An Analysis of the Energy and Climate Impacts of High-Speed Rail and Aviation in the United States

REGINA R. CLEWLOW

Union of Concerned Scientists
Citizens and Scientists for Environmental Solutions

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Regina R. Clewlow is a Kendall Science Fellow in the UCS Clean Vehicles Program.

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SECTION 1. INTRODUCTION

Although the United States has seen only limited investment in passenger rail since the 1920s and '30s, there is now renewed interest in this travel mode—especially in high-speed passenger rail—to meet future mobility needs. In 2009, for example, the Obama administration unveiled a “Vision for High-Speed Rail in America” that formalized the identification of 10 high-speed rail corridors as potential recipients of federal funds. Several factors have motivated this recent attention, including: 1) population growth and increased congestion of airports and highways, particularly in the mega-regions of the East and West Coasts; 2) the potential to create new jobs (a high priority during the recent recession); and 3) concerns about the growing impact of transportation on the environment.

The U.S. Federal Railroad Administration’s 2009 plan to develop intercity high-speed rail (HSR) passenger service suggests that HSR development is part of a broader energy and climate policy initiative (FRA 2009), given that transportation is the fastest growing source of U.S. greenhouse gas emissions; the transportation sector accounts for 47 percent of the increase in total emissions since 1990 and 30 percent of current annual emissions (EPA 2012). Further, in large part because of the U.S. population’s present reliance on personal vehicles and aviation for the bulk of intercity travel, roughly 70 percent of the nearly 19 million barrels of oil consumed on average in this country each day are used for transportation (Davis, Diegel, and Boundy 2012). High-speed rail, and passenger rail in general, is more efficient than automobiles or aircraft on a vehicle-mile basis, and rail has the potential to operate on non-liquid sources of energy (e.g., electrification). Both of these factors suggest that transitioning to high-speed rail passenger service could substantially reduce the energy and carbon footprint of intercity passenger travel.

Of course, high-speed rail infrastructure, as well as aviation infrastructure, requires significant upfront investments; however, it will typically be utilized over substantial periods of time—its expected design life ranges from 50 to 100 years (Auld, MacIver, and Klaassen 2006). Also, as policymakers consider future investments in intercity transportation infrastructure, it is increasingly important to recognize that such investments will affect demand, energy use, and climate impacts long into the future.

This white paper provides an overview of the potential energy and climate impacts of high-speed rail and aviation in the United States. First,
brief overviews of high-speed rail and aviation systems around the world are presented. Next, the substitution of high-speed rail for aviation is explored, including a discussion of the broader trends in high-speed transportation demand and their environmental implications. Third, potential high-speed rail and air transportation demand scenarios in the United States are analyzed, with a focus on long-range projections of future demand and their energy and climate impacts. Fourth, other factors that influence the environmental impacts of high-speed rail and air transportation are discussed. Finally, this paper ends with a summary of key findings from the literature and our policy recommendations and conclusions.
SECTION 2. BRIEF OVERVIEWS OF AIR TRANSPORTATION AND HIGH-SPEED RAIL

AIR TRANSPORTATION
Since commercial airline service was introduced in the mid-20th century, air transportation has grown in importance as a means of intercity and global travel. Two phenomena in particular have spurred aviation growth: the introduction of wide-body “jumbo jets” by Boeing, McDonnell Douglas, and Lockheed in the 1970s; and airline-industry deregulation, starting in the United States in 1978 and in Europe in the 1990s, which resulted in lower costs, increased productivity, and eventually the establishment of low-cost carrier airlines.

Today, around the world some 30 million scheduled flights carry 2 billion passengers annually (MIT Global Airline Industry Program 2012). Historically, the United States has represented a large portion of global aviation market share (about 15 percent in 2011); and it is anticipated that U.S. air travel demand will continue to grow, albeit at a slower rate than previously experienced. The Federal Aviation Administration (FAA) forecasts an average annual growth rate of 3.1 percent in U.S. air traffic between 2011 and 2031 (FAA 2011).

Air transportation is currently responsible for 8.1 percent of CO₂ emissions in the U.S. transportation sector, and most analyses suggest that aviation’s climate impacts will continue to grow at a steady pace even under the most stringent policies to mitigate greenhouse gas emissions (Winchester et al. In press). As governments around the world consider various policies to address the climate impacts of the transportation sector, this challenge involving the global airline industry has become one of the issues most discussed.

HIGH-SPEED RAIL DEVELOPMENT
Typically designed for passenger service (as opposed to freight), high-speed rail was first developed in Japan and Europe during the 1960s. The initial service, the Tokaido Shinkansen, which ran between Tokyo and Osaka, was launched in 1964. During the 1970s and 1980s, new rail technology was
introduced, enabling higher top speeds (up to 270 mph during trial runs). Regular passenger service was subsequently introduced in France, West Germany, and Italy, and has since expanded to additional countries, primarily in Europe and Asia.

