California High-Speed Rail Program Draft 2012 Business Plan

NOVEMBER 1, 2011

Building California's Future

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Acronyms and Abbreviations

APTA	American Public Transportation Association
ARB	Air Resources Board
ARRA	American Recovery and Reinvestment Act of 2009
ASCE	American Society of Civil Engineers
Authority	California High-Speed Rail Authority (see also "CHSRA")
AVE	Alta Velocidad Española (Spanish HSR service)
AVTA	Antelope Valley Transit Authority
B2B	Bay to Basin
BART	Bay Area Rapid Transit
BCA	benefit-cost analysis
BNSF	Burlington Northern Santa Fe
CADWR	California Department of Water Resources
CALPIRG	California Public Interest Research Group
CALTRANS	California Department of Transportation
CHSRA	California High-Speed Rail Authority (see also "Authority")
CHSRP	California High-Speed Rail Program
CTC	California Transportation Commission
DBB	design-bid-build
DBF(O)M	design-build-finance-operate-maintain
EIR/EIS	environmental impact report/environmental impact statement
EPA	U.S. Environmental Protection Agency
FAX	Fresno Area Express
FR	*Federal Register*
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
GET	Golden Empire Transit
GHG	greenhouse gas
HSR	high-speed rail
HUD	U.S. Department of Housing and Urban Development
ICE	InterCityExpress (German HSR)
ICS	Initial Construction Section
IOS	initial Operating Section
IRJ	*International Railway Journal*
JR Central	Central Japan Railway Company
KART	Kings Area Rural Transit
Metro	Los Angeles County Metropolitan Transportation Authority
Metrolink	Southern California Regional Rail Authority

MOU	memoranda of understanding
MPO	metropolitan planning organization
MTS	San Diego Metropolitan Transit System
MUNI	San Francisco Municipal Railway Transit System
NCTD	North County Transit District
O&M	operating and maintenance
OCTA	Orange County Transportation Authority
PMT	Program Management Team
PPP	public-private partnership
QTCB	Qualified Tax Credit Bonds
RASP	Regional Aviation System Planning
RCTC	Riverside County Transportation Commission
RENFE	Red Nacional de los Ferrocarriles Españoles
ROW	right-of-way
RPA	Regional Plan Association
RRIF	Railroad Rehabilitation and Improvement Financing
RTA	regional transportation agencies
SANDAG	San Diego Association of Governments
SHCC	Self-Help Counties Coalition
TAV	Trem de Alta Velocidade (Planned Rio-Sao Paulo HSR)
TC	Transportation California
TCAT	Tulare County Area Transit
TGV	Train à Grande Vitesse (French HSR service)
TIFIA	Transportation Infrastructure Finance and Innovation Act
TOD	transit-oriented development
TRIP	The Road Information Program
UIC	International Union of Railways
UKDT	United Kingdom Department of Transport
UP	Union Pacific Railroad
UPRR	Union Pacific Railroad
USBEA	U.S. Bureau of Economic Analysis
USDOT	U.S. Department of Transportation
VTA	Santa Clara Valley Transportation Authority
YOE	year of expenditure

Executive Summary

In 2008, Californians voted to develop a statewide high-speed rail (HSR) program. The 2012 Business Plan marks the transition from the vision of a world-class high-speed rail system to the realities of building and operating that system. Reflecting that change, this Business Plan differs significantly from previous versions. Advances in engineering and design have provided far better information about the detailed scope and costs of the program. The environmental documentation, review, and clearance process has progressed. Ridership assumptions and modeling were thoroughly re-evaluated and tested with an independent panel of experts to support revenue projections. Risks have been identified and mitigation plans put into place. Cost-effective and timely methods to achieve the goals of the High-Speed Rail Bond Measure, Proposition 1A, have been developed in cooperation with regional and local transportation partners. Business models for delivering the program and the role of the private sector have been defined based on international experience and extensive discussions with rail operators. The role of the private sector has been clarified, also based on the best experience of HSR operations and outreach to potential investors. Realistic and conservative costs, contingencies, schedules, and funding options have been prepared and used to develop a plan for moving forward.

The case for investing in high-speed rail in California is tied to two key factors:

- Recognition that continued growth will require major investments, measured in the tens of billions of dollars, in expanded transportation systems over the coming decades; and,
- High-speed rail can meet those demands more effectively and at lower costs than the alternatives, and can be delivered through a fiscally responsible phased implementation plan that ties the system together with regional and local rail networks and generates net positive cash flow from its operations.

The need is clear. Today, our transportation systems are straining to meet current demand. Congestion on our roads results in $18.7 billion annually in lost time and wasted fuel. Air flights between the Los Angeles and San Francisco metropolitan areas—the busiest short-haul market in the U.S.—are the most delayed in the country, with approximately one of every four flights late by close to an hour or more.

Continued population and economic growth will place even more demand on mobility systems that are already overburdened. Over the next 30 to 40 years, California is projected to add the equivalent of the current population of the state of New York. There is no question: meeting the demands of that growth will require *major* investments in transportation infrastructure over the next generation. Those investments will measure in the tens of billions of dollars. The question will not be *if* those investments need to be made, but *how* the investments that will be made can provide the greatest benefit.

As has been proven around the world, high-speed rail, integrated into a balanced transportation system, can meet a large part of the increased demand in a sustainable, cost-effective manner. Providing equivalent new capacity through investment in highways and aviation would cost California almost twice as much as the Phase 1 high-speed rail system and would require approximately:

> **With 20 million more people expected to be in California within the next 40 years, we can't build enough highways and airport runways to accommodate the demand.**
>
> *Joseph C. Szabo, Federal Railroad Administrator*

- 2,300 miles of new highways
- 115 new airport gates
- 4 new airport runways

The costs of these expansions would exceed $170 billion over the next 20 years. Such highway expansions would be contrary to important state policies such as AB 32, the Global Warming Solutions Act of 2006, and SB 375, the Sustainable Communities and Climate Protection Act of 2008. Those new highways would also impose millions of dollars in annual maintenance costs that are not factored into the cost comparison, while operations and maintenance costs for high-speed rail are covered by revenues. As has been the case in San Francisco and Los Angeles, the addition of new runways not only would be costly, but may not be possible in light of community and environmental concerns.

As detailed in this Plan, a statewide HSR system can be delivered to the citizens of California, producing economic benefits, enhancing and supporting environmental and energy goals, creating near and long-term employment, enhancing mobility, and saving money. This Business Plan lays out the framework for doing so in a way that recognizes the budgetary and economic realities facing the state and country today.

Building the entire system will take longer and cost more than previously estimated; however, as detailed in this Business Plan, the previous notion of what the system will look like and how it will be built has also been updated. Answers to the questions regarding how much longer it will take and how much more it will cost will depend in part on the pace and type of funding that is provided. It also will depend on decisions on system routing and design to be made by a wide range of stakeholders, including communities, elected officials, the federal government, and partner transportation agencies.

Economic analysis shows that the benefits of the system far outweigh the costs of building, operating, and maintaining it, even with higher costs factored into the equation. Californians will begin to see these benefits next year, when initial construction will provide a much-needed boost to the Central Valley, the fastest growing part of the state and the region hardest hit by unemployment. Almost 100,000 jobs will be generated by the first construction work.

It also has become clear that the key to success is to focus on putting into place the first operational segment of a high-speed rail system and using that as a building block for the full system. That Initial

Operating Section can be in place within 10 years, generating positive cash flows, carrying millions of riders, and serving as a launch pad for private participation.

There are two keys to cost-effective and timely implementation of a statewide high-speed rail system:

- Dividing the program into a series of smaller, discrete projects that build upon each other but also can stand alone to provide viable high-speed rail service
- Making advance investments in regional and local rail systems to leverage existing infrastructure and benefit travelers by providing interconnecting "blended" services

By implementing the program in phases, work can be matched to available funding. Each segment can be delivered through business models that transfer design, construction, cost, and schedule risks to the private sector and maximize efficiency by capturing the advantages of private-sector innovation. Importantly, the phased approach means that decisions made today won't tie the state's hands tomorrow. With the state's success in securing almost $4 billion in federal funding, the first step can be taken now. It will create jobs, obtain right-of-way, position the system for future expansion, and preserve options for future decision makers.

The decision to move ahead with the initial step does not commit the state to proceeding with the full program. By providing decision-makers with the flexibility to change course or timing, the plan preserves flexibility and can adapt to changing economic and budgetary realities or new opportunities. This approach is consistent with how other major infrastructure programs are implemented. The Interstate Highway System was designated in whole at the outset but constructed in phases over more than 50 years based on availability of funds, economic conditions, and other factors. The same has been true with the California freeway system and the state water project. In other countries, HSR systems have been delivered this same way, with plans outlined for full development but implementation taking place in segments, sometimes with years between the completion of one segment and the initiation of the next. This Business Plan has been developed by applying successful implementation strategies that have evolved over the last half-century or more of experience throughout the world.

Phasing the California State Water Project: "50 Years and Counting"

The California State Water Project is the largest state-built and operated multipurpose water and power system in the United States. It encompasses 701 miles of canals and pipelines that provide drinking water for 25 million people and irrigation for 750,000 acres of farmland. It began in 1960 and its expansion continues today, with the newest reservoir beginning construction in 2006.

Funding began with the approval of $1.75 billion in bonds. Since that time, the 29 contracting agencies that deliver the water locally have made cumulative payments totaling more than $9 billion.

Through the implementation of this Business Plan, California has an unprecedented opportunity to develop a modern, efficient statewide rail system. High-speed trains will connect the major metropolitan areas through the Central Valley, tying together with regional and local rail systems to move people effectively throughout urban areas. Agreement on a strategy among state, regional, and local agencies will free up funds authorized in Proposition 1A for regional and local rail improvements, and lead to an effective integrated statewide system for the benefit of travelers throughout California.

> Starting up a new high-speed service is challenging, as was the case in Japan in 1964; however, it is very rewarding for the country in the longer term .... Step-by-step extension of high-speed rail construction is common in Japan, too. For example our Tohoku-Shinkansen line, which runs through the northern part of Japan, has been constructed step-by-step. The initial section up to Morioka was completed in 1982, and the line was extended to Hachinohe in 2002 and to Aomori in 2011.
>
> *Masaki Ogata, Vice Chairman, East Japan Railway Company*

How will California benefit from high-speed rail?

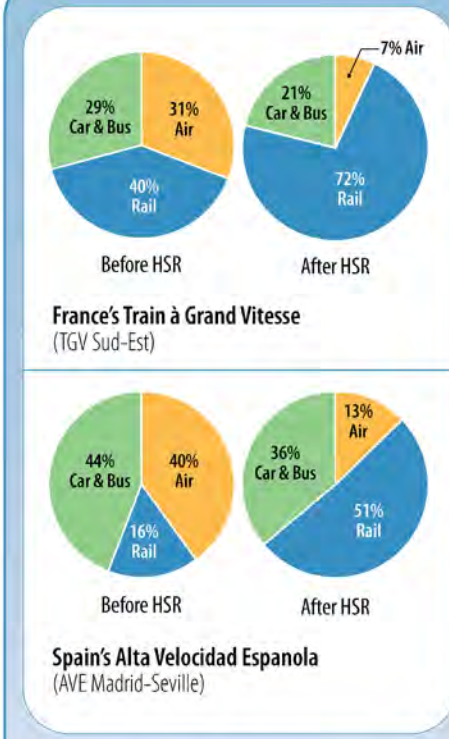
High-speed rail will bring significant benefits to California, both in the near term and in the long run, and for individuals and the state as a whole. Benefits will be statewide and will encompass both economic and environmental concerns, including the reduction of three million tons of carbon dioxide emissions annually.

