system, and develop guidance and tools to improve the reliability and accuracy of ridership, cost, and other forecasts for these systems. The Department of Transportation (DOT) said it generally agreed with the information presented but did not take a position on GAO's recommendations. DOT said the strategic plan required by the American Recovery and Reinvestment Act of 2009 may include a vision for high speed rail.

To view the full product, including the scope and methodology, click on [GAO-09-317](#). For more information, contact Susan Fleming at (202) 512-2834 or [flemings@gao.gov](mailto:flemings@gao.gov).

#### What GAO Found

Factors affecting the economic viability of high speed rail lines include the level of expected riders, costs, and public benefits (i.e., benefits to non-riders and the nation as a whole from such things as reduced congestion), which are influenced by a line's corridor and service characteristics. High speed rail tends to attract riders in dense, highly populated corridors, especially where there is congestion on existing transportation modes. Costs largely hinge on the availability of rail right-of-way and on a corridor's terrain. To stay within financial or other constraints, project sponsors typically make trade-offs between cost and service characteristics. While some U.S. corridors have characteristics that suggest economic viability, uncertainty associated with rider and cost estimates and the valuation of public benefits makes it difficult to make such determinations on individual proposals. Research on rider and cost forecasts has shown they are often optimistic, and the extent that U.S. sponsors quantify and value public benefits varies.

Once projects are deemed economically viable, project sponsors face the challenging tasks of securing the up-front investment for construction costs and sustaining public and political support and stakeholder consensus. In the three countries GAO visited, the central government generally funded the majority of the up-front costs of high speed rail lines. By contrast, federal funding for high speed rail has been derived from general revenues, not from trust funds or other dedicated funding sources. Consequently, high speed rail projects must compete with other nontransportation demands on federal funds (e.g., national defense or health care) as opposed to being compared with other alternative transportation investments in a corridor. Available federal loan programs can support only a fraction of potential high speed rail project costs. Without substantial public sector commitment, private sector participation is difficult to secure. The challenge of sustaining public support and stakeholder consensus is compounded by long project lead times, by numerous stakeholders, and by the absence of an established institutional framework.

The recently enacted Passenger Rail Investment and Improvement Act of 2008 will likely increase the federal role in the development of high speed rail, as will the newly enacted American Recovery and Reinvestment Act of 2009. In the United States, federal involvement with high speed rail to date has been limited. The national rail plan required by the Passenger Rail Investment and Improvement Act of 2008 is an opportunity to identify the vision and goals for U.S. high speed rail and how it fits into the national transportation system, an exercise that has largely remained incomplete. Accountability can be enhanced by tying the specific, measurable goals required by the act to performance and accountability measures. In developing analytical tools to apply to the act's project selection criteria, it will be important to address optimistic rider and cost forecasts and varied public benefits analyses.

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### Abbreviations

Amtrak	National Railroad Passenger Rail Corporation
ARRA	American Recovery and Reinvestment Act of 2009
DOT	Department of Transportation
FDOT	Florida Department of Transportation
FOX	Florida Overland Express
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
I-15	Interstate 15
maglev	magnetic levitation
NEPA	National Environmental Policy Act
PRIIA	Passenger Rail Investment and Improvement Act of 2008
RFF	Réseau Ferré de France
SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users
SNCF	Société Nationale des Chemins de Fer Français
TEA-21	Transportation Equity Act of the 21 <sup>st</sup> Century
TGV	Train à Grande Vitesse
THSRA	Texas High Speed Rail Authority
TIFIA	Transportation Infrastructure Finance and Innovation Act of 1998

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**United States Government Accountability Office  
Washington, DC 20548**

March 19, 2009

Congressional Requesters

Federal, state, and local decision makers have had a renewed interest in looking at how high speed rail might fit into our national transportation system and address increasing mobility constraints on the nation's highways and at airports due to congestion. Although the current economic downturn has recently reduced the level of highway and air travel, projections show that intercity travel will grow again and that existing transportation capacity limitations will constrain mobility. The Department of Transportation (DOT) estimates that several intercity highways linking major urban markets will experience significant congestion by 2035. According to a recent report, capacity limitations will constrain air traffic at 14 airports in 8 metropolitan areas, even if planned capacity improvements are carried out through 2025.<sup>1</sup> In addition, the dependence of growing highway and air travel on fossil fuels raises significant environmental concerns regarding greenhouse gas emissions. As a result, transportation decision makers are exploring options that not only expand transportation capacity and relieve increasing congestion but also minimize the deleterious environmental impacts of increasing highway and air travel. The average intercity passenger train can produce significantly less emissions than other transportation modes.

The National Railroad Passenger Rail Corporation (Amtrak), the nation's intercity passenger rail provider, has seen nearly a 20 percent increase in riders in the last 2 years, in part because service enhancements in some intercity corridors have improved overall travel time and reliability, making the train more competitive with highway and air travel. Still, Amtrak does not offer service in many heavily traveled intercity corridors. Moreover, Amtrak's service continues to have slow average speeds relative to other transport modes, and experiences significant delays, often resulting from sharing track with commuter and freight rail. Proposals for investment in high speed rail in the United States have existed for decades. However, corridor service that exceeds Amtrak's predominant top speed of 79 miles per hour currently only exists on Amtrak's Northeast Corridor

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<sup>1</sup>The MITRE Corporation, Center for Advanced Aviation System Development, *Capacity Needs in the National Airspace System (2007-2025), an Analysis of Airports and Metropolitan Area Demand and Operational Capacity in the Future* (May 2007).

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between Boston, Massachusetts, and Washington, D.C., and in a few other corridors—including New York City, New York, to Albany, New York; Philadelphia, Pennsylvania, to Harrisburg, Pennsylvania; and Los Angeles, California, to San Diego, California—and on a segment of track between Chicago, Illinois, and Detroit, Michigan.<sup>2</sup> By contrast, countries in Europe and Asia have developed extensive rail systems with top speeds exceeding 150 and even 200 miles per hour, which have attracted relatively high numbers of riders compared with other transportation modes.

As part of a larger effort to reexamine transportation funding and decision making in the United States, the National Surface Transportation Policy and Revenue Study Commission and its Passenger Rail Working Group issued a report that laid out the potential for a new vision of intercity and high speed rail development in the United States, and that called for an initial investment of \$5 billion per year.<sup>3</sup> Moreover, in October 2008, Congress enacted the Passenger Rail Investment and Improvement Act of 2008 (PRIIA), which establishes a program to develop high speed rail corridors—authorizing \$1.5 billion in funding for project development.<sup>4</sup> The recently enacted American Recovery and Reinvestment of Act of 2009 (ARRA) appropriated \$8 billion for high speed rail and intercity passenger rail congestion and capital grants (the latter of which were authorized by the PRIIA), with priority given to projects that support the development of high speed rail service.<sup>5</sup> To better understand the role that high speed rail service could play in the U.S. transportation system, we were asked to assess (1) the factors affecting the economic viability of high speed rail projects—that is, whether a project's total social benefits offset or justify the total social costs—and difficulties in determining the economic viability of proposed projects; (2) the challenges that U.S. project sponsors experience in developing and financing high speed rail projects; and (3) the federal role in the potential development of high speed rail systems.

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<sup>2</sup>In addition to these corridors, the long-distance route between Chicago, Illinois, and Los Angeles, California, operates at 90 miles per hour over portions of its route.

<sup>3</sup>"Vision for the Future: U.S. intercity passenger rail network through 2050," prepared by the Passenger Rail Working Group for the National Surface Transportation Policy and Revenue Study Commission, December 6, 2007.

<sup>4</sup>Pub. L. No. 110-432, Div. B, title V, § 501(d), 122 Stat. 4907, 4963 (Oct. 16, 2008), codified at 49 U.S.C. § 26106(h).

<sup>5</sup>Pub. L. No. 111-5, 123 Stat. 115 (2009)(ARRA).

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For the purposes of this report, we use the Federal Railroad Administration's (FRA) definition of high speed ground transportation, which is "service that is time-competitive with air and/or automobile travel in a given intercity corridor."<sup>6</sup> This definition does not define high speed rail on the basis of a specific speed threshold. As a result, our review includes a wide range of projects, including both "incremental" projects, which are designed to increase the speed—above 79 miles per hour and up to 150 miles per hour—or reliability of rail service on existing track usually shared with commuter or freight railroads, and "new" high speed rail projects—capable of speeds above 150 miles per hour—which are designed to operate on their own tracks or guideway not shared with other rail services. Our review is also technology neutral, meaning that we did not analyze or consider the technical feasibility of the various rail technologies available, such as diesel, electrified trains, or magnetic levitation (maglev) trains,<sup>7</sup> but rather we considered only the service and performance aspects of these different technologies in the proposals we reviewed.

We obtained information from numerous sources to address our objectives. Specifically, we conducted structured interviews with officials involved in the planning and operation of the 5 corridor rail lines that currently exceed 79 miles per hour, and with project sponsors for 11 specific corridor projects in the United States that are actively being pursued and have advanced into the environmental review phase of project development. (See app. I for a detailed discussion of our scope and methodology, and apps. II and III for a detailed description of each project we reviewed.) The 5 existing projects are all incremental improvements, and of the 11 proposed projects, 6 are incremental projects, and 5 are new high speed rail projects that would involve new track or guideways. Three of the latter projects are considering maglev technology. We structured the interviews to determine (1) the most important characteristics and factors that affect the project's viability; (2) the most important challenges faced by project sponsors in developing the project; and (3) the roles of various

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<sup>6</sup>See, for example, FRA's Notice Requesting Expressions of Interest in Implementing a High Speed Intercity Passenger Rail Corridor, 73 Fed. Reg. 76443 (issued Dec. 16, 2008).

<sup>7</sup>According to FRA, maglev is an advanced transport technology in which magnetic forces lift, propel, and guide a vehicle over a specially designed guideway. This technology can reduce or eliminate the need for wheels and many other parts, thereby minimizing mechanical friction and permitting excellent acceleration, with cruising speeds of about 300 miles per hour or more. See Department of Transportation, Federal Railroad Administration, *Costs and Benefits of Magnetic Levitation* (Washington, D.C.: 2005).

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federal, state, local, and private sector entities in the development of the project. Also, we conducted case studies of 2 high speed rail projects that had been terminated (the Florida Overland Express and the Texas TGV) as well as case studies of high speed rail in France, Japan, and Spain (see app. IV for more details on the terminated projects, and app. V for information on the high speed rail systems in France, Japan, and Spain). We chose the terminated projects to identify the challenges encountered by previous attempts to develop high speed rail in the United States, and we chose these countries on the basis of their experiences with the development and operation of high speed rail service. In addition, we reviewed relevant literature on high speed rail systems in these and other countries as well as information, studies, and reports on domestic high speed rail proposals. Lastly, we conducted over 90 interviews with a wide range of stakeholders and interested parties, including academics; consultants involved in ridership forecasting and planning; representatives from private firms that invest in transportation infrastructure; engineers involved in developing various rail technologies; state and local government agencies and organizations; and officials at Amtrak, FRA, the Surface Transportation Board, and other federal agencies involved in the domestic projects we reviewed.

We conducted this performance audit from December 2007 to March 2009 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

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## Results in Brief

Factors affecting the economic viability of high speed rail lines include expected ridership levels, construction and operating costs, and public benefits (i.e., benefits to nonriders and to the nation as a whole) due, for example, to reduced congestion. While some U.S. corridors have characteristics that suggest potential economic viability, decision makers have faced difficulties in ascertaining whether a specific proposed high speed rail line will be viable, due to the uncertainties of ridership forecasts, cost estimates, and public benefits proposed by project sponsors. In the United States or elsewhere, high speed rail tends to attract riders in corridors with high population and density, especially where congestion on existing transportation modes prevails. Service characteristics of a high speed rail line relative to other travel alternatives—such as trip time, frequency of service, reliability, and

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safety—are also critical factors. High speed rail lines incur high up-front costs, whether built on dedicated right-of-way or as incremental improvements to existing right-of-way. Corridors where right-of-way is available for rail purposes and are relatively flat with straight track alignments can help lower costs. To stay within financial or other constraints, project sponsors must typically trade-off some level of ridership to reduce costs. For example, most domestic projects currently under consideration are incremental projects on track shared with freight operators—a choice that limits the travel time competitiveness and reliability valued by riders that would be possible on more expensive, dedicated track. Research on ridership and cost forecasts for transportation projects has shown that such forecasts are often significantly optimistic, and different ridership forecasting methods may yield diverse, and therefore uncertain, results. While all U.S. sponsors cited a variety of public benefits that would flow from their projects, such as congestion relief or environmental benefits, the extent to which benefits have been quantified and valued varied across projects.

Once projects are deemed economically viable, project sponsors encounter several other challenges—most notably, securing the up-front investment necessary to fund the substantial construction costs as well as sustaining public and political support and obtaining stakeholder consensus. In each of the three countries we visited, the central government paid the up-front construction costs of their country's high speed rail lines, and did so with no expectation that its investment would be recouped through ticket revenues. Federal funding for rail in general, and high speed rail in particular, has largely been derived from general revenues, as opposed to trust funds or other dedicated federal funding sources, such as those that fund other transportation modes. Consequently, high speed rail projects must compete with other nontransportation demands on federal funds, such as national defense, education, or health care, as opposed to being compared with other alternative transportation investments or policies in a corridor. Alternative federal funding sources, such as authorized under the Transportation Infrastructure Finance and Innovation Act of 1998 (TIFIA), are available, but in their present form can support no more than a small fraction of potential high speed rail project costs. State funding is also limited since few states have dedicated funding sources for passenger rail, and general revenues can be limited. Private sector participation is also difficult to secure without a substantial public sector commitment—both financial and political. The financial and ridership risks associated with high speed rail projects can also deter private entities from investing. Sustaining public and political support for high speed rail development is also

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challenging, particularly since uncertainties regarding ridership forecasts and cost estimates can undermine confidence in the benefits claimed for proposed projects. Long project lead times compound the difficulty in sustaining political support, which typically must extend over several electoral cycles. In addition, project sponsors must coordinate project decisions among numerous stakeholders and across jurisdictional boundaries—a difficult task, especially in the absence of an established institutional framework.

Although in the United States the federal government has not historically exercised a strong leadership role in the development of high speed rail, the recently enacted PRIIA will likely increase the federal role. Following key principles we have developed for reexamining surface transportation programs would help ensure that implementation of the PRIIA and a possible heightened federal role is both efficient and effective. For example, there is currently no federal high speed rail policy. The national rail plan required by the PRIIA provides an opportunity to identify the vision and goals for U.S. high speed rail and how high speed rail might fit into the national transportation system, as well as to identify the appropriate federal role in achieving the established goals. There has been little effort previously to identify the role of high speed rail, and the national rail plan required by the PRIIA does not explicitly include high speed rail, although it must be consistent with state rail plans that are to, among other things, include a review of proposed high speed rail lines. In the countries we visited, we found that national rail plans have proven instrumental in guiding high speed rail development. In addition, the PRIIA specifies criteria for selecting high speed rail corridors and projects for development. The act also requires FRA to develop a schedule for achieving specific, measurable goals related to such things as the development of a national rail plan and to assess progress against these goals. We have previously reported on the importance of incorporating performance and accountability for results to help target resources to programs that best achieve intended outcomes and national transportation priorities. FRA has not yet determined how performance and accountability will be incorporated into the review and evaluation of grant applications. Accountability can be enhanced by tying the specific, measurable goals required by the PRIIA to performance and accountability measures. Furthermore, as FRA develops analytical tools and approaches to apply the project selection criteria, it will be important to address such things as optimistic ridership and cost forecasts. Obtaining forecasts from independent sources and subjecting forecasts to peer review are among the ways to potentially increase the reliability of these forecasts. Ensuring the fiscal sustainability of high speed rail projects, both while projects are

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being planned and constructed, as well as once they become operational, will also be important. The project selection criteria contained in the PRIIA will help in efforts to ensure the short- and long-term fiscal sustainability of federal investments in high speed rail projects. FRA is currently in the process of evaluating the PRIIA and preparing final rules for how high speed rail projects will be reviewed and selected for federal funding under provisions of the act.

To ensure effective implementation of the provisions of the PRIIA that relate to high speed passenger rail, we are recommending that the Secretary of Transportation, in consultation with Congress and other stakeholders, develop a written strategic vision for high speed rail, particularly in relation to the role that high speed rail can play in the national transportation system, clearly identifying potential objectives and goals for high speed rail systems and the roles that federal and other stakeholders should play in achieving each objective and goal. We also recommend that the Secretary develop specific policies and procedures for reviewing and evaluating grant applications under the PRIIA that clearly identify the outcomes expected to be achieved through the award of grant funds and that include performance and accountability measures. Finally, we recommend that the Secretary develop guidance and methods for ensuring the reliability of ridership and other forecasts used to determine the viability of high speed rail projects and to support the need for federal grant assistance.

We provided copies of our draft report to DOT and Amtrak for comment. DOT said that it generally agreed with the information presented and noted that with the passage of ARRA, its work on high speed rail has been considerably accelerated. Specifically, the act calls for FRA to submit, within an expedited time frame, a strategic plan to the Congress describing how FRA will use the \$8 billion funding identified in the act to improve and deploy high speed passenger rail systems. DOT indicated that the strategic plan may include the Department's vision for developing high speed rail services, criteria for selecting projects, an evaluation process that will be used to measure effectiveness, and a discussion of the relationship between the ARRA grant programs and the recently enacted PRIIA. DOT said it is also working to comply with statutory requirements to issue interim guidance in June 2009, describing grant terms, conditions and procedures. DOT told us that in order to provide information to the public and potential grantees as expeditiously as possible, it has already posted a set of questions and answers relating to ARRA on its Web site. Finally, DOT noted that the draft report does not include information relating to the administration's new federal commitment to high speed rail.

Specifically, as described in the President's proposed fiscal year 2010 budget, the administration has proposed a 5-year \$5 billion high-speed rail state grant program. DOT indicated that this program is intended to build on the \$8 billion included in ARRA for high speed rail and marks a new federal commitment to practical and environmentally sustainable transportation. DOT did not take a position on our recommendations. Amtrak said it generally agreed with our conclusions and also did not take a position on our recommendations. Amtrak provided technical comments, which we incorporated where appropriate.

## Background

Five corridor rail lines currently exceed Amtrak's predominant top speed of 79 miles per hour in the United States. Proposals for high speed rail projects in 44 other specific corridors are at some stage of planning and development. Eleven of these projects have advanced into the environmental review phase (see table 1).

**Table 1: High Speed Rail Projects in the United States**

Corridor	Number of miles	Proposed type of improvement and technology to be used	Current top speed of existing rail services (miles per hour)
<b>Rail corridors in current operation above 79 miles per hour<sup>a</sup></b>			
Los Angeles, California – San Diego, California	130	Incremental/Diesel	90
New York, New York – Albany/Schenectady, New York	158	Incremental/Diesel	110
Philadelphia, Pennsylvania – Harrisburg, Pennsylvania	104	Incremental/Electric	110
Boston, Massachusetts – New York, New York – Washington, D.C.	458	Incremental/Electric	150
Chicago, Illinois – Detroit/Pontiac, Michigan	304	Incremental/Diesel	95
<b>High speed rail projects in the environmental review process</b>			
Los Angeles, California – San Francisco, California <sup>b</sup>	520	New/Electric	79 <sup>c</sup>
Anaheim, California – Las Vegas, Nevada	269	New/Maglev	No service
Victorville, California – Las Vegas, Nevada	183	New/Electric or diesel	No service
Eugene, Oregon – Portland, Oregon – Vancouver, Canada	310	Incremental/Diesel	79
New York, New York – Scranton, Pennsylvania	133	Incremental/Diesel	No service
Chicago, Illinois – St. Louis, Missouri	284	Incremental/Diesel	79
Chicago, Illinois – Minneapolis/St. Paul, Minnesota	441	Incremental/Diesel	79
Baltimore, Maryland – Washington, D.C.	40	New/Maglev	110 <sup>d</sup>
Atlanta, Georgia – Chattanooga, Tennessee	251	New/Maglev or electric	No service
Washington, D.C. – Charlotte, North Carolina	452	Incremental/Diesel	79
Richmond, Virginia – Hampton Roads, Virginia	108	Incremental/Diesel	79

Corridor	Number of miles	Proposed type of improvement and technology to be used	Current top speed of existing rail services (miles per hour)
<b>High speed rail projects being planned that have yet to move into the environmental review process</b>			
Phoenix, Arizona – Tucson, Arizona	119	Incremental/Diesel	No service
Bay area, California – Los Angeles, California (Coastal)	476	Incremental/Diesel	79 <sup>c</sup>
San Jose, California – Sacramento, California	137	Incremental/Diesel	79
Jacksonville, Florida – Orlando, Florida	140	Not specified	79
Orlando, Florida – Miami, Florida	235	Not specified	79
Tampa, Florida – Orlando, Florida	92	Not specified	79
Casper, Wyoming – Denver, Colorado – Albuquerque, New Mexico	788	Incremental/Diesel	No service
Atlanta, Georgia – New Orleans, Louisiana	518	Incremental/Diesel	79
Houston, Texas – New Orleans, Louisiana	350	Incremental/Diesel	79
New Orleans, Louisiana – Mobile, Alabama	141	Incremental/Diesel	79
Chicago, Illinois – Carbondale, Illinois	309	Incremental/Diesel	79
Chicago, Illinois – Cincinnati, Ohio	304	Incremental/Diesel	79
Chicago, Illinois – Cleveland, Ohio	373	Incremental/Diesel	79
Chicago, Illinois – Grand Rapids/Holland, Michigan	212	Incremental/Diesel	79
Chicago, Illinois – Green Bay, Wisconsin	217	Incremental/Diesel	No service <sup>e</sup>
Chicago, Illinois – Omaha, Nebraska	476	Incremental/Diesel	79
Chicago, Illinois – Port Huron, Michigan	319	Incremental/Diesel	95 <sup>f</sup>
Chicago, Illinois – Quincy, Illinois	258	Incremental/Diesel	79
Indianapolis, Indiana – Louisville, Kentucky	111	Incremental/Diesel	No service
Kansas City, Missouri – St. Louis, Missouri	283	Incremental/Diesel	79
Twin Cities, Minnesota – Duluth, Minnesota	154	Incremental/Diesel	No service
Boston, Massachusetts – Montreal, Canada	330	Incremental/Diesel	No service <sup>g</sup>
New Haven, Connecticut – Springfield, Massachusetts	58	Incremental/Diesel	79
Columbus, Ohio – Pittsburgh, Pennsylvania	99	Incremental/Diesel	No service
Cincinnati, Ohio – Cleveland, Ohio	260	Incremental/Diesel	No service
Cleveland, Ohio – Buffalo, New York – Toronto, Canada	294	Incremental/Diesel	79
Cleveland, Ohio – Pittsburgh, Pennsylvania	154	Incremental/Diesel	79
Cleveland, Ohio – Toledo, Ohio – Detroit, Michigan	154	Incremental/Diesel	No service <sup>h</sup>
Raleigh, North Carolina – Jacksonville, Florida	446	Incremental/Diesel	79
Charlotte, North Carolina – Atlanta, Georgia – Macon, Georgia	346	Incremental/Diesel	No service <sup>i</sup>
Atlanta, Georgia – Jacksonville, Florida	321	Incremental/Diesel	No service
Dallas, Texas – Houston, Texas	280	New/Electric	No service <sup>j</sup>
Dallas, Texas – San Antonio, Texas	271	New/Electric	79

Source: GAO, based on Joseph P. Schweiterman and Justin Scheidt, "Survey of Current High-Speed Rail Planning Efforts in the United States," interviews with project sponsors, and Amtrak schedules.

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<sup>a</sup>All of these lines have plans to improve the speed and reliability of the service. In addition to these corridors, the long-distance route between Chicago, Illinois, and Los Angeles, California, operates at 90 miles per hour over portions of its route.

<sup>b</sup>This represents phase one of this project, starting in Anaheim, California. Phase two envisions extensions to Sacramento, California, and San Diego, California.

<sup>c</sup>Service between Los Angeles, California, and San Francisco, California, exists along the coastal route as well as along an inland route. The inland route requires a connection by bus between Los Angeles, California, and Bakersfield, California.

<sup>d</sup>Current service is part of the Northeast Corridor, and reaches 110 miles per hour on this segment.

<sup>e</sup>Service exists on this corridor from Chicago, Illinois, to Milwaukee, Wisconsin, but not between Milwaukee, Wisconsin, and Green Bay, Wisconsin.

<sup>f</sup>Current service reaches 95 miles per hour on a segment that is also part of the Chicago, Illinois, to Detroit, Michigan, line.

<sup>g</sup>Service is not direct and can only be provided through Albany, New York. Service to Albany can be provided through Springfield, Massachusetts.

<sup>h</sup>Rail service exists between Cleveland, Ohio, and Toledo, Ohio, but not between Toledo, Ohio, and Detroit, Michigan. A bus connection is required between Toledo, Ohio, and Detroit, Michigan.

<sup>i</sup>Service exists between Charlotte, North Carolina, and Atlanta, Georgia, but not between Atlanta, Georgia, and Macon, Georgia.

<sup>j</sup>Service is not direct, and can only be provided through San Antonio, Texas.