The European Union defines high-speed rail as lines equipped for speeds of 250 km/h (155 mph) or greater for new lines, and speeds “of the order of 200 km/h” (125 mph) for upgraded lines. In the United States, statutory definitions of high-speed rail include speeds as high as 125 mph and as low as 90 mph. But although technologically feasible, such speeds are not always achieved in practice. The International Union of Railways recognizes that some high-speed rail lines are not permitted to operate at maximum speed because of noise, safety, or capacity issues. Nevertheless, under most circumstances passenger rail, including high-speed rail, is more energy efficient on a vehicle-mile basis than aviation.
SECTION 3. IMPACTS OF HIGH-SPEED RAIL ON AVIATION DEMAND

HIGH-SPEED RAIL AND SHORT-HAUL AIR TRAFFIC

In the past decade, numerous studies have examined the substitution of high-speed rail for air transportation in Europe and Asia (Clever and Hansen 2008; Park and Ha 2006). The majority of these studies focused on travel between two major cities, and they contrasted travelers’ “stated” and “revealed” preferences. For example, one analysis of the Korea Train eXpress examined stated preference data (collected prior to the opening of a high-speed rail line) as well as measured actual demand (following the rail line’s opening). Such studies are often utilized to forecast future market shares of high-speed rail and air transportation, using explanatory variables—travel time, fares, access time, frequency, trip purpose, and income—to predict traveler’s choices of mode.

Studies based on European high-speed rail development have compared historical market share and general trends in air transportation and high-speed rail demand. A few studies documenting these trends in France, Spain, and Japan conclude that it is very difficult for air transportation to compete effectively in short-haul markets of 500 kilometers or fewer (GAO 2009; Park and Ha 2006). Other analyses arrive at similar conclusions. A study prepared for the European Commission, for example, documented nine intercity routes and concluded that rail journey time was the most significant factor affecting market share (Steer Davies Gleave 2006). (See Figure 1 and Table 1).
An economic study of European air traffic conducted by the author helped to explain the variability in substitution rates between high-speed rail and air transportation among European intercity travel corridors (Clewlow 2012, Ch. 3). This study examined 94 airport-market pairs over a 15-year time period—including the eight major city pairs examined in previous European cases—and it confirmed that short-haul air travel demand has clearly been affected by the introduction of improved rail travel times for the four major European countries included in the analysis: France, Spain, Germany, and the United Kingdom.

The study estimated a rail travel-time “elasticity” of 4.7 to 5.3, suggesting that a 10 percent reduction in rail travel time could lead to an
approximately 50 percent reduction in air traffic on short-haul routes. In reality, it is likely that there is a threshold (e.g., three-hour journey times) under which rail has a significant impact on air travel demand. Yet perhaps the more interesting finding from this study was a confirmation that increased population density results in further reductions in air traffic. That is, European city pairs with higher population densities experienced an even greater reduction in air traffic when high-speed rail service was introduced.

**BROADER SYSTEM-WIDE TRENDS IN GLOBAL AIR TRAFFIC**

Although the introduction of competitive high-speed rail service in the United States would likely yield substantial reductions in intercity, short-haul air traffic, it is important to consider the broader system-wide trends in air travel demand and their environmental impacts. For example, even though high-speed rail played a significant role in reducing domestic air travel in Europe over the past two decades, other major factors have resulted in a significant increase in air passenger-miles traveled – and thus associated energy use and climate impacts (see Figure 2).

When high-speed rail was introduced at major European hub airports, many airlines shifted their capacity from short-haul “feeder” flights to medium- and long-haul flights (which typically are more profitable). This shift in capacity has been even more significant at major airports such as Paris Charles de Gaulle and Frankfurt, where there was greater integration of high-speed rail and air transportation services (Clewlow 2012), though the shift cannot be attributed solely to the introduction of high-speed rail.

Three other key factors have had a significant influence on European air travel trends over the past 20 to 30 years: the Schengen Agreement, which eased cross-border travel in most of Europe; the deregulation of European airlines; and especially the emergence of low-cost carriers. While it is clear that high-speed rail has played a significant role in reducing domestic air travel in Europe, low-cost carriers have had a greater influence in the opposite direction; they have *increased* air travel, primarily to medium-haul destinations within the European Union, with a resultant rise in aviation’s impact on our environment (Clewlow 2012).
IMPLICATIONS FOR THE UNITED STATES

Based on lessons learned from the European experience, it is clear that high-speed rail has the potential to mitigate the growth of short-haul air traffic in the United States, thus likely providing energy and CO₂ emissions savings for this segment of travel. But the European experience also suggests that, given projected growth rates in population and travel demand, air travel originating the United States is likely to continue to increase, along with its impact on our environment.