Early benefits will come to the Central Valley, which has the highest unemployment rate in the state, as well as to the construction industry, which is the hardest-hit sector of our economy. As noted earlier, moving forward with initial construction of the system, starting in the Central Valley will generate approximately 100,000 jobs for people who need them most. Connecting the Los Angeles and San Francisco metropolitan areas will generate approximately 800,000 to 900,000 jobs and eventually will result in well over one million jobs. High-speed rail is a major job generator, both in the short and long terms.

> SFO is a strong supporter of High-Speed Rail. Connecting SFO to HSR will provide outstanding service to our passengers, providing quick and convenient connections to the rest of California. HSR will put SFO on [a] par with other world airports already benefiting from HSR, including Hong Kong, Shanghai, Tokyo, Frankfurt, and Zurich.
>
> *John L. Martin, San Francisco Airport Director*

California's drivers will see significant relief in traffic congestion, with a reduction of 320 billion vehicle miles traveled over the next 40 years. That will translate into 146 million hours saved for Californians each year—time spent doing better things than sitting in traffic. Similarly, airport congestion will be reduced. Ample precedent for this exists around the world. When high-speed rail service was introduced between Madrid and Seville, Spain, the share of trips taken by plane was reduced from 40 percent to 13 percent, and rail trips grew from 16 percent to 51 percent. This reduction in air travel means that limited airport capacity can be used more efficiently for longer-haul routes where aviation is more cost-effective and energy efficient.

This type of shift from automobiles and airplanes to high-speed trains has been the consistent experience internationally, from Taiwan to Germany, France, and Spain. Moreover, HSR has also generated an overall growth in travel, not just a reallocation between modes. The increased mobility from HSR prompts greater travel, generating more economic activity. On the high-speed route between Paris and Lyon, France, for example, half of the trips taken were new trips. The efficiency, reliability, and connectivity between economic centers provided by HSR contribute to long-term economic benefits. With implementation of the HSR system in California, as many as 400,000 long-term jobs could be created as the state's economy becomes more efficient.



The French and Spanish high-speed rail systems, which were built in phases and continue to expand, demonstrate a decrease in air and automobile travel and an increase in rail travel.

How phased implementation will work

Prior to this Business Plan, there was no clear delineation of how a statewide high-speed rail system would be delivered. Moreover, in the past, high-speed rail has been viewed as a stand-alone system with connections to local services. The sheer scale of the program—500 miles of rail lines in Phase 1 traversing the diverse geography of the state—makes the development of a clear plan critical. In the absence of such a strategy, the current budgetary and economic climate has prompted questions about the viability of moving forward.

The priority is to construct the first Initial Operating Section, or IOS. At that stage, a private operator will be brought on board to operate service, and the potential for attracting private capital investment is greatly enhanced. At the IOS stage, connections can be made with regional and local rail systems, allowing blended operations in metropolitan areas. By linking with existing commuter and intercity rail systems on both ends, travelers can conveniently reach final destinations throughout metropolitan San Francisco and Los Angeles as well as points in between. Two options for the IOS have been developed: one connecting the Central Valley to San Jose and the other extending service to the San Fernando Valley. Combined, they result in the Bay to Basin system, providing direct linkage on high-speed rail between the north and south.

Construction of the Initial Operating Section begins with the Initial Construction Section, or ICS—a 130-mile system "spine" through the Central Valley. If conditions warrant prior to implementation of the IOS, the ICS can be used by Amtrak's San Joaquin service, cutting travel time by 45 minutes for the one million passengers currently using that line. The ICS will also become the first high-speed rail test track in the nation. The federal government has already provided funding for the ICS, and state funding can be used to match it, allowing construction to begin in 2012, with completion in 2017.

Under our cooperation agreement which has been in place since 2003, we have been pleased to be able to provide the California High-Speed Rail Authority with information regarding develop-ment of the Spanish HSR system, and to discuss … various issues related to development of the system in California. There are nu-merous parallels between Spain and California with regard to HSR, including the distance between key cities and the potential for significant mode shift from air to train travel for those cities. We believe that the phased approach to building the system makes sense; in fact, it is very consistent with how the system has been developed here in Spain.

Ministry of Public Works/
Spanish Government

As discussed in this Business Plan, a portion of the necessary funding to reach the first IOS is identified, and potential funding and financing tools are described for the remainder. Several existing and proposed federal programs are identified that can support large portions of the project's funding requirements. Importantly, the state has authorized $9 billion in Proposition 1A bonds, and projec-tions illustrate that an additional $11 billion should be available in private capital when the IOS is completed. As additional funding becomes available, operating sections will be added, to create the full statewide system. This incremental approach is how most large transportation projects are built, both in the U.S. and around the world. It will accelerate benefits for California and will attract private investment far earlier than if the system were moved ahead as a whole.

The Bay to Basin system will connect the San Francisco Bay and Los Angeles metropolitan areas, along with the state's fastest growing region—the Central Valley—with world-class high-speed rail service.

Exhibit ES-1. Capital costs for phased sections (billions 2010$)

Section[1]	Length (approx)	Endpoints	Service Description	Incremental Cost (billions 2010$)[2]	Cumulative Cost (billions 2010$)[2]
Initial Construction Section	130 miles	Fresno–Bakersfield	Provides track and structures to support system spine	5.2	5.2
IOS-North	290 miles	Bakersfield to Merced and San Jose	Supports 220 mph HSR service; includes trains and systems. Ridership and revenues sufficient to attract private participation. Connects with regional/local rail for blended operations	19.4 to 26.4	24.6 to 31.7
IOS-South	300 miles	Merced to the San Fernando Valley	Supports 220 mph HSR service; includes trains and systems. Ridership and revenues sufficient to attract private participation. Connects with regional/local rail for blended operations.	21.4 to 25.8	26.6 to 31.0
Bay to Basin	410 miles	San Jose and Merced to the San Fernando Valley	First HSR service to connect the San Francisco Bay area with the Los Angeles Basin.	14.2 to 17.3	40.8 to 48.3
Phase 1 Blended	520 miles	San Francisco to Los Angeles/ Anaheim	Builds on Bay to Basin with blended operations with existing commuter/intercity rail, and additional improvements for a one-seat ride, connecting downtown San Francisco and Los Angeles/ Anaheim. Caltrain corridor electrified for HSR, and new dedicated lines into Los Angeles and Anaheim	14.1 to 18.0	54.9 to 66.3
Full Phase 1	520 miles	San Francisco to Los Angeles/ Anaheim	Continues dedicated high-speed alignment in full from San Jose to San Francisco and into Los Angeles/Anaheim.	8.2 to 10.5	65.4 to 74.5

[1] Decision on which IOS to advance will be made at a future date, as described in Chapter 2, A Phased Implementation Strategy.

[2] Ranges reflect the difference between the combination of lowest cost feasible options and the combination of highest cost feasible options.

How funding and financing can deliver the system

Funding for the system will require a mix of federal, state, and private sources and use of innovative program delivery models that allow the private sector to design, build, operate, and help finance the system. Specific funding approaches are detailed in this plan; potential program delivery models are explained as well. Delivery approaches rely on the private sector to perform the final design and to provide operations, ultimately resulting in a franchise to operate the full system. **Private-sector involvement is feasible because each of the operating sections generates a net operating profit.** Chapter 5, Business Models, includes a discussion of proven delivery and financing methods applicable to the high-speed rail program. Based on projected cash flows from operations, nearly $11 billion in potential private-sector capital is anticipated once an IOS is in operation. These funds can provide a significant contribution toward completion of the Bay to Basin system.

Phased implementation provides two additional benefits with respect to project funding and finance: the funding required to advance any individual section is significantly less than if the system were to be constructed all at once; and risk is reduced for each subsequent section due to the successful performance of HSR operations on prior sections. In this way, success feeds on success and enhances the ability to attract private capital and operating expertise.

The Business Plan includes an *illustrative scenario* for use in projecting performance of the system. This illustrative scenario does not represent or suggest decisions by the California High-Speed Rail Authority's Board or staff. In order to generate key performance data, this illustrative scenario includes several basic assumptions regarding the Bay-to Basin and Phase 1 operating sections: the system will be completed by 2033; the average ticket fare between San Francisco and Los Angeles will be $81 (83% of anticipated airline ticket prices) in 2010 dollars, with up to nine trains per hour during the peak period; express trains will take under three hours between San Francisco and Los Angeles; multi-stop trains will take longer.

For this Business Plan, an illustrative schedule was adopted, extending the date for completion of Phase 1 from 2020 to 2033 to mitigate funding and other risks. Based on this schedule, costs have been inflated to assess the total costs in the year of expenditure. The following assumptions were included in the estimates through Phase 1:

- $16 billion in contingencies
- $27.5 billion in inflation costs, tied to time
- 2010 costs are inflated at 3 percent per year until final expenditure

Capital costs for each section are shown in Exhibit ES-2 in 2010 dollars and inflated year-of-expenditure dollars.

Exhibit ES-2. Illustrative case showing impact of 2033 schedule on year-of-expenditure cost

Section	Incremental Capital Cost (Billions 2010$)	Cumulative Capital Cost (Billions 2010$)	Completion of Section	Incremental Year of Expenditure Capital Cost	Cumulative Year of Expenditure Capital Cost
ICS	5.2	5.2	2017	6.0	6.0
IOS-South	21.4	26.6	2021	27.2	33.2
Bay to Basin	14.2	40.8	2026	21.1	54.3
Phase 1 Blended	14.1	54.9	2030	23.9	78.2
Phase 1 Full HSR	10.5	65.4	2033	19.9	98.1

Three ridership scenarios were modeled: Low, Medium, and High. As described in Chapter 6, Ridership and Revenue, conservative assumptions for key factors, such as population and the cost of driving, were assumed throughout the modeling. Operating and maintenance costs are highly correlated to the number of riders and use of the system; that is, the more riders, the more trains needed and the higher the cost of operating and maintaining them.

Analysis of the three scenarios shows that there are net operating profits (revenues minus operating costs) from the first year of operation under each phasing scenario (Exhibit ES-3). This is a consistent finding across operating segments, phases, and development scenarios once an IOS is achieved. The IOS-South has stronger projected ridership and net operating profits when compared to the IOS-North.