Financing for the proposed projects has yet to be arranged, with the partial exception of the proposed Los Angeles, California, to San Francisco, California, system, for which voters recently approved \$9.95 billion in bond funding.<sup>8</sup> For those projects that currently operate above 79 miles per hour, financing came from federal or state sources. Federal funding for high speed rail has generally gone to improvements to rail service in the Northeast Corridor between Washington, D.C., and Boston, Massachusetts, and to research and development. Some \$3.1 billion has been spent by the federal government on the Northeast Corridor since 1990—about 75 percent of all federal funding identified by FRA as having been spent for high speed rail over this period. The remaining 25 percent has primarily gone to research and development purposes related to high speed rail. For example, the first foray into high speed rail development was in 1965, when Congress provided funding to begin studying high speed rail technologies.<sup>9</sup> Later, the Magnetic Levitation Deployment Program provided funds to begin studying maglev as a new high speed transportation technology and to advance a demonstration project in the

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<sup>8</sup>Proposition 1A, Safe, Reliable High-Speed Train Act, approved November 2008. This funding represents less than one-third of the total estimated project cost.

<sup>9</sup>High Speed Ground Transportation Act of 1965, Pub. L. No. 89-220, 79 Stat. 893 (1965).

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United States.<sup>10</sup> States have also invested in high speed rail in some instances. For example, state funding was used to help achieve speeds above 79 miles per hour between New York, New York, and Albany, New York; Los Angeles, California, and San Diego, California; Chicago, Illinois, and Detroit, Michigan; and Philadelphia, Pennsylvania, and Harrisburg, Pennsylvania.

Several federal agencies have played a role in the planning and development of high speed rail projects to date, and others may potentially be involved as projects progress. FRA has generally been the lead federal agency—sharing that role with other federal agencies, such as the Surface Transportation Board—regarding the environmental review process. The Surface Transportation Board must give its approval before any new rail lines can be constructed that connect to the interstate rail network.<sup>11</sup> FRA also designates corridors as “high speed rail” corridors, and is the agency responsible for any safety regulations or standards regarding high speed rail operations. Safety standards relative to tracks and signaling requirements become more stringent as train speeds increase. For example, at speeds of 125 miles per hour or higher, highway-rail grade crossings must be eliminated, and trains must be equipped with positive train control, which will automatically stop a train if the locomotive engineer fails to respond to a signal. To operate at speeds above 150 miles per hour, FRA requires dedicated track—that is, track that can only be used for high speed rail service. No safety regulations currently exist for speeds above 200 miles per hour. In addition to FRA and the Surface Transportation Board, the Federal Highway Administration and the Federal Transit Administration (FTA) may play a role if highway or other transit right-of-way will be used or if highway or transit funds are to be used for some part of a high speed rail project. The Bureau of Land Management is responsible for granting rights-of-way on public lands for transportation purposes and, thus, would be involved in any new high speed rail project that envisions using public lands. Various other agencies would be involved in the environmental approval process, including the U.S. Fish and Wildlife Service and the Environmental Protection Agency, among others.

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<sup>10</sup>Section 1218 of the Transportation Equity Act for the 21st Century created a National Magnetic Levitation Transportation Technology Development Program, Pub. L. No. 105-178, 112 Stat. 107, 216-219 (1998).

<sup>11</sup>49 U.S.C. § 10901.

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## Economic Viability of High Speed Rail Is Affected by Many Corridor and Service Characteristics, but Uncertainties About Ridership and Other Estimates Make Viability Determinations Difficult

Based on our interviews with both domestic project sponsors and foreign operators of high speed rail lines, in addition to a literature review, we identified many common characteristics that tend to lead to relatively high numbers of riders and resulting public benefits and to relatively lower costs. High speed rail tends to attract the most riders and resulting public benefits in corridors between roughly 100 and 500 miles with existing high demand for intercity travel. Service characteristics relative to other travel alternatives—such as travel time and price competitiveness, high frequency, greater reliability, and safety—are also critical in attracting riders and producing public benefits. Costs of high speed rail tend to be lower in corridors where right-of-way exists that can be used for high speed rail purposes, and a relatively flat- and straight-alignment can be used. While several U.S. corridors exhibit characteristics that suggest potential economic viability, decision makers have faced difficulties in ascertaining whether any specific proposed line will be viable due to uncertainties in how accurately project sponsors forecast riders and estimate costs, and to the lack of agreement and standards regarding how a project's public benefits should be valued and assessed.

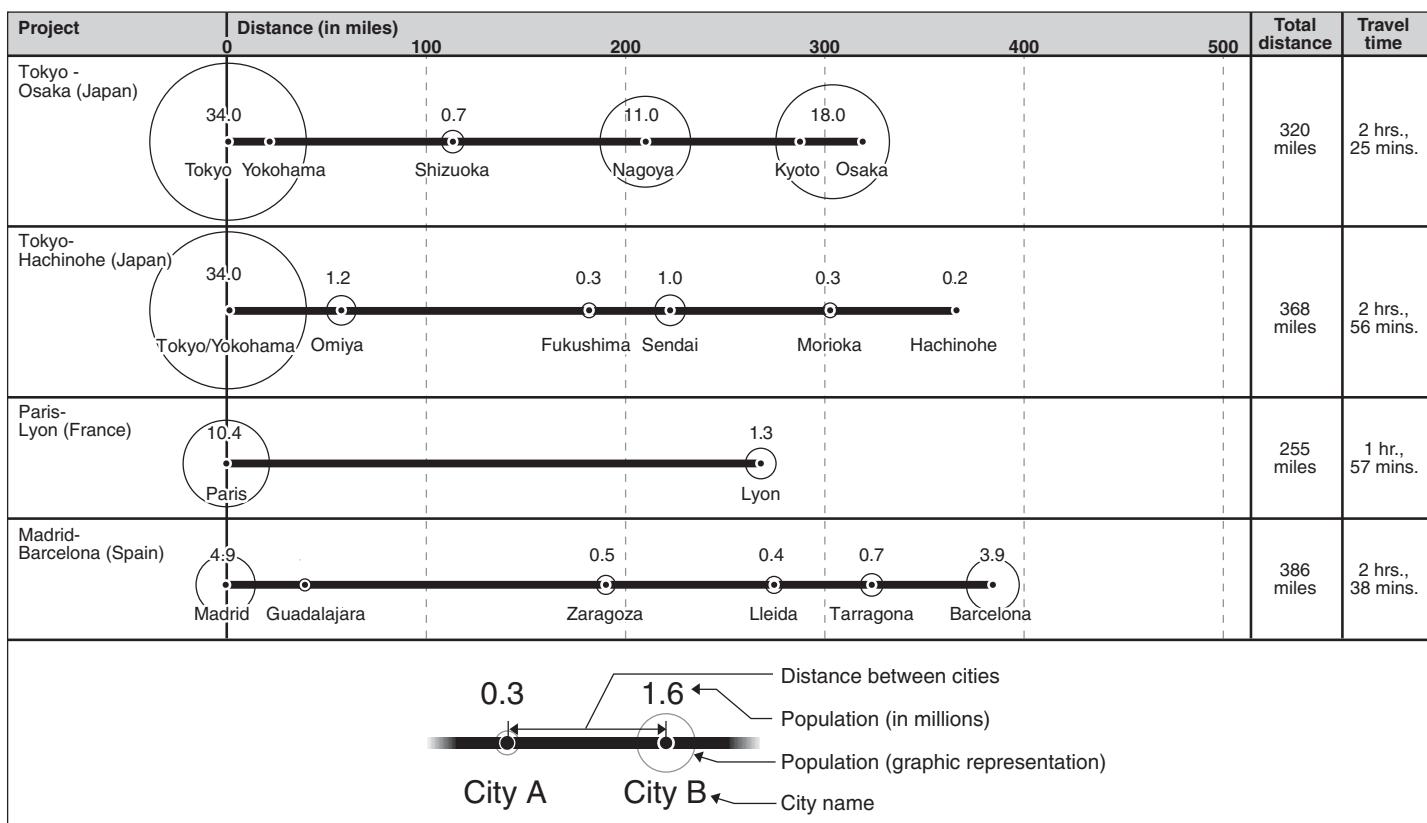
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## Numerous Corridor and Service Characteristics, and Trade-offs between Service and Costs, Influence a Project's Economic Viability

High levels of demand for intercity travel are needed to justify a new high speed rail line. (See app. V for a discussion of techniques for forecasting demand for intercity travel and riders on high speed rail.) Project sponsors identified high levels of population and expected population growth along a corridor, and strong business and cultural ties between cities as factors that can lead to higher demand for intercity travel. In some corridors, riders are expected to come from business travelers and commuters due to the strong economic ties between cities along the corridor; while in other corridors, a larger number of tourists and leisure travelers comprise the expected riders. Officials in Japan expressed the importance of connecting several high-population areas along a corridor as a key factor in the high number of riders on their system, to effectively serve several travel markets, including commuters and travelers from cities along the corridor. The corridor between Tokyo and Osaka in Japan is unique in that it is one of the most populous regions in the world, with multiple urban areas of several million inhabitants located along the corridor. This corridor attracts the highest number of riders of any high speed rail line in the world—over 150 million riders annually. In other foreign corridors we examined, however, population and densities were not as high, but foreign officials indicated that high speed rail revenues in these areas were sufficient to cover ongoing operating costs, although not necessarily sufficient to recoup the initial investment in the line. Some, but not all of the corridors under development in the United States today have

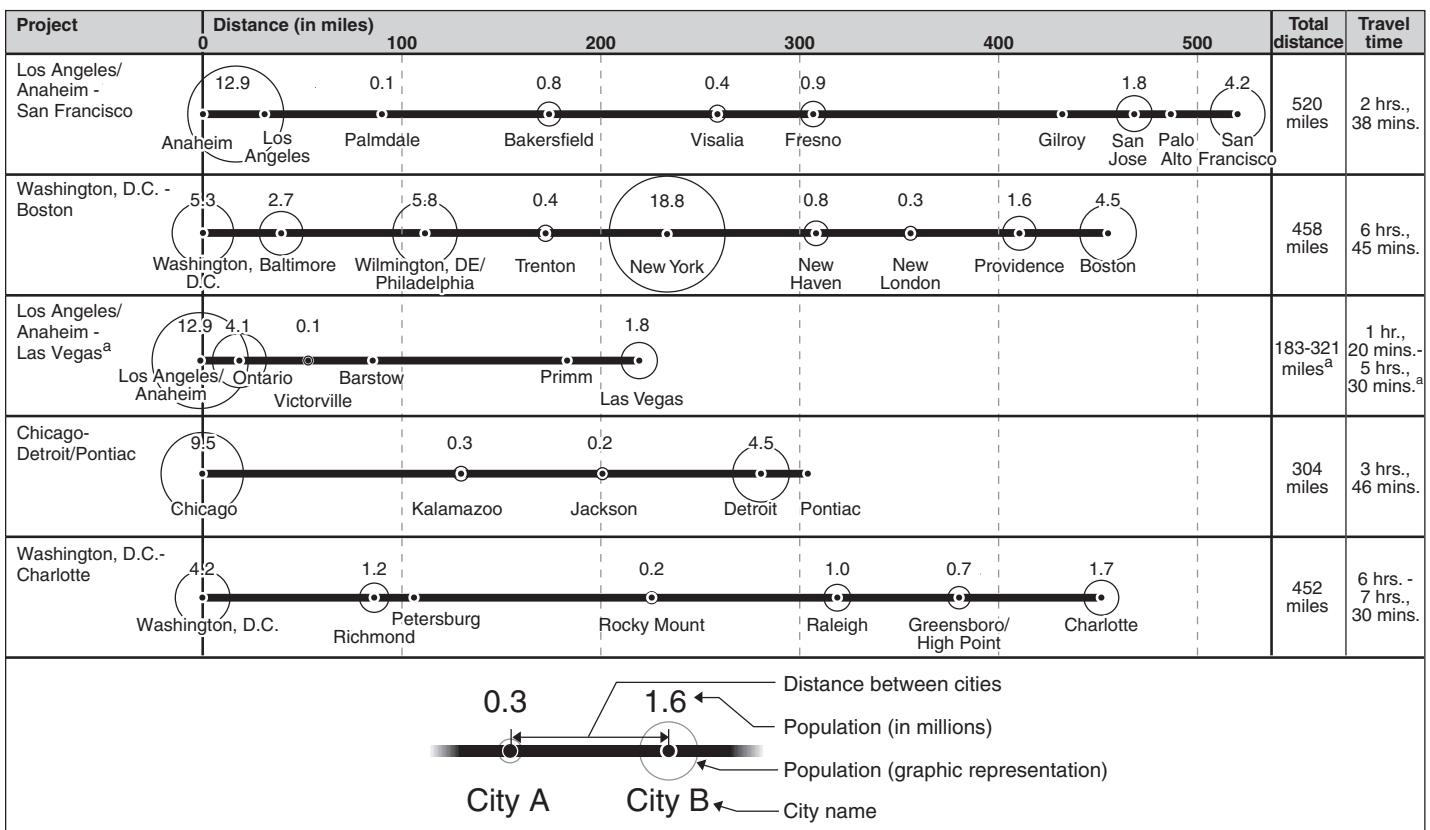
population levels similar to corridors in the foreign countries we examined (see figs. 1 and 2).

**Figure 1: Population of Cities Along Selected Foreign High Speed Rail Lines**



Source: GAO analysis of data from domestic project sponsors, foreign transportation officials, the U.S. Census Bureau, and Demographia.

**Figure 2: Population of Cities Along Selected Current and Proposed High Speed Rail Lines in the United States**



Source: GAO analysis of data from domestic project sponsors, foreign transportation officials, the U.S. Census Bureau, and Demographia.

<sup>a</sup>Several proposals exist in this corridor, with varying attributes and estimated travel times. See appendix VII of this report for more information on the various proposals.

High speed rail also has more potential to attract riders in corridors experiencing heavy travel on existing modes of transportation (i.e., conventional rail, air, and highways—including automobile and bus) and where there is, or is projected to be, congestion and constraints on the capacity of existing transportation systems.<sup>12</sup> These situations lead to demand for an additional transportation alternative, or demand for expansion or improvements to existing transport modes. To attract riders from existing transportation alternatives, a proposed high speed rail line

<sup>12</sup>The initial high speed rail lines in each of the three countries we visited (i.e., Paris-Lyon, Madrid-Seville, and Tokyo-Osaka) were specifically constructed, in part, to relieve at or near capacity conventional rail lines.

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needs to be time- and price-competitive with the alternatives, and also needs to have favorable service characteristics related to frequency, reliability, and safety. FRA and others have found that high speed rail tends to be most time-competitive at distances of up to 500 miles in length.<sup>13</sup> Existing high speed rail lines in Japan tend to be most time-competitive and attain the highest relative levels of service in corridors of roughly similar distances (see fig. 3).<sup>14</sup> According to foreign and domestic officials with whom we spoke, generally lines significantly shorter than 100 miles do not compete well with the travel time and convenience of automobile travel, and lines longer than 500 miles are unable to overcome the speed advantage of air travel.<sup>15</sup> Between 100 and 500 miles, high speed rail can often overcome air travel's speed advantage because of reductions in access and waiting times. Air travel requires time to get to the airport, which can often be located a significant distance from a city center, as well as time related to checking baggage, getting through security, waiting at the terminal, queuing for takeoff, and waiting for baggage upon arrival at a destination.<sup>16</sup> By contrast, high speed rail service is usually designed to go from city center to city center, which generally allows for reduced access times for most travelers. Some travelers will have destinations or starting points outside of city centers in closer proximity to airports, thus, potentially minimizing or eliminating in some cases the access time advantage of high speed rail where high speed rail service does not

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<sup>13</sup>See DOT/FRA, *Costs and Benefits of Magnetic Levitation*, ES-6. Also see GAO, *Intercity Passenger Rail: National Policy and Strategies Needed to Maximize Public Benefits from Federal Expenditures*, GAO-07-15 (Washington, D.C.: Nov. 13, 2006), which finds that corridor services are most competitive between 100 and 300 miles; and Ginés De Rus and Gustavo Nombela, "Is Investment in High Speed Rail Socially Profitable?" *Economics of Infrastructure and Transport*, University of Las Palmas (Spain), April 2005, which finds that the time savings of high speed rail relative to air are sufficient to offset the greater speed of airplanes over trains typically over distances of 120 to 480 miles.

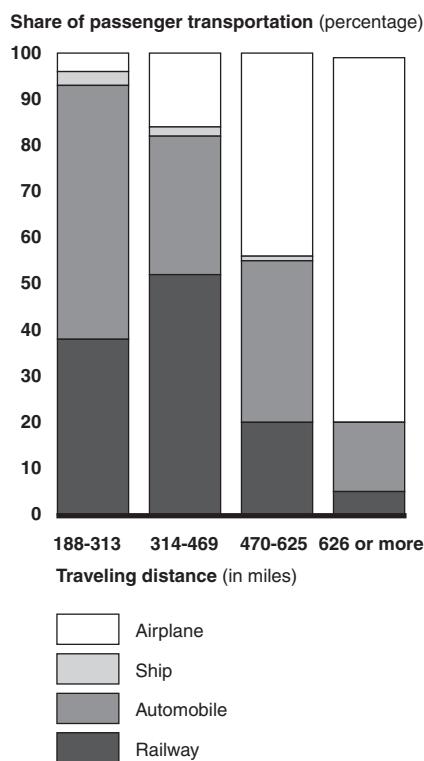
<sup>14</sup>In and of itself, a total travel time advantage does not guarantee that a mode is viable, nor superior in those terms to some alternative.

<sup>15</sup>According to Amtrak officials, some shorter distance routes can be competitive with automobile travel (e.g., New York, New York, to Philadelphia, Pennsylvania, has the third highest *Acela Express* ridership of any city pair on the Northeast Corridor), depending on the level of traffic congestion.

<sup>16</sup>As an example, an official with the Department of Aviation for Clark County, Nevada (Las Vegas), told us that at Las Vegas/McCarren International Airport, it takes passengers about 35 to 45 minutes to get to their gate from the curb. Upon arrival, a high percentage of passengers claim a bag once they deplane, which takes an average of 22 minutes. At nonpeak times, it will take a passenger 15 minutes to get a taxi or onto a bus connection and another 15 to 20 minutes to get to their hotel. This results in it taking nearly 1 hour to get to the Las Vegas city center once the plane has arrived.

connect to airports or other locations preferred by travelers. High speed rail also generally has less security and waiting time than airports.<sup>17</sup> On the foreign high speed rail lines we observed, there was no formal security comparable to airport security, and travelers could arrive at a station just a few minutes prior to departure.<sup>18</sup>

**Figure 3: Transportation Mode Share in Japan, by Distance Traveled**



Source: GAO presentation of Japanese Ministry of Land, Infrastructure, Transport, and Tourism data.

In France, Japan, Spain, and elsewhere, high speed rail has been shown to be time-competitive with air travel and has relieved capacity constraints at airports. For example, high speed rail in Japan has resulted in eliminating

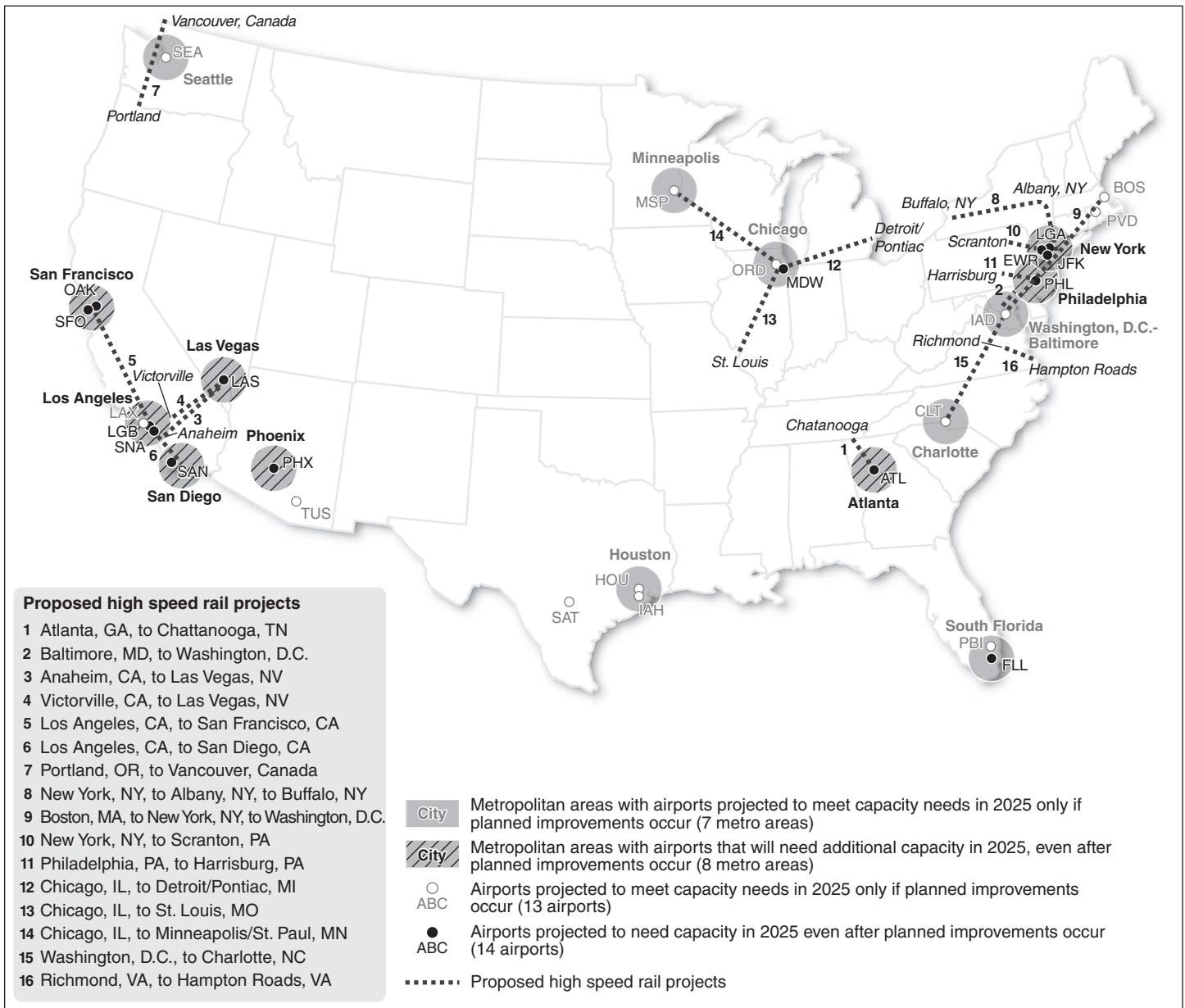
<sup>17</sup>Some stakeholders argue that high speed rail may require additional security that would increase these times for high speed rail.

<sup>18</sup>Airports in these countries generally have fewer security delays than airports in the United States. According to Japanese airline officials, air travelers can arrive at Japanese airports 15 to 20 minutes prior to a domestic departure.

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one air route (Tokyo-Nagoya), while several others have lost significant market share to high speed rail. With the introduction of the Madrid-Barcelona high speed rail line in February 2008, air travel between the two cities has dropped an estimated 30 percent (from 5.0 million to 3.5 million air passengers), while high speed rail riders increased markedly. In France, high speed rail has captured 90 percent of the Paris-Lyon air-rail market, and Air France officials estimated that for high speed rail trips of between 2 and 3 hours, high speed rail is likely to capture about 80 percent of the air-rail market over time. By displacing shorter distance air travel, high speed rail has freed up considerable airport capacity in those cities for other longer distance flights. However, because high speed rail becomes a new competitor with short-distance air travel, airlines have in some cases actively opposed its development. In the United States, most of the 16 high speed rail projects we focused on will connect metropolitan areas with anticipated capacity constraints at nearby airports (see fig. 4).

**Figure 4: Future Airport Capacity, by 2025, and Selected High Speed Rail Proposals in the United States**



While high speed rail will generally have superior travel times compared with automobile or bus travel for trips greater than 100 miles—depending on the service—it is difficult for a high speed rail service to compete with

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the low price of bus travel and convenience of automobile travel and, therefore, is not likely to attract a sufficient number of these travelers to have a significant effect on highway congestion and capacity in a corridor. According to a study on high speed rail ridership forecasting, intercity bus travel is limited and bus riders care more about price than about time. Therefore, to the extent that a new high speed rail line provided time savings at somewhat higher cost, the contribution of bus travel to a new high speed rail line will be insignificant.<sup>19</sup> However, this result depends on how the high speed rail service is priced. If the high speed rail service is publicly funded, then a legitimate public policy question arises regarding fare-setting (i.e., whether high speed rail fares should be set to maximize revenues or to attract higher numbers of riders from other modes). The study also contends that those who travel by car tend to care more about price and convenience (e.g., leaving when they choose, bringing additional passengers or cargo at no extra cost) and less about trip time.