(Source: Clewlow, 2012)
SECTION 4. THE ENERGY AND CLIMATE IMPACTS OF AIR TRANSPORTATION AND HIGH-SPEED RAIL

PROJECTED ENERGY USE AND CLIMATE IMPACTS OF AIR TRANSPORTATION

Recent studies that examine the potential role of climate policies to mitigate the environmental impacts of air transportation suggest that these policies’ effects may be limited (Winchester et al. In press; Hofer, Dresner, and Windle 2010). That is, even with a stringent climate policy or a carbon tax, air travel demand and its associated climate impacts will likely continue to increase substantially. In the most recent study involving the United States, it was estimated that aviation emissions would increase by between 97 percent and 122 percent between 2012 and 2050 under a representative climate policy, compared to 130 percent without a climate policy (Winchester et al. In press). (See Figure 3.)

The author examined the environmental benefits of introducing high-speed rail for intercity short-haul travel markets (Clewlow 2012, Ch. 5). Figure 4 presents one of the study’s results: a summary of projected passenger demand in short-haul air travel markets in 2020, 2035, and 2050 both for California and the Boston-New York-Washington, D.C., Northeast Corridor (NEC) under a reference case (business-as-usual) and climate policy case for each system. Economic impacts of the climate policy (e.g., increased fuel price and slower rate of GDP growth) would likely have relatively modest impact in reducing passenger demand. This finding suggests that reductions in CO₂ emissions would largely be driven by the relative efficiency and lower carbon intensity of rail travel, as described further below.
Aviation CO₂ emissions in a reference scenario and other policy scenarios, where M2 represents the most stringent policy option. (Source: Winchester et al, 2011)

Passenger demand in the reference and policy cases (Source: Clewlow, 2012)
HIGH-SPEED RAIL AND AVIATION UNDER ENERGY AND CLIMATE POLICY SCENARIOS

Based on the author’s analysis of air-to-rail substitution scenarios, the potential reductions in energy and CO₂ emissions would be significant (see Figure 5 for the California case, and please note that its abbreviations are defined here and in the next paragraph). Two high-speed rail (HSR) scenarios in particular were examined: a moderately competitive case, where high-speed rail fares are 83 percent of airfares; and a very competitive case, where high-speed rail fares are 50 percent of airfares. For both of these cases, the air traffic forecasts and substitution rates used in the analysis were based on data reported by the Bay Area regional airport planning association (SH&E 2011). When compared to the 2050 reference scenario, the resulting potential reduction in aviation emissions due to high-speed rail substitution ranged from 19 percent (in the moderately competitive case) to 42 percent (in the very competitive case). When these substitution scenarios were combined with energy and climate policies aimed at transforming how electricity generation is produced, the environmental savings were more significant. (See Table 2, which summarizes the CO₂ emissions in 2035 and 2050 as compared with the reference scenario.)

FIGURE 5. TOTAL AVIATION AND HIGH-SPEED RAIL CO₂ EMISSIONS: CALIFORNIA

Projected total aviation and high-speed rail CO₂ emissions for the California corridor (Source: Clewlow 2012, Ch. 5)
TABLE 2. ANNUAL CO₂ EMISSIONS REDUCTIONS

<table>
<thead>
<tr>
<th></th>
<th>California 2035</th>
<th>California 2050</th>
<th>NEC 2035</th>
<th>NEC 2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy policy/no HSR</td>
<td>3%</td>
<td>4%</td>
<td>0.01%</td>
<td>0.01%</td>
</tr>
<tr>
<td>Moderately competitive HSR</td>
<td>31%</td>
<td>19%</td>
<td>6%</td>
<td>6%</td>
</tr>
<tr>
<td>Very competitive HSR</td>
<td>49%</td>
<td>42%</td>
<td>36%</td>
<td>35%</td>
</tr>
<tr>
<td>CES/HSR (mod. competitive)</td>
<td>38%</td>
<td>37%</td>
<td>36%</td>
<td>44%</td>
</tr>
<tr>
<td>CES/HSR (very competitive)</td>
<td>54%</td>
<td>56%</td>
<td>51%</td>
<td>56%</td>
</tr>
<tr>
<td>CAT/HSR (mod. competitive)</td>
<td>36%</td>
<td>39%</td>
<td>43%</td>
<td>48%</td>
</tr>
<tr>
<td>CAT/HSR (very competitive)</td>
<td>53%</td>
<td>57%</td>
<td>56%</td>
<td>59%</td>
</tr>
</tbody>
</table>

Annual CO₂ emissions reductions compared with the reference scenario (Source: Clewlow, 2012, Ch. 5)