Exhibit ES-3. Operating results for IOS-South, year 2025

Ridership Scenario	Ridership (millions)	Revenue (millions)	Operating and Maintenance Cost (millions)	Net Operating Profit (millions)	Operating Subsidy?
High	10.8	$1,195	$613	$582	No
Medium	9.1	$1,002	$539	$464	No
Low	7.4	$810	$458	$352	No

Projections demonstrate that high-speed rail in California will be viable, even at the very conservative Low scenarios. Each operating section is projected to generate an operating profit and not require a subsidy. This is not only important in terms of achieving the Proposition 1A criteria, but it supports investment of private capital for construction.

The role of the private sector

Development of the high-speed rail system will involve significant private-sector engagement, starting with the Initial Construction Section in 2012. The private sector will be brought on board through design-build contracts to finalize the design of the ICS and then construct it. This will result in the transfer of key risks from the public to the private sector where they can be better managed—an important part of the program's cost containment strategy.

As explained in Chapter 8, Funding and Finance, the Business Plan does not assume capital investment in the system until the first Initial Operating Section is in place and generating revenues. This is the point in the program at which risks have been reduced sufficiently to allow access to more private capital at lower costs. One mechanism for seeking early investment is by allowing and seeking unsolicited proposals for private-sector participation from interested parties. Under this process, the Authority invites investors, concessionaires, constructors, and other parties to submit proposals for advancing the program in ways not currently planned. These proposals might include alternative financing and delivery mechanisms, innovative financing arrangements, and alternative implementation strategies. If unsolicited proposals are received, they need to be analyzed to determine if they are in the state's best interests, and a determination would be made if they should be actively considered, which would involve allowing competitive proposals to be submitted.

Alternative financing and delivery processes, including early investment by the private sector in programs, continue to be developed and adapted. Although more prevalent outside the United States, innovative public-private partnerships are being introduced and used more frequently here. Adoption of a policy to encourage unsolicited proposals for private-sector involvement in the high-speed rail program will be an important tool to accelerate the development of the IOS and projects related to blended system improvements.

A portion from a letter printed in the Sacramento Bee from the Mayors of San Francisco, Sacramento, San Jose, Fresno and Los Angeles:

"California will need high-speed rail in the coming years to do something about the gridlock on our roads and at our airports. Building it is a major investment, but the most recent estimates say it would cost twice as much over the next generation to build new highways and runways just to move the same number of people. With California expected to grow by 12 million people in the next 25 years, investment in the State's transportation system is inevitable, and high-speed rail is a cost-effective alternative."

How the program will be managed

As the program transitions to the implementation stage, two of the most important keys to success will be the integration of high-speed rail with other transportation systems and agencies and the transparency of information and decision-making. This Business Plan takes important steps to lay the foundation for both.

As is the case throughout the world where high-speed rail has become a key part of economic growth and sustainable development strategies, California's system must complement and leverage local and regional systems with which it connects. At each operational step prior to Phase 1, the system will connect with local and regional rail and bus systems, providing travelers with new and better options. Blended operations on the San Francisco Peninsula and in the Los Angeles Basin, starting at the IOS stage, will provide seamless integration of high-speed and commuter rail services. In turn, that will be made possible by coordinated planning and funding strategies.

The ability to effectively plan and manage the integration of high-speed rail and regional and local systems will require an open and transparent exchange of information with stakeholders and decision-makers. An example of this is the establishment of the Southern California Passenger Rail Planning Coalition. Consisting of the major public and private rail transportation providers in the region, the coalition is assessing joint planning and operations opportunities and coordination of investment in corridors. Similar discussions involving multiple agencies in the San Francisco Bay area are producing promising results, as is the case with agencies in the Central Valley. As the program moves into implementation, the importance of engaging all stakeholders, including the Legislature and the public, in decision-making is critical. The Authority is committed to engaging more effectively with stakeholders and making important steps forward to improve information sharing.

Contents of the Business Plan

The 2012 Business Plan addresses the requirements in Section 185033 of the Public Utilities Code. The Business Plan also includes summaries of key changes in implementation strategy, ridership, and costs from the 2009 Business Plan. Case studies of foreign high-speed rail systems that have informed the development of the Business Plan and a series of technical supporting documents will be posted on the Authority's website at: www.cahighspeedrail.ca.gov/business_plan_reports.aspx.

In accordance with the requirements for the funding plan, the Business Plan includes the analysis of scenarios that assume hypothetical annual funding levels and schedules. These scenarios are illustrative only and do not represent or suggest decisions made by the Authority's Board or staff, or by other stakeholders.

Central Tenets of the 2012 Business Plan

Analysis

- A thorough re-evaluation and review of ridership models, with international peer review of the model and methodology
- An update of project capital and operating costs, using conservative inflation assumptions and a large contingency budget
- A re-examination of whether a revenue guarantee would be required
- A re-thinking of the critical relationships between HSR and local/regional transit systems
- An analysis of whether the system could be built in segments, with each having independent utility
- A reassessment of the federal and state funding environment, particularly over the short term
- A realistic appraisal of when and how private capital will be available

Conclusions

- The ridership model is sound and can be used for business planning. Projections show that the Initial Operating Section will generate a net operating profit.
- The capital costs have grown, as more engineering and environmental analysis has been done. However, the new capital costs are an accurate, current reflection of the cost of building out the segments and the system, with sufficient contingency to address foreseeable changes.
- Under this plan an operating subsidy will not be required. California HSR will be able to sustain operations going forward, consistent with HSR systems around the world. Profits will be able to contribute to future construction costs.
- Criticism that HSR has failed to leverage existing regional rail systems has been justified. The 2011 Business Plan moves toward a much fuller integration with those systems and to realize the benefit of advanced investment in upgrading those existing lines. The Authority plans to use those systems for strategic connections in the early years and to run "blended service" (i.e., HSR trains running at appropriate urban-area speeds on existing or improved tracks where possible).
- It is both desirable and necessary to construct HSR in phases—adding lateral segments and later service-level upgrades. This can be done so that each segment has independent value and so that funding confidence can be achieved before each such segment is commenced.
- The Authority realizes that the current funding environment is challenging and has not assumed any additional federal funding before FY 2015. However, there are sufficient funds to construct the foundation segment of HSR and secure important right-of-way. Moreover, progress toward fully funding the all-important Initial Operating Section can be secured from a variety of potential sources.
- The private sector will play a major role in HSR. This project neither can nor should be built entirely with public funds. We expect private-sector operations and maintenance in the near term. Significant private capital is available upon completion of the IOS and demonstration of ridership, and we are actively working with the private sector to explore innovative, cost-effective ways to secure private participation for all elements of the program.

Chapter 1

High-Speed Rail's Place in California's Future

Introduction

California's transportation system, once the envy of the world and a key driver of economic growth, is facing gridlock.

- California's 170,000 miles of roadway are the busiest in the nation.[1] Six California urban areas rank in the 30 most congested in the nation: Los Angeles-Long Beach-Santa Ana, San Francisco-Oakland, San Jose, San Diego, Riverside-San Bernardino, and Sacramento.[2] As a result, the statewide cost of time lost and fuel wasted in traffic congestion is estimated at $18.7 billion annually.[3]
- Travel on California's Interstate system is increasing at a rate five times faster than capacity has been added, with vehicle miles traveled increasing by 36 percent between 1990 and 2004, and the number of Interstate lane miles increasing by only 7 percent during that same period. This increase in traffic has significantly increased congestion.

Six of California's metro areas are among the most congested in the nation.

- The busiest short-haul air market in the country is between the Los Angeles and San Francisco metro areas with hundreds of daily flights and more than 5 million passengers annually. This is larger than the New York to Washington, D.C. market.
- The LA-San Francisco air route is one of the most delay-prone in the nation, with approximately one out of every four flights delayed by about an hour.[4]
- San Diego-San Francisco, Los Angeles–Sacramento, and Los Angeles-San Jose are also in the top 20 short-haul air travel markets in the nation, representing millions of additional annual passengers.[5]

California has some of the busiest "short-haul" air travel markets in the nation with hundreds of daily flights traveling to and from major airports along the high-speed rail corridor.

Continued airport congestion will have a tremendous negative impact. For example, a recent study of three New York area airports concluded that, in 2008, the total value of lost time to travelers resulting from congestion was $1.67 billion. This same study concluded that for business travelers, the travel time lost cost $676 million.[6]

High-speed rail will help reduce San Francisco airport delays

A recent study prepared to support the Bay Area Regional Aviation System Planning (RASP) Update forecasts that passenger demand to and from the Bay Area's commercial airports will grow from 61 million passengers in 2007 to approximately 101 million passengers in 2035. The study predicts severe delays at SFO by 2035 unless something is done to accommodate growing aviation demand. The study evaluates a range of scenarios to meet this growth. The study concluded that scenarios that include a high-speed rail component were the highest performing with the greatest reduction in future delay. It found that HSR could be an important part of a regional strategy to serve future air passenger demand, from capacity and environmental perspectives.[7]

What are our transportation alternatives?

In the past, transportation efficiency has been one of the competitive advantages for California in the global marketplace. The state cannot continue meeting the demands of 50 to 60 million residents by taking a "more of the same" approach. California's projected population growth will necessitate, and support, viable new transportation alternatives. Keeping pace with this anticipated growth will require major new investments in state transportation infrastructure.

> **With 20 million more people expected to be in California within the next 40 years, we can't build enough highways and airport runways to accommodate the demand.**
>
> *Joseph C. Szabo Federal Railroad Administrator*

> **Passenger rail will play a much greater role in how Californians move throughout the state to ensure California's economy keeps moving forward.**
>
> *U.S. Department of Transportation[8]*

To put this additional demand in perspective, by 2050 California will *add* more people than now live in New York state.[9] California's existing infrastructure cannot be expected to support that level of population growth and the additional travel demand it will generate. To keep the state moving and to remain economically viable, California will need to add significant new capacity to its transportation network and these investments, no matter what they are, will cost tens of billions of dollars to build and millions of dollars a year to maintain. The question facing California is how to make the most effective capacity investments? Issues such as land use, cost-efficiency, economic competitiveness, livability, and community impacts all need to be considered in answering that question.

Through the passage of the Global Warming Solutions Act of 2006 (AB 32) and the Sustainable Communities and Climate Protection Act of 2008 (SB 375) California has established a clear policy direction for future growth. AB 32 fights climate change by establishing a comprehensive program to reduce greenhouse gas (GHG) emissions from all sources—with passenger vehicles being the largest source of GHG emissions, accounting for approximately one-third of total emissions. SB 375 supports and builds on that policy by requiring that emissions reduction targets be established by the state's metropolitan planning organizations (MPOs) and that each MPO develop a Sustainable Communities Strategy to achieve the emissions target for their region. The statewide high-speed rail (HSR) system supports these major policy objectives. Conversely, adding more freeway lanes and expanding airports just to accommodate growing intrastate travel runs contrary to those objectives.