The effect on highway congestion of diverting automobile travelers to high speed rail will vary based on the specific locations and times. For example, if high speed rail can divert travelers from making an intercity trip through a congested highway at peak times, then it may have a noticeable effect on traffic. Over the long term, however, whatever trips are diverted on a congested corridor to another mode of travel are likely to be at least partially replaced by other trips, since the reduced congestion from diversion makes it easier to travel—a phenomenon known as “induced demand.” Nonetheless, given the great number of trips by car, the diversion of a small percentage of automobile travelers to high speed rail could have a significant impact on the number of high speed rail riders, and result in benefits arising from increased capacity in the transportation system and thus more trips being carried. For example, in Japan, a survey on a recently developed high speed rail line showed that 21 percent of riders on a new high speed rail line diverted from the automobile mode. Similarly, in studies conducted for California’s proposed statewide high speed rail system, over 40 percent of forecasted riders are projected to be diverted from automobile travelers, but the high speed rail line will only reduce automobile travel by an estimated 7 percent.

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<sup>19</sup>Daniel Brand, Thomas E. Parody, Poh Ser Hsu, and Kevin F. Tierney, “Forecasting High-Speed Rail Ridership,” *Transportation Research Record* 1341 (1992), 12-18.

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In the countries we visited, automobile travel also tends to be significantly more expensive than in the United States, resulting from tolls on intercity roads and higher gas prices and taxes, which makes high speed rail a more cost-competitive option.<sup>20</sup> For example, according to Japanese government officials, to drive between Tokyo and Osaka—a distance of approximately 318 miles by automobile—can cost almost \$200 each way, including over \$90 in tolls, and between \$70 and \$105 in fuel costs, depending on the fuel economy of the vehicle (in August 2008, the average price of gasoline in Japan was \$6.50 per gallon).<sup>21</sup> This cost compares with a high speed rail fare of about \$130 per passenger. By comparison, to travel one-way between Los Angeles and San Francisco by automobile, a distance of 432 miles, will require a \$4 toll to cross the Bay Bridge, and roughly \$25 to \$40 in fuel costs (on Jan. 27, 2009, the average price of gasoline in California was \$2.10 per gallon, although at gas prices over \$4 per gallon, at which they were recently, fuel costs could be over \$80 and could rise over the long term). This cost compares with an average air fare of about \$108, and the California High Speed Rail Authority is anticipating a high speed rail fare of about half the air fare, or about \$60 in this example.

Another factor that affects the competitiveness of high speed rail relative to alternative intercity transportation modes is the extent to which it is part of an integrated transportation system and adequate transit services are available at the destination points for travelers. Foreign officials in France, Japan, and Spain pointed to the importance of strong transit access to, from, and within downtown areas to attract riders to high speed rail. European high speed rail stations are designed to be integrated with the urban transportation network, including subways, conventional rail, and local buses. In France, high speed rail also connects with airports. In Spain, high speed rail generally does not connect to airports. Japanese stations are also integrated with transit options, although high speed rail in Japan also does not connect to airports. In these countries, rail travelers will generally not require an automobile at the end of the rail line to get to

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<sup>20</sup>In addition to costs associated with driving, several other factors may also influence travelers' decisions between traveling by automobile or rail. For example, lower car-ownership rates in an area may make rail a more attractive option, whereas higher car-ownership rates could predispose travelers to drive rather than travel by train.

<sup>21</sup>The level of tolls and taxation is a decision by the government to make automobile travel more expensive. It reflects a social commitment to divert some travel away from highways and toward other transport modes, such as rail. One might view the tolls and taxes as either justified or excessive recompense for the use of public roads, depending on one's view of the social costs of automobile compared with rail travel.

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their final destination in metropolitan areas. Most urban transit systems in the United States are not as well developed as compared with systems in France or Japan. For some proposed lines in the United States, travelers may need access to an automobile at their destination, potentially making travel by high speed rail a less attractive option for those riders. However, a number of domestic project sponsors recognize the importance associated with designing and constructing their high speed rail systems to take advantage of existing transit connections and planned improvements. For example, the proposed maglev line between Las Vegas, Nevada, and Anaheim, California, is being designed to connect to a new intermodal transit terminal being built in Anaheim. In addition, in California, the bond measure that was recently passed to help fund high speed rail development allocates \$950 million for funding toward connecting rail transit services.

Officials in France, Japan, and Spain also attributed their high ridership to the reliability and safety of their high speed rail lines, relative to alternative modes of transportation. In Japan, the average delay between Tokyo and Osaka was 30 seconds per train in 2007,<sup>22</sup> and, beginning in March 2009, up to 13 trains per hour will leave Tokyo for Osaka on any given business day. In Spain and France, delays are also minimal, although service is less frequent. Between 20 and 36 one-way trains run daily on the Madrid to Seville, Madrid to Barcelona, and Paris to Lyon lines.<sup>23</sup> Regarding safety, there have been no fatalities on Japanese high speed rail lines in over 40 years of service, with a similar record in France and Spain. By contrast, other transport modes do not have similar records of safety reliability, particularly at peak periods, or where capacity constraints exist. For example, automobile travel can be significantly delayed by congestion at peak periods and results in tens of thousands of injuries and fatalities per year. Similarly, the U.S. aviation system is prone to significant delays. As we recently reported, 2007 represented the second worst year

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<sup>22</sup>This is the average delay throughout the year and includes delays caused by typhoons, earthquakes, snowfall, heavy rain, and other natural disasters.

<sup>23</sup>To ensure on-time performance in Europe and Japan, train operators are given strong incentives to stay on-time, including passengers receiving a full ticket price refund in Spain if the train is delayed more than 5 minutes, and driver pay deductions in Japan if the train is delayed more than 1 minute due to human error.

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on record for flight delays and cancellations, which have been steadily increasing since 2002.<sup>24</sup>

The economic viability of high speed rail is also affected by cost. Costs of high speed rail tend to be lower in corridors where right-of-way exists that can be used for rail purposes, and a relatively flat- and straight-alignment can be used, compared with corridors that require the acquisition of new right-of-way, substantial tunneling, or bridges. In addition, tradeoffs are often made relative to cost and service characteristics. For example, incremental projects on track shared with freight operators may be less expensive, but these tracks often cannot achieve the same types of travel time-competitiveness or reliability as dedicated track, which is not shared with other trains.<sup>25</sup> The foreign high speed rail systems we reviewed attributed their ability to achieve the time-competitiveness, frequency, reliability, and safety, that we have previously described, to operating on dedicated track and having no at-grade highway or other crossings. These systems cost billions of dollars to construct, although construction cost per mile varied substantially (see table 2). In Spain, construction costs ranged from \$37 million to \$53 million per mile, the latter heavily influenced by the construction of two tunnels.<sup>26</sup> According to Japanese transportation officials, construction costs in Japan are typically higher because of antiseismic safeguards, high land costs, and the number of bridges and tunnels needed to accommodate straight- and level-track through Japan's mountainous terrain.

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<sup>24</sup>GAO, *National Airspace System: DOT and FAA Actions Will Likely Have a Limited Effect on Reducing Delays during Summer 2008 Travel Season*, GAO-08-934T (Washington, D.C.: July 15, 2008).

<sup>25</sup>Some lines have limited shared track in metropolitan areas.

<sup>26</sup>The 18-mile Guadarrama tunnel is the world's fifth longest tunnel and cost about \$1.5 billion to build.

**Table 2: Estimated Construction Costs for Selected High Speed Rail Projects in France, Japan, and Spain, by Construction Cost Per Mile**

Dollars in millions				
High speed rail project	Length (in miles)	Approximate construction cost (per route mile)	Estimated construction cost (in 2008 dollars) <sup>a</sup>	Construction completion date
<b>Europe</b>				
Cordoba – Malaga (Spain)	96	\$37	\$3,558	December 2007
Madrid – Barcelona – Figueras (Spain) <sup>b</sup>	468	39	18,223	February 2008
Paris – Strasbourg (France)	186	42	7,730	June 2007
Madrid – Valladolid (Spain)	111	53	5,894	December 2007
<b>Japan</b>				
Yatsushiro – Kagoshima	79	82	6,508	March 2004
Takasaki – Nagano	73	143	10,403	October 1997

Source: GAO analysis of data provided by French, Japanese, and Spanish officials.

<sup>a</sup>The cost figures for different projects are not strictly comparable for a number of reasons including: provided data may be calculated according to diverse accounting conventions, outlays for a project may be expended at different points in time, and the schedule of such outlays was not available to us. Cost estimates are based on different foreign currencies with varying rates of inflation and fluctuating exchange rates. Cost data was converted into 2008 dollars to provide a rough approximation of the variation in construction costs for different projects in different countries. Also, total construction cost does not include the cost of the passenger rail vehicles. The International Union of Railways noted that, historically, one high speed rail trainset costs between \$32 million and \$40 million.

<sup>b</sup>Spanish officials noted that 82 miles of this line are still being planned and constructed.

Four of the five new domestic projects we reviewed that were planning to use dedicated track are also expected to cost several billion dollars to construct (see table 3). The Baltimore, Maryland, to Washington, D.C., project has the highest estimated construction cost per mile, because it plans to use maglev technology, which is costlier to construct than lines using electrified, diesel, or other train technology,<sup>27</sup> and to be built along a corridor that is densely populated, meaning higher land acquisition costs

<sup>27</sup>While construction costs of maglev systems are higher than other technologies, proponents of this technology cite reduced ongoing maintenance and operations costs as an advantage that should be taken into account.

and more costly technical construction. On the other end of the spectrum is the Victorville, California (a city 80 miles outside of Los Angeles, California), to Las Vegas, Nevada, project. Factors contributing to this project's relatively low estimated cost include the use of electrified or diesel train technologies, which operate at lower top speeds (i.e., up to 150 miles per hour); construction along a relatively flat corridor; and starting service in Victorville, instead of Los Angeles proper. These factors allow the project to avoid the additional costs of bridges and tunnels through the mountain range between the Los Angeles area and Victorville, as well as to avoid the costs to build through the densely populated areas entering Los Angeles. In addition, because the project is looking to use existing highway right-of-way and land owned by the federal government, acquisition costs are expected to be lower as compared with developing new right-of-way on privately owned land.<sup>28</sup> However, by starting outside of the Los Angeles area, many stakeholders expressed significant uncertainty about whether travelers will use the line at the level being forecasted. (See app. VII for a more detailed discussion of the Los Angeles-Las Vegas corridor.)

**Table 3: Estimated Construction Costs for Dedicated Right-of-Way High Speed Rail Projects in the United States, by Construction Cost Per Mile**

Dollars in millions						
High speed rail project	Top speed	Average speed	Length (miles)	Approximate construction cost (per route mile)	Estimated construction cost (in 2008 dollars) <sup>a</sup>	Year costs were projected
Victorville, California, to Las Vegas, Nevada	150	125	183	\$22	\$3,990	2003
Anaheim, California, to Las Vegas, Nevada	311	150-200	269	48	12,798	2005/2006
Los Angeles, California, to San Francisco, California <sup>b</sup>	220	Not available	520	63 – 65	32,785 – 33,625	2008
Baltimore, Maryland, to Washington, D.C.	250	125	40	132	5,267	2007

Source: GAO, from information provided by project sponsors.

Note: The Atlanta to Chattanooga dedicated high speed rail project did not have project cost estimates available.

<sup>28</sup>This project will construct new rail right-of-way to provide service, but this rail right-of-way will primarily be built in existing highway right-of-way.

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<sup>a</sup>The cost figures for different projects are not strictly comparable for a number of reasons including: provided data may be calculated according to diverse accounting conventions, outlays for a project may be expended at different points in time, and the schedule of such outlays was not available to us. Cost data was converted into current dollars to provide a rough approximation of the variation in construction costs for the proposed dedicated high speed rail projects.

<sup>b</sup>Only includes phase 1 of project and does not include phase 2 extensions of project to San Diego and Sacramento.

Incremental projects tend to cost less than new dedicated track projects. Construction costs per mile for the 6 proposed incremental projects that we reviewed ranged from \$4.1 million to \$11.4 million per mile. Top and average speeds for the incremental projects, however, ranged from 80 to 110 miles per hour—substantially slower than dedicated track speeds. This slower speed could make these projects less competitive with other transportation modes and less reliable than dedicated track because of the need to share rail lines with other passenger and freight operations.

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## Uncertainty Regarding Forecasts of Riders and Costs, and How Public Benefits Are Quantified and Valued Make Determinations of a Specific Project's Economic Viability Difficult

### Uncertainty and Inaccuracy in Forecasts of Riders and Costs

While several U.S. corridors exhibit characteristics that suggest potential economic viability, determining whether any specific proposed line will be viable has proven to be difficult for decision makers. This difficulty is due to uncertainties with the forecasts of riders and cost estimates that project sponsors produce, the lack of agreement and standards regarding how a project's public benefits should be valued and quantified, and the lack of comparison with alternative investments in highway or air infrastructure.

Rider forecasts and cost estimates are inherently uncertain and subject to some degree of inaccuracy simply because they are trying to predict future circumstances. However, analyses and research on the accuracy of rider forecasts and cost estimates for rail infrastructure projects have found that a systematic problem and incentive to be optimistic may exist—that is, actual riders are more likely to be lower than forecasted, while actual costs are more likely to be higher than estimated. For example, a study of over 250 transportation infrastructure projects in Europe, North America, and elsewhere, found that rail projects—while not all high speed—had the

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highest cost escalation out of all the transportation modes studied—averaging 45 percent higher than estimated.<sup>29</sup> Another study that included 27 rail projects, 1 of which was a high speed rail project, from around the world found that rider forecasts for over 90 percent of the rail projects studied were overestimated, and 67 percent were overestimated by more than two-thirds.<sup>30</sup>

Numerous techniques are available in travel demand modeling<sup>31</sup> (a common tool for forecasting riders) and, thus, different models for the same proposed project could have diverse results. A modeler usually makes choices on the theory and assumptions upon which the model is based, the mathematical form of the model, and the variables to be included. For example, a modeler may design a survey to determine how travelers would react to a new transportation mode, but there is a risk that the design or implementation of that survey could lead to biased survey results. Survey instruments can be scrutinized by third parties, but the process of data collection is less accessible to outside observers, especially after the fact. Furthermore, decisions on how to handle data within a model may enable the analyst to steer the result in a preferred direction. For an external, disinterested reviewer, the evolution of such decisions is very difficult to trace. (See app. VI for more details on travel demand forecasting and modeling.)

#### Lack of Consistency or Standards, and Difficulty in Valuing Public Benefits Relative to Modal Alternatives

While most project sponsors in the United States cited a variety of public “external” benefits, such as congestion relief or environmental benefits that would flow from their projects, the extent to which benefits had been quantified and valued varied across projects. For the 16 domestic projects

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<sup>29</sup>Bent Flyvbjerg, Mette K. Skamris Holm, and Soren L. Buhl, “Underestimating Costs in Public Works Projects: Error or Lie?,” *Journal of the American Planning Association*, vol. 68, no. 3 (2002). Fifty-eight of the total 258 transportation infrastructure projects studied were rail projects.

<sup>30</sup>Bent Flyvbjerg, Mette K. Skamris Holm, and Soren L. Buhl, “Inaccuracy in Traffic Forecasts,” *Transport Reviews*, vol. 26, no. 1 (2006). The study covered a total of 210 transportation infrastructure projects.

<sup>31</sup>In this context, a model is a mathematical equation describing a relationship among a set of variables.

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that we reviewed, formal benefit-cost analyses<sup>32</sup> have been conducted for 4 of them<sup>33</sup>—although many proposed projects have not advanced to the stage of conducting in-depth analyses. Of these analyses, none have formally compared the proposed project with alternative modal investments, such as airport or highway expansion, although the proposed high speed rail line between Los Angeles, California, and San Francisco, California, has created a rough comparison of high speed rail investment with stated investment needs on the highway and air modes. Even if a formal benefit-cost analysis has not been done, public benefits of some domestic projects are considered in some ways within the context of the National Environmental Policy Act (NEPA) process.<sup>34</sup> Under NEPA, the weighing of the merits and drawbacks of the various alternatives need not be displayed in a monetary benefit-cost analysis, but an environmental impact statement should at least indicate factors not related to environmental quality, which are likely to be relevant and important to a decision.<sup>35</sup>

Project sponsors with whom we spoke—domestically and internationally—cited several types of public benefits that were significant in determining the economic viability of proposed high speed rail lines, including:

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<sup>32</sup>Benefit-cost analysis is an established method for evaluating infrastructure projects in the United States. For example, Executive Order 12893 states that expected benefits and costs should be quantified and monetized to the maximum extent practicable when evaluating federal infrastructure investments in the areas of transportation, water resources, energy, and environmental protection. Federal spending infrastructure programs include direct spending and grants. Executive Order 12893, *Principles for Federal Infrastructure Investments*, 59 Fed. Reg. 4233 (Jan. 31, 1994).

<sup>33</sup>Studies of proposed domestic projects that have been conducted have found the potential for positive public benefits. For example, a study of the proposed California statewide high speed rail project found that the total benefits exceeded costs by more than 2 to 1. See Daniel Brand, Mark R. Kiefer, Thomas E. Parody, and Shomik R. Mehndiratta, “Application of Benefit-Cost Analysis to the Proposed California High-Speed Rail System,” *Transportation Research Record*, no. 1742, Paper 01-2959 (2001). Also see DOT/FRA, *High Speed Ground Transportation for America* (Washington, D.C.: September 1997), 7-23 through 7-28, which finds numerous corridors with the potential for positive economic benefits.

<sup>34</sup>Pub. L. No. 91-190, 83 Stat. 852 (Jan. 1, 1970); 42 U.S.C. § 4321 et seq.

<sup>35</sup>40 C.F.R. § 1502.23.

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- *Travel time savings:* Travelers using alternative modes may experience travel time savings as a result of reduced highway traffic and airport use by travelers shifting to high speed rail.
  - *Environmental benefits:* Environmental benefits could result from reducing pollution and carbon dioxide emissions, to the extent that the rail service reduces congestion on highways or at airports and makes use of fuel-efficient technology (i.e., high speed rail service using diesel locomotives would provide less environmental benefit than service that is electrified, all else being equal).
  - *Traffic safety:* Benefits from increased traffic safety include reduction in traffic accidents, to the extent that the rail service reduces congestion on highways.
  - *Economic development, land use, and employment:* A high speed rail system that encourages relocation of households and firms, and in cities where passenger rail stations are located, could experience growth of population and business presence—increasing retail sales, rental income, and property values.

Government officials in the countries we studied told us that a national policy decision had been made that the public benefits flowing from high speed rail are sufficient to justify some amount of public subsidy in high speed rail systems. In other words, passenger fare revenues are not necessarily expected to cover the full cost of constructing, operating, and maintaining the system. For example, in Japan, government officials told us that the construction of a new high speed rail line will be built only if certain criteria are met, including stable public subsidies, profitability of the operator, and a positive benefit-cost ratio. In Spain, one of the goals of high speed rail is to increase social and territorial cohesion. French officials said subsidies depend on the line—core lines like Paris-Lyon can cover construction costs from passenger fares.

Quantifying public benefits can be difficult, however, and the level at which to value some benefits can be subject to disagreement. Furthermore, there are currently multiple federal guidelines in the United States for valuing public benefits, yet none have been designated for use in analyzing proposed high speed rail projects. For example, high speed rail service that reduces congestion on highways or at airports and makes use of fuel-efficient technology may provide an environmental benefit (i.e., reduced pollution and greenhouse gas emissions). However, the value to assign to the reduction of pollution and greenhouse gas reductions is

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## **High Up-front Costs Are the Main Challenge to High Speed Rail Development, and Challenges Also Exist in Sustaining Support and Building Consensus**

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difficult to determine, since there is no current market for pollution reduction in the United States.<sup>36</sup> Thus, the valuation of pollution reduction—defined as the public’s willingness to pay—is generally left to economists to estimate by indirect methods. The valuation of greenhouse gas reductions entails additional considerations that are based on uncertain future benefits. Other intangible benefits, such as economic development impacts, are also difficult to estimate and are subject to disagreement. Officials in Japan told us that, although they previously calculated regional economic development benefits and included them in high speed rail decision making, they abandoned the practice because it was too difficult to isolate the impacts and because they believe that benefits accrued through revenues and passenger benefits alone are sufficient to meet their criteria for constructing new high speed rail lines. Moreover, while benefits such as improvements in economic development and employment may represent real benefits for the jurisdictions 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.

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Once domestic projects are deemed to be economically viable, efforts to develop those projects will continue to encounter significant challenges in financing the high up-front construction and other costs. In addition, sustaining public and political support for project development will also be a challenge. Uncertainties regarding rider forecasts and cost estimates can undermine confidence in whether projects will actually produce claimed benefits. Project sponsors must also sustain political support over several electoral cycles and coordinate project decisions among numerous stakeholders in different jurisdictions, typically without the benefit of an established institutional framework.

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<sup>36</sup>Efforts are under way to organize “cap-and-trade” markets for emission rights, but currently participation in such arrangements is voluntary.

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## Substantial Up-front Investment Requirements Far Exceed Limited Available Public Funding

Once economic viability is determined, the main challenge is securing the investment necessary to fund the substantial up-front capital costs, such as those incurred for planning and preliminary engineering, building the infrastructure, and acquiring train equipment. In addition, high speed rail projects require a very long lead time, and the lengthy development periods can increase the uncertainty over future costs and benefits, and the front-loaded nature of the required spending can increase risk. Passenger fares are generally insufficient to finance the capital and operating costs of a high speed rail system, and the public “external” benefits cannot necessarily be captured in a revenue stream based on prices. Therefore, public subsidies are generally required, at least for the initial investment. Domestic project sponsors for all of the proposed high speed rail projects we reviewed, except one,<sup>37</sup> indicated that they have or will need some federal funding to develop and construct their projects. The PRIIA authorized annual funding—a total of \$1.5 billion for fiscal years 2009 to 2013—for high speed rail corridor development across the entire United States. ARRA appropriated \$8 billion for high speed rail and intercity passenger rail congestion and capital grants (the latter of which were authorized by the PRIIA). However, this funding will not likely be sufficient to fund large-scale projects.<sup>38</sup> For example, project sponsors for the proposed high speed rail line between Los Angeles, California, and San Francisco, California, are anticipating \$12 billion to \$16 billion in federal funding alone, and, according to the California High Speed Rail Authority, total project costs are expected to exceed \$40 billion if the entire system is constructed.

Federal funding that has historically been made available for high speed rail has been derived from general revenues, rather than a dedicated funding source. Consequently, high speed rail projects must compete with other nontransportation demands on federal funds, such as national defense, education, or health care, as opposed to being compared with other alternative transportation investments or policies in a corridor. By contrast, other transportation modes are funded through federal programs—such as federal-aid highways, the FTA’s New Starts Program, and the federal Airport Improvement Program—which benefit from (1) dedicated funding sources based on receipts from user fees and taxes, (2) a format for allocating funds to states, and (3) in some cases, a

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<sup>37</sup>The proposed project between Victorville, California, and Las Vegas, Nevada, proposed by Desert Xpress Enterprises, expects to be financed solely with private funds.

<sup>38</sup>Pub. L. No. 110-432, § 501(d).

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structure for identifying projects to be funded. As we have previously reported, comparison of alternative investments in other transport modes, such as high speed rail, generally does not occur when decision makers are evaluating projects or applying for funding from any of these programs.<sup>39</sup>

Given the lack of dedicated federal grant funding currently available for high speed rail projects, project sponsors are exploring other federal financing mechanisms for high speed rail projects, such as federal loan programs. Available federal loan programs, however, may be limited in their ability to help fund the substantial cost of high speed rail projects or the number of projects competing for federal loans. Two project sponsors told us that they plan to apply (and one project sponsor indicated it did not plan to apply, but elements of its project would be eligible) for credit under the TIFIA program, which offers credit assistance to surface transportation projects.<sup>40</sup> According to TIFIA documents, the \$122 million authorized by Congress annually for the program provides over \$2 billion in credit assistance.<sup>41</sup> Sponsors of high speed rail projects could request that amount or more for one loan, thereby constraining TIFIA's ability to fund other projects in the same year, as we noted when analyzing the Florida Overland Express (FOX) project in 1999.<sup>42</sup> There may be other challenges as well. For example, because TIFIA assistance cannot exceed 33 percent of a project's construction costs, project sponsors must secure other sources of funding to construct a project, which has proven difficult.<sup>43</sup> In addition, the availability of TIFIA funds, or other federal funding, may be questionable since the federal government faces

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<sup>39</sup>GAO, *Highway and Transit Investments: Options for Improving Information on Projects' Benefits and Costs and Increasing Accountability for Results*, GAO-05-172 (Washington, D.C.: Jan. 24, 2005).

<sup>40</sup>TIFIA authorizes DOT to provide credit assistance for projects of national significance. As of February 2008, the Federal Highway Administration had approved 15 TIFIA projects totaling over \$4.3 billion, with individual TIFIA direct loans and loan guarantees ranging from \$42.0 million to \$916.8 million. Project sponsors did not indicate why they plan to use TIFIA in lieu of other debt-financing mechanisms.

<sup>41</sup>TIFIA Program Guide (January 2007), 1-2.

<sup>42</sup>GAO, *Surface Transportation: High-Speed Rail Projects in the United States*, GAO/RCED-99-44 (Washington, D.C.: Jan. 14, 1999).

<sup>43</sup>See 49 C.F.R. § 80.5.