Two energy policy options were considered in the author’s study: a federal clean energy standard (CES); and a cap-and-trade (CAT) program based on the emissions targets originally identified by the American Clean Energy and Security Act. When combined with a CES or CAT, the additional energy and CO₂ emissions savings provided by high-speed rail would be substantial. In 2050, a very competitive high-speed rail system would result in an annual CO₂ emissions reduction of 56 percent to 59 percent, compared with the reference case, both in California and the Northeast Corridor.
SECTION 5. OTHER KEY ISSUES

LIFE-CYCLE IMPACTS OF HIGH-SPEED RAIL AND AIR TRANSPORTATION

Although high-speed rail is more energy-efficient than air transportation on a vehicle-mile basis, it is also important to consider the environmental benefits of both modes on a full life-cycle basis. Recent efforts to account for the life-cycle impacts of high-speed rail and air transportation, as well as of automobiles, in California suggest that high-speed rail is likely to be the lowest-carbon alternative of the three with strategies to reduce the life-cycle impacts of HSR systems (Chester and Horvath 2012). Given the significant environmental impacts associated with the construction of the California high-speed rail system, the Chester and Horvath study estimates that it would take 20 to 30 years after the groundbreaking to reap the environmental savings (i.e., when the system would have been fully operational for some time). The analysis provided by this author confirms similar results: the annual energy and emissions savings would likely be significant once the high-speed rail system is operational, particularly when one considers potential transitions to cleaner electricity generation (Clewlow 2012, Ch. 5). Given that the majority of such systems are utilized for 50 or more years without major reconstruction (Auld et al 2006), current analyses predict that the long-range benefits are likely to make up for the near-term environmental costs.

POTENTIAL SUBSTITUTION BETWEEN PERSONAL VEHICLES AND HIGH-SPEED RAIL

This white paper has focused primarily on the substitution of high-speed rail for short-haul intercity flights. But there will also be a shift from personal vehicles to high-speed rail, particularly for shorter distances and daily commutes ranging from 30 minutes to 1.5 hours. Regarding the potential environmental benefits of this shift from auto to rail, several uncertainties remain. They include: 1) potential changes in land use patterns as a result of high-speed rail and their impacts on personal vehicle-miles traveled; and 2) likely changes in the personal vehicle fleet and its future environmental footprint. Although future studies could more fully analyze the shift from
personal vehicles to high-speed rail, it is likely that the resulting energy and climate impact reductions would be beneficial and significant.

OTHER ENVIRONMENTAL IMPACTS OF THE TRANSPORTATION SECTOR

While this paper has focused on the energy and CO₂ emissions impacts of high-speed rail and air travel, additional issues should be also considered when evaluating the near-term and long-range environmental impacts of these modes. Such issues include:

- **Air pollutant emissions (in addition to CO₂)** that have adverse health consequences, including ozone, particulate matter, carbon monoxide, nitrogen oxides, sulfur dioxide, and lead. Studies of the California high-speed rail corridor have begun to examine and compare other pollutants associated with high-speed rail, aviation, and personal vehicles (Chester 2008).

- **Land use**: both high-speed rail and aviation systems require land upon which to build transportation infrastructure. Existing studies from the European Union have indicated that land use intensity may be comparable for high-speed rail and aviation (Janic 2003).

- **Noise**, which typically affects communities located near airports, high-speed rail tracks, and highways. There is significant research on the noise impacts of aviation (with a particular focus on airports); however, there is little literature comparing high-speed rail and aviation.
SECTION 6. POLICY IMPLICATIONS

AN OVERVIEW OF HIGH-SPEED RAIL POLICY IN THE UNITED STATES

Over the past 50 years, U.S. transportation funding has overwhelmingly been dedicated to highways and the air transportation system, thereby accelerating decline in intercity rail passenger demand. Although a few efforts explored the potential of U.S. high-speed rail after Japan’s introduction of its Tokaido Shinkansen in 1964, limited financial backing was available for creating similar systems in the United States. In recent years, however, there has been renewed U.S. interest in (and some substantial financial support for) high-speed rail development.

In 2008, the Passenger Rail Improvement and Investment Act (PRIIA) was signed into law, reauthorizing the National Railroad Passenger Corporation, better known as Amtrak, with $2.6 billion a year through 2013. PRIIA included funds to support the only existing high-speed rail service in the United States (i.e., along the Northeast Corridor) and to lay the groundwork for improving intercity passenger rail service across the United States. In February 2009, the first substantial federal investment in high-speed rail was committed through the American Recovery and Reinvestment Act (ARRA) of 2009, which authorized $8 billion to develop a new U.S. high-speed rail intercity passenger system.