Assuming that such expansions would even be feasible, providing the same new capacity as the San Francisco to Los Angeles/Anaheim HSR system would cost California approximately twice as much as the HSR investment. As shown in Exhibit 1-1 building equivalent capacity through road and airport expansions would cost an estimated $114 billion ($2010), which is equivalent to $171 billion in year-of-expenditure dollars. **To achieve the same capacity as the HSR system, California would need to construct:**[10]

- **2,300 new lane-miles of highway**
- **115 additional gates at California airports**
- **4 new airport runways**

Exhibit 1-1. Comparing the cost of HSR to the cost of highway and airport expansion

Transportation Alternative	Added capacity	Required Investment (2010$)	Required Investment (YOE through 2033)
High-speed rail	Full Phase 1 San Francisco-Los Angeles/Anaheim 520 miles	$65 billion	$98.5 billion
Highways and airports	2,300 new miles of highway 115 new airport gates 4 new runways	$114 billion	$171 billion

Year-of-expenditure (YOE) dollars account for inflation over time-between now and the time when the money would be spent to complete a project. For the YOE calculations used throughout the 2012 Business Plan, a 3 percent inflation rate was assumed. To estimate the YOE costs for the equivalent highway and airport expansion, the same illustrative implementation schedule discussed in the Executive Summary, which assumes that the investments are completed by 2033, was used.

The choice California faces is not whether to build *both* the high-speed rail system *and* undertake a major freeway/airport expansion program, it is which of these two fundamental options is more affordable and what is most consistent with California's environmental, land use, and economic objectives.

Even with implementation of AB32 and SB375, some limited expansions to the state's highway and aviation networks will be needed. However, recent trends suggest that the ability to add significant new highway mileage is limited and could not approach the 2,300 miles noted above. In the last two decades, the state has added less than 1,000 miles in a period when two major federal surface transportation programs significantly increased available highway funding for California. Attempts to gain approval for new or expanded runways at San Francisco International Airport have not been successful. Such alternatives run counter to state policies and create noise, air quality, and other livability impacts that engender significant opposition from adjacent communities. In addition, expanding freeways and airports would require extensive right-of-way in California's dense urban areas, would be more costly than HSR, and would conflict with the land use and development goals of most communities. As part of a balanced transportation system, a statewide HSR system can provide the additional capacity needed to keep a state with 60 million people moving.

High-speed rail makes sense in California

HSR is a viable option to expand the state's transportation capacity while supporting environmental objectives.

Two studies recently prepared by America 2050 evaluated corridors where conditions exist to support strong passenger demand for high-speed rail services.[11] The studies concluded that the following attributes make California an ideal geography for high-speed rail:

- **Population size and growth**—California has some of the largest and fastest growing regions in the nation.
- **Transit connections**—California has numerous city centers where existing transit networks provide connectivity.
- **Existing intercity rail market**—California has well-patronized intercity rail services, with Amtrak's Pacific Surfliner and Capital Corridor lines representing the second and third highest volume corridors in the nation, respectively.
- **Freeway congestion**—California has some of the most congested highways in the nation.
- **Economic productivity**—California has highly productive metropolitan regions, leading to a well-established intercity travel market.
- **Megaregions**—California's high-speed rail system will connect two key megaregions: the San Francisco Bay area and the Los Angeles Basin via the Central Valley.

> **What this means for us in the Central Valley as a region, and in Fresno as ground zero for the start of this most ambitious project: a positive, clean, environmentally sound transportation alternative that will infuse into our sagging agrarian economy a much needed game-changing boost that will be beneficial for at least the next 100 years.**
>
> *Edward P. Graveline, Former Vice Chair, California High-Speed Rail Authority*

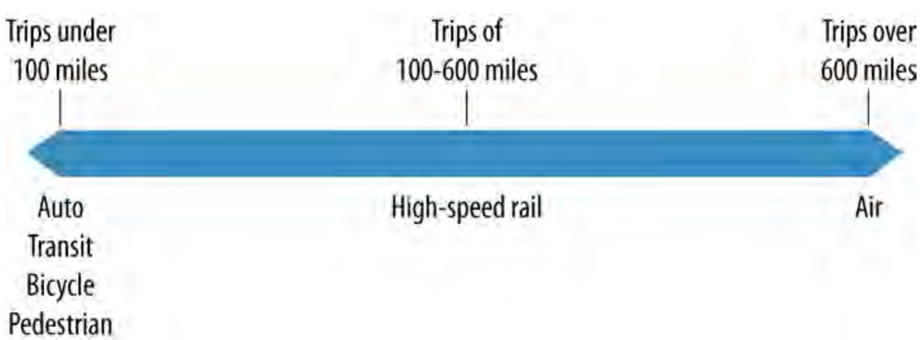
Around the world, high-speed rail continues to demonstrate its value as a complement to other transportation modes. It reduces transportation costs and demand for oil, mitigates highway and air traffic congestion, enhances other forms of public transportation, promotes livable communities, supports sustainability objectives, increases land values, links metropolitan regions together and with suburban and rural population centers, and spurs economic development in communities both large and small. These benefits accrue from long-term planning and careful program development and they support state policy. This is evidenced in Japan, Spain, France, and Germany, among other nations, where such benefits have been realized and the commitment to improve high-speed rail continues to enhance these countries' transportation networks and global competitiveness.

High-speed rail fills a gap

Other countries' experiences demonstrate that high-speed rail meets some specific transportation needs more effectively and efficiently than other modes. As shown in Exhibit 1-2, for trips between 100 and 600 miles, automobile and air travel become inefficient measured in cost, time, energy, and greenhouse gas emissions. High-speed rail is much more efficient and economical for these shorter intercity trips, yielding substantial savings in cost, fuel, safety, and time, as well as environmental benefits. The availability of high-speed rail between key cities can free airport capacity for long-haul flights, promoting efficiency in both modes. An example of this is the implementation of high-speed service between Madrid and Seville, Spain. The share of passengers using rail for trips between the two cities increased from 16 percent to 51 percent, and the total traffic between the two cities increased by 35 percent overall; this indicates that high-speed rail induced some travelers to make the trip between Seville and Madrid that previously were not travelling between those destinations.[13]

> **Based on the experience in Europe and the Northeast Corridor, rail trip times of less than three hours between Los Angeles and the Bay Area are likely to capture the vast majority of the point-to-point travel between the two regions.**
>
> *Regional Plan Association*[12]

Exhibit 1-2. Most efficient methods of travel based on trip length



High-speed rail is particularly cost-effective with oil prices at or above current levels. For California, this should factor into decisions about how to make the most efficient use of transportation resources and infrastructure and how to focus limited funding.

As the first state to develop and operate HSR, California stands to benefit by strengthening its economic competitiveness and becoming a national HSR hub. In the 1950s and 1960s, California seized the moment and took the leadership role in the burgeoning aerospace industry. Although employment has declined from its peak, aerospace remains an important California industry. Much the way the advent of aerospace industry was a boon for California, the introduction of high-speed rail in the United States can be a catalyst for growth. The first state to develop high-speed rail likely will be the state that becomes the country's home to domestic research, engineering, production, assembly, and repair of high-speed rail equipment.

Strengthening California's economic competitiveness

California's standing as a national and global leader has been shaped by a series of investments in its people, infrastructure, and economy. Decisions to move forward with bold initiatives have helped make California one of the world's largest and most diverse economies. Some of these transformative initiatives were undertaken during economic downturns and even during the Great Depression of the 1930s, creating jobs when they were most needed and laying the foundation for future growth and prosperity.

These and other forward-thinking decisions propelled California into economic powerhouse status. With its $1.9 trillion economy, California ranks among the 10 largest economies in the world. Today, however, the State's infrastructure is straining to keep up with increased demands in light of constrained budgets, rising energy prices, and environmental challenges. This is especially true of California's transportation system, which is stretched to capacity. New investments are needed to support the continued health and growth of California's economy and quality of life.

Californians have clearly recognized the need for investment and have repeatedly demonstrated their willingness to support major infrastructure initiatives. Super-majorities of voters in 19 counties, accounting for 81 percent of the state's population, have approved local sales tax measures generating a combined $140 billion[14] in local and regional transportation investments.

> **"I would like to be part of the group that gets America to think big again.**
>
> *Governor Jerry Brown, August 16, 2011*[15]

In November 2008, Californians voted to move ahead with another game-changing initiative—the creation of a statewide high-speed rail system that will transform the state and serve as an impetus for further economic prosperity. A statewide HSR system will link the state's metropolitan areas, create a world-class network that can better position California for the future by providing a more balanced, efficient transportation system, enhance economic competitiveness, and, advance environmental goals.

Bold investments shape California's economic prosperity

Golden Gate Bridge—Many called it "the bridge that couldn't be built." But after four years, 80,000 miles of steel cable, and enough concrete to pave a sidewalk from New York to San Francisco, the Golden Gate spanned the San Francisco Bay, providing a new major artery between the San Francisco peninsula and cities to the north in Marin County.

State Water Project—California has constructed 34 dams and reservoirs, 20 pumping plants, and 5 power plants linked by more than 700 miles of canals and pipelines to provide clean, fresh drinking water and support the state's agricultural industry.

Freeway System—Today's 50,000 miles of California highways and freeways began as a vision dating back to the mid-1800s. Starting with the Arroyo Seco, California created one of the nation's first freeways and committed to develop a statewide system almost a decade before the Federal Interstate Highway System was established.

University of California Higher Education System—In the late 1800s, just 20 years after the Gold Rush, the University of California started with 10 professors and 38 students. Today it is one of the world's leading centers of academic achievement and research, serving 250,000 students on ten campuses and operating five medical centers and three national laboratories.

Since 1964, when Japan inaugurated its first Shinkansen system, 14 countries have constructed high-speed rail lines around the world, including France, Spain, the United Kingdom, and Germany, and approximately 20 other countries are planning or building new lines. As previously noted, California—with its $1.9 trillion economy—is one of the 10 largest economies in the world.[1] California's Gross State Product is 30 percent larger than the Gross Domestic Product of Russia, 143 percent larger than The Netherlands, 188 percent larger than South Korea, and 341 percent larger than Taiwan. All of these countries have made investments in high-speed rail systems a part of their strategy for economic growth and competitiveness.