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significant future fiscal challenges, as we have noted in recent reports.<sup>44</sup> Finally, as Amtrak officials suggested, the TIFIA program's requirement that loans and loan guarantees be repaid may be another limitation on the program's usefulness in funding high speed rail projects.

In the countries we visited, the central government generally funds the majority of up-front costs of their country's respective high speed rail projects, and they do so without the expectation that their investment will be recouped through ticket revenues. The public sector's ability to recover its financial investment has varied on the basis of how revenues have grown, but transportation officials in Japan and Spain told us that a public subsidy was generally necessary because ticket revenues are insufficient to fully recoup the initial investment. In Japan, while two early lines developed in the 1960s and 1970s may have fully repaid the initial investment and debt related to their construction, three of the high speed rail lines built since the 1987 privatization have been able to recover 10 percent, 52 percent, and 63 percent of their construction costs through ticket revenues. Spanish officials told us the original high speed line in Spain between Madrid and Seville has been profitable on an operating cost basis but has not covered all of its costs, including the original construction costs. A Spanish academic researcher told us that future lines might not cover even their operating costs.

State funding for high speed rail can also be limited by the lack of dedicated funding sources and restrictions on the use of gasoline tax revenues. None of the project sponsors with whom we spoke obtained funding from a dedicated source of state funding for high speed rail; one project sponsor (i.e., the Virginia Department of Rail and Public Transportation), however, noted that it had a dedicated rail funding source available. Since the two high speed rail projects currently being developed in Virginia are still in the planning stages, according to the Virginia Department of Rail and Public Transportation, they have not yet sought funds from Virginia's Rail Enhancement Fund, which provides about \$25 million annually for both freight and passenger rail improvements. In addition, according to a report by the Brookings Institution, 30 states—including states where high speed rail projects are proposed, such as Minnesota, Nevada, and Pennsylvania—are restricted from spending

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<sup>44</sup>GAO, *The Nation's Long-Term Fiscal Outlook: September 2008 Update*, GAO-09-94R (Washington, D.C.: Nov. 7, 2008).

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revenues from excise taxes on gasoline, which typically is a state's main source of transportation revenue.<sup>45</sup>

In lieu of a dedicated source of state funding, some project sponsors have sought funding directly through appropriations of state revenue or bond measures, which compete with numerous other state budgetary needs. New York State Department of Transportation officials said that appropriations from general state revenue and bonding measures enabled them to fund only incremental improvements along the New York, New York, to Albany, New York, corridor, not the major expansions that had been planned. The choice of a financing mechanism can have serious implications for states and local governments, which as we have previously reported, will face broader fiscal challenges over the next 10 years, because of increasing gaps between receipts and expenditures.<sup>46</sup> For example, in November 2008, California voters passed a ballot initiative that would allow the state to issue \$9.95 billion in bonds, \$9.0 billion of which would go toward the construction of a statewide high speed rail system.<sup>47</sup> According to information prepared by California, this bond issue, including principal and interest, could cost the state general fund about \$19.4 billion over 30 years. Also, bonding mechanisms may cost more than using appropriations of general revenues. For example, we reported that a proposal to allow Amtrak to issue up to \$12.0 billion in tax credit bonds over a 10-year period for capital improvements on designated high speed rail corridors and the Northeast Corridor would have cost the U.S. Treasury as much as \$11.2 billion (in present value terms) in lost tax receipts over a 30-year period if states had financed their contribution from tax-exempt borrowing and Amtrak had used accumulated losses to offset taxable earnings in a trust fund established to repay the bond

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<sup>45</sup> Robert Puentes and Ryan Prince, *Fueling Transportation Finance: A Primer on the Gas Tax*, Brookings Series on Transportation Reform, Center on Urban and Metropolitan Policy, Brookings Institution (March 2003). In some states, excise taxes on gasoline and other fuels may be used to fund transit projects, including rail transit.

<sup>46</sup> GAO, *State And Local Governments: Growing Fiscal Challenges Will Emerge during the Next 10 Years*, GAO-08-317 (Washington, D.C.: Jan. 22, 2008); and, *A Call For Stewardship: Enhancing the Federal Government's Ability to Address Key Fiscal and Other 21st Century Challenges*, GAO-08-93SP (Washington, D.C.: Dec. 17, 2007).

<sup>47</sup> Proposition 1A, Safe, Reliable High-Speed Train Bond Act, approved November 2008.

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principal.<sup>48</sup> This cost compared with an estimated total cost to the U.S. Treasury of between \$7.3 billion and \$8.2 billion (in present value terms) if annual federal appropriations of federal revenues had been used for the same purpose. Another possibility are tax-exempt private activity bonds, which can be used to finance high speed rail facilities. Such bonds were formerly restricted to high speed intercity passenger rail facilities that operate at speeds in excess of 150 miles per hour and proceeds could not be used for rolling stock (passenger rail vehicles).<sup>49</sup> ARRA modified these restrictions to make eligible projects that are “capable of attaining” maximum speeds in excess of 150 miles per hour, rather than operating at such speeds. This modification may increase the number of projects that can qualify to use tax-exempt private activity bonds for high speed intercity passenger rail facilities.<sup>50</sup>

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## Attracting Private Capital Is Also a Challenge, Particularly When the Public Sector Does Not Assume Substantial Financial Risk

Both current and former domestic high speed rail project sponsors have sought private financing but found it difficult to obtain private sector buy-in, given the significant financial risks high speed rail projects pose. In February 2008, we reported that public-private partnerships can provide potential benefits, such as transferring some risk from the public to the private sector, and an increased potential for operational efficiencies. The level of private sector involvement anticipated by some domestic high speed rail projects is unprecedented, particularly given the limited private

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<sup>48</sup>GAO, *The High-Speed Rail Investment Act of 2001 (S. 250)*, GAO-01-756R (Washington, D.C.: June 25, 2001). Under the proposal, bondholders would have received tax credits instead of interest payments, and the principal would have been repaid from a trust fund established for that purpose.

<sup>49</sup>Tax-exempt private activity bonds are used for purposes such as transportation and water infrastructure, including high speed rail facilities. Tax-exempt means that the interest paid to bondholders is generally not included in the gross income of bondholders for federal income tax purposes. Private activity bonds allow tax-exempt debt to be used by private entities to help finance qualified facilities. Private activity bonds used for government-owned high speed intercity facilities are not subject to state volume caps—that is, a maximum amount of tax-exempt bonds that can be issued during a calendar year. However, 25 percent of private activity bonds used for privately owned high speed intercity facilities are subject to state volume caps. In both cases, for a government-owned high speed intercity rail facility or a privately owned high speed intercity rail facility, a government entity must approve the private activity bonds.

<sup>50</sup>See ARRA § 1504. AARA also provides a temporary modification of alternative minimum tax limitations for such bonds. See § 1503.

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sector involvement with operating domestic high speed rail to date.<sup>51</sup> For example, the California High Speed Rail Authority is looking to the private sector to provide between \$6.5 billion and \$7.5 billion of the total cost to finance, construct, operate, and maintain the first phase of its statewide system.

Private sector firms have expressed interest in high speed rail projects, but the firms with which we spoke noted that without public sector commitment—both financial and political—private sector involvement and financing would be limited, due to the financial and ridership risks of such projects. A good illustration of the domestic relationship between the public and private sectors in high speed rail is the FOX project. The private sector's willingness to finance a portion of that project's construction costs was predicated on an understanding that Florida would cover costs that could not be recouped through ticket revenues. Although the state agreed to provide \$70 million annually over a 40-year period to support the project, it was terminated when this support was withdrawn. (See app. IV for more detail on the FOX project.) Similarly, in California, private sector entities have expressed interest in investing in part of the high speed rail project, but noted that they would need substantial public sector commitment to the project before participating.

Efforts to develop entirely privately financed high speed rail projects in the United States have proven unsuccessful to date. According to the Texas High Speed Rail Authority, the Texas TGV project, which was intended to be a privately financed project in the Texas triangle (Houston-Dallas-Fort Worth-San Antonio), was unsuccessful, primarily because one of the firms involved in the private consortium encountered financial difficulties. (See app. IV for more details on the Texas TGV project.) In Florida, an effort to pursue a privately financed high speed rail project during the 1980s also failed (before the FOX project). One current project, the Desert Xpress project, from Victorville, California, to Las Vegas, Nevada, is also seeking to develop an entirely privately financed high speed rail line, but as of February 2009, the project had not secured private financing.<sup>52</sup>

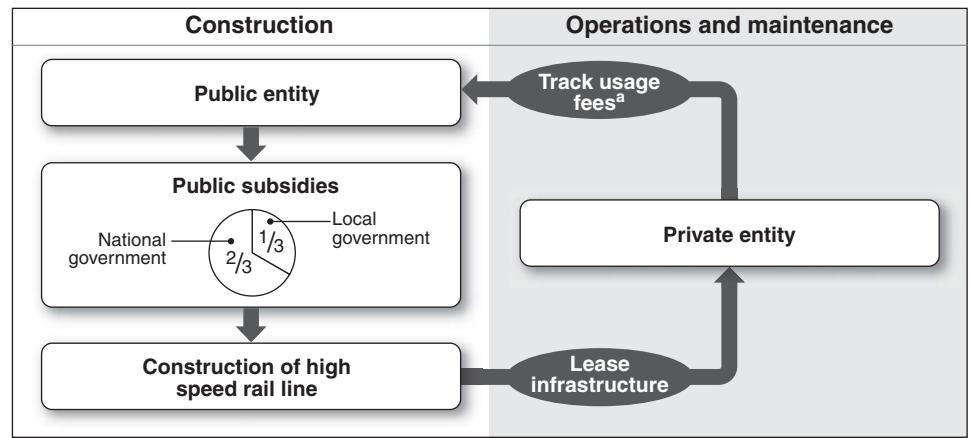
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<sup>51</sup>GAO, *Highway Public-Private Partnerships: More Rigorous Up-front Analysis Could Better Secure Potential Benefits and Protect the Public Interest*, GAO-08-44 (Washington, D.C.: Feb. 8, 2008).

<sup>52</sup>The Desert Xpress project has made progress on its planning and environmental review studies, but has not yet started right-of-way acquisition or construction.

Public-private partnerships are one means by which foreign governments are seeking to share the financial risks of their expanding high speed rail systems. In Japan—where the rail system was privatized in 1987—the national government and local governments still assume the financial risk of constructing a new high speed rail line, investing two-thirds and one-third of the construction costs, respectively (see fig. 5). With the government's financial commitment, the private railroad operating companies undertake the operational risk and rely on ticket revenues to cover operating and maintenance costs.<sup>53</sup> The railroad operating companies' business model, which includes various business ventures and nonrail revenue streams, also helps them assume this risk for rail lines with relatively low numbers of riders, since these additional revenues may be able to cover high speed rail operating losses, if they occur.

**Figure 5: Public and Private Sector Roles in High Speed Rail Development and Operation in Japan**



Source: GAO.

<sup>a</sup>According to Japanese officials, track usage fees are set at the break-even level, assuming the rail operator's income is only from ticket revenues. This fee is set for a 30-year period, indirectly providing incentives to improve the operational efficiency of the rail operator over time.

As France and Spain look to expand their high speed rail systems, they are exploring private sector participation to, among other reasons, attract additional financing, and, in the case of France, tap private sector

<sup>53</sup>DOT officials told us that certain Japanese railroads, including JR Kyushu, JR Hokkaido, JR Shikoku, and JR Freight are owned by the Japanese government and that the remote island JRs are not profitable enough for privatization.

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management and technical expertise.<sup>54</sup> France is contemplating a public-private partnership contract scheme where risks associated with financing, designing, building, and maintaining a high speed rail line are allocated to the private sector (see fig. 6). Under this scheme, the private sector essentially would assume the responsibilities of the public infrastructure manager,<sup>55</sup> put up the initial construction financing, take on the projects' construction cost and schedule risks, and ensure that the infrastructure is available to a passenger rail operator for a certain percentage of time.<sup>56</sup> The line must also be maintained to certain levels to ensure safety. The public sector assumes the risk associated with operating the rail service, and commits to making fixed annual payments to the private sector, as long as the infrastructure is available the prescribed percentage of time.<sup>57</sup> French officials acknowledged that there is currently much uncertainty about how these arrangements will work and whether there will be sufficient private sector interest. At the time of our visit, France had not implemented a public-private partnership. However, a recent call for tenders on the Tours-Bordeaux line raised the interest of 3 French contractors. French officials expect this contract to close by the end of 2009. Spain was in the process of completing a public-private partnership for a line from Figueras to the French border. However, this arrangement was used to construct a portion of a high speed rail line in the Netherlands, and, according to an official with the private sector consortium that constructed this line, if there is a public sector commitment, the private sector can make a public-private partnership work.

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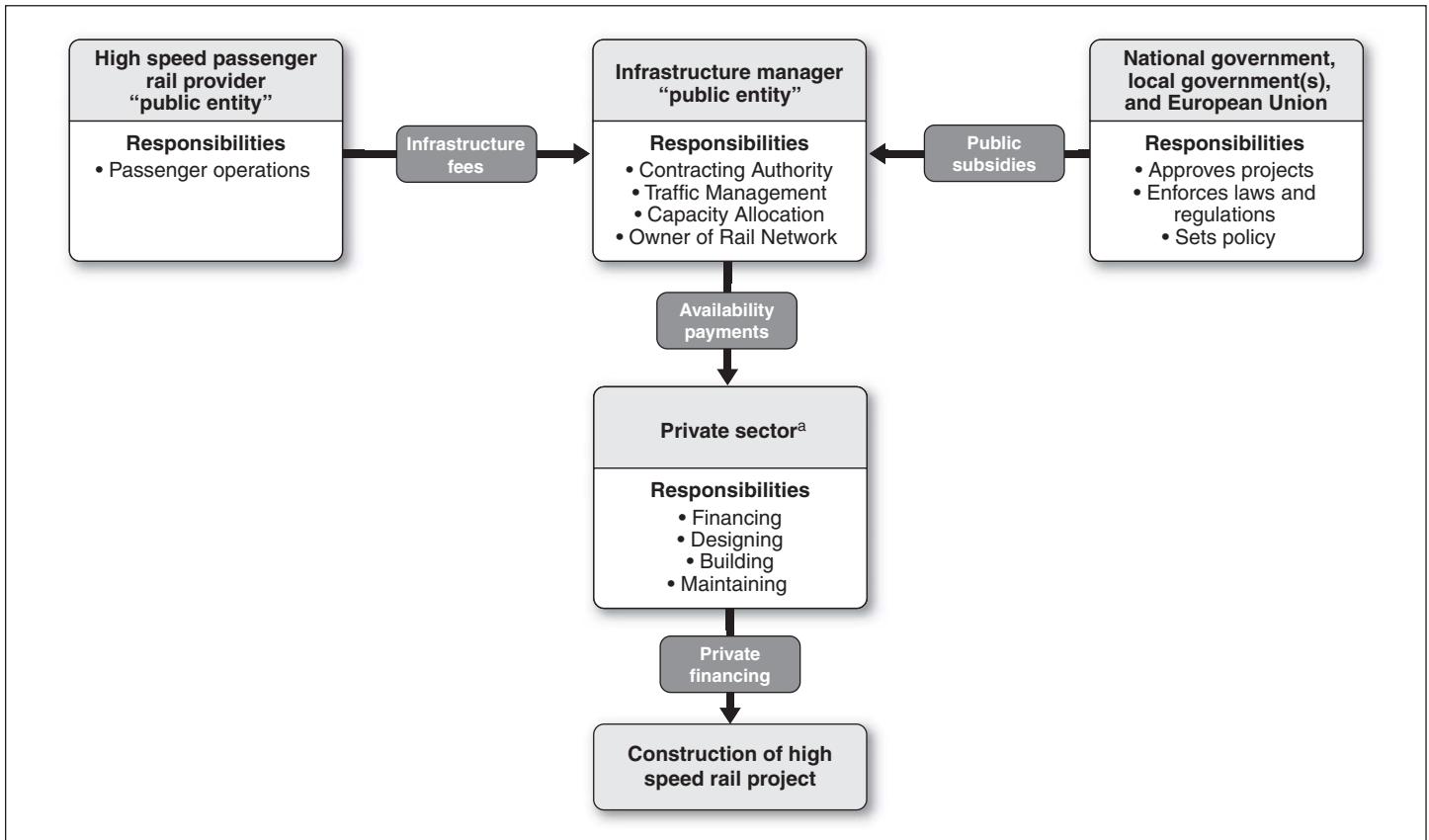
<sup>54</sup> According to French documents, in 2006, a French national law authorized the national government and infrastructure manager to develop major national and international rail infrastructure projects through public-private partnerships.

<sup>55</sup> In the early 1990s, Europe adopted a scheme in which rail operations were separated from rail infrastructure ownership and management. Under this scheme, rail operators pay an access fee to use rail infrastructure to provide service. This separation of rail operations from rail infrastructure ownership and management is not typically seen in the United States.

<sup>56</sup> The availability payments begin once the private sector entity makes the rail line available to an operator(s) and are calculated on the basis of the percentage of time the line is available to the operator(s). The availability payments should cover the cost of financing, constructing, and maintaining a high speed rail line, while providing a return on investment.

<sup>57</sup> A line might not be available due to such things as routine maintenance or capital improvements.

**Figure 6: Proposed French Public-Private Partnership Contract Model**



Source: GAO.

<sup>a</sup>In countries such as the Netherlands where the contract partnership structure has been implemented, the private sector entity was a consortium consisting of construction, engineering, management, and financial firms.

## Sustaining Public and Political Support over Lengthy Development Process and Reaching Multistakeholder Consensus Will Also Be Challenges

Additional challenges faced in developing high speed rail projects include sustaining public and political support over lengthy development timelines for high speed rail. As we have previously mentioned, high speed rail projects require long lead times. The five new right-of-way rail projects we reviewed have been in project development between 4 years and 18 years, and on average 13 years. Similarly, in France, transportation ministry officials told us that high speed rail projects in their country take about 14 to 16 years to complete. This time comprises when project planning begins to when the project opens for revenue service. A considerable amount of this time is for studies and analysis as well as public debate about the

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merits of a project. Sustaining public support over this length of time can be difficult and can have significant impacts on a project. As the experience with the FOX project demonstrated, development of high speed rail projects can occur over multiple electoral cycles, which not only can change the course of project development but can also lead to project termination if public and political support is not sustained. For example, as we have previously discussed, the Florida DOT had planned to provide \$70 million annually to help construct the FOX project. The project began under one gubernatorial administration that supported the project. The project was terminated under a different administration that did not support the project. Several public and private sector officials we spoke with cited the need for someone or some organization to “champion” a project over a long period of time. French officials told us it is easier to sustain public support for a high speed rail project once it has the commitment of the central government.

There are also challenges associated with the ability to provide transparency and confidence in project cost estimates and rider forecasts. As we have previously discussed, these estimates and forecasts can often be inaccurate, which may erode public support for high speed rail. During the FOX project, advocacy organizations, state transportation agencies, and GAO each questioned the reliability of project cost estimates and rider forecasts.<sup>58</sup> The governor of Florida decided to cancel state funding for the project, in part due to the skepticism raised by these organizations. Cancellation of state funding led to termination of the project. More recently in California, a report by numerous advocacy organizations raised similar concerns about the rider forecasts and costs estimates for the statewide high speed rail project. Although the public approved nearly a \$9.95 billion bond to support this project, over time public support could erode, along with public funding, if confidence in rider, revenue, and cost estimates is lost.

Reaching consensus on project decisions, such as a rail line’s actual route, involves difficult negotiations, which can cause substantial project delays and disagreements among stakeholders. Given that high speed rail projects can span hundreds of miles and sometimes cross multiple states, numerous stakeholders and jurisdictions are involved. Stakeholders typically include, among others, federal, state, and local governments; the private sector; and advocacy organizations. For example, project sponsors

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<sup>58</sup> GAO/RCED-99-44.

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of the Southeast High Speed Rail Corridor (a project from Washington, D.C., to Charlotte, North Carolina) noted that some 50 federal, state, and local government agencies are involved in the project as well as a 214-member advisory committee. Coordinating on project decisions with these stakeholders—each with their own priorities and views—can be difficult, particularly without an established institutional framework within which this can occur, as exists for other transportation modes. For example, in planning highway and transit projects, federal agencies, local transit agencies, metropolitan planning organizations, and state transportation departments benefit from established procedures for planning and public involvement.

Development of domestic high speed rail projects may typically be led by rail divisions within state DOTs or by high speed rail authorities and commissions. These organizations are often limited in terms of institutional and financial resources. For example, in the case of the California High Speed Rail Authority, funding has fluctuated from a little over \$1 million per year to a little over \$14 million (see table 4) as a result of changes in its annual appropriation from the state legislature. The \$3.9 million in state funding for fiscal year 2005-2006 was planned to support approximately 4 staff members in developing a \$45 billion, 800-mile statewide high speed rail system. Rail divisions within state DOTs also face similar funding and manpower issues, since there is typically no dedicated state funding for rail services, as we previously discussed. In addition, rail has generally not been a primary focus of state transportation plans, which are more focused on highway projects.

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**Table 4: State Funding for California High Speed Rail Authority**

Dollars in millions (nominal)	
<b>Fiscal year</b>	<b>Budget</b>
2004-2005	\$1.1
2005-2006	3.9
2006-2007	14.3
2007-2008	1.2

Source: GAO analysis of California budgets.

Commissions and authorities may face other institutional challenges related to their role and authority. For example, a Virginia official told us that legislation to create a high speed rail authority fails every year it comes up for a vote because of concerns that an authority might issue bonds and jeopardize the state's triple A bond rating. In addition, the role

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of high speed rail authorities is sometimes unclear. According to the final report of the Texas High Speed Rail Authority, as well as the former director of the authority, rail authorities can sometimes be conflicted between advocating for a high speed rail project and objectively determining whether a system is in the “public convenience and necessity.”<sup>59</sup>

Stakeholder consensus is also a considerable challenge for projects that involve incremental improvements for high speed rail service. Nine of the 11 incremental project sponsors with whom we spoke said that working with stakeholders such as Amtrak, commuter railroads, and private freight railroads can be difficult and time-consuming since each has its own interests. Projects that cross state lines pose additional stakeholder challenges, particularly with respect to allocating benefits and costs among the states. To address multistate issues, some states have pursued interstate compacts and commissions as a means to formalize decision making. For example, the Virginia-North Carolina Interstate High Speed Rail Compact established a commission to provide project leadership and vision and to define roles. However, interstate compacts can be difficult to implement and involve working out many practical issues, including deciding on what type of service to provide, how financial contributions will be distributed, and what occurs if and when one or more states do not meet their financial or other responsibilities.

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<sup>59</sup>Texas High Speed Rail Authority, *High Speed Rail in the Rear-View Mirror: A Final Report of the Texas High Speed Rail Authority* (October 1995).

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## Federal Leadership Has Been Limited, but Following Reexamination Principles Can Ensure That the Federal Role Is Focused on Yielding Maximum Benefits

### Federal Leadership Has Been Limited, but Recent Legislation Provides for a Potentially Greater Federal Role

In the United States, the federal government has not historically had a strong leadership role in high speed rail. The recently enacted PRIIA provides a framework for developing a federal role. ARRA will also likely affect the federal role by providing \$8 billion for high speed rail. Following reexamination principles we have reported on for surface transportation programs would help ensure that the implementation of the act, and a possible heightened federal role, is efficient, effective, and focused on yielding maximum benefits for its investment.

Since the 1960s, Congress has authorized various programs dealing with high speed ground transportation, including high speed rail, but no federal vision or national plan for determining the role of high speed rail in the U.S. transportation system exists. FRA officials told us that they do not have a high speed ground transportation policy, and, as one FRA official told us, policies related to high speed rail have varied from one administration to another. FRA officials also told us that creating interest in promoting high speed rail at the national level has been difficult to sustain.

The recently enacted PRIIA, in addition to authorizing funding, provides numerous other opportunities for a greater federal role in high speed rail development, as follows:

- the act requires the Secretary of Transportation to establish and carry out a rail cooperative research program that will address, among other things, new high speed wheel on rail systems;<sup>60</sup>
- the FRA Administrator is tasked with the development of a long-range national rail plan consistent with approved state rail plans and the rail needs of the nation;

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<sup>60</sup>Pub. L. No. 110-432, § 306, codified at 49 U.S.C. § 24910.

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- the FRA Administrator is required to support high speed rail development, including high speed rail planning;<sup>61</sup>
  - the act explicitly provides a framework for the establishment of a High Speed Rail Corridor Development Program, which permits the Secretary to make grants to states, groups of states, and others to finance capital projects in high speed rail corridors;<sup>62</sup>
  - the act requires the Secretary to issue a request for proposals for the financing, design, construction, operation, and maintenance of high speed intercity passenger rail systems operating within high speed rail corridors;<sup>63</sup> and
  - the Secretary is to study high speed rail routes and establish a process for states or groups of states to redesignate or modify designated high speed rail corridors.<sup>64</sup>

High speed rail projects will largely continue to be initiated at the state-level, but the federal government can be expected to play an increased role in funding and assisting in the development of high speed rail corridors and projects.

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<sup>61</sup>A preliminary national rail plan is to be developed within 1 year after the enactment of the PRIIA, Pub. L. No. 110-432, § 307, codified at 49 U.S.C. § 103(j)(2), (3), and (5).