The ARRA also required that the Federal Railroad Administration (FRA) formulate a strategic plan for high-speed rail throughout the United States. Figure 7 illustrates the proposed corridors envisioned in April 2009. The strategic plan identified 10 corridors, in addition to the existing Northeast Corridor, as potential funding targets. Through a competitive grant process, in August and October 2009 the FRA received applications from 34 states for over $57 billion in funding requests. In January 2010, the agency announced that 31 states and 13 corridors were to receive funding. (See Table 3.)
FIGURE 6. PROPOSED U.S. HIGH-SPEED RAIL CORRIDOR MAP

VISION for HIGH-SPEED RAIL in AMERICA

(Source: FRA, 2009)

TABLE 3. INITIAL CORRIDORS AWARDED ARRA FUNDS IN 2010

<table>
<thead>
<tr>
<th>Corridor</th>
<th>Grant received (in million $)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chicago Hub/Ohio Hub</td>
<td>2,614</td>
</tr>
<tr>
<td>California</td>
<td>2,250</td>
</tr>
<tr>
<td>Florida</td>
<td>1,250</td>
</tr>
<tr>
<td>Southeast</td>
<td>620</td>
</tr>
<tr>
<td>Pacific Northwest</td>
<td>598</td>
</tr>
<tr>
<td>Other Corridors in NE</td>
<td>371</td>
</tr>
<tr>
<td>Northeast Corridor</td>
<td>112</td>
</tr>
<tr>
<td>South Central</td>
<td>4</td>
</tr>
</tbody>
</table>

(Source: FRA, High-Speed Rail Intercity Passenger Program, 2010)

A major challenge facing the development of U.S. high-speed rail has been criticism of the spending required to build these advanced transportation systems. Although the ARRA funding represents the largest federal investment in high-speed rail to date, the majority of corridors would need significant additional investment (e.g., through state bonds and private sources). However, following the U.S. gubernatorial elections in November 2010, some newly elected conservative governors—in Ohio, Wisconsin, and Florida—rejected federal high-speed rail funding that had been allocated to their states through the ARRA economic stimulus funds.
Also in 2010, the 111th U.S. Congress allocated $2.5 billion (in addition to ARRA’s $8 billion) to high-speed rail in the FY 2010 budget, which included major grants for California, Florida, and the Chicago hub. However, a proposal by Vice President Joe Biden in 2011 to build on the initial total investment of $10.5 billion with an additional $53 billion over the following six years was met with significant resistance. Nor have there been any additional federal investments in high-speed rail through the FY 2011 or FY 2012 budgets. Meanwhile, there have been a handful of unsuccessful legislative attempts to rescind the initial federal funding committed in 2009 and 2010 (see H.R. 2811, H.R. 3143).

Although U.S. intercity passenger rail in those two years received the largest commitments of funding over the past 50 years, significant sustained investment will be required in order to achieve the FRA’s current vision to develop high-speed rail in the United States. In particular, the two corridors that are often regarded as having the most potential—California and the Northeast Corridor—will require some level of additional federal funding in order to be successfully completed. (The current status of these corridors will be discussed further below.)

U.S. CLIMATE AND ENERGY POLICY

With the American Clean Energy and Security Act (ACES), also known as the Waxman-Markey Bill (H.R. 2454), the 111th Congress considered the establishment of a cap-and-trade system aimed at limiting national greenhouse gas emissions. Although the House of Representatives approved the bill in June 2009, it failed to gain Senate approval. This proposed bill was arguably the United States’ most significant step at the federal level toward establishing a cap on greenhouse gas emissions, and the desire for a future climate bill is still supported by many. Given the economic downturn of 2008 and subsequent political shifts in the 112th U.S. Congress, however, the likelihood that such major U.S. climate legislation will be approved in the near future is slim.

Alternative policy measures focused on energy have gained more traction in the United States, both at the state and federal levels. The Energy Independence and Security Act of 2007 (P. L. 110-140), passed by the 110th U.S. Congress, calls for improved automobile fuel economy, the development of biofuels, and energy efficiency in buildings. More recently, regulations to mandate increased production of energy from renewable, or “clean,” energy sources have been passed at the state level and are currently being considered at the federal level.

The Clean Energy Standard Act of 2012 (S. 2146), introduced in March 2012, is currently under consideration in the 112th U.S. Congress. If passed, a federal clean energy standard (CES) would mandate that the largest utilities in the United States procure a certain percentage of their electricity from clean energy sources starting in 2015. As compared with a renewable energy standard, the CES is a more flexible framework in that it allows utilities to include a wider variety of sources for “clean” electricity production (e.g., natural gas and coal with carbon capture and storage).
By contrast, renewable energy standards (RESs), also commonly referred to as renewable portfolio standards (RPSs), are policies that require utilities to source a certain share of their electricity from designated renewable sources such as wind, solar, geothermal, biomass, and some types of hydroelectricity. As of January 2012, 30 states and the District of Columbia had established an enforceable RPS or other mandated renewable energy policy. Although several RPS proposals have been considered at the federal level, political analysts regard the approval of a clean energy standard as more likely in the near future.