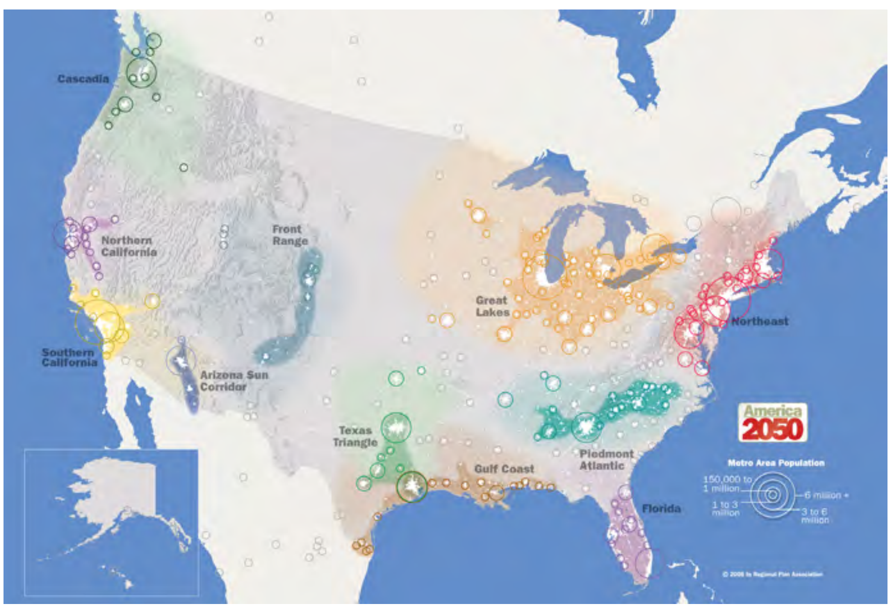
> **Most of America's major economic competitors in Europe and Asia–including Japan, Germany, France, Spain, and Great Britain, as well as rapidly developing and developed countries such as China, Taiwan, and South Korea–have already invested in and are reaping the benefits of improved competitiveness from their inter-metropolitan high-speed rail systems. Simply continuing to invest in the nation's existing transportation infrastructure may not be enough to maintain [our] standing in the global economy in the long run.**
>
> *American Society of Civil Engineers*[16]

What is America 2050?

America 2050 is a national initiative to meet the infrastructure, economic development, and environmental challenges of the United States as it prepares to grow by about 130 million more Americans by the year 2050. America 2050 is guided by a coalition of regional planners, scholars, and policy-makers to develop a framework for future growth that considers trends such as rapid population growth and demographic change, global climate change, the rise in foreign trade, infrastructure systems that are reaching capacity, and the emergence of megaregions. America 2050 serves as a clearinghouse for research on the emergence of megaregions and its aim is to advance research on this new urban form while promoting solutions to address the challenges they face. America 2050 is supported by a number of entities including the Rockefeller Foundation, the Ford Foundation, the Lincoln Institute of Land Policy, and the Doris Duke Charitable Foundation.

California's future growth is seen by many as being part of "the era of the megaregion." Megaregions Exhibit 1-3) are areas with large or dense populations but, more importantly, they are regions where significant economic capacity, highly skilled talent, scientific achievement, and technological innovations are concentrated and compete on a global scale. Megaregions produce billions—and sometimes trillions—of dollars in economic output. The greater San Francisco Bay/Sacramento area and the Los Angeles Basin/Inland Empire/San Diego region have been identified as two of America's eleven emerging megaregions by the National Committee for America 2050 (America 2050).[17] A key to California's continued economic growth and success is to foster the effective transfer and interaction of people, materials, and ideas ensuring free-flow and optimizing efficiencies within megaregions and between its two megaregions. While previous investments in the state highway system and airports facilitated this process, high-speed rail will increase and enhance its effectiveness for decades to come.

Exhibit 1-3. Megaregions of the United States



Advancing California's sustainability and livability objectives

Since its inception, the Authority set the goals of helping reduce statewide emissions and supporting sustainability policy objectives. Sustainability encompasses the concept of stewardship and focuses on how to meet the needs of the present without compromising the ability to meet the needs of future generations. Environmental economists[18] cite three common sustainability goals: to achieve enhanced and balanced social, environmental, and economic outcomes.

The statewide high-speed rail system will provide greater economic, mobility, environmental, and community benefits than relying solely on the transportation systems in place today. The high-speed rail program will help promote livable communities and support sustainable housing and development.

To further its goal to advance the system sustainably, the Authority has joined with several federal agencies to establish a partnership for sustainable planning. In July 2011, the Authority signed a Memorandum of Understanding (MOU) with the Federal Railroad Administration (FRA), the U.S. Department of Housing and Urban Development (HUD), the U.S. Department of Transportation Federal Transit Administration (FTA), and the U.S. Environmental Protection Agency (EPA). Together these agencies established seven goals centered on the need to plan, site, design, construct, operate, and maintain the system using environmentally preferable practices. These seven goals, as embodied in the MOU, are as follows:

- Goal 1—Protect the health of California's residents and preserve California's natural resources
- Goal 2—Minimize air and water pollution, energy use, and other environmental impacts
- Goal 3—Promote sustainable housing and development patterns that recognize local goals and interests
- Goal 4—Integrate station access and amenities into the fabric of surrounding neighborhoods
- Goal 5—Stimulate multimodal connectivity, thereby increasing options for affordable and convenient access to goods, services, and employment
- Goal 6—Reduce per passenger transportation emissions across California, thereby reducing associated environmental and health impacts
- Goal 7—Protect ecologically sensitive and agricultural lands[19]

These seven goals will help guide sustainability objectives as this program moves forward.

One of the ways the Authority plans to achieve these objectives is by committing to operate using 100 percent renewable energy. This will not only reduce California's dependence on foreign oil, but will also contribute to reducing pollution in the state.

The Authority has also been working with experts to help frame how HSR can enhance livability. The study *Vision California* examined how population, communities, energy use, and transportation choices, including high-speed rail, will affect California in the coming decades.[20]

Summary of Vision California—Charting Our Future

California must plan for future growth—by 2050, the state's population is expected to grow to nearly 60 million people and 24 million jobs. The path that we take to accommodate growth can lead us in many directions. Vision California is an unprecedented effort to explore the critical role of land use and transportation investments in meeting the environmental and fiscal challenges facing California over the coming decades. Vision California strives to provide the information needed to make informed decisions about how and where we want to grow, and explores how the high-speed rail network can support more compact and fiscally sustainable development across the state.

Vision California builds upon the challenges set forth by the California Global Warming Solutions Act (Assembly Bill 32) in 2006, the groundbreaking legislation that sets aggressive targets for the reduction of greenhouse gases (GHG) across the state. Meeting these targets will require taking a new direction in how we invest in and develop our communities, transportation systems, and critical infrastructure. In bolstering the framework for more sustainable land use patterns and choices across California, high-speed rail is a critical component not only in meeting these targets, but in creating healthier and more livable communities.

Vision California's statewide scenarios depict and model a "Business as Usual" future, in which we follow past development trends into the coming decades, and a "Growing Smart" future, in which growth is focused in a more compact and efficient manner. The results show a full range of benefits—from natural resource conservation to public and household cost savings—that can be realized by focused growth. Linked closely to the California high-speed rail system and its supportive feeder services, which reinforce cities as hubs of our economy and future growth, the Growing Smart scenario demonstrates how a coordinated vision for our land use and transportation investments can help us realize a more sustainable future.

As compared to a Business as Usual future, a Growing Smart future supported by the investments and connections of the high-speed rail network would yield considerable benefits for California;

- By 2050, households in the Growing Smart scenario would spend, on average, $7,250 less per year on auto-related costs and utility bills. These savings are tied to lower driving needs, energy, and water demands.
- Costs to build, operate, and maintain the local infrastructure needed to support new growth would be lowered by as much as $47 billion to 2050, reflecting the cost savings of more compact, efficient development patterns.
- More compact development patterns, along with more efficient cars and buildings, cleaner fuels, and a cleaner energy portfolio are all essential to reduce GHG emissions. The Growing Smart scenario prevents the release of 70 million metric tons of CO2 equivalent in 2050, or 25 percent less than a Business as Usual future.
- The Growing Smart scenario would reduce emissions equivalent to a forest covering 45,000 square miles, about one-quarter the size of California.
- Local revenues would be higher by $120 billion, or $2.7 billion per year, due to the higher property values of more compact and urban development.

The proportion of housing types in the Growing Smart future, in which 37 percent of new homes are single-family detached and 63 percent are townhome and multifamily, is supported by real estate market analysis that indicates that demand is moving away from larger single-family detached homes toward smaller detached or attached housing units. Affordability, accessibility, and demographics are key factors behind this change. Market analysts predict that apartment and townhouse living near transit will drive much housing demand going forward, in California and nationwide. In California, the shift is strong enough such that the current supply of large-lot single-family detached homes may already exceed the total demand for that housing type projected in 2035. On a related note, demand for homes in transit-oriented developments (TODs)—those within one-half mile of transit stations—is high enough to surpass the over 3.7 million new residential units of all housing types expected to be built to 2035.

The California high-speed rail network, and the regional and local transit services to which it is linked, are integral to this vision for the future. As regional and local land use plans and policies evolve to meet California's energy and water challenges and the state's greenhouse gas and pollution reduction targets, the synergy between meeting environmental goals and changing lifestyle preferences has become clearer. Targeted investments in statewide, regional, and local transportation networks are necessary to bring about a more environmentally sustainable and economically healthy future. These same investments will help create and reinforce the living options that promote mobility, accessibility, and the community-friendly amenities (such as sidewalks, narrower streets, shops and services, and parks) desired by many Californians.

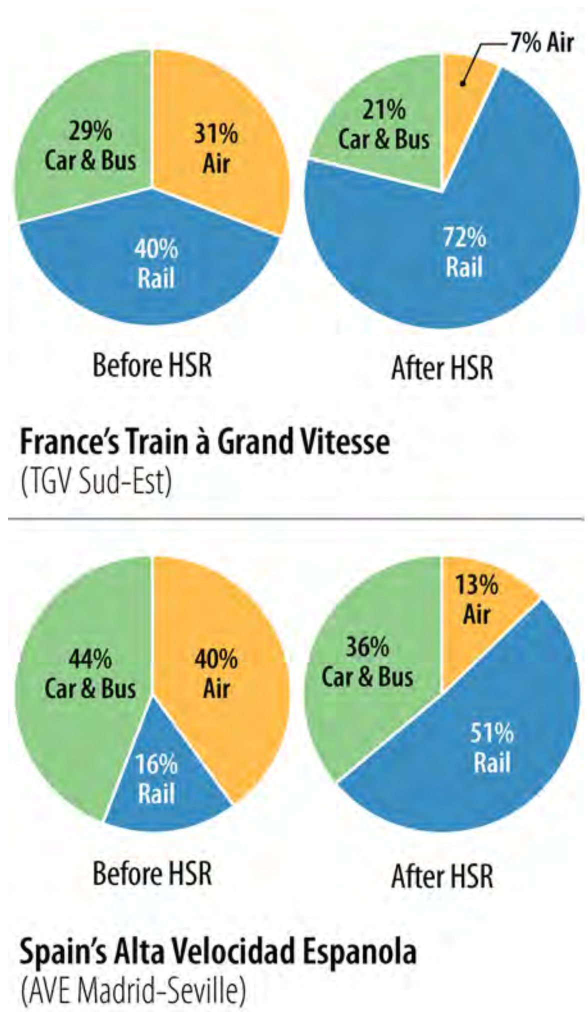
How does California high-speed rail compare to international programs?

The Authority has consulted with other countries to learn from their experiences implementing high-speed rail, how it fits into each country's broader intermodal transportation network, and to apply important lessons learned in developing California's system. The Authority is drawing from this wide experience in a variety of ways—from project development, to ridership forecasting and estimating operating costs, and determining how the private sector can participate in building and operating the system. California has entered into agreements with nine countries that have already built high-speed rail and has regularly exchanged information and sought feedback on planning and development, technical standards, technologies, procurement methods and submissions, funding options, and operation and maintenance, among other topics.