<sup>62</sup>For the purposes of this section, “high speed” is defined as intercity passenger rail service that could reasonably be expected to reach top speeds of at least 110 miles per hour. Pub. L. No. 110-432, § 501(d), codified at 49 U.S.C. § 26106(h)(4).

<sup>63</sup>Pub. L. No. 110-432, § 502(d), codified at 49 U.S.C. § 26106 note. The law defines “high speed rail corridors” as the Northeast Corridor and those corridors which have been designated by the Secretary of Transportation pursuant to provisions of the law. The latter corridors were designated under laws that predated the PRIIA. The request for proposals was issued on Dec. 16, 2008. 73 Fed. Reg. 76443 (December 16, 2008). This is just the first step in the process. Expressions of interests received will be reviewed by the Secretary and possibly by a commission formed by the Secretary. The results of these reviews will be summarized in one or more reports to Congress, which will make recommendations for further action regarding no more than one project concept for each corridor.

<sup>64</sup>Pub. L. No. 110-432, § 224(c)(1),(2). The high speed rail corridor studies are to be submitted to Congress within 1 year after enactment of the PRIIA.

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## Following Reexamination Principles Can Help Ensure the Federal Role Is Effective and Efficient and Focused on Yielding Maximum Benefits

A number of principles could help guide the potential federal role in high speed rail, particularly as the newly enacted PRIIA and ARRA are implemented. These principles will increase the likelihood that the federal role in high speed rail is efficient, effective, sustainable, and focused on maximizing public benefits. We have discussed such principles in our work calling for a reexamination of federal surface transportation programs.<sup>65</sup> As applied here, the principles would address, going forward, the federal interest in developing a high speed intercity passenger rail policy, based on high speed rail purpose and relevance, its effectiveness in achieving goals and outcomes, its efficiency and targeting, its affordability, and its sustainability. These principles are as follows:

- Create well-defined goals based on identified areas of national interest. This would include establishing the expected outcomes related to each goal, and the federal role in achieving each goal.
- Incorporate performance and accountability for results into funding decisions.
- Employ the best analytical tools and approaches to emphasize return on investment.
- Ensure fiscal sustainability. This would include consideration of such things as whether funding is affordable and stable over the short- and long-term; the extent to which costs and revenues are shared among federal, state, and local participants; and whether any project fees and taxes are aligned with use and benefits.

Given the current fiscal crisis facing the nation and the pressing needs facing the federal government in many areas, it is critical that federal dollars are used efficiently and effectively and are focused where they can produce the greatest benefits. Failure to apply these principles could lead to an unfocused federal investment in high speed rail corridors or projects and, as a consequence, little impact on the congestion, environmental, energy, and other issues that face the U.S. transportation system.

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<sup>65</sup>See, for example, GAO, *Surface Transportation: Principles Can Guide Efforts to Restructure and Fund Federal Programs*, GAO-08-744T (Washington, D.C.: July 10, 2008); and *Surface Transportation: Restructured Federal Approach Needed for More Focused, Performance-Based, and Sustainable Programs*, GAO-08-400 (Washington, D.C.: Mar. 6, 2008).

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**Identify Areas of Federal Interest, Create Well-Defined Goals, and Establish and Define the Federal Role**

We have previously reported that specific, measurable, achievable, and outcome-based goals that are in turn based on identified areas of federal interest, improve the foundation for allocating federal resources and optimizing the results from the investment. Determining the federal interest involves examining the relevance and relative priority of programs, including high speed rail, in light of 21st century challenges and identifying areas of emerging national importance, such as congestion, dependence on foreign fuel sources, and the impacts of transportation on climate change. With the federal interest clearly defined, policymakers can clarify the goals for federal involvement (i.e., specific goals could be set on the basis of the expected outcomes), and can clearly define the roles of federal, state, and local government in working toward each goal. Where the federal interest is greatest, the federal government may play a direct role in setting priorities and allocating resources, as well as fund a higher share of program costs. Conversely, where the federal interest is less evident, state and local governments could assume more responsibility.

To date, there has been little consideration at a national policy level of how high speed rail could or should fit into the national transportation system and what high speed rail development goals should be. In the 1990s FRA studied the commercial feasibility of high speed rail and focused on the economics of bringing high speed ground transportation (including high speed rail) to well-populated groups of cities in the United States. Its report identified potential opportunities where high speed rail could complement highway or air travel.<sup>66</sup> One purpose of the study was to lay the groundwork for high speed rail policy in the United States. However, according to FRA, this policy was never developed.

The PRIIA requires the FRA Administrator to prepare a long-range national rail plan; preparing that plan will provide an opportunity for the federal government to identify the vision and goals of high speed rail for the nation and identify how, if at all, high speed rail fits into the national transportation system.<sup>67</sup> Although the act does explicitly require that high speed rail be included in the national rail plan, the national rail plan must be consistent with state rail plans and, among other things, state rail plans are to include a review of all rail lines in a state, including proposed high

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<sup>66</sup>DOT/FRA, *High Speed Ground Transportation for America*.

<sup>67</sup>Certain provisions of the PRIIA reflect intermodal considerations; for example, FRA's high speed rail project selection will be based, in part, on a project's anticipated ability to help relieve air and highway congestion.

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speed rail lines. National vision and goals, influenced by an intermodal perspective, have been key components in the development of high speed rail systems and national rail plans in both Europe and Asia. For example, in Europe, the vision and goals laid out by the central governments have evolved from being focused on reviving an industry (the railroads) and addressing transportation capacity constraints, to being focused on increasing the role of rail in an intermodal transportation system, making rail a preferred transport mode in short-distance intercity corridors, and using rail to achieve broader environmental, energy, and economic development goals. In Japan, after the initial success of the first high speed rail line between Tokyo and Osaka, the central government developed a national rail master plan that laid out the vision and goals for how the system would develop (including making passenger rail competitive with air travel), where it would extend, and the benefits that were to be expected. That master plan has guided high speed rail development ever since.

The development of a vision for high speed rail in the United States may need to be coordinated with reexamination of other federal surface transportation programs. As we reported, in March 2008, one reason that existing federal transportation programs are not effective in addressing key challenges, such as increasing highway and airport congestion and freight transportation demand, is because federal roles and goals are not clear. In addition, we reported that many programs lack links to needs or performance, the programs lack the best analytical tools and approaches, and there is modal stovepiping at DOT.<sup>68</sup>

Project sponsors, states, and others with whom we spoke are looking for federal leadership and funding in creating a structure for high speed rail development and in identifying how to achieve the potential benefits that these projects may offer. All but 1 of the 11 high speed rail proposals we reviewed have a projected need for federal funds in addition to any state, local, or other funding they may receive. Aside from funding, project sponsors and others are also looking for a stronger federal policy and programmatic role. For example, officials from 15 of the 16 projects we reviewed told us that the federal role should be to set the vision or direction for high speed rail in the United States. An official with the Florida DOT told us that no high speed rail system would be built in Florida or elsewhere in the United States absent a true federal high speed

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<sup>68</sup> GAO-08-400.

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rail program. Private sector officials also told us of the importance of a federal role and vision for high speed rail, and that leadership is needed from the federal government in providing governance structures for high speed rail projects that help to overcome the institutional challenges previously described in this report. Other stakeholders similarly mentioned the need for a federal role in promoting interagency and interstate cooperation, and identified other potential federal roles, such as setting safety standards, promoting intermodal models of transportation, and assisting with right-of-way acquisition.

## Incorporate Performance and Accountability for Results

As we reported in July 2008, our work has shown that an increased focus on performance and accountability for results could help the federal government target resources to programs that best achieve intended outcomes and national transportation priorities.<sup>69</sup> Tracking specific outcomes that are clearly linked to program goals can provide a strong foundation for holding potential grant recipients responsible for achieving federal objectives and measuring overall program performance. Accountability mechanisms can be incorporated into grants in a variety of ways. For example, as we reported in March 2008, grant guidelines can establish uniform outcome measures for evaluating grantees' performance toward specific goals, and grant agreements can depend in part on the grantees' performance instead of set formulas. Incentive grants or penalty provisions in transportation grants can also create clear links between performance and funding and help hold grantees accountable for achieving desired results.

The PRIIA establishes criteria for the selection of high speed rail corridors and high speed rail projects for development.<sup>70</sup> The criteria include a determination that the proposals are likely to result in a positive impact on the nation's transportation system. The Secretary of Transportation will select proposals that provide substantial benefits to the public and the national transportation system, is cost-effective, offers significant advantages over existing services, and meets other relevant factors determined by the Secretary. The PRIIA also requires that the FRA Administrator develop a schedule for achieving specific, measurable performance goals related to such things as the development of a long-range national rail plan, and, beginning in fiscal year 2010, to submit to the relevant congressional committees the administration's performance

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<sup>69</sup> GAO-08-744T.

<sup>70</sup> Pub. L. No. 110-432, § 501(d), 502, codified at 49 U.S.C. § 26106.

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goals, schedule, and a progress assessment.<sup>71</sup> FRA has not yet determined how performance and accountability will be incorporated into the review and evaluation of grant applications under the PRIIA.

The extent to which other countries we visited used performance and accountability measures in their high speed rail systems was limited. In France, postproject evaluations of the performance of major transport infrastructure projects have been required since 1982. However, a French government official told us that most of the current French high speed rail network was built before this 1982 postproject evaluation requirement began to be enforced. Consequently, few postproject evaluations have been done, even though this official said some evaluations had been done. Government officials in Spain said that economic evaluations of high speed lines had been conducted but, in some cases, did not determine the government's choice of lines to develop. Rather, the government chose to develop lines that would create a high speed network that extends the benefits of high speed rail to the whole national territory. Territorial criteria have played an important role in the Spanish government's decision to prioritize high speed rail. In Japan, historical postproject evaluations have generally not been done. A comparison of actual and forecasted ridership has been done for recent high speed rail lines and the estimates have been within 90 percent accuracy. The performance of high speed rail lines has focused on the accuracy of ridership forecasts, and these estimates are an integral part of negotiations between the government and private operators for construction of new high speed rail lines. For example, construction of new lines is carried out by the government, but a private operator assumes control over the line and assumes all the operating and maintenance responsibilities and ridership risk. Under the Japanese rail structure, the private company has an incentive—the profit motive—to ensure that the line performs well. We discuss Japan's incentive structure further in the next section on analytical tools.

#### Employ the Best Analytical Tools and Approaches to Emphasize Return on Investment

The effectiveness of any overall federal program design can be increased by promoting and facilitating the use of the best analytical tools and approaches. We have reported on a number of analytical tools and approaches that may be used.<sup>72</sup> These include using quantitative analyses based on identifying benefits and costs, managing existing transportation

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<sup>71</sup>Pub. L. No. 110-432, § 307, codified at 49 U.S.C. § 103(k).

<sup>72</sup>GAO-08-400.

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capacity, and developing public-private partnerships. Benefit-cost analysis, in particular, is a useful analytical tool for evaluating projects and ensuring goals are met. Benefit-cost analysis gives transportation decision makers a way to identify projects with the greatest net benefits and compare alternatives for individual projects. By translating benefits and costs into quantitative comparisons to the maximum extent possible, these analyses provide a concrete way to link transportation investments to program goals.

The PRIIA specifies various criteria for which high speed rail grant proposals will be evaluated to determine federal investment. Specifically, project selection is partially dependent on the consideration of the project's anticipated favorable impact on air or highway traffic congestion, capacity, and safety. Project selection criteria encourage a project sponsor to evaluate public benefits. For example, greater consideration is to be given to proposed projects that, among other things, provide environmental benefits and positive economic and employment impacts. The rail cooperative research program established by the PRIIA will also, among other things, include research into developing more accurate models for evaluating the impact of rail passenger and freight service, including the effects on highway and airport and airway congestion, environmental quality, and energy consumption.

Although the PRIIA does not provide explicit guidance for quantifying or valuing the economic and other impacts specified in the project selection criteria, a more established approach to analyzing proposed projects and quantifying and valuing nonfinancial benefits may emerge, given the potential results of the rail cooperative research program and since future proposed rail projects may be evaluated within the context of state transportation systems and will need to meet specific criteria contained in the PRIIA to obtain federal funding. In our view, any approach developed, to the extent practicable, should conform to Executive Order 12893.<sup>73</sup> This order directs federal executive departments and agencies with infrastructure responsibilities to develop and implement infrastructure investment and management plans consistent with the principles in the order. A key principle is that infrastructure investments are to be based on a systematic analysis of expected benefits and costs, including both quantitative and qualitative measures reflecting values that are not readily

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<sup>73</sup>Executive Order 12893, *Principles for Federal Infrastructure Investment*. 59 Fed. Reg. 4233 (Jan. 31, 1994).

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quantified. The order also directs that agencies encourage state and local recipients of federal grants to implement planning and information management systems that support the principles articulated in the order. In creating a more consistent approach, proposed projects may be more easily compared with one another, ensuring that public funding is applied to the projects and corridors with the greatest potential benefits.

Similarly, the PRIIA requires that consideration be given to projects with positive economic and employment impacts, but again does not provide explicit guidance on determining what is or is not a positive economic or employment impact. As we have previously discussed in this report, economic impacts are difficult to isolate, therefore, economic development locally may not constitute a national net benefit—rather it could be a redistribution of resources. For example, development of a high speed rail system could increase economic development in the area where it is built. However, this increased economic development could be a redistribution of resources rather than a net benefit. Consequently, it will be important in implementation of the PRIIA for guidelines to be developed on how to consider national economic and employment benefits in relation to local benefits. FRA is currently in the process of evaluating the PRIIA and preparing final rules for how high speed rail projects will be reviewed and selected for federal funding under provisions of the act. The final rules are required to be issued in October 2009.<sup>74</sup>

Forecasts of riders and costs are two key components of evaluating the economic viability of high speed rail projects, and rider forecasts are the anchor for the array of public benefits that a new line might bring. However, as we have discussed, these forecasts are often optimistic, calling into possible question the credibility of information being used by decision makers to pursue high speed rail. Development of stronger policies, procedures, and tools could enhance the accuracy and credibility of the forecasts and contribute to better decision making. There are a variety of means that have been discussed in the transportation literature and could potentially be employed to strengthen the accuracy of forecasting.<sup>75</sup> These means include the following:

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<sup>74</sup>Pub. L. No. 110-432, § 501(d), codified at 49 U.S.C. § 26106(g).

<sup>75</sup>Bent Flyvbjerg, “Measuring inaccuracy in travel demand forecasting: methodological considerations regarding ramp up and sampling,” *Transportation Research Part A: Policy and Practice*, vol. 39 (2005), 522-530.

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- obligating state and local governments to share some of the risks of underestimated costs for those projects seeking federal financial support;
  - obtaining forecasts and estimates from independent sources, such as a state auditor or a federal agency, rather than sources contracted to construct projects for a high speed rail project sponsor;
  - subjecting forecasts to peer review with possible public disclosure of all relevant data and public hearings; and
  - conducting horizontal comparisons of projects—that is, using data from different projects reported using a standardized accounting system to prepare probability distributions of the accuracy of project estimates of cost and demand—to evaluate new high speed rail projects.

Another potential means to improving the accuracy of these estimates is to align the incentives of public and private interests. For example, in Japan, for a new line to be built, the private operator must be able to make a reasonable profit over and above operating costs, maintenance costs, and lease payments made to the government for use of the track. The private operator then has an incentive to maximize riders, but also to minimize the lease payments, to increase its profit potential. Therefore, the private operator wants to be conservative regarding rider forecasting and wants the government to build the infrastructure in order to allow for the lowest cost operation and maintenance. The central government has an incentive to keep costs low in constructing the line and to extract the highest lease payment it can negotiate from the private operator. The private rail operator and the central government negotiate and agree upon a lease payment, which remains set over a 30-year period. These negotiations are based on forecasts of riders over the ensuing 30 years and the existing cost estimates. According to officials and academics in Japan, this structure has resulted in a discipline that has vastly improved the accuracy of rider forecasting and cost estimation. For one newly constructed line, actual riders were within 90 percent of forecasted riders, and the construction of the line was within budget and ontime.

In Europe, we found that the use of analytical tools and approaches for analyzing the public benefits of high speed rail projects was generally a requirement, and that these analytical tools led to public benefits being more systematically quantified and valued compared with projects in the United States. As we previously discussed in this report, evaluation of benefits can often be difficult and give rise to disagreements, and few standards exist in the United States to govern such analyses. A French

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official said evaluations of public benefits and costs began in the 1980s as the result of a 1982 law. France's current approach to analyzing proposed projects includes analysis of public benefits—including travel-time savings, security, noise, and pollution—in conjunction with financial benefits to calculate financial and socioeconomic indicators (such as financial internal rate of return and socioeconomic rate of return). These financial and socioeconomic indicators are generally used to compare proposed projects that meet certain minimum thresholds<sup>76</sup> and to prioritize them for construction. France's 2004 Ministerial Order for analyzing proposed transportation infrastructure projects provides guidance to project sponsors in quantifying and valuing these benefits, and sets forth monetized values for specific public benefits and costs. In addition, France plans to soon build a multicriteria analysis tool that will take into account additional nonfinancial benefits and costs, such as building in greenhouse gas emissions reductions, as a means to advance sustainable development objectives. This tool will guide France in adopting a new national infrastructure planning scheme. Spain began explicitly including public benefits and costs in proposed project analyses in 2003. Specific benefits of rail projects are also outlined in a European Commission guide for investment projects, and include time savings, additional capacity, and wider economic benefits such as economic development.<sup>77</sup>

## Ensure Fiscal Sustainability

Our work has shown that transportation funding faces an imbalance of revenues and expenditures and other threats to its long-term sustainability.<sup>78</sup> We have reported that a sustainable surface transportation program will require targeted investment, with adequate return on investment, from not only the federal funds invested but also investments from state and local governments and the private sector. In the context of high speed rail, fiscal sustainability includes consideration of such things as whether federal, state, and other funding is affordable and stable over the short- and long-term (i.e., both while a project is being planned and

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<sup>76</sup>For example, according to French officials, a project's financial internal rate of return should exceed 8 percent, and the socioeconomic internal rate of return should exceed 4 percent for the project to proceed.

<sup>77</sup>European Commission, *Guide to Cost-Benefit Analysis of Investment Projects, Final Report* (June 16, 2008). This guide updates and expands the previous edition (2002), which in turn was the follow-up of a first brief document (1997) and of a subsequent substantially revised and augmented text (1999). The guide was developed under specific requirements for the European Commission to provide guidance on project appraisals because projects receiving funding from the European Union require a cost-benefit analysis.

<sup>78</sup>GAO-08-744T.

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constructed as well as after the high speed rail line is in operation); the extent to which costs and revenues are shared among federal, state, local, and private participants; and whether any project fees and taxes are aligned with use and benefits. Moreover, sustainability can refer to the extent to which ticket revenues will cover ongoing operating and maintenance costs to avoid ongoing public subsidy.

The PRIIA includes recognition of the potential fiscal sustainability high speed rail projects that might be selected for development. For example, the PRIIA requires the federal government to give greater consideration to high speed rail corridor projects that incorporate, among other things, equitable financial participation in the project's financing, including financial contributions by intercity passenger, freight, and commuter railroads commensurate with the benefits expected to their operations as well as financial commitments from host railroads, nonfederal entities, and nongovernment entities.<sup>79</sup> Similarly, proposals under the PRIIA for specific high speed rail projects are required to contain a description of the projected revenues and sources of revenue, including the expected levels of both public contributions and private investment.<sup>80</sup> The level of public and private contributions, in addition to a summary of the potential risks to the public, including risks associated with project financing, must be considered in project selection by commissions set up by the Secretary to review the proposals.<sup>81</sup>

The National Surface Transportation Policy and Revenue Study Commission,<sup>82</sup> created to study the condition and needs of the nation's surface transportation infrastructure, called for an increase in intercity passenger rail service, including high speed rail service, and also proposed a system of fiscal sustainability in its final report in January 2008. The commission's final report suggested that funding should come from a variety of sources, and that a fund should be set up for rail investment that

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<sup>79</sup>Pub. L. No. 110-432, § 501, codified at 49 U.S.C. § 26106 (e)(2)(C)(ii).

<sup>80</sup>Pub. L. No. 110-432, § 502, codified at 49 U.S.C. § 26106 note.

<sup>81</sup>Section 502 requires the Secretary to establish and support the formation of commissions, representing affected governors, mayors, freight railroads, transit authorities, labor organizations, and Amtrak.

<sup>82</sup>Congress created the National Surface Transportation Policy and Revenue Study Commission in 2005 under Section 1909 of the Safe, Accountable, Flexible, Efficient Transportation Equity Act—A Legacy for Users, Pub. L. No. 109-59, § 1909, 119 Stat. 1471 (Aug. 10, 2005).

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would collect money from a new federal ticket tax levied on users of the system. Currently, users of intercity passenger rail in the United States do not pay ticket taxes or user fees similar to those paid by users of the aviation system or fuel taxes used to support the highway system.

In other countries, high speed rail systems appear to be fiscally sustainable on an ongoing financial basis. For example, new high speed rail lines are not constructed in Japan unless they can cover their operating and maintenance costs, not including the payback of the initial investment in the infrastructure. Similarly, European officials told us that some of their high speed rail lines require little, if any, public operating subsidies outside of initial capital costs, since revenue is sufficient to cover operating costs.

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## Conclusions

High speed rail does not offer a quick or simple solution to relieving congestion on our nation's highways and airways. High speed rail projects are costly, risky, take years to develop and build, and require substantial up-front public investment as well as potentially long-term operating subsidies. Yet the potential benefits of high speed rail—both to riders and nonriders—are many. Whether any of the nearly 50 current domestic high speed rail proposals (or any future domestic high speed rail proposal), may eventually be built will hinge on addressing the funding, public support, and other challenges facing these projects. Determining which, if any, proposed high speed rail projects should be built will require decision makers to be better able to determine a project's economic viability.

It is not likely high speed rail projects will come to fruition without federal assistance. The PRIIA establishes a good framework for helping craft a federal role in high speed rail (which, to date, has been limited) to address these challenges. Given the complexity, high cost, and long development time for high speed rail projects, it will be critical to first determine how high speed rail fits into the national transportation system and establish a strategic vision and goals for such systems. This will establish the baseline for federal involvement. To maximize returns on federal investments, it will also be critical when reviewing grant applications under the PRIIA high speed rail provisions to clearly identify expected outcomes and to incorporate performance and accountability measures to ensure these outcomes are achieved. The failure to incorporate such measures is a common drawback of federal transportation programs. Finally, it will be incumbent upon the federal government to develop the guidelines, methods, and analytical tools to develop credible and reliable ridership, cost, and public benefit forecasts. Without such guidelines, methods, and tools, reliable determinations of economic viability will continue to be the

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exception rather than the norm, and the efficiency and effectiveness of any federal assistance to high speed rail could be jeopardized.

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## Recommendations for Executive Action

To ensure effective implementation of provisions of the PRIIA related to high speed rail and equitable consideration of high speed rail as a potential option to address demands on the nation's transportation system, we recommend that the Secretary of Transportation, in consultation with Congress and other stakeholders, take the following three actions:

- Develop a written strategic vision for high speed rail, particularly in relation to the role high speed rail systems can play in the national transportation system, clearly identifying potential objectives and goals for high speed rail systems and the roles federal and other stakeholders should play in achieving each objective and goal.
- Develop specific policies and procedures for reviewing and evaluating grant applications under the high speed rail provisions of the PRIIA that clearly identify the outcomes expected to be achieved through the award of grant funds and include performance and accountability measures.
- Develop guidance and methods for ensuring reliability of ridership and other forecasts used to determine the viability of high speed rail projects and support the need for federal grant assistance. The methods could include such things as independent, third-party reviews of applicable ridership and other forecasts, identifying and implementing ways to structure incentives to improve the precision of ridership and cost estimates received from grant applicants, or other methods that can ensure a high degree of reliability of such forecasts.

## Agency Comments and Our Evaluation

We provided copies of our draft report to DOT for comment prior to finalizing the report. DOT provided its comments in an e-mail message on March 10, 2009. DOT said that it generally agreed with the information presented and noted that with the passage of ARRA, its work on high speed rail has been considerably accelerated. Specifically, the act calls for FRA to submit, within an expedited time frame, a strategic plan to the Congress describing how FRA will use the \$8 billion funding identified in the act to improve and deploy high speed passenger rail systems. DOT indicated that the strategic plan may include the Department's vision for developing high speed rail services, criteria for selecting projects, an evaluation process that will be used to measure effectiveness, and a discussion of the relationship between the ARRA grant programs and the

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recently enacted PRIIA. DOT said it is also working to comply with statutory requirements to issue interim guidance in June 2009, describing grant terms, conditions, and procedures. DOT told us that in order to provide information to the public and potential grantees as expeditiously as possible, it has posted a set of questions and answers relating to ARRA on its Web site. These questions and answers provide potential program applicants with some preliminary but specific information on what to expect in terms of coverage, limitations, and potential selection criteria. Finally, DOT noted that the draft report does not include information relating to the administration's new federal commitment to high speed rail. Specifically, as described in the President's proposed fiscal year 2010 budget, the administration has proposed a 5-year \$5 billion high speed rail state grant program. DOT indicated that this program is intended to build on the \$8 billion included in ARRA for high speed rail. The Department said the President's proposal marks a new federal commitment to practical and environmentally sustainable transportation. DOT did not take a position on our recommendations.