As argued by the literature cited earlier in this paper, the implications of the above climate or energy policies on high-speed rail emissions are significant. U.S. electricity generation is all but certain to become cleaner, though there is likely to be variation in the carbon intensity of electricity production on a regional basis.

**CALIFORNIA’S PROPOSED HIGH-SPEED RAIL**

The development of a high-speed rail system to connect northern and southern California has been under consideration for two decades as part of long-range transportation plans. The first large investment in the rail system was approved in November 2008 by voters through Proposition 1A, which authorized $9.95 billion in bonds for the project. In 2009, the state was awarded an additional $2.25 billion in federal funds through the American Recovery and Reinvestment Act.

The proposed California system would connect San Francisco and Los Angeles with 432 miles of dedicated high-speed rail passenger service. Secondary phases of the project would add extensions to Sacramento (in the north) and possibly to San Diego (in the south). Figure 7 illustrates the proposed routes and stations.

As with concerns at the federal level, the primary controversy surrounding the California project regards its budget. The California High-Speed Rail Authority (CHSRA) originally estimated that the core segment—San Francisco to Anaheim—would cost $35.7 billion (in 2009 USD). However, a new business plan released in November 2011 by the CHSRA predicted a figure of $65.4 billion (in 2010 USD), or $98.5 billion after adjusting for inflation. Although new board members appointed in August 2011 by California Governor Jerry Brown defended the updated business plan as more realistic, it added to opponents’ existing concerns about the project’s costs. After leadership changes at the CHSRA in January 2012, the agency released another updated plan, in April 2012, that estimated the costs to be $68 billion—$30 billion less than the estimate of the preceding November. The primary cost reductions would result from making better use of existing commuter-rail lines in urban areas, as opposed to building entirely new track there.
In order for the project to move forward, California’s State Legislature needed to approve the selling of state bonds to raise a portion of the $9.95 billion that voters authorized in 2008. On July 6, 2012, the Legislature did just that, and on July 18 Governor Brown signed the law, which appropriated $5.8 billion to start construction of the high-speed rail line. The initial funds include $2.6 billion in state rail bonds and $3.2 billion in federal aid. Although the approval of these funds is one step toward construction of the California high-speed rail system, there is continued opposition to the project in the Central Valley, where the CHSRA plans to break ground in September 2012.

Table 4 presents a summary of key stakeholders and their interests in the development of California’s high-speed rail system.
### TABLE 4. OVERVIEW OF KEY STAKEHOLDERS OF CALIFORNIA HIGH-SPEED RAIL PROJECT

<table>
<thead>
<tr>
<th>Stakeholder</th>
<th>Stakeholder description, interests, and views</th>
</tr>
</thead>
</table>
| **California High-Speed Rail Authority (CHSRA).** State agency established in 1996 by the California High-Speed Rail Act (S.B. 1420). | • The agency’s primary objective is to develop and implement high-speed intercity passenger rail in California.  
• The initial business plan estimating the costs and benefits may have been overly optimistic (i.e., underestimating costs and overestimating ridership).  
• New leadership of the CHSRA appointed in August 2011 and January 2012 appears to be focused on ensuring that future estimates are as realistic as possible. |
| **California State Legislature.** Consists of the California State Assembly (80 members) and California State Senate (40 members). | • Composition of State Assembly: 52 Democrats, 27 Republicans, 1 Independent from 2010–2012. Composition of State Senate: 25 Democrats, 15 Republicans.  
• The state of California has had a budget crisis since 2008, which has been one of the primary issues facing the State Legislature from 2008 through the present. |
| **Office of Governor.** Currently Edmund Gerald “Jerry” Brown. | • Governor Brown has been a very outspoken advocate of the California high-speed rail project.  
• His predecessor, Arnold Schwarzenegger, was also a strong supporter of the project. |
| **California members of the U.S. Congress** | • Certain California members in the U.S. Senate and House of Representatives have been involved in federal legislation to either increase or ensure funding for high-speed rail development.  
• At the same time, other California members of the U.S. House of Representatives have made legislative attempts to rescind the federal funding allocated to the state of California for high-speed rail projects (H.R. 2811, H.R. 3143). |
Transportation planning agencies

- Until recently, there had been somewhat limited or strained interactions between the CHSRA and the California Metropolitan Planning Organizations (MPOs) and Regional Transportation Planning Agencies (RTPAs). Some members of the MPOs and RTPAs viewed the high-speed rail system as a separate and more costly enterprise that might detract support from local commuter rail.
- The new leadership at the CHSRA has made an effort to build more strategic partnerships with these agencies. Memorandums of understanding have been signed to establish working relationships and funding from the CHSRA to upgrade local urban rail systems.