Some relevant findings shared among the countries having HSR systems include the following:

- According to the International Union of Railways, high-speed rail systems throughout the world achieve positive operating revenues. The revenues generated from fares and other sources more than cover the cost of operating and maintaining the system.[21] Many systems generate sufficient revenue to cover not only the operating costs associated with the initial phases but also to help fund extensions. Two high-speed sections, the Paris-Lyon TGV route in France and the Tokyo-Osaka route in Japan, have fully covered both their infrastructure and operating costs after 15 years of service.

Exhibit 1-4. Mode of travel before and after high-speed rail operations in France and Spain



- Japan Rail, which began service in 1964, is notable for its positive safety and reliability records, having carried more than six billion passengers without a single fatality caused by collision or derailment.
- Introduction of high-speed rail in other countries has resulted in modal shifts from air and car to high-speed rail, creating a more balanced and efficient transportation system. As shown in Exhibit 1-4, France and Spain provide good examples of travelers shifting to HSR from other travel modes once high-speed rail became an option.
- As a result of its speed and convenience, the new Alta Velocidad Espanola, or AVE railway line that opened in 1992, radically changed the

transportation patterns and modal travel split between major cities in Spain. Within 10 years of beginning operations, high-speed rail transported more than four times as many passengers as planes between Seville and Madrid, freeing limited airport capacity for long-haul flights.[22] Between Madrid and Seville, rail modal share increased from 16 percent to 51 percent between 1991 and 1994.[23]

- In 1981, during the first year of operation, the French Train à Grande Vitesse, or "TGV" system, carried 1.26 million passengers. Three decades later, in 2010, the expanded TGV system carried 160 million passengers.[24] Rail gained more than 32 percent market share after high-speed rail was developed between Paris and Lyon in the 1980s.
- In its first year, the Japanese Tokaido Shinkansen line between Tokyo and Osaka carried 23 million passengers. By 2008 that line was carrying more than 151 million passengers.[25] The Shinkansen currently has more than an 80 percent share of the transportation market between those two cities.

Moving forward

California's history of investing in game-changing infrastructure improvements has been key to making the state an economic powerhouse. The vision for high-speed rail as the next such investment is reinforced by the experience of other countries—some of them California's competitors in the global economy—in demonstrating that high-speed rail is key to a more efficient transportation system, boosts economic productivity, and promotes sustainability. Leaders of California's major cities recognize this and have called for the state to move ahead and make high-speed rail a part of California's future (Exhibit 1-5).

Exhibit 1-5. State's mayors support high-speed rail

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Viewpoints: Case for high-speed rail grows only stronger

Special to The Bee

The last time many Californians thought about high-speed rail was in the voting booth. On that day, Nov. 4, 2008, more than 6 million of us voted to tell the state to get going, to build high-speed rail in California.

Now, 2 1/2 years later, the second guessing is in full swing. In recent weeks some have suggested that we should put the project on hold.

We couldn't disagree more.

California will need high-speed rail in the coming years to do something about the gridlock on our roads and at our airports. Building it is a major investment, but the most recent estimates say it would cost twice as much over the next generation to build new highways and runways just to move the same number of people. With California expected to grow by 12 million people in the next 25 years, investment in the state's transportation system is inevitable, and high-speed rail is a cost-effective alternative.

In the last 2 1/2 years the case for high-speed rail has gotten stronger, not weaker. When voters approved the plan, a barrel of oil cost about $55; today the price is almost $100. Unemployment was around 8 percent back then, and it is now over 12 percent statewide and even higher in many areas. Californians need the jobs.

There are bound to be questions with any project of this size. We welcome the dialogue. Last month the Legislative Analyst's Office published a report calling for at least a temporary halt to the project. The report alluded to a number of concerns about the project:

The amount and timing of future federal funding are unclear.

Spending state funds on rail will mean there is less money for other things.

We do not yet know how much private investment the system can attract, or when it will come.

Starting construction in the Central Valley is "a gamble."

Let's take the criticisms one at a time.

First is federal funding. While we don't know precisely how much we will get in future years, we've competed well up to this point. California's project has received the largest slice of federal high-speed rail funds to date – $3.6 billion out of $10.2 billion. This is in large part due to the extensive planning already under way at the state level and the ability to leverage voter-approved Proposition 1A funds. There is no other program where California competes so well for federal funding. We will continue to encourage additional investment – both public and private – while promoting efficiencies that allow us to stretch every dollar in creating jobs and planning for the future growth of this great state.

Second is state funding. The voters said high-speed rail was a priority and authorized spending $9 billion in state funds. The state continues to experience fiscal constraint due to diminishing revenues, but because construction is ramping up slowly we will only need 2 percent of these funds in the coming year to keep the project on track. The amount approved by voters will be spent over many years, keeping the impact on our state's budget low in any given year.

Third is private funding. Our high-speed rail system is expected to make money and attract private investment – similar to systems in Europe and Asia. Twenty-two different funds have shown investment interest in financing part of the system's capital costs. Demonstrating our commitment by beginning major construction and finalizing all the approvals will minimize investor risk and net the best terms for the taxpayers.

Finally, there is the matter of where to start building. Many Southern Californians have said we should give priority to their part of the state; same in the Bay Area. We know that this system will never be a success until it connects these two population centers and does so in a way that is sensitive to local concerns. But the question of where to start does not require complicated analysis. The place to start is the place where we're ready to start, and that's the Central Valley.

No one thinks we should build the line through the Central Valley and then stop. And we won't. There is a parallel to the building of the Interstate Highway System more than 50 years ago. When we started building the Interstate Highway System, the first segments to be completed were not in New York or Los Angeles. The interstate was born in the middle of the country, America's heartland, with the very first sections laid in Kansas and Missouri and then connected to the rest of the nation.

On the day that first segment of interstate was dedicated we did not know where all the money would come from to build a 40,000-mile network throughout the nation, and we did not know when it would be finished. However, it was because of the vision of those who were willing to initiate the effort that, today, America has the most extensive highway system in the world.

California and the United States need high-speed rail, so let's keep going.

Edwin Lee is mayor of San Francisco. Kevin Johnson is mayor of Sacramento. Chuck Reed is mayor of San Jose. Ashley Swearengin is mayor of Fresno. Antonio Villaraigosa is mayor of Los Angeles.

End notes

[1] *Source:* The Road Information Program. 2004. *TRIP Analysis of Highway Statistics, 2004,* Federal Highway Administration (cited by Transportation California).

[2] *Source:* Texas Transportation Institute. *2010 Urban Mobility Report* (cited by Transportation California).

[3] *Source:* TRIP 2009

[4] *Source:* California Public Interest Research Group. June 2010 "Next Stop: California—The Benefits of High-Speed Rail around the World and What's in Store for California."

[5] *Source:* Regional Plan Association. America 2050. 2011. *High-Speed Rail in America.* http://www.america2050.org/pdf/HSR-in-America-Complete.pdf

[6] *Source:* Regional Plan Association. America 2050. *High-Speed Rail in America.* http://www.america2050.org/pdf/HSR-in-America-Complete.pdf

[7] *Source:* SH&E, Inc. January 2010. *Regional Airport System Planning Analysis-2011 Update Final Report.*

[8] *Source:* U.S. Department of Transportation. 2011. "Secretary LaHood Announces $179 Million to California for Continued Development of Integrated, Statewide Passenger Rail Network." Press release. Monday, August 8. 2011.

[9] *Source:* U.S. Census Bureau. 2011. *Population Estimates.* http://factfinder.census.gov/servlet/GCTTable?_bm=y&-geo_id=01000US&-_box_head_nbr=GCT-T1-R&-ds_name=PEP_2009_EST&-_lang=en&-format=US-40S&-_sse=on)

[10] *Source:* Parsons Brinckerhoff. October 2011. "Technical Memorandum: Cost of Alternative Modes to High-Speed Rail, October 2011"

[11] *Source:* Regional Plan Association. America 2050. 2011. *Where High-Speed Rail Works Best.* http://www.america2050.org/pdf/Where-HSR-Works-Best.pdf)

[12] *Source:* Regional Plan Association. America 2050. 2011. *High-Speed Rail in America.* http://www.america2050.org/pdf/HSR-in-America-Complete.pdf

[13] *Source:* Regional Plan Association. America 2050. 2011. *High-Speed Rail in America.* http://www.america2050.org/pdf/HSR-in-America-Complete.pdf

[14] *Source:* Self Help Counties Coalition. 2011. www.selfhelpcounties.org and www.facebook.com/pages/Self-Help-Counties-Coalition/103345919749642#!/pages/Self-Help-Counties-Coalition/103345919749642?sk=info

[15] *Source:* Siders, D. August–September 2011. "Jerry Brown backs going forward with high-speed rail project." Fresno Bee. www.fresnobee.com/2011/08/18/2503133/jerry-brown-backs-going-forward.html

[16] *Source:* American Society of Civil Engineers. 2011. "Failure to Act: The Economic Impact of Current Investment Trends in Surface Transportation Infrastructure."

[17] *Source:* U.S. Bureau of Economic Analysis. 2011. "GDP by State." http://www.bea.gov/iTable/iTable.cfm?reqid=70&step=1&isuri=1&acrdn=1 (accessed August 3, 2011).

[18] *Source:* United Kingdom Department of Transport. December 2006. *The Eddington Transport Study.*

[19] *Source:* California High-Speed Rail Authority. July 2011. "Memorandum of Understanding for Achieving an Environmentally Sustainable High-Speed Train System in California." CHSRA, FRA, HUD, FTA, EPA.

[20] *Source:* Calthorpe Associates. March 2011. "Vision California: Charting our Future" www.visioncalifornia.org/Vision%20California%20-%20Charting%20Our%20Future%20-%20Report%20-%20June%202011.pdf

[21] *Source:* February 2011 "Official stance of UIC, the worldwide railway association, on the profitability of the high speed rail system." Position Paper.

[22] *Source: International Railway Journal*. September 1, 1999. "Spanish to Build More High-Speed Lines."

[23] *Source: International Railway Journal*. September 1, 1999. "Spanish to Build More High-Speed Lines."

[24] *Source:* Central Japan Railway Company (JR-Central). 2011. http://english.jr-central.co.jp/company/company/achievement/transportation/index.html (accessed July 22, 2011)

[25] *Source:* Central Japan Railway Company (JR-Central). 2011. http://english.jr-central.co.jp/company/company/achievement/transportation/index.html (accessed July 22, 2011)

Chapter 2

A Phased Implementation Strategy: Building Blocks to Link Northern and Southern California

This chapter describes a phased strategy for implementing the statewide high-speed rail (HSR) program, an approach that draws on international experience in building HSR systems. This process will create an integrated statewide passenger rail network by connecting HSR with existing regional and local rail systems. Developing California's statewide high-speed rail system is a long-term and complex program, more comparable to developing the state's freeway system or state water project than to any traditional transportation project. As with those systems, it will cover long distances over varying terrains, connect multiple cities and metropolitan areas, and will be built over a long period of time. The program's scale and complexity require an implementation strategy that best fits the available funding and recognizes national and local budgetary and economic realities. Accordingly, this business plan presents a multi-step flexible *phased* implementation strategy.