We agree that the recently enacted ARRA will likely accelerate activity related to the consideration and development of high speed rail in the United States and will place a new emphasis on the federal role in such development. We also agree that the President's proposed fiscal year 2010 budget, if enacted, could further increase the emphasis on high speed rail and its potential development. As discussed in the report, high speed rail systems can offer a number of benefits. However, these systems are very expensive, can take a long time to develop, and face numerous financial and other challenges to bring to fruition. Given the renewed interest in high speed intercity passenger rail and its development and the substantial resources that might be made available, it is even more important that potential challenges are addressed and a clear federal role be established. This includes developing a strategic vision for high speed rail that includes consideration of how high speed rail fits into the nation's transportation system; that the review and evaluation of grant applications under PRIIA, ARRA and other programs clearly identify outcomes to be achieved and incorporate into grant documents appropriate performance and accountability measures to ensure these outcomes are achieved; and that guidance and methods be developed that increase the reliability of ridership and other forecasts used to determine the economic viability of high speed rail projects. Each of these actions is essential for ensuring that federal expenditures on high speed rail are efficient, effective, and focused on maximizing the return on the investment.

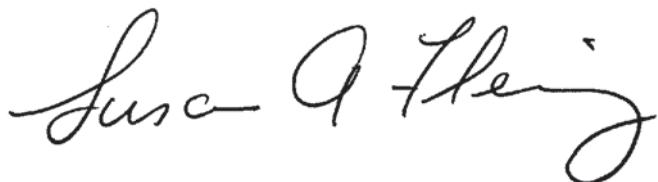
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We also received comments from Amtrak in an e-mail message dated March 3, 2009. Amtrak said it generally agreed with our conclusions. Amtrak did not take a position on our recommendations. Amtrak also provided technical corrections and comments, which we incorporated where appropriate.

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We are sending copies of this report to the appropriate congressional committees; the Secretary of Transportation; the Administrator of the Federal Railroad Administration; and the Director of the Office of Management and Budget. The report will also be available at no charge on the GAO Web site at <http://www.gao.gov>.

If you or your staff have any questions about this report, please contact me at (202) 512-2834 or [flemings@gao.gov](mailto:flemings@gao.gov). Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. GAO staff who made major contributions to this report are listed in appendix VIII.

A handwritten signature in black ink, appearing to read "Susan A. Fleming".

Susan A. Fleming  
Director, Physical Infrastructure Issues

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*List of Requesters*

The Honorable Harry Reid  
Majority Leader  
United States Senate

The Honorable John L. Mica  
Ranking Member  
Committee on Transportation and Infrastructure  
House of Representatives

The Honorable John W. Olver  
Chairman  
Subcommittee on Transportation, Housing and  
Urban Development, and Related Agencies  
Committee on Appropriations  
House of Representatives

The Honorable Bill Shuster  
Ranking Member  
Subcommittee on Railroads, Pipelines, and  
Hazardous Materials  
Committee on Transportation and Infrastructure  
House of Representatives

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# Appendix I: Scope and Methodology

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To better understand the potential viability of high speed rail service in the United States, we reviewed (1) the factors affecting the economic viability of high speed rail projects—that is, whether a project’s total social benefits offset or justify the total social costs—and difficulties in determining the economic viability of proposed projects; (2) the challenges that U.S. project sponsors experience in developing and financing high speed rail projects; and (3) the federal role in the potential development of high speed rail systems.

For the purposes of this report, we used the Federal Railroad Administration’s (FRA) definition of high speed ground transportation, which is “service that is time-competitive with air and/or automobile for trips in corridors of roughly 100 and 500 miles in length,”<sup>1</sup> as opposed to a specific top speed threshold. As a result, we included in our review a wide range of projects, including “incremental” projects that are designed to increase the speed (generally above 79 miles per hour up to 150 miles per hour) or reliability of existing rail service on existing track usually shared with freight or other passenger trains; and “new” high speed rail projects (above 150 miles per hour and, in some cases, above 200 miles per hour) designed to operate on new tracks or guideway on dedicated right-of-way not shared with other rail services. Our review was technology neutral, meaning that we did not analyze or consider the technical feasibility of diesel, electrified, or magnetic levitation trains, but only considered the service and performance aspects of the different technologies in the project proposals we reviewed. The scope of our work did not include an assessment of commuter rail or transit service where the primary purpose is to travel between a suburb and a city center or within a metropolitan area. However, the presence of these transportation modes as intermodal connections to high speed rail service was considered in identifying characteristics significant to how proposed high speed rail service is analyzed and evaluated. Furthermore, it was not the intent of this study to identify specific routes or corridors that are viable. Rather, this study identifies characteristics of corridors and service and other factors that contribute to a proposed project’s benefits and costs and the challenges in developing and financing such projects.

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<sup>1</sup>DOT/FRA, *High Speed Ground Transportation for America* (Washington, D.C.: September 1997), 2-1.

## Structured Interviews with Domestic Project Sponsors

To address our objectives, we conducted structured interviews with officials for 5 projects that currently exceed Amtrak's predominant top speed of 79 miles per hour, and project sponsors for 11 different high speed rail proposals in the United States. The criteria used to select which existing or proposed domestic projects to review were twofold, as follows:

1. The project's planned or existing high speed rail service must include operating at a top speed greater than 79 miles per hour (generally the top speed for intercity passenger trains).
2. The project's planned service must be supported by a completed environmental review (or equivalent project review) that would make the project eligible for federal funding, or the project sponsor needed to be actively pursuing the completion of such a review.

To identify projects for inclusion in our study, we reviewed a recent survey of high speed rail projects in 64 corridors across the United States to identify potential projects.<sup>2</sup> The survey identified 16 projects that met our criteria.<sup>3</sup> To verify this information, we contacted project sponsors, or another project affiliate, for each of these projects (16 projects). We also contacted project sponsors (or another project affiliate) for the remaining projects in the survey to verify that they had not advanced in their planning process since issuance of the survey report, such that they would now meet our criteria. As a result of this verification, one additional project was included in our study, and two projects were dropped since they had either not progressed to the environmental review phase or were

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<sup>2</sup>Joseph P. Schwieterman and Justin Scheidt, "Survey of Current High-Speed Rail Planning Efforts in the United States," Transportation Research Board of the National Academies, *Transportation Research Record: Journal of the Transportation Research Board*, no. 1995 (Washington, D.C.: 2007).

<sup>3</sup>The survey authors considered the Washington, D.C., to New York City, New York, and the New York City, New York, to Boston, Massachusetts, high speed rail project as two separate projects. For the purposes of this report we considered these projects as one since they are both part of Amtrak's Northeast Corridor *Acela Express* service. The author also considered the Bay Area, California, to San Diego, California, project and the Sacramento, California, to San Diego, California, project as two separate projects. Again, for the purposes of this report, we considered these projects as one since they are both part of the California High Speed Rail Authority's planned statewide high speed rail initiative. Finally, the author considered the Washington, D.C., to Raleigh, North Carolina, project and the Raleigh, North Carolina, to Charlotte, North Carolina, project as two separate projects. For the purposes of this report, we considered these projects as one, since they are considered by project sponsors to be one project under the Southeast High Speed Rail Corridor development initiative.

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not being pursued for high speed rail. We also added another project (Los Angeles, California, to San Diego, California) that met our criteria on the basis of discussions with Amtrak. The latter project is separate from the California High Speed Rail Authority's statewide high speed rail initiative, which also plans to serve San Diego from Los Angeles.

All 5 existing projects were incremental projects, and of the 11 proposed projects included in our review, 6 were incremental improvements to existing rail service in a corridor, and the remaining 5 projects would implement service on new high speed track or guideways using dedicated right-of-way. Three of the 5 dedicated right-of-way projects were considering magnetic levitation technology at the time of our study.<sup>4</sup> To collect information about the high speed rail projects in development, we conducted structured interviews with each project sponsor. The interviews were structured to identify such things as (1) the important characteristics and factors that affect a project's viability; (2) the most important challenges faced by project sponsors in developing the project; and (3) the roles of various federal, state, local, and private sector entities in the development of the project. We pretested the structured interview instrument and made changes based on the pretest. These changes included additional questions about project development and background and stakeholders involved with the project. In addition, we requested and reviewed any available data on ridership forecasts and evaluations, project cost estimates and evaluations, costs to construct and maintain any existing high speed rail service as well as any environmental reviews, transportation plans, and other studies associated with the projects. Information about the projects was shared with project sponsors to ensure its accuracy.

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## **International Case Studies**

We also conducted case studies of international high speed rail systems in France, Japan, and Spain. In selecting these three countries, we considered a number of factors, including location, how long high speed rail has been in service, and the availability of data and other information. At the time of our visit, France and Spain had the highest kilometers of high speed rail lines in Europe. Japan similarly had extensive high speed rail lines and was one of the first countries to implement high speed rail service. We conducted interviews in these countries with relevant

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<sup>4</sup>The Atlanta, Georgia to Chattanooga, Tennessee, project is considering both magnetic levitation and electrified locomotives.

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government officials, including transportation bureaus and embassy officials; high speed rail infrastructure owners and service operators; and other stakeholders, including academic professors and domestic airline carriers or their trade associations. We requested and reviewed any available data on ridership forecasts and evaluations, project cost estimates and evaluations, as well as the costs to construct and maintain high speed rail service in these countries. We also reviewed relevant literature and studies on high speed rail systems in these and other countries. To the extent available, we reviewed relevant laws, directives, and guidance related to high speed rail systems in France, Japan, and Spain, and the European Union. The information presented in this report on international high speed rail systems, however, cannot be generalized beyond these three countries.

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## **Case Studies of Terminated Projects**

To further identify the challenges encountered by previous high speed rail projects in the United States, we conducted a case study analysis of two terminated domestic high speed rail projects: the Florida Overland Express (FOX) and the Texas TGV. To conduct the case study analyses, we interviewed stakeholders affiliated with the projects and reviewed documents, such as legislation, ridership studies, and other research materials related to the projects.

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## **Additional Methodologies**

To further address our objectives, we obtained and analyzed information from a variety of other sources, including reports and documentation from FRA, the Department of Transportation (DOT), Amtrak, and the Surface Transportation Board; prior GAO work; and other evaluations and studies on transportation infrastructure projects and high speed rail service. In addition to our structured interviews and international case studies, we conducted over 90 interviews covering a wide range of stakeholders and interested parties, including officials at FRA, DOT, Amtrak, the Surface Transportation Board, state and local government agencies and organizations, academics, consultants involved in high speed rail ridership forecasting and planning, representatives from private equity firms that invest in transportation infrastructure, and engineers involved in developing various rail technologies.

To review how characteristics of corridors and proposed service identified in our structured interviews and international case studies compare with other corridors in the United States and internationally, we obtained and analyzed data on corridor and service characteristics from numerous sources, including the DOT's Bureau of Transportation Statistics, the

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Census Bureau, and other domestic and international academic studies and government reports. We used standard tests and methodologies to ensure reliability of the data collected. This included reviewing the data for abnormalities, omissions, and obvious errors and corroborating information obtained to the extent possible. These data are not intended to make definitive conclusions on viability, but rather to allow us to make reasonable comparisons using the best available data. For example, variations exist in how data sources report population numbers based on differences between the geographical definitions of cities, metropolitan and other areas. In trying to maintain consistency, we attempted to use the same population data source for international corridors, but this was not always possible.

To further assess the roles and relevant interests of national and state government agencies and officials, and the private sector in planning, developing, and operating high speed rail projects, we reviewed applicable federal laws and regulations. This included analyzing selected high speed rail legislation from 1965 to 2008, including the Passenger Rail Investment and Improvement Act of 2008. The latter includes a review of the high speed rail provisions contained in the act, the role of the Secretary of Transportation in relation to these provisions, and application procedures for federal high speed rail grants.

We conducted this performance audit from December 2007 to March 2009 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

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## Appendix II: Description of U.S. Rail Corridors Operating at Speeds Greater Than 79 Miles per Hour

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### Washington, D.C.-New York-Boston Corridor

Project Description	Projects and improvements associated with Amtrak's 456-mile Northeast Corridor began in the 1970s. This included the Northeast Corridor Improvement Program and the Northeast High Speed Rail Improvement Program. Improvements included electrifying the line from New Haven Connecticut, to Boston, Massachusetts, enhancing signaling systems, and acquiring new high speed rail trainsets called <i>Acela Express</i> . The average speed from Washington, D.C., to New York City, New York, is 82 miles per hour, and the top speed is 135 miles per hour. The average speed from New York City to Boston is 68 miles per hour, and the top speed is 150 miles per hour.
Date Originated	1970s
Technology	Electrified locomotives on existing railroad right-of-way
Project Sponsors	Amtrak FRA
Cost Estimate	\$3.8 billion (estimated since 1990)
Funding to Date	\$3.8 billion (estimated since 1990)
Current Status	Project is open for passenger operations. Amtrak, in conjunction with the nine states along the corridor, is currently developing a master plan for the corridor that includes additional capital improvements.

## **Los Angeles to San Diego Corridor**

<b>Project Description</b>	Amtrak began operating on the Los Angeles to San Diego corridor in 1971. When Amtrak began operations, the passenger trains were already capable of maximum speeds of 90 miles per hour on segments between Santa Ana in Orange County and the Sorrento Valley because of an automatic track signaling system that was already in place. Average speed along the 130-mile corridor is approximately 55 miles per hour.
<b>Date Originated</b>	1971
<b>Technology</b>	Diesel locomotives on existing railroad right-of-way
<b>Project Sponsors</b>	Amtrak Southern California Regional Rail Authority North County Transit District Orange County Transit Authority California Department of Transportation Burlington Northern Santa Fe Railroad
<b>Cost Estimate</b>	Not available
<b>Funding to Date</b>	Not available
<b>Current Status</b>	Passenger rail operations are under way with top speeds of 90 miles per hour in certain segments; however, continuing capital improvements are occurring along the corridor to increase total average speed.

## New York City to Albany/Schenectady Corridor

### Project Description

From 1977 to 1997, the New York State Department of Transportation made a series of incremental improvements to existing passenger rail service between New York City and Albany/Schenectady along the Empire Corridor, which stretches to Buffalo. Doing so has allowed for passenger rail service to operate at a top speed of 110 miles per hour and an average speed of between 80 and 90 miles per hour along the 158-mile corridor.

Date Originated 1977

Technology Diesel locomotives on existing railroad right-of-way

Project Sponsors New York State Department of Transportation  
Amtrak

Cost Estimate \$97.2 million (actual)

Funding to Date \$97.2 million (100 percent from state funds)

Current Status Intercity passenger rail operations are currently under way with a top speed of 110 miles per hour. The New York State Department of Transportation is planning on making \$22 million in additional incremental corridor investments, and is also anticipating new federal funding to make further improvements.

## Harrisburg to Philadelphia Corridor

Project Description	The Keystone Corridor Improvement Program consisted of making incremental improvements (e.g., track work, bridge repairs, communication and signaling improvements, and enhanced power generation) along the Harrisburg to Philadelphia corridor to allow for speeds of up to 110 miles per hour.
Date Originated	Late 1990s
Technology	Electrified locomotives on existing railroad right-of-way
Project Sponsors	FTA Amtrak Pennsylvania Department of Transportation
Cost Estimate	\$145.5 million (actual)
Funding to Date	\$145.5 million (50 percent from Amtrak, 40 percent from FTA, and 10 percent from state funds)
Current Status	Intercity passenger operations are currently under way with a top speed of 110 miles per hour. There are currently discussions under way to plan for a second phase of improvements for the corridor.

## **Chicago to Detroit Corridor**

<b>Project Description</b>	Implementation of a positive train control system on 55 miles of Amtrak-owned right-of-way (Kalamazoo, Michigan, to about the Indiana state line) along the Chicago, Illinois, to Detroit, Michigan, corridor. Improvements to signaling and communication systems will allow Amtrak to operate up to a top speed of 110 miles per hour along the 55-mile stretch.
<b>Date Originated</b>	1994
<b>Technology</b>	Positive train control and diesel locomotives on existing railroad right-of-way
<b>Project Sponsors</b>	Michigan Department of Transportation Amtrak General Electric FRA
<b>Cost Estimate</b>	\$39 million (actual)
<b>Funding to Date</b>	\$39 million (49 percent from FRA, 27 percent from state, and 24 percent from Amtrak and General Electric)
<b>Current Status</b>	From Kalamazoo, Michigan, to Niles, Michigan, trains operate at 95 miles per hour. From Niles, Michigan, to a point 20 miles west, positive train control equipment is installed but is currently in the process of getting approval from FRA for its use. Amtrak is currently testing a new radio system with different frequencies. When testing is complete and the radio system is installed, passenger rail operations would be able to operate at 110 miles per hour along the 55 mile-test bed.

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# Appendix III: Description of Current U.S. High Speed Rail Proposals in the Environmental Review Phase

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## Atlanta, Georgia, to Chattanooga, Tennessee, High Speed Rail Project

Project Description	The project will connect Atlanta, Georgia, to Chattanooga, Tennessee, along a combination of new right-of-way, rail right-of-way, and highway right-of-way with a new high speed rail system. The length is approximately 110 miles between the two cities. The envisioned system is expected to operate at a top speed of 200 miles per hour and an average speed of 180 miles per hour.
Date Originated	1998
Proposed Technology	To be determined. Project sponsors are considering both magnetic levitation and electrified steel-wheel on steel-rail technology. The preferred technology will be recommended as a result of the program level environmental impact statement.
Project Sponsors	Georgia Department of Transportation FRA Federal Highway Administration
Cost Estimate	Not available
Funding to Date	Funding for the feasibility study, which was conducted by the Atlanta Regional Commission, was provided through the Transportation Equity Act of the 21st Century (TEA-21). <sup>1</sup> Additional funding was authorized by the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU), to study various transportation technologies <sup>2</sup> as well as through the SAFETEA-LU Technical Corrections Act of 2008. <sup>3</sup>
Current Status	Georgia Department of Transportation officials noted they were half way through the 36-month program level environmental impact statement. The department plans to have a record of decision on the program level environmental statement by 2010.

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<sup>1</sup>Pub. L. No. 105-178, 112 Stat. 107 (1998).

<sup>2</sup>Pub. L. No. 109-59, 119 Stat. 1144 (2005).

<sup>3</sup>Pub. L. No. 110-244, 122 Stat. 1572 (2008).

**Baltimore, Maryland, to  
Washington, D.C.,  
Magnetic Levitation  
Project**

**Project Description**

The Baltimore, Maryland, to Washington, D.C., project is a magnetic levitation project that plans to connect the two cities, with a planned stop at Baltimore-Washington International Airport. The length is 40 miles between the two cities. The system is expected to operate at a top speed of 250 miles per hour and an average speed of 125 miles per hour.

**Date Originated** 1992

**Proposed Technology** Magnetic levitation

**Project Sponsors**  
FRA  
Maryland Department of Transportation  
Baltimore Development Corporation  
District of Columbia Department of Transportation

**Cost Estimate** \$5.15 billion (projected - 2007)

**Funding to Date**  
The project completed a preliminary feasibility study in 1994 in response to the Maglev Prototype Development Program created by the Intermodal Surface Transportation Efficiency Act of 1991. In 1998, the project was one of the seven projects selected and funded for study by the FRA as part of the Maglev Deployment Program. In 2001, FRA selected this project to receive funds for a draft environmental impact statement as part of the TEA-21 Maglev Deployment Program. In 2003, a draft environmental impact statement was completed and accepted by FRA.

**Current Status**  
In October 2007, a draft of the final environmental impact statement was submitted to FRA. FRA has requested additional information as part of their review of this statement. Project sponsors are pursuing funding under the SAFETEA-LU Technical Corrections Act of 2008 to complete the final environmental impact statement.

## Anaheim, California, to Las Vegas, Nevada, Magnetic Levitation Project

Project Description	This project is planned to connect Las Vegas, Nevada, to Anaheim, California, with stops in Ontario, Victorville, Barstow (California) and Primm (Nevada) with a magnetic levitation system. The length is 269 miles between Anaheim, California, and Las Vegas, Nevada. The initial segment to be developed is 40 miles from Las Vegas to Primm, Nevada. The system is expected to operate at a top speed of 311 miles per hour and an average speed of between 150 and 200 miles per hour.
Date Originated	1988
Proposed Technology	Magnetic levitation
Project Sponsors	FRA California Nevada Super Speed Train Commission (created by California and Nevada legislatures)
Cost Estimate	\$12 billion (projected - 2005)
Funding to Date	\$45 million, from the SAFETEA-LU Technical Corrections Act of 2008
Current Status	The commission recently received \$45 million from the SAFETEA-LU Technical Corrections Act of 2008, of which the commission will need to provide 20 percent matching funds. Work on the environmental impact statement is continuing, as is design/engineering work and preparation of cost estimates. Project sponsors expect to issue a fixed price contract to construct this project. The commission continues to have legislative authority in Nevada, but its authorizing legislation in California was allowed to lapse. However, according to the commission, the project enjoys strong support in California, and is supported by the California Department of Transportation in preparation of the environmental impact statement.

## **Victorville, California, to Las Vegas, Nevada, High Speed Rail Project**

### **Project Description**

The Desert Xpress is a high speed rail project intended to connect Las Vegas, Nevada, with Southern California through a station in Victorville, California, a city that is less than 50 miles east of Palmdale where an intermodal station is planned on the California High Speed Rail system; 35 miles northeast of Ontario International Airport; and 80 miles northeast of downtown Los Angeles. The system is planned to operate on a new dedicated right-of-way. The distance between Victorville, California, and Las Vegas, Nevada, is approximately 183 miles. Project sponsors expect to operate at a top speed of 150 miles per hour and an average speed of 125 miles per hour. Project sponsors also expect to construct the project using existing highway right-of-way and using public lands owned by the Bureau of Land Management. Desert Xpress is being implemented by a private sector entity without public funding.

Date Originated	2002
Proposed Technology	A dedicated right-of-way, steel-wheel on steel-rail system
Primary Sponsor	Desert Xpress Enterprises
Cost Estimate	\$3.5 billion (projected - 2003)
Funding to Date	No public funding has been expended. All funding to-date has come from Desert Xpress Enterprises.
Current Status	The draft environmental impact statement is currently being developed and is scheduled for publication in early 2009. Desert Xpress officials expect the final environmental impact statement to be completed in July 2009 with a final record of decision issued by the federal government shortly thereafter.

## **Los Angeles, California, to San Francisco, California, High Speed Rail Project**

<b>Project Description</b>	The California High Speed Rail Authority is pursuing a statewide high speed rail system in California. Phase 1 of system will be from Anaheim, California, to Los Angeles, California, then through California's Central Valley, and through the Pacheco Pass to the San Francisco Bay Area. Phase 2 will include extensions to Sacramento, California, and San Diego, California. Phase 1 of the system is 520 miles, and the authority expects the service will operate at a top speed of 220 miles per hour. Authority officials did not provide an average speed.
<b>Date Originated</b>	1996
<b>Proposed Technology</b>	A predominantly dedicated right-of-way electrified steel-wheel on steel-rail system. According to the authority, about 10 percent of the line will be shared with other rail services.
<b>Project Sponsors</b>	FRA California High Speed Rail Authority (created by the California legislature)
<b>Cost Estimate</b>	\$32.8 - \$33.6 billion for Phase 1 of project (projected - 2008)
<b>Funding to Date</b>	\$9.95 billion in state bond funding (in addition to state support provided for administration of California High Speed Rail Authority)
<b>Current Status</b>	As of July 2008, all program-level environmental review work has been completed. The authority is now undertaking the project-level review and approval process. In addition, on November 4, 2008, California voters approved a ballot initiative that allows the state to issue \$9.95 billion in bonds for transit and other projects, \$9.0 billion of which will go for development of the statewide high speed rail system. Authority officials said they plan to seek additional funding from the federal government and private sector, as well as from local governments for the construction of the system.

## **Richmond, Virginia, to Hampton Roads, Virginia, High Speed Rail Project**

### **Project Description**

The Virginia Department of Rail and Public Transportation is pursuing improved passenger rail service between Richmond, Virginia, and the Hampton Roads area of Virginia (Norfolk, Newport News, and other cities). This service will ultimately connect to the Northeast Corridor in conjunction with development of the Southeast High Speed Rail Corridor. This project will use existing right-of-way. Depending on the preferred alignment, the length of the corridor could be 74 miles or 93 miles, with a planned top speed of 90 miles per hour. On December 14, 1995, FRA administratively extended the Southeast High Speed Rail Corridor from Richmond, Virginia, to Hampton Roads, Virginia.

Date Originated 2004

Proposed Technology Steel-wheel on steel-rail

Project Sponsors FRA  
Virginia Department of Rail and Public Transportation

Cost Estimate Not available

Funding to Date Not available

Current Status Portions of the draft environmental impact statement were sent to FRA for review in spring 2008. The project sponsor is currently awaiting FRA's response.