Communities affected by construction

- As is common in transportation infrastructure development projects, some of the communities located along the California high-speed rail route have objected to its construction.
- The cities of Palo Alto, Menlo Park, and Atherton have sued the CHSRA, alleging that its ridership and revenue forecasts were flawed. They have also challenged the project on the basis of its Environmental Impact Review (EIR).

Citizens

- General public support for and against the project is roughly 50-50.
- Based on a survey conducted in March 2012 by the Public Policy Institute of California, 51 percent of adults indicated that they support the rail project.
- However, when told that the rail project would cost $100 billion over 20 years, 53 percent of likely voters indicated they would oppose it.
| Environmental advocacy groups | • When the project was first initiated, there was general support among environmental advocacy groups because of the likely environmental benefits of high-speed rail.  
• However, in the past two years, support from environmental advocacy groups has diminished as a result of two key issues: 1) proposed plans to ease the EIR process; and 2) the potential for the high-speed rail project to utilize funds from California’s cap-and-trade program (to be launched on January 1, 2013).  
• Given the significant costs associated with the high-speed rail project, environmental groups are concerned that limited funds would remain in the cap-and-trade program for other environmental endeavors if some of its budget were directed toward rail. |

**THE NORTHEAST CORRIDOR**

The Northeast Corridor, which connects cities between Boston and Washington, D.C., is the only existing high-speed rail service in the United States. The rail line was originally constructed between 1830 and 1917; but significant upgrades were made through the Northeast Corridor Improvement Project between 1976 and 1980. Approximately 720,000 passengers ride on the system each day; it is the most successful rail corridor in the United States in terms both of passenger use and load factors.

Amtrak, which owns the majority of the Northeast Corridor, prepared a “State of Good Repair” (SOGR) plan in April 2009, in response to the Passenger Rail Investment and Improvement Act of 2008. The initial plan estimated that $38 billion between 2009 and 2030 would be required for SOGR safety, mandates, capacity, and trip-time improvements. But implementation of this plan would not much reduce trip time for the Boston–New York route (currently 3 hours and 25 minutes) or New York–Washington, D.C., route (currently 2 hours and 48 minutes). So in 2010, Amtrak released a more ambitious plan, “A Vision for High-Speed Rail on the Northeast Corridor,” that could reduce travel time for the Boston–New York trip to 84 minutes and the New York–Washington, D.C. trip to 96 minutes. The estimated cost for this ambitious next-generation, or “NextGen,” high-speed rail system is $117 billion (in 2010 dollars).

On a more prosaic but practical front, in August 2011 Amtrak was awarded $450 million in federal funding for the Northeast Corridor (NEC) and New York State was awarded $295 million for improvements on the Harold Interlocking rail junction, which would also improve service on the Northeast Corridor. The NEC FUTURE planning effort, established by the Federal Railroad Administration in coordination with the NEC Commission, was formed in February 2012 to define, evaluate, and prioritize future investments in the Northeast Corridor. Critical next steps in the planning process include: 1) a Service Development Plan that outlines the costs and
benefits of proposed rail alternatives; and 2) a Tier 1 Environmental Impact Statement that addresses the environmental effects of the NEC.

One of the challenges of developing advanced high-speed rail service in the Northeast Corridor is the large number of stakeholders associated with the project, across several state jurisdictions. In addition to Amtrak, parts of the rail line are owned or operated by a variety of commuter rail and freight rail companies. That said, the Northeast Corridor has fairly broad bipartisan and local support for infrastructure improvements, due largely to its record of attracting rail passenger ridership. For example, the current chairman of the House Transportation and Infrastructure Committee, John Mica, although critical of virtually all other proposed high-speed rail corridor projects, has supported improvements to the Northeast Corridor. In April 2012, the National High-Performance Passenger Rail Transportation-Oriented Development Act (H.R. 4361) was also proposed by a Republican Congressman; it would encourage dedicated revenue sources for urban and regional rail corridor development, including the Northeast Corridor. Thus although there have been many criticisms of a nationwide intercity high-speed passenger rail program, the Northeast Corridor has experienced relatively strong support in Washington, D.C., as well as within the northeast states.

RECOMMENDATIONS FOR POLICY AND PRACTICE

While the greatest potential for U.S. high-speed rail development at this time involves California and the Northeast Corridor, both projects still face numerous obstacles. Successful implementation of high-speed rail, in these two regions as well as elsewhere, will heavily depend on navigating such obstacles and on the ability to find solutions that draw on shared interests, rather than differences, among stakeholders. In that spirit, we offer a set of policy and planning recommendations that we believe would assist in establishing high-speed rail for intercity passenger travel in the United States.