A system cornerstone will be its integration into the statewide transportation system. Proposition 1A recognized the key importance of this connectivity, authorizing both $9 billion in bond funds for HSR and $950 million for complementary improvements in the state's connecting rail systems. With connections at all new high-speed rail stations to existing regional and local transit systems, HSR will significantly enhance the passenger transportation network across the state as shown on Exhibit 2-1. Existing intercity and regional systems will provide important feeder service to the HSR. Equally important, HSR will also bring new passengers to regional and local transit systems. Blended services linking statewide high-speed rail service with regional and local transit systems will benefit travelers in the near term and provide the platform for continued improvement in rail transportation. Connectivity and mobility will improve significantly across the state by expanding the network of inter-connected public transportation systems and can be expedited through early investments in the regional systems.

Proposition 1A authorized bond funds for HSR and improvements to existing rail systems.

What does "blended" mean?

This Business Plan refers to a *blended system* and *blended operations.* This emphasis reflects the recognition that a key to success in developing a statewide rail network, including the high-speed system, is the integration of high speed and regional/local rail systems.

The commitment to a blended system has been initiated through extensive cooperative planning among state, regional, and local partners. In this chapter, additional steps are proposed for formalizing and carrying these efforts forward. As described and anticipated in this Business Plan, blended operations will begin at the Initial Operating Section stage. For example, passengers arriving on a northbound high-

Exhibit 2-1. Full high-speed rail system with connections[1]

The HSR will significantly enhance mobility across the state by expanding the network of inter-connected public transportation systems.

speed train into San Jose would be able to connect quickly and easily with a Caltrain train; schedules and ticketing would be coordinated, providing a seamless transfer to their final destination. The same would apply to southbound high-speed rail passengers arriving in the San Fernando Valley, connecting to coordinated Metrolink service. Sacramento-area passengers would see similar benefits, connecting via the San Joaquin service at Merced to a high-speed train. As further improvements are made, blended operations progress to the point where transfers would not be necessary, and passengers could have a "one-seat ride" on a train that is able to travel over both the high-speed line and upgraded regional rail lines. This would be in advance of, or, in some cases, in lieu of, the construction of dedicated high-speed lines in the metropolitan areas served by the commuter agencies.

It is important to note that, although improvements to the regional and local rail systems are intended to improve or facilitate connections with the high-speed system, they do not need to be implemented sequentially. As with the stages of the HSR system, these improvements, such as grade-crossing eliminations and additional tracks, have independent utility that will benefit riders prior to connection to the high-speed system. Where possible, they should move ahead independently and as quickly as feasible.

Creating a statewide system by leveraging state and local roles and resources

Today, extensive rail systems with high ridership levels exist within California's metropolitan areas. Recognizing the role that enhanced regional mobility plays in growing local economies and improving quality of life, cities and counties are making unprecedented investments in their transit systems. In California's most populous counties, voters have approved a combined $140 billion of investments in local transportation improvements. Los Angeles County, with its $40 billion Measure R program, is in the midst of the largest transit expansion program in the country.

As these landmark intra-regional investments are being made, what is lacking is the inter-regional connection that will tie together the state's economic centers. The state's three intercity rail lines are among the five busiest in the country, indicating a strong underlying ridership base for high-speed rail. However, they do not provide direct connectivity between the north and south. Today, state-funded Amtrak service requires passengers to switch from train to bus service between Los Angeles and Bakersfield. Speed on this rail line is capped at 79 miles per hour and it averages just over 50 miles per hour.[2] In spite of these limitations, the San Joaquin line is Amtrak's fifth busiest, with more than one million riders annually. This gap is a major detriment to greater rail ridership and closing it will be an important element of a statewide rail system.

In approving Proposition 1A, voters gave the state tools to do two things:

- Provide the HSR connection between California's economic centers
- Enhance the regional rail systems that will tie into that connection

This Business Plan ties together these two goals and can help advance both simultaneously.

Of the $950 million in Proposition 1A set aside to enhance regional rail systems, $190 million is allocated to the state's three intercity rail lines and $760 million to local and regional rail systems. Proposition 1A gave approval authority over project selection to the California Transportation Commission (CTC).[3]

> **2704.095.(a)(1) Net proceeds received from the sale of nine hundred fifty million dollars ($950,000,000) principal amount of bonds authorized by this chapter shall be allocated to eligible recipients for capital improvements to intercity and commuter rail lines and urban rail systems that provide direct connectivity to the high-speed train system and its facilities, or that are part of the construction of the high-speed train system as that system is described in subdivision (b) of Section 2704.04, or that provide capacity enhancements and safety improvements.**
>
> *AB 3034, Safe, Reliable High-Speed Passenger Train Bond Act for the 21st Century*

The $760 million for regional rail systems was allocated to 10 agencies based on existing state formula distributions. Because these 10 systems will connect directly with the high-speed system, it is imperative that the state and regional/local agencies work cooperatively to ensure that those linkages are efficient and effective. The 10 agencies are as follows:

- Altamont Commuter Express (ACE)
- Los Angeles County Metropolitan Transportation Authority (LA Metro)
- North Coast Transit District, San Diego County (NCTD)
- Peninsula Corridor Joint Powers Board (Caltrain)
- Sacramento Regional Transit District (RT)
- San Diego Trolley, Inc.
- San Francisco Bay Area Rapid Transit District (BART)
- San Francisco Municipal Railway (MUNI)
- Santa Clara Valley Transportation Authority (VTA)
- Southern California Regional Rail Authority (Metrolink)

In February 2010, the CTC adopted guidelines for the program. Those guidelines state that, "the Commission will give priority to those projects that provide direct connectivity to the high-speed train system." [4] A program of projects was identified and adopted by the CTC in May 2010. However, to date, of the $760 million, only $82 million has been approved, specifically to advance important safety programs. Two governors have vetoed the appropriation of additional funding, each citing the lack of a coordinated plan for improvements as called for in Proposition 1A and the CTC guidelines. This Business Plan, with its introduction of phased implementation that explicitly leverages statewide and regional/ local systems, provides the basis for such coordination. It can result in approval for the regional and local agencies to put their shares of the funding to use for important projects—creating jobs, transportation improvements, and economic activity as the system progresses. The California High Speed Rail Authority is committed to working collaboratively with regional and local rail operators to develop an integrated statewide rail system.

A goal of this collaboration is to identify and move forward with a program of "early investments" in the regional and local rail systems. These investments will provide two levels of benefit: first, they will benefit the riders of those systems prior to being connected to the high-speed system. Second, as the high-speed system is developed and connects with these regional and local systems, they will provide the basis for enhanced blended operations. This Business Plan builds on the foundation of Proposition 1A to lay out a framework for establishing the partnerships and coordination to create the statewide system that is needed. It recognizes that metropolitan areas have existing rights-of-way and rail service, as well as the transportation agencies that fund and provide those services. While those services and entities exist within the metropolitan areas, there is no comparable entity that exists between them to connect them. The state is the appropriate entity to fill that void and provide the connection between Northern and Southern California. Under an overarching cooperative arrangement, the agencies within the metropolitan areas can take the lead in planning, initiating, providing, and improving the intra-regional services with improvements that have independent utility and will connect to the statewide high-speed service, and the state can take the lead in developing and implementing the inter-regional connection.

To ensure that such progress can be achieved, the Authority will work with state, regional, and local agencies to establish formal processes to:

- Identify and advance mutually beneficial investments that can proceed quickly using authorized Proposition 1A funding
- Identify additional sources of funding that can be agreed upon and put to use for early investments in improvements in the regional/local systems in anticipation of high-speed rail
- Develop operational procedures to ensure seamless integration of inter-regional and intra-regional transportation services, including coordinated schedules, ticketing, marketing, and other activities
- Identify potential opportunities for improving financial performance of the various services through improved coordination, potential leveraging of resources, joint purchases, and other steps
- Develop proposals for institutional arrangements that will facilitate cooperative actions
- Develop a cooperative and complementary agenda for jointly pursuing federal support

Phased implementation

A new HSR system for California cannot be built all at once, nor should it be. As discussed elsewhere in this Business Plan, the California HSR program will depend on a mix of public and private investment, the latter becoming available after the fundamental economics of the program are demonstrated. A phased approach to system development is the prudent course to build a foundation that allows for greater efficiency in the use of private investment once the initial segments of the system are in place.

This approach also recognizes current budgetary and funding realities. Among other things, the phased approach will help ensure the system's success by introducing Californians to HSR service and building ridership over time. At the same time, improvements can be made to the regional systems that connect with HSR, resulting in the conventional and high-speed systems complementing each other.

Developing the phasing strategy for the statewide HSR system to achieve the Proposition 1A goals was guided by the following key principles:

- Divide the statewide high-speed rail *program* into a series of smaller, discrete *projects* that will be able to stand alone, will provide viable revenue service, can be matched to available funding, and can be delivered through appropriate business models
- Advance sections as soon as feasible to realize benefits, especially employment, and to minimize inflation impact
- Leverage existing rail systems and infrastructure, including connecting rail and bus services
- Forge a long-term partnership with the federal government in program delivery
- Develop partnerships with other transportation operators to identify efficiencies through leveraging state, regional, local, and capital program investments and maximizing connectivity between systems
- Seek earliest feasible and best value private-sector participation and financing with appropriate risk transfer and cost containment
- Mitigate against the risk of funding delays by providing decision points for state policy-makers to determine how and when the next steps should proceed while leaving a fully operational system and generating economic benefits at each step.

Application of these principles, taking into account key factors discussed in subsequent chapters such as cost, funding scenarios, and ridership and revenue projections, leads to a focus on the development and operation of an Initial Operating Section (IOS) that will be the state's—and the country's—first fully operational high-speed rail system. Either could be operated by a proven private operator and will generate sufficient revenues not only to cover operating costs, but also to contribute to construction of the next section. The IOS will have full independent utility and will be expanded to create the ultimate full statewide system. Each IOS will connect with regional and local systems to allow blended operations.

When combined, the two Initial Operating Sections form a "Bay to Basin" HSR system with stations at San Jose in the north and in the San Fernando Valley in the south, as shown on Exhibit 2-2. The Bay to Basin high-speed system will connect with regional and commuter rail systems in metropolitan areas, creating an integrated rail transportation system between Northern and Southern California. Through the blended approach taken at each end of the Bay to Basin system, passengers will be able to take a "one-seat ride" (meaning that they could travel from end to end without changing trains) between San Francisco and Los Angeles/Anaheim.