**Eugene, Oregon, to  
Vancouver, British  
Columbia, Canada, High  
Speed Rail Project**

**Project Description**

The federally designated Pacific Northwest Rail Corridor stretches from Vancouver, British Columbia, Canada, to Eugene, Oregon, a distance of 466 miles. The Washington State Department of Transportation is pursuing incremental improvements to intercity passenger rail service between Portland, Oregon, to Vancouver, British Columbia, Canada, a distance of 341 miles. Improvements include upgrading grade crossings, improving tracks and facilities, enhancing the signaling system, purchasing passenger train equipment and improving stations, which would allow the top speed to be 110 miles per hour.

**Date Originated**

Late 1980s

**Proposed Technology**

Nonelectric locomotives on existing freight railroad right-of-way, with minor alignment changes as needed.

**Project Sponsors**

FRA  
Washington Department of Transportation  
Amtrak  
State of Oregon  
Province of British Columbia

**Cost Estimate**

\$6.5 - \$6.8 billion (2006 – projected)

**Funding to Date**

\$563.7 million

**Current Status**

Current intercity passenger rail operating speeds are at or below 79 miles per hour and, according to the department, increases in speed will require a new signaling system along the corridor, although increases in frequencies and travel times have occurred due to capital investments in the corridor.

**Scranton, Pennsylvania, to  
New York City, New York,  
High Speed Rail Project**

<b>Project Description</b>	This is an extension of New Jersey Transit service to Scranton via existing railroad right-of-way. The corridor is 133 miles and work will include refurbishing 28 miles of abandoned railroad right-of-way. The top speed is expected to be 110 miles per hour, with an average speed of just under 80 miles per hour.
<b>Date Originated</b>	1995
<b>Proposed Technology</b>	Diesel locomotives on existing railroad right-of-way
<b>Project Sponsors</b>	FTA FRA Pennsylvania Northeast Regional Rail Authority New Jersey Transit
<b>Cost Estimate</b>	\$551 million (projected)
<b>Funding to Date</b>	According to project sponsors, \$21 million in federal funding has been received, primarily through earmarks in legislation.
<b>Current Status</b>	Project received a Finding of No Significant Impact <sup>4</sup> by the FTA and, according to one of the project sponsors, is ready to begin construction upon availability of funding. The project sponsors are currently working on a bistate funding agreement to allocate Pennsylvania's and New Jersey's share of funding.

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<sup>4</sup>A Finding of No Significant Impact presents the reasons why an action, not otherwise excluded, will not have a significant effect on the human environment and for which, therefore, an environmental impact statement will not be prepared.

**Chicago, Illinois, to  
Minneapolis/St. Paul,  
Minnesota, High Speed  
Rail Project**

**Project Description**

This project includes making track, station, bridge, and culvert improvements along the Chicago, Illinois, to Minneapolis/St. Paul, Minnesota, corridor, with stops in Milwaukee and Madison, Wisconsin. Enhanced passenger rail service, along existing railroad right-of-way, is being pursued for a top speed of 110 miles per hour and average speeds of between 66 and 70 miles per hour.

**Date Originated**

1994

**Proposed Technology**

Diesel electric on existing railroad right-of-way

**Project Sponsors**

FRA  
Amtrak  
Wisconsin Department of Transportation

**Cost Estimate**

\$1.5 billion (2002-projected)

**Funding to Date**

\$5 million from Capital Assistance to States—Intercity Passenger Rail Service Program<sup>5</sup>

**Current Status**

The environmental review for the Madison to Milwaukee segment is complete, and FRA has issued a Finding of No Significant Impact. Engineering design work is complete for the Madison to Milwaukee segment. In addition, updates to ridership and cost estimates were recently completed for the full project. A grant of \$5 million from FRA's Capital Assistance to States—Intercity Passenger Rail Service Program will be used to complete track work between Milwaukee and the Illinois state line. The Wisconsin Department of Transportation has also applied for federal funds to improve highway-rail grade crossings between Madison and Watertown.

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<sup>5</sup>This program was established in the fiscal year 2008 DOT appropriations act that provided \$30 million in fiscal year 2008 in matching grants to states for intercity passenger rail capital projects.

## **Chicago, Illinois, to St. Louis, Missouri, High Speed Rail Project**

### **Project Description**

The Illinois Department of Transportation said numerous incremental improvements have been made along this corridor to allow for increased speeds. This includes track work and grade crossings on 118 miles of track between Mazonia, Illinois, and Springfield, Illinois, completed in 2004. In addition, the department is currently pursuing three phases of improvements: a new cab signaling system (similar to the signaling system used by the private freight carrier that owns this corridor); track work that has been completed in Springfield, Illinois; and a centralized traffic control system for the Joliet, Illinois, to Mazonia, Illinois, segment of the corridor.

Date Originated 1991

Proposed Technology Diesel locomotives on existing railroad right-of-way

Project Sponsors FRA  
Amtrak  
Illinois Department of Transportation

Cost Estimate \$125 million (actual)

Funding to Date According to project sponsors, \$125 million in funding has been received to date (28 percent from FRA, 56 percent from the states (Illinois and Missouri), and 16 percent from private entities).

Current Status A \$1.55 million Capital Assistance to States—Intercity Passenger Rail Service Program grant was received that will be used to continue work on the project. Planned top speed is 110 miles per hour between Joliet, Illinois, and Mazonia, Illinois.

## **Washington, D.C., to Charlotte, North Carolina, Southeast High Speed Rail Project**

### **Project Description**

The Washington, D.C., to Charlotte, North Carolina, corridor, which is 468 miles in length, will connect to the Northeast Corridor. Both Virginia and North Carolina have established an interstate compact to pursue this project. The project will make incremental improvements to existing infrastructure, including track, route alignment, signaling systems, highway-rail grade crossings, stations, train equipment, and facilities. These improvements will allow a top speed of 110 miles per hour and an average speed of between 85 to 87 miles per hour.

### **Date Originated**

In 1992, FRA designated the corridor as a federal high speed rail corridor.

### **Proposed Technology**

Diesel locomotives primarily on existing railroad right-of-way

### **Project Sponsors**

FRA  
Federal Highway Administration  
North Carolina Department of Transportation  
Virginia Department of Transportation  
Virginia Department of Rail and Public Transportation

### **Cost Estimate**

\$3.8 – 5.3 billion (2011 to 2016 - projected)

### **Funding to Date**

Over \$300 million in state and federal funds have been invested in the Washington to Charlotte portion of the corridor since 1999.

### **Current Status**

The program-level environmental impact statement has been completed for this project. Project sponsors are currently in the process of preparing the project-level environmental impact statement for the Richmond, Virginia, to Raleigh, North Carolina, segment of the corridor. This statement has been in development since 2003 and is expected to be available for public review in the summer of 2010.

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# Appendix IV: Description of Past Projects: Florida Overland Express and Texas TGV Projects

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## Florida Overland Express (FOX)

Proposed Technology	Proposed using an electrified high speed rail system similar to the French Train à Grande Vitesse (TGV) system, capable of operating at a maximum speed of 200 miles per hour.
Project Sponsors	Florida Department of Transportation FOX Consortium <sup>1</sup> FRA Federal Highway Administration
Cost Estimates	The preliminary cost estimates ranged from \$6 billion to \$8 billion, depending on the route chosen. In general, the FOX Consortium planned on the system costing about \$6 billion (in 1997 dollars).
Proposed Route	The FOX project would have operated along a 320-mile long dedicated right-of-way from Miami, Florida, to Tampa, Florida, via Orlando, Florida. The project was planned to serve seven stations: Miami International Airport, Fort Lauderdale, West Palm Beach, Orlando International Airport, Orlando Attractions, Lakeland, and Downtown Tampa.
Financing Plan	In total, the FOX Consortium planned to raise \$9.3 billion to finance the estimated \$6.3 billion needed for construction. The additional \$3 billion accounts for inflation and to pay for such things as interest on state and system infrastructure bonds during the construction period, establish reserve funds required by bondholders, and cover the costs of issuing the bonds. According to the FOX Consortium, the following sources were expected to provide the \$9.3 billion in funding:
	<ul style="list-style-type: none"><li>• State contributed equity – \$256 million (3 percent)</li><li>• FOX Consortium contributed equity – \$349 million (4 percent)</li><li>• Train equipment financing – \$569 million (6 percent)</li><li>• Interest earnings and balances – \$588 million (6 percent)</li><li>• Federal loan – \$2.0 billion (22 percent)</li><li>• State infrastructure bonds – \$2.146 billion (23 percent)</li><li>• System infrastructure bonds – \$3.346 billion (36 percent)</li></ul>

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<sup>1</sup>The FOX Consortium consisted of the Fluor Daniel Corporation, a U.S.-based engineering and construction firm, Odebrecht Contractors of Florida, Bombardier Corporation, the manufacturer of rail passenger cars, and GEC-Alstom (now known as Alstom).

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**Appendix IV: Description of Past Projects:  
Florida Overland Express and Texas TGV  
Projects**

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Ridership Forecasts	KPMG Peat Marwick projected annual ridership of 8 million passengers by 2010. Systra projected ridership of 8.5 million by 2010. The consensus average of the two ridership studies was approximately 8.3 million passengers by 2010.
Timeline	Table 5 shows the timeline of events in the development of high speed rail in Florida.

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**Table 5: Timeline of High Speed Rail Development in Florida**

Date	Event
1982	The Governor of Florida established a committee to study high speed rail development in Florida.
1984	The committee recommended using a public-private partnership to develop a high speed rail system on existing right-of-way. State legislation created the Florida High Speed Rail Commission (the commission) to grant a franchise to develop a privately funded high speed rail system.
1989	One of two private entities that submitted proposals to the commission withdrew its proposal when it became apparent that Florida would not provide any public funding.
1990	The Florida High Speed Rail Corporation revised its proposal after the commission concluded that the proposed use of real estate development rights along the route would not pay for the project.
1991	The Florida High Speed Rail Corporation withdrew its revised proposal after the Governor rejected it, citing high project costs.
1992	State legislature transferred the commission's responsibilities to the Florida Department of Transportation (FDOT).
1992-1996	After conducting corridor studies, FDOT said it would provide \$70 million annually for at least 40 years, to be adjusted for inflation, to construct a high speed rail system. FDOT issued a request for proposals. The FOX Consortium submitted the winning proposal from among five, and entered into agreements with FDOT to develop the system.
1997-1998	Stakeholders conducted work on environmental review, preliminary engineering, ridership studies, and composed a financing plan and safety regulations. Two external groups issued reports questioning ridership studies, cost estimates, and construction schedule. Citizens and elected public officials who were concerned about the potential effect on land in their area formed an advocacy organization to oppose the FOX project.
1999	After GAO and others issued reports raising concerns about ridership and construction cost estimates, the construction schedule, and the financing plan, the Governor recommended withdrawing FOX project funding. The Florida legislature did so, ultimately terminating the project.
2000-2001	Florida voters passed a constitutional amendment requiring Florida state government to build a high speed ground transportation system. The Florida legislature passed an act creating the Florida High Speed Rail Authority (the authority) in response.
2002-2004	The authority selected a winning proposal from among four responding to its request for proposal. Work on environmental review, ridership studies, financing plan, and additional design work was initiated.
2004	A general election ballot initiative passed, repealing the state's 2000 constitutional amendment, which restricted the activities of Florida High Speed Rail Authority.

Source: This timeline is primarily based on information contained in: *High Speed Rail Projects in the United States: Identifying the Elements of Success*, MTI Report 05-01, Mineta Transportation Institute, College of Business, San Jose State University (October 2005).

## Texas TGV

Proposed Technology	A new electrified, steel-wheel on steel-rail high speed rail system similar to the French TGV system.
Project Sponsors	Texas High Speed Rail Authority Texas TGV <sup>2</sup> FRA
Cost Estimates	The cost estimate was \$4 billion.
Proposed Route	The high speed rail system would have provided service to Dallas, Fort Worth, Dallas/Fort Worth Airport, Houston, Austin, and San Antonio. The initial service between Dallas/Fort Worth and Houston would have begun in 1998, and subsequent service between San Antonio and Austin to Dallas would have begun by 1999. Special or limited service would have been provided to Bryan/College Station and Waco if it were determined to be economically feasible. In addition, service from Houston to San Antonio would have been provided if it were determined to be economically feasible.
Financing Plan	We were not able to obtain a complete financing plan. The 1993 security offering was for \$200 million in notes, backed by a \$225 million letter of credit from the Canadian Imperial Bank of Commerce and a \$75 million counter-guarantee to be provided by Morrison Knudsen Corporation (one of the original project developers). The Texas High Speed Rail Authority Act prohibited use of public funds for constructing the system, and, as a result, all construction costs would have been privately financed.
Ridership Projections	Based on the five route alternatives, ridership projections by 2015 ranged from 11.3 million to 18.0 million.
Timeline	Table 6 shows the timeline of events in the development of high speed rail in Texas.

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<sup>2</sup>Texas TGV Corporation consisted of Morrison Knudsen (USA), Bombardier (Canada), Alstom (France/UK), Crédit Lyonnais (France), Banque IndoSuez (France), Merrill Lynch (USA), and others.

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**Appendix IV: Description of Past Projects:  
Florida Overland Express and Texas TGV  
Projects**

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**Table 6: Timeline of High Speed Rail Development in Texas**

Date	Event
1982	A Texas legislature joint committee recommended that feasibility studies examine the potential of conventional rail and high speed rail between Texan cities. Proposed legislation to enact the joint committee report recommendations failed.
1985	A German Consortium reported that a high speed rail system would be viable from Dallas to Houston if the project obtained \$500 million for start up contributions and was financed with tax exempt bonds.
1987	German Consortium unsuccessfully lobbied the Texas legislature to undertake the proposal. A job creation task force created by the then-Governor recommended that the Governor support enabling legislation for the Texas Turnpike Authority to conduct a high speed rail feasibility study. The enabling legislation passed.
1989	After receipt of the study, the Texas legislature created the Texas High Speed Rail Authority (THSRA). The THSRA was charged to review objectively applications and grant a franchise for the financing, construction, operation, and maintenance of a high speed rail facility if it found that it is for the public convenience and necessity.
1990 - 1991	The THSRA issues requests for proposals, in which two of three applications met the criteria. Texas TGV Corporation was ultimately granted the franchise after evidentiary hearings were held on franchise applications. Court dismissed lawsuits filed by Southwest Airlines to postpone the hearings and to rescind the rules of the THSRA. Texas TGV Corporation, the THSRA, and FRA signed a memorandum of understanding establishing environmental review responsibilities as well as other responsibilities.
1992	The THSRA and Texas TGV Corporation signed the franchise agreement and outlined responsibilities of Texas TGV Corporation, many of which were time-sensitive. Work began on environmental review and ridership studies, but environmental review work was eventually stopped because of cost overruns. The first portion of public financing offering of Texas TGV Corporation was delayed until December 31, 1993. The Texas TGV argued it was due to lack of progress on environmental review and investment grade ridership studies as well as other reasons.
1993	Delays forced renegotiation of franchise agreement, and additional requirements were placed on the Texas TGV Corporation. The corporation submitted a plan to the THSRA, which did not include required detailed financial and milestones information, and released its independent ridership study. Texas TGV Corporation issued its initial security offering as we have previously described. A day before the pricing and sale of the notes was scheduled to occur, Morrison Knudsen announced that it was no longer going to provide the counter-guarantee, and that the offering was going to be withdrawn. The Texas TGV Corporation could not meet its deadline of December 31, 1993.
1994	Work was halted by the Texas TGV Corporation, which led to the termination of the franchise agreement.
1995	The Texas legislature abolished the THSRA and its enabling legislation. <sup>a</sup>

Source: This timeline is primarily based on information contained in the following: Marc H. Burns, *High Speed Rail in the Rear-View Mirror, Final Report of the Texas High Speed Rail Authority* (October 1995).

<sup>a</sup>Texas has taken no further action to establish a state high speed rail system. However, a grassroots organization comprising of local elected officials and others is pursuing high speed rail in the Texas Triangle.

# Appendix V: Description of High Speed Rail Systems in France, Japan, and Spain

## France

### Background

France first developed high speed rail lines with the opening of the TGV Sud Est line from Paris to Lyon in 1981. Since then, France has constructed additional high speed rail lines connecting major cities in France, as well as connecting high speed rail lines to cities in Germany, Belgium, and the United Kingdom. The French railway system has undergone a couple of major reforms, the most notable one occurring in 1997, with the creation of Réseau Ferré de France (RFF), France's national intercity rail network infrastructure manager. This reform took place as France had to comply with European Union directives, which required the separation of passenger operations and infrastructure management. In addition, the ownership of the rail network, including the high speed rail network, was transferred from the national government to RFF. RFF is also responsible for capacity allocation, contracting, traffic management, and maintenance, although it subcontracts the traffic management and maintenance to the passenger rail operator, Société Nationale des Chemins de Fer Français (SNCF). The Ministry of Ecology, Energy, Sustainable Development, and Spatial Planning sets policy, enforces laws and regulations, and approves and finances projects. Moving forward, France is pursuing a high speed rail plan on the basis of a recommendation from a national environmental conference (Le Grenelle Environnement), which called for investments in sustainable transportation modes. Specifically, it recommended building about 1,200 miles of additional high speed rail lines before 2020 and studying the viability of another approximately 1,500 miles of high speed rail lines.

#### Snapshot of the French High Speed Rail System

- Date of initiation: 1981
- Length of high speed rail system: 1,180 miles
- Top commercial speed: 199 miles per hour
- High speed rail ridership: Approximately 100 million (2007)

### Funding

Prior to the creation of RFF in 1997, most of the funding for the construction of high speed rail lines came from the national government (through SNCF). Since then, funding for high speed rail construction is

derived from a variety of sources, including the national government, regional governments, RFF, SNCF, and the European Union.

**Operations**

SNCF is the sole provider of domestic high speed rail operations in France. The Eurostar and Thalys TGV, of which SNCF is a shareholder, provide international high speed rail operations to locations in Belgium, Holland, and the United Kingdom. According to European Union directives, international high speed rail lines must be opened for competition starting in 2010. Therefore, France will be required to allow private and public competitors to operate their trains over these lines.

**Infrastructure**

In terms of track ownership, RFF is an owner of all intercity railway property in France. RFF is also responsible for allocating capacity for the high speed rail infrastructure and for the maintenance and management of traffic of the high speed rail system. However, these responsibilities have been subcontracted to SNCF. SNCF pays RFF infrastructure fees to use the high speed rail lines.

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**Japan**

**Background**

Japan was the first country in the world to develop high speed rail operations, which occurred in 1964 with the opening of the Shinkansen between Tokyo and Osaka. In addition, in 1970, the Nationwide Shinkansen Railway Development Act was established, which created a master plan for the expansion of high speed rail lines throughout Japan. After this, four high speed rail lines were constructed prior to the 1987 reform of the passenger rail industry in Japan. The 1987 reform broke the fully integrated state railway entity, Japanese National Railways, into six private intercity passenger rail operators based on six distinct geographic regions, as well as a freight operator. Since then, three high speed rail lines have been built under the reformed structure, and the high speed rail system continues to expand on the basis of the high speed rail master plan.

**Snapshot of the Japanese High Speed Rail System**

- Date of initiation: 1964
- Length of high speed rail system: 1,360 miles
- Top commercial speed: 188 miles per hour
- High speed rail ridership: Approximately 300 million (fiscal year 2006)

**Funding**

Prior to the 1987 reform, the construction of high speed rail in Japan was funded through debt incurred by the national government and Japan National Railways. After the 1987 reform, the national government funds two-thirds of the construction cost, and local governments fund one-third of the construction cost under the Nationwide Shinkansen Railway Development Act. The national government funding is derived from the revenues from the sale of rail lines to private companies and the national public works budget. Private companies purchased the four constructed high speed rail lines from the national government in 1991, and in turn the companies have to pay an annual fee to the national government for 60 years. For high speed rail lines built after the 1987 reform, the companies pay a lease payment to the Japan Railway Construction, Transportation, and Technology Agency for the use of the high speed rail lines, on the basis of projected ridership. The national government does not provide operating subsidies for high speed rail passenger operations.

**Operations**

Prior to the 1987 reform, Japan National Railways was a fully integrated state-owned entity that was the sole high speed passenger rail operator in Japan. After the 1987 reform, Japan National Railways was split into six private operators, three are on the mainland (JR East, JR Central, and JR West) and the other three are each on an island (JR Hokkaido, JR Shikoku, and JR Kyushu). JR East, JR Central, JR West, and JR Kyushu operate high speed rail lines. JR East operates Shinkansen lines between Tokyo and Nagano, Tokyo and Niigata, and Tokyo and Hachinohe; JR Central operates the Shinkansen line between Tokyo and Osaka; JR West operates the Shinkansen line between Osaka and Fukuoka; and, JR Kyushu operates the Shinkansen line between Kagoshima and Shin Yatsushiro. The three mainland operators are considered fully privatized entities.

**Infrastructure**

High speed rail lines built after the 1987 reform are constructed and owned by the Japan Railway Construction, Transportation, and

Technology Agency, and are leased to the JR companies. As a result of the 1991 law, JR East purchased the high speed rail line from Tokyo to Niigata and the track from Tokyo to Morioka. JR Central purchased the high speed rail line from Tokyo to Osaka, and JR West purchased the high speed rail line from Osaka to Hakata.

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## Spain

### Background

Spain first developed high speed rail lines with the opening of the Madrid to Seville line in 1992. Since then, Spain has constructed additional high speed rail lines from Madrid to Barcelona and Madrid to Valladolid, in 2007 and 2008, respectively, and from Córdoba to Málaga, with extensions built off these main lines as well (i.e., to Toledo in 2005). The construction of these lines was based on a national rail plan created in 1987 and national transportation plans created in 1993, 1997, and 2005. In 2005, Spain's railway system was restructured in accordance with the European Union directive requiring the separation of passenger operations and infrastructure management. In accordance with these directives, Spain passed its own legislation, which split its state railway entity, Renfe, into two entities, Adif and Renfe-Operadora. Adif is responsible for infrastructure management and capacity allocation, and Renfe-Operadora is responsible for passenger operations. The Ministerio de Fomento (Ministry of Public Works) is responsible for setting policy, enforcing laws and regulations, and approving and financing projects. Spain's most recent national transportation plan calls for \$103.9 billion in investment for creating 5,592 miles of high speed rail lines.

#### Snapshot of the Spanish High Speed Rail System

- Date of initiation: 1992
- Length of high speed rail system: 981 miles
- Top commercial speed: 186 miles per hour
- High speed rail ridership: 9 million (2007)

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Funding	Spanish transportation officials with whom we spoke noted that a majority of funding to construct the Madrid to Seville high speed rail line was provided by the national government. Of the high speed rail lines built since then, construction costs have been derived from funding from the national government, the European Union, and Adif. Moving forward, it is planned that funding for expansion of the existing high speed rail network will be derived from the national government, local governments, Adif, and loans from the European Investment Bank. For cross-border high speed rail lines, it is also planned that funding will be derived from the European Union as part of the Trans-European Transport Network.
Operations	Renfe-Operadora is the sole provider of high speed rail operations in Spain. According to European Union directives, international high speed rail lines must be opened to competition starting in 2010. Therefore, Spain will be required to allow private and public competitors to operate their trains over these international lines.
Infrastructure	In terms of track ownership, Adif owns the current high speed rail lines as well as passenger rail stations, freight terminals, and the telecommunications network. In addition, Adif constructs and maintains high speed rail lines, allocates capacity to passenger rail operators, and manages traffic control operations and safety systems. Renfe-Operadora pays Adif infrastructure fees to use the high speed rail lines.

# Appendix VI: Description of Travel Demand Forecasting

## Travel Demand Modeling

The benefits of a proposed project depend on the popularity of a new service, that is, high ridership. Thus, a critical factor in determining the net benefits, or viability, of a proposed project is its ridership forecasts.

Ridership forecasts are generally conducted by modeling travel demand for the corridor in which the new service is being proposed. Travel demand modeling can be conducted at the macro level or the micro level, depending on the types of available data and the level of information needed from the results of the model. The use of travel demand models in the policy process could be conceived of in terms of the following three activities: data collection, model building, and estimation.

1. *Data collection:* Aggregate data refers to variables that summarize the characteristics of a group of individual units, such as an average, a total, or a median. Examples include per capita income or vehicle miles traveled. An aggregate model is founded on such data. In the case of travel demand, the analysis applies to those residing or doing business in a region. Data sources are typically official statistics routinely collected by public agencies, including administrative data. An advantage of such data is that they are inexpensive for the secondary user and have been subjected to some degree of quality control by the originating agency. One disadvantage is that the results of any analysis do not necessarily apply to a specific transportation project. Another limitation is that the model is limited by the available data. Micro models can help inform specific policy changes, such as the option of adding high speed rail service to a transportation system. Micro data refers to individuals' characteristics and behavior. These data are often gleaned from surveys of travelers or households.<sup>1</sup> Micro data, however, are generally expensive to obtain, their collection may be limited due to privacy considerations, and their quality depends on the sophistication of the survey methodology. A danger in survey data, just as in political polling, is that the design or implementation of a survey could lead to biased survey results. Survey instruments can be scrutinized by third parties, but the process of data collection is less accessible to outside observers, especially after the fact. Typically, a survey, as well as ensuing analysis, will be commissioned by the public agency that is sponsoring a project, raising conflict-of-interest concerns. Surveys can provide ambiguous results for innocent reasons as well (e.g., such results may be due to differences in methodology).