1. SUSTAIN FEDERAL FUNDING FOR HIGH-SPEED RAIL

Historically, no country has successfully established high-speed rail service without significant political and financial backing from the national government. Thus although it is a significant challenge in the current U.S. economic and political landscape, sustained federal funding for high-speed rail infrastructure is critical for ensuring that other stakeholders are willing to move forward with planning and investment. The situation right now, however, is not encouraging. Following the $8 billion in funding through the American Recovery and Reinvestment Act of 2009 (ARRA) and the $2.5 billion allocated through the FY2010 federal budget, additional proposals for sustained investment have not succeeded.
2. PRIORITIZE DEVELOPMENT OF CORRIDORS WITH THE GREATEST LIKELIHOOD OF SUCCESS

The initial investment of $8 billion through the ARRA was divided among 13 proposed corridors in the United States, many of which, in the near term, are unlikely to be developed as international-standard high-speed rail intercity systems. Given the opposition at the federal level to many of these proposed corridors, it could be more beneficial to utilize the limited funds available for high-speed rail development on priority corridors, such as California and the Northeast Corridor, which have stronger political and financial support at the local/regional level.

3. ENABLE INTERNATIONAL COOPERATION IN HIGH-SPEED RAIL DEVELOPMENT

Outside of Japan and Europe, where innovation in high-speed rail technologies began, the majority of nations that have built their own high-speed rail systems have relied on international partnerships and technology transfer. Although there is interest among international firms in investing in U.S. high-speed rail corridors, limited levels of federal support (both financial and political), as well as priorities to protect American jobs, threaten these potential partnerships. Ironically, the development of high-speed rail is likely to revitalize jobs in the United States, though not necessarily in manufacturing. Based on experiences abroad, the majority of new jobs would result from development in and around new high-speed rail stations, and from broader regional productivity due to improved mobility.

4. DEVELOP LONG-RANGE PLANS FOR REGIONAL DEVELOPMENT AND ECONOMIC GROWTH

Well-conceived long-range plans and improved estimates of economic growth likely to occur from high-speed rail development would improve its political support. Literature based on recent international experiences with high-speed rail can inform planning aimed at maximizing the potential regional benefits of high-speed rail service; and the lessons from such experiences can also help in developing forecasts of a proposed system’s land use, population redistribution, job creation, and resultant economic growth.

5. ENSURE INDEPENDENT DEVELOPMENT OF FORECASTS

After local communities filed lawsuits citing the initial ridership (and thus revenue) forecasts for California’s proposed high-speed rail system as flawed, the forecasts—and the models on which they were based—were evaluated by an independent academic research institution. These independent evaluators concluded that there indeed were significant flaws in the forecasts developed by the consulting firm hired by the California High-Speed Rail Authority, and that skepticism about the cost and benefit estimates surrounding this particular case was justified. The lesson here is that to enable policymakers’ informed decisions about high-speed rail and
other transportation infrastructure investments, ensuring independent review and transparency of such systems’ cost and benefit forecasts is essential.

6. ENABLE COORDINATION BETWEEN RAIL AGENCIES

Because high-speed rail systems may experience lower ridership levels in the absence of accessible and reliable “feeder” rail lines, building coordination between emerging high-speed rail agencies and local rail agencies will lay the groundwork for both parties’ long-term success. Additionally, upgrading existing commuter rail systems will result in travel time and capacity improvements for high-speed rail systems that are likely to share track.
SECTION 7. CONCLUSIONS

The development of high-speed intercity passenger rail offers an important way for the United States to reduce its reliance on liquid fuels and limit the climate impacts of the transportation sector. These properties are particularly attractive when one considers the long time frame over which this infrastructure will be utilized and the increasingly cleaner sources of energy over time that would power these systems. Although the upfront costs to develop technologically advanced high-speed rail service for intercity travel in the United States are significant, these investments offer one of the most carbon-efficient paths for meeting the increased travel demands of growing urban populations.

Based on the experience with high-speed rail in Europe, it is clear that high-speed rail offers a competitive alternative to short-haul intercity air travel. However, over the same time frame when high-speed rail was introduced in many parts of Western Europe, air travel continued to expand there, particularly in international travel markets (both within and outside of the European Union). Similarly, it is anticipated that although high-speed rail is likely to reduce the carbon footprint of U.S. passenger travel for trips shorter than about 500 miles, air travel will likely continue to increase over the next 50 years regarding distances for which there are limited transportation alternatives. Given the anticipated growth in air travel demand in the United States and around the world, stringent policies and investments in technological improvements will continue to be essential for curbing the environmental impact of the air travel sector.
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