<sup>1</sup>Surveys may collect data on circumstances surrounding actual choices (i.e., "revealed preference"), or they may collect data on a hypothetical setting for a new mode of transportation (i.e., "stated preference").

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2. *Model building:* Constructing a formal travel demand model<sup>2</sup> generally entails a number of choices and professional judgment. For example, a modeler usually makes choices on the theory and assumptions upon which the model is based, the mathematical form of the model, and the variables to be included. Because models entail professional judgment, many models are sufficiently diverse (e.g., include differing assumptions) such that alternative models of the same problem can yield different results. Also, alternative theories of travel demand could imply different models with diverse findings. Models with conflicting rationales can both claim legitimate empirical support.

In predicting future demand for an existing or new transportation facility, two types of data are typically involved: historic and prospective. A model is often initially developed using historic data. The effects and implied outcomes of the model are then compared with actual experience to test the structure of the model (e.g., the theory and assumptions on which the model is based). Details of the model may be adjusted to improve the results—that is, to make the modeled effects more closely match actual experience. Once a model has provided satisfactory results, it may be deployed with data on projected future conditions. Again, forecast modelers may adjust and readjust the structure of the model. The use of statistical methods in testing models is usually a trial-and-error process, thus, rarely is the first result the end of the study.

3. *Estimation:* There are usually multiple criteria by which to analyze or interpret the results of a model, and the analyst enjoys considerable discretion in determining the direction of the analysis. In addition, the foundation of the analysis is survey data, and the data collected could yield results dramatically at variance with theory, expected empirical impacts, and past experience. For these reasons, the nature of the data and the decisions on how to handle them may enable the analyst to steer the result in the analyst's preferred direction. For an external, disinterested reviewer, the evolution of such decisions is very difficult to trace. Because circulation of data and models for outside review may be restricted by proprietary considerations and the population of private sector organizations equipped to conduct large-scale projects may be sufficiently limited, the evaluation by independent peer reviewers may be difficult.

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<sup>2</sup>In this context, a model is a mathematical equation describing a relationship among a set of variables.

## Standard Framework for Travel Demand Modeling

In the intercity context, the standard framework for estimating travel demand has been the four-step model.<sup>3</sup> The four steps are as follows:

1. *Trip generation:* This step refers to the total number of trips, based on the idea of “productions” (households are the most important source of production) and “attractions” (places of employment or retail establishments are obvious attractors). Trips can have the purpose of moving people or freight, either within a region, to or from a region, or through a region. The main purposes for persons to travel include commuting, business travel, and leisure travel. Thus, household and business patterns of commuting and shopping are the most stable source of information used in modeling, while a more variable source of information are trips aimed at recreation, and other more episodic decisions. Model inputs (or variables) used to explain trip productions include trip purpose (e.g., commuting and home-to-school) household size, auto ownership, and income. Trip attractions are chiefly workplaces and retail outlets. These data can be obtained through records, such as ticket sales, and supplemented by or derived exclusively from surveys.
2. *Trip distribution:* This step pertains to trips in terms of connected origins and destinations. The standard approach to estimating trip distribution is what is known as a “gravity model.” Gravity models were used in models of trade and migration. In the context of this discussion, trips from point A to point B are positively affected by measures of mutual attraction (i.e., “productions” at point A and “attractions” at point B). The analogy is to Newton’s law of the gravitational force between two bodies: that it increases with the mass of each, and decreases with the distance between them. Trips are negatively affected by some measure of “impedance” or friction affecting the desirability of a trip between the two points, such as distance, travel time, cost of travel, or some combination of such factors. The inputs to a gravity model could be the number of trips originating and ending at a given number of zones. A problem in distribution is the feedback implied by possible congestion or crowding of a transit facility. The more people decide to move from point A to point B, the greater the impedance factor could be, depending on how the factor is represented. This in turn could influence the number of trips. Allowing for

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<sup>3</sup>Edward A. Beimborn, “A Transportation Modeling Primer,” *Center for Urban Transportation Studies*, University of Wisconsin-Milwaukee (June 2006). Kenneth A. Small and Clifford Winston, “The Demand for Transportation: Models and Applications,” *UCI-ITS-WP-98-8, Institute of Transportation Studies*, University of California/Irvine (October 1998).

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feedback requires additional complexity in a trip distribution model. More complex models can be implemented. An alternative approach to the gravity model—where time series data are available—is a model that combines steps one and two.<sup>4</sup> In such a model, the number of trips between a given origin and destination is explained by population levels at each end, travelers' incomes, and the level of service available for the mode (e.g., rail and automobile) in question. The apparent simplicity of such an approach may obscure the advantages of implementing such a model for the full gamut of trip purposes, in each mode, for each origin-destination pair.

3. *Mode choice:* This step pertains to the decision on how to travel, such as driving alone, carpooling, or taking some type of public transportation. The probability of choosing among modes is modeled as a function of the characteristics of individuals, trip purpose, and the relative costs of alternative modes, among other possible factors. The estimated probability for a population is the share estimated for a given transportation mode.<sup>5</sup> Obvious factors in the choice of a travel mode include the relative costs, travel time, convenience, and comfort of the travel alternatives in question. The choice of a travel mode interacts with personal decisions on whether to own an automobile, and, if so, how many, and where to reside. This chicken-egg interaction complicates the analysis of causality in mode choice. Mode choice models are founded on microeconomic consumer theory that depends on a bevy of controversial, technical economic assumptions about human behavior. In general, the theory assumes a high degree of rational and consistent behavior on the part of individuals, including foresight, self-discipline, an aversion to risk, and the capacity to process information. Over the past two decades, a growing literature has developed providing empirical evidence against such notions of rationality.<sup>6</sup>

The purpose of a mode split analysis is to predict the shares of trips over existing and prospective modes. In principle, the factors that distinguish

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<sup>4</sup>Charles Rivers Associates Incorporated, *Independent Ridership and Passenger Revenue Projections for High Speed Rail Alternatives in California*, draft final report prepared for the California High-Speed Rail Authority, CRA Project no. 1680-04 (January 2000).

<sup>5</sup>These estimates are derived from binary choice models, often with the use of what are known as probit or logit specifications.

<sup>6</sup>Camerer, Colin F., George Loewenstein, and Matthew Rabin (eds.), *Advances in Behavioral Economics*, Princeton University Press, 2003.

choices in Europe from those in the United States would be accounted for in the model. For example, if motor fuel in the United States, factoring in the relevant taxes, is cheaper than in Europe, the impact of differences in the costs of trips under different modes would be reflected in the overall explanation of the extent to which travelers might choose high speed rail over automobile and air. A good mode split model will indicate the strengths of the assorted factors, including the preference for one transportation mode over another, assuming all other factors are equal. The extent to which government policies—such as the impact of motor fuels' taxes on travel costs—fluence the choice, can be abstracted from, to assess underlying preferences.

4. *Route assignment:* The final step of travel demand modeling is to determine the distribution of trips between two given points for all modes over the possible routes between the points. Assuming travelers prefer the route that takes the least time, given decisions about destination and mode, in a regional setting with many zones and a multitude of paths between a multitude of points, a mathematical programming problem of considerable complexity is encountered. Even so, such a problem glosses over the extent of congestion and resulting changes in travel time to which particular routes can be subjected. Reckoning with the associated feedback—travelers on congested routes choose alternatives—adds complexity to the exercise. When travel times are minimized on all routes and no traveler has an incentive to choose yet another alternative, the system is said to be in equilibrium. Uncovering such an equilibrium is a goal of route assignment modeling. Pressure on particular route segments provides information to the policymaker on the possible expansion of the network or the use of tolls to reduce congestion.

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# Appendix VII: Description of the Proposed Los Angeles, California, to Las Vegas, Nevada, High Speed Rail Corridor

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Three separate high speed rail proposals connecting the Los Angeles, California, and Las Vegas, Nevada, metropolitan areas illustrate the ridership and cost trade-offs that are associated with selecting, among other things, a particular route or train technology. The three options being explored include an incremental improvement to an existing conventional rail line, a high speed electrified (or diesel) steel-wheel on steel-rail line on dedicated track (project sponsor – Desert Xpress), and a magnetic levitation (maglev) proposal on dedicated guideway (project sponsor – California-Nevada Super Speed Train Commission). (See fig. 7.) One selection of route or train technology may maximize ridership and increase construction costs, while another option may draw lower ridership but at a substantially lower cost.

Las Vegas is one of the most visited cities in the United States, and, according to project proponents, the mostly flat and desert terrain between Los Angeles and Las Vegas makes high speed rail development relatively straightforward, although some portions of the corridor are mountainous and have steep grades. Project sponsors for each option indicated that a transportation need exists between the two regions, due to capacity constraints on existing transportation modes, significant growth in population and employment, and projections for future growth in the long term. One-third of all visitors to Las Vegas are from California, and more than 10 million visitors are estimated to come from the Southern California area. This travel is estimated to grow substantially by 2030, although the Las Vegas economy has been hit particularly hard by the recent economic crisis, as reflected in the recent decreases in visitor volume. However, according to one project sponsor, travel from Southern California to Las Vegas has not been as severely impacted as visitation from elsewhere, as reflected by traffic counts on Interstate 15 (I-15) at the Nevada state line, which show only about a 5 percent reduction in automobile traffic.

High speed rail stakeholders with whom we spoke said ridership on any high speed rail line will be impacted by the location of the rail stations in relation to where potential riders live for all stations along the line, but especially at the ends of the line. Desert Xpress will most likely forgo some ridership by terminating service outside of the Los Angeles area (in Victorville). Because riders must first drive their personal vehicles to Victorville—typically the most congested portion of the automobile trip between the Los Angeles area and Las Vegas—and then board a train, stakeholders have expressed concern regarding the level of risk related to the estimates of riders. Similarly, the maglev project is designed to terminate in Anaheim, which may also result in fewer riders than

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**Appendix VII: Description of the Proposed  
Los Angeles, California, to Las Vegas, Nevada,  
High Speed Rail Corridor**

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connecting directly to the more populous Los Angeles area, and similar concerns over risks associated with overly optimistic ridership estimates have been expressed.<sup>1</sup> The conventional rail proposal, while connecting directly into downtown Los Angeles, is plagued by slow speeds and travel times that are not as competitive with automobile or air travel. As such, the conventional rail proposal is likely to attract far fewer riders than the other proposed services.

**Table 7: Summary of Three High Speed Passenger Rail Proposals in the Los Angeles to Las Vegas Corridor**

<b>Project</b>	<b>Corridor length (in miles)</b>	<b>Rail technology</b>	<b>On-board travel time</b>	<b>Service frequency (daily)</b>	<b>Projected construction costs / Cost per mile<sup>a</sup></b>	<b>Annual ridership (forecast year)<sup>b</sup></b>	<b>Revenue forecast (forecast year)</b>
Los Angeles – Las Vegas Conventional Rail Option	321	Steel-wheel on steel-rail (diesel)  Shared use with other commuter and freight rail services	5 hrs. 30 min.	Between 4 and 9 one-way trips/day	\$1.1-3.5 billion / \$3.4-10.8 million	322,000-406,000 (2010)	\$16.7-20.9 million (2010)
Desert Xpress	183	Steel-wheel on steel-rail (either diesel or electrified)  Exclusive, grade-separated right-of-way	1 hr. 24 min.	Between 69-102 one-way trips/day	\$3.5 billion / \$19.5 million	16.2 million (2030)	\$1.2 billion (2030)
California – Nevada Super Speed Train	269	Magnetic levitation  Exclusive guideway	1 hr. 20 min.	114 one-way trips/day	\$12.1 billion / \$44.9 million	42.9 million (2025)	\$517.4 million (2025)

Sources: IBI Group, Transmax Group, and American Magline Group.

<sup>a</sup>In nominal dollars.

<sup>b</sup>We did not validate the ridership and cost estimates.

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<sup>1</sup>BSL Management Consultants. *Maglev or high speed rail in the Las Vegas to Southern California Corridor*. A report prepared at the request of the City of Victorville. November, 2008.

## Project Proposals

### Los Angeles-Las Vegas Conventional Rail

The Regional Transportation Commission of Southern Nevada, the metropolitan planning organization for Southern Nevada, which encompasses Las Vegas, has been focusing on reestablishing conventional rail passenger service between Los Angeles and Las Vegas. Amtrak's *Desert Wind* service<sup>2</sup> was discontinued in 1997 as part of a broader restructuring of intercity passenger rail service that included the discontinuation, truncation, or restructuring of service on a number of Amtrak's routes. The conventional rail option would make incremental improvements to existing rail track (using diesel equipment) and operate in a shared-use environment with commuter and freight trains, and, as such, would require negotiations with the private freight railroads that own the tracks. With the incremental improvements, train speeds would be increased to allow for up to 90 miles per hour. The line would most likely begin in Los Angeles and terminate in Las Vegas—a total length of over 300 miles and an estimated travel time of over 5 hours. Prior passenger rail service on Amtrak's *Desert Wind* took approximately 7 hours and 15 minutes between Los Angeles and Las Vegas. The conventional rail option projects to draw approximately 300,000 riders per year, and the estimated construction costs to implement these upgrades would be between \$1.1 and \$3.5 billion, which would be less than either of the following two options (see table 7 for a comparison of trip times, riders, and costs for all three proposals).

### Desert Xpress

The Desert Xpress option would operate on dedicated right-of-way with all new tracks not shared with other rail service with no grade crossings, using steel-wheel on steel-rail electrified (or diesel) equipment, with maximum speeds of up to 150 miles per hour, between Victorville and Las Vegas—a distance of a little less than 200 miles. Travel time between the two cities would be about 84 minutes. Victorville, California—located in San Bernardino County—is the first population center beyond the Cajon Pass from the Los Angeles basin. Traffic from the Los Angeles area funnels onto I-15 south of Victorville. Passengers from the Los Angeles area would need to drive to Victorville to catch the train. According to project sponsors, Victorville is generally within  $\frac{1}{2}$  to  $1\frac{1}{2}$  hours for many of the

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<sup>2</sup>The *Desert Wind* service originated in Chicago and operated via Denver, Salt Lake City, and Las Vegas to Los Angeles.

more than 20 million residents of the 4 county area (Los Angeles, San Bernardino, Riverside, and Orange). However, according to transportation officials, this segment of the trip can be significantly delayed depending on traffic conditions, in some cases, resulting in travel times to Victorville of up to 3 hours. Therefore, the overall envisioned trip time for a traveler using the Desert Xpress is expected to be between 2 and 3 hours, with the potential to go to over 4 hours on the basis of traffic conditions between Los Angeles and Victorville. According to ridership forecasts prepared for Desert Xpress and reviewed by a third-party contractor, the service is expected to attract up to 16.2 million riders per year by 2030 (8.1 million round trips), and Desert Xpress estimates the total project to cost approximately \$3.5 billion. Desert Xpress officials indicate that the project costs are significantly less than most dedicated high speed rail projects, primarily because, by terminating service in Victorville, they would avoid the construction challenges and high costs of building through both the densely populated and developed areas in Los Angeles and Orange counties and the mountainous Cajon Pass. The planned route would also help reduce project costs by mostly using existing right-of-way, running either within or adjacent to the I-15 right-of-way and using adjacent federal lands where the use of highway right-of-way is not possible. The project sponsor is a private entity and would not be seeking any public funding to finance the costs of this project.

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**California-Nevada Super Speed Train**

The California-Nevada Super Speed Train option would operate on dedicated right-of-way, using maglev technology, with maximum speeds of up to 300 miles per hour. The line would begin in Anaheim, California, and terminate in Las Vegas—covering a distance of 269 miles in approximately 1 hour and 20 minutes. Project sponsors indicate that connecting Anaheim (where Disneyland is located) and Las Vegas, two popular tourist destinations, will help them draw significant ridership. The project is also being designed to connect to a new intermodal facility that is planned to be the Anaheim station terminus and would house transit connections to the Los Angeles area, including the proposed Los Angeles to San Francisco high speed rail line. In addition, project sponsors are considering a stop at the Ontario Airport that would allow for a 15-minute trip from Anaheim and, thus, make possible some diversion of air travelers from Los Angeles International and Orange County airports, which are soon to be at capacity. The estimated project costs of over \$12 billion is the highest among the three high speed rail options, mostly due to the higher costs of constructing a maglev system. However, project sponsors highlighted some advantages unique to maglev technology, such as lower ongoing projected operation and maintenance costs and its ability to handle

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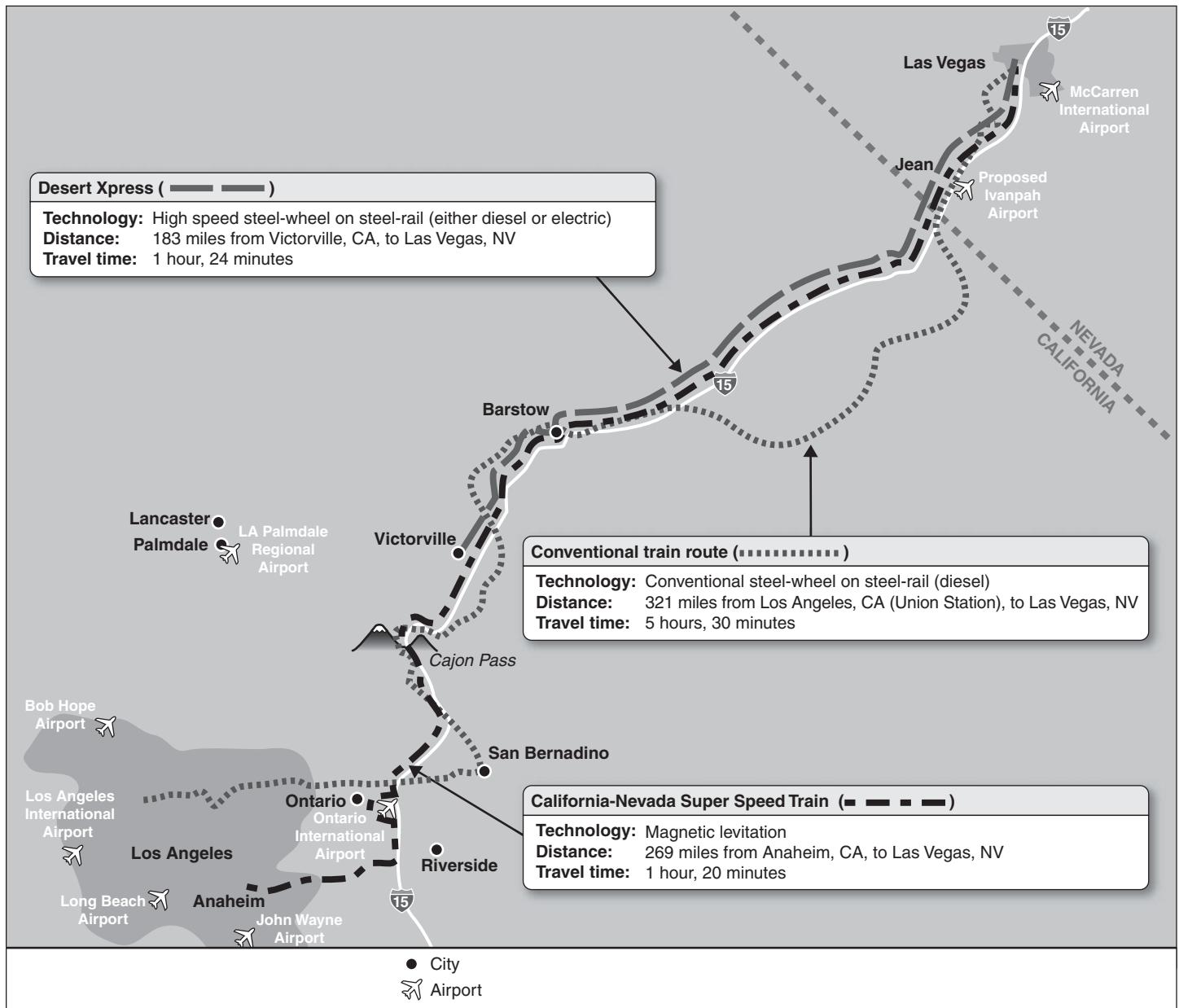
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steeper grades and curves as compared with steel-wheel on steel-rail technologies.

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**Appendix VII: Description of the Proposed  
Los Angeles, California, to Las Vegas, Nevada,  
High Speed Rail Corridor**

**Figure 7: High Speed Rail Project Proposals from Los Angeles to Las Vegas**



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## Highway Congestion

It is estimated that 90 percent of the visitors to Las Vegas from the Southern California region drive on I-15, which is the major highway and the only available driving route connecting Las Vegas and Southern California. According to stakeholders, congestion on I-15 has gotten increasingly worse over the years, with a major choke point occurring in Victorville, where the eight-lane highway narrows to three through lanes in each direction for 30 miles to Barstow, and then to only two through lanes in each direction through the desert to Las Vegas. Travel times between the Los Angeles area and Las Vegas can increase 2 hours or more (from approximately 4 to 6 hours) during weekend and holiday peak travel times (reflective of the recreational nature of most travelers). I-15 is also a heavily traveled freight route between the two regions. Both Desert Xpress and the California-Nevada Super Speed Train Commission anticipate that their high speed rail will help relieve congestion along the I-15 corridor during peak periods. For example, Desert Xpress anticipates that 87 percent of its riders will be diverted from automobiles. However, other stakeholders indicated that none of the current proposals are holistically looking at the transportation problems endemic to the corridor, such as looking at how to most effectively relieve some of the main drivers of traffic congestion in the Southern California area, and as we discussed earlier in this report, high speed rail's ability to have an impact on highway congestion may be limited by the properties of induced demand and the preferences of drivers.

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## Airport Congestion

The single largest air market to Las Vegas is from Southern California, and airports in Los Angeles and Las Vegas anticipate reaching and exceeding capacity by 2025. Clark County Department of Aviation<sup>3</sup> officials estimate that in 2007, approximately 3.6 million passengers (15 percent of all passengers) flew in from 1 of the 5 Southern California airports (Los Angeles International Airport, Bob Hope Airport in Burbank, Long Beach Airport, John Wayne Airport in Orange County, Ontario International Airport) servicing Las Vegas's McCarran International Airport (McCarran). Both Desert Xpress and the California-Nevada Super Speed Train Commission anticipate that their service will draw a significant number of travelers off of planes and into trains. Desert Xpress estimates that just over 12 percent of its passengers will be diverted from air, while

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<sup>3</sup>The Clark County Department of Aviation is responsible for the management of five aviation facilities in the Las Vegas region, including McCarran International Airport and the proposed Ivanpah Airport.

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California-Nevada Super Speed Train Commission estimates attracting 20 percent of its passengers from air. In addition, as we have previously mentioned, the commission is planning a potential connection to Ontario International Airport to relieve capacity constraints at other Southern California airports.

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## **Planned Capacity Improvements for Highways and Airports**

Current airport and highway expansion projects in the corridor also complicate the decision of whether to invest in high speed rail and how to design the system, and highlight the importance of comparing high speed rail proposals with investment alternatives in other modes. However, no single institutional entity exists to consider these investments relative to one another, or in comparison with one another to determine how the transportation needs in the corridor can best be served. For example, two airport projects are currently being developed that will significantly expand airport capacity in the Las Vegas area. To address future projected growth, Clark County Department of Aviation officials said they are preparing to add a third terminal to expand McCarran's capacity by an additional 8 million passengers. In addition, the department has plans to build a new airport in the Ivanpah Valley, which is 6 miles north of the California state line and 30 miles south of downtown Las Vegas (approximately a 45-minute drive from Las Vegas). McCarran would then handle most of the domestic air travel, while the Ivanpah Airport would handle primarily international air travel. The planned opening of Ivanpah is in 2018, and, at full build-out, the airport is expected to accommodate 30 to 35 million annual passengers. The officials were incorporating the planned maglev line or Desert Xpress line into plans for the new Ivanpah Airport, but primarily as a means to transport international travelers from Ivanpah to the Las Vegas city center. Officials indicated that the existence of a high speed rail line could provide capacity that could delay the need to build the Ivanpah Airport for several years, although eventually they anticipate enough demand to support an additional airport. However, airport expansion proposals do not consider the effects of a potential new high speed rail line, nor are airport expansions evaluated comparatively with high speed rail or highway expansion proposals. Similarly, capacity improvements are also planned on I-15 between Los Angeles and Las Vegas, and as with planned airport expansions, highway expansion proposals do not consider the potential effects of either rail or air travel alternatives and are not considered comparatively with such investments.

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# Appendix VIII: GAO Contact and Staff Acknowledgments

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## GAO Contact

Susan A. Fleming, (202) 512-2834 or [flemings@gao.gov](mailto:flemings@gao.gov)

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## Staff Acknowledgments

In addition to the individual named above, Andrew Von Ah, Assistant Director; Jay Cherlow; Colin Fallon; Greg Hanna; David Hooper; Delwen Jones; Richard Jorgenson; Catherine Kim; Max Sawicky; Gretchen Snoey; Jason Vassilicos; and Mindi Weisenbloom made key contributions to this report.

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