> "Under our cooperation agreement which has been in place since 2003, we have been pleased to be able to provide the California High Speed Rail Authority with information regarding development of the Spanish HSR system, and to discuss with you and your team various issues related to development of the system in California. There are numerous parallels between Spain and California with regard to HSR, including the distance between key cities and the potential for significant mode shift from air to train travel for those cities We believe that the phased approach to building the system makes sense; in fact, it is very consistent with how the system has been developed here in Spain.
>
> *Ministry of Public Works/Spanish Government*

The implementation steps for advancing the California HSR system are as follows:

- **Step 1**—Start construction of an Initial Operating Section with the Initial Construction Section (ICS) in the Central Valley. As with all of the steps, this initial section has independent utility, providing transportation and economic benefits.
- **Step 2**—Introduce the state's (and nation's) first fully operational high-speed service with the Initial Operating Section. This service can be operated by a private entity without subsidy, will have the potential to attract private investment in expansion to Bay to Basin, and can be completed within a decade. The service will be blended with regional/local services. The IOS is achieved through expansion of the ICS into an electrified operating high-speed rail line from the Central Valley (from Merced to Bakersfield) to the north **or** south:
  - The north extension will expand the system to Merced and San Jose.
  - The south extension will expand the system to the San Fernando Valley through Sylmar, Burbank, or Santa Clarita.
- **Step 3**—Bay to Basin will complete the remaining extension from Step 2, to the north or the south, providing HSR service between the state's major population centers in the north and south and providing the platform for blended operations in metropolitan areas.
- **Step 4**—Building from Bay to Basin—Completion of Proposition 1A Phase 1 will provide HSR service between San Francisco and Los Angeles/Anaheim through a one-seat ride and potentially through expanded dedicated high-speed rail extensions.
- **Step 5**—Proposition 1A Phase 2 will extend the high-speed system to Sacramento and San Diego, representing completion of the 800-mile statewide system. Travelers will be able to travel among all of the state's major population centers on high-speed rail. As noted earlier, some communities in Phase 2 will be able to gain access to high-speed service earlier resulting from the phasing approach.

Exhibit 2-2. Bay to Basin/Blended

The Bay to Basin system will connect the San Francisco Bay and Los Angeles metropolitan areas, along with the state's fastest growing region—the Central Valley—with world-class high-speed rail service.

Step 1: IOS begins with the Initial Construction Section

Assuming approval of a state appropriations request to use Proposition 1A bond proceeds to match federal funds, HSR construction will begin in 2012, laying the foundation for HSR with the ICS in the Central Valley. The ICS will cover approximately 130 miles of new high-speed rail alignment from just north of Bakersfield to north of Fresno. Because the ICS has a set budget tied to the award of federal funds to date, the actual length will depend on the alignment selected through the pending environmental process and prices received for the procurement of design-build contracts in 2012. Funded in significant part by the American Recovery and Reinvestment Act of 2009 (ARRA) as part of the program to promote economic recovery, construction of the ICS will bring with it much needed employment to the Central Valley—some 100,000 jobs will be created during the construction period.[5]

> Federal funding requirements for the nation's high-speed rail program were established by two related pieces of legislation: the Passenger Rail Investment and Improvement Act of 2008, which created the High-Speed and Intercity Passenger Rail Program; and ARRA. The Consolidated Appropriations Act of 2010 provided additional funding for the ICS. These federal funds require state matching funds. These are to come from California Proposition 1A bond proceeds.

The ARRA funding comes with three important requirements:

- First, because the legislative intent was to stimulate the economy, any funded project must be fully completed by September 30, 2017.
- Second, any project funded with ARRA funds must have "operational independence."
- Third, funding was limited to "rail passenger transportation except commuter rail passenger transportation."[6]

The Authority submitted funding applications for four of the Phase 1 sections:

- San Francisco-San Jose
- Los Angeles-Anaheim
- Merced-Fresno
- Fresno-Bakersfield

These sections were initially prequalified for funding. To ensure that all criteria were met, as well as conditions in Proposition 1A, the Authority, in unison with the Federal Railroad Administration, decided to use the ARRA funds to start construction in the Central Valley. Work on the selected ICS can be completed by 2017; operational independence can be achieved with the diversion of parallel existing intercity rail service should the need arise; and this section will be the first high-speed, intercity section in the state. In addition, it will become the country's only test facility for high-speed rail.

In addition to meeting the federal funding criteria, beginning construction in the Central Valley is an important first step for the California high-speed rail system. The "spine" of the statewide high-speed rail system will be created which can then be extended north and south, creating the first true high-speed rail system in the nation. Starting the ICS in the Central Valley is a cost-effective way to use initial funding. As detailed in Chapter 3, Capital Costs, the per-mile cost of building this section is significantly lower than the cost per mile of construction in developed and densely populated metropolitan areas. Moving ahead in the Central Valley, which is the fastest-growing area of the state, will allow the acquisition of necessary right-of-way before more development occurs, thus avoiding further increases in land costs or re-routing to avoid impacts on newly established residential areas. The state will own this right of way—an asset of more than $400 million that will increase in value over time.

The ICS will be built using a design-build approach under which the private sector will assume responsibility for completion of design and construction. This will allow the state to transfer design, construction, schedule, and cost risks to the private sector and obtain the benefits of the current highly competitive bidding market. Furthermore, construction in the Central Valley is relatively straightforward from a construction standpoint. This allows local contractors to become familiar with the new requirements related to construction of high-speed infrastructure, which should translate into efficiencies in later stages.

As it is expanded to an Initial Operating Section (IOS), the ICS offers a cost-effective facility on which to operate at extended periods of high speeds and resolve regulatory, safety, and technical issues. This flat, straight, and fully separated alignment is ideally suited for testing that is not possible on mountainous or tunneled sections. The country's first high-speed rail section requires the resolution of significant regulatory, safety, and technical issues and operational development before system-wide operations can begin. All future rolling stock, signaling and control systems, turnouts, and electric power systems need to be tested as a complete system. The only feasible location to do this is in a stretch of 120 miles or more in the Central Valley.

Should continued progress on the IOS be substantially delayed, the ICS could become an operational rail facility. This independent utility is a key element of each step in the development of the system. This is the first of the points at which decisions can be made to move forward or delay the next step to ensure that funding and other requirements are in place. The ICS will become operational by allowing San Joaquin service to move from its present Burlington Northern Santa Fe (BNSF) rail line onto the ICS. Without any additional improvements elsewhere, this will reduce travel times on the San Joaquin service between northern and southern California—already one of Amtrak's five busiest corridors in the country—by approximately 45 minutes. To achieve this, track connections will be built to connect the ICS to the BNSF freight line at the northern and southern ends, and minimum rail systems of signaling, positive train control, and other investments will be made to augment the base ICS infrastructure. At this stage, electrification of the route will not be required as the service is diesel-hauled. The Authority has set aside federal funds in an interim reserve fund to pay for these minimum systems and track connections required to provide independent utility and to allow interim intercity passenger service to operate on the segment if this should be required. This is consistent with the ARRA requirements discussed above.

Step 2: Initial Operating Section—California's, and the nation's, first operational high-speed service

The ICS will be expanded either to the north or to the south to create an Initial Operating Section that will connect with regional and local rail systems to provide blended service. The decision as to which to implement first is a future policy decision to be based on a number of factors, including the following:

- Ridership and revenue generation
- Capital and operational costs
- Funding availability
- Public input
- Environmental approvals
- Level and type of potential private investment

Regardless of which direction the expansion occurs, **this step will bring high-speed rail service to California**. The rail line will be electrified, necessary safety and signaling systems will be put into place, rail cars will be procured, and revenue service through a private operator will begin. As discussed in detail in Chapter 8, Funding and Financing, under the three different revenue and operating and maintenance cost scenarios analyzed, there is an operating profit from the first year of operation of each IOS.

Completion of an IOS is a pivotal step in the development of the statewide system, providing a high-speed link between either of the state's two major metropolitan areas and the fastest-growing part of California. The Central Valley, with a population approaching seven million, is larger than 38 states. By 2030, its population is projected to exceed 10 million and reach almost 12 million by 2040—making its population larger than Paris, France—one of the most successful high-speed rail markets in the world.[7]

With population being a key driver, as detailed in Chapter 6, Ridership and Revenue, each of the Initial Operating Sections is able to support operations without a subsidy and, with the revenues from ridership, has the potential to begin attracting private investment to expand the system further. On its own, either IOS is a viable, profitable high-speed system. Of equal importance, an IOS becomes the basis for expansion of the system statewide. This creates the foundation for an unprecedented integrated statewide system that will provide inter-regional and intra-regional benefits, as envisioned in Proposition 1A, which authorized both $9 billion for the high-speed rail system and $950 million for connecting rail programs.

The 290-mile IOS-North/Central Valley to Bay Area, shown on Exhibit 2-3, will extend the ICS north from Fresno to San Jose and to Merced. It will close the gap from just north of Bakersfield into downtown Bakersfield. This will allow for HSR service from San Jose and Merced to Bakersfield.

The train will serve the following city stations and be connected to each city's transit services:

- San Jose (Santa Clara Valley Transportation Authority-VTA)
- Monterey-Salinas Transit-MST)

Exhibit 2-3. IOS-North/Blended

The IOS-North/Central Valley to Bay section will provide HSR service from San Jose and Merced to Bakersfield and provide connections to each city's transit systems.

Artist's rendering of Fresno Station

- Gilroy (San Benito County Express, Caltrain)
- Merced (Merced County Transit-The Bus)
- Fresno (Fresno Area Express-FAX)
- Kings/Tulare (Kings Area Rural Transit-KART) and Tulare County Area Transit (TCAT)
- Bakersfield (Golden Empire Transit District-GET Bus), and Kern Regional Transit

In addition to local transit, a range of connecting regional rail and bus services to the new high-speed rail service will include the following connections:

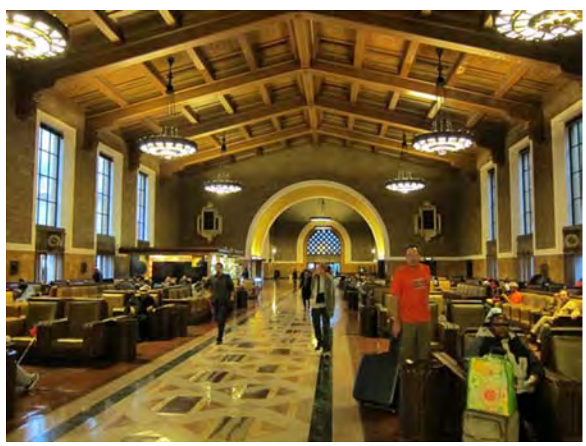
- In San Jose to Caltrain, Amtrak (Capitol Corridor), ACE, and eventual BART services that will allow passengers to continue their trip to destinations both on the peninsula and to San Francisco, and up the East Bay to Oakland and points east.
- In Merced to Amtrak's San Joaquin serving both Sacramento and the Bay Area along with other potential Amtrak Thruway connections to Yosemite and other regional destinations.
- In Bakersfield, dedicated bus feeder service connecting into the Los Angeles Basin.

The IOS-North also provides the basis for blended operations, leading to a "one-seat ride" to San Francisco, meaning that passengers could travel over the systems without having to change trains. Since conceptual planning of the statewide HSR system, the San Francisco to San Jose section has been envisioned as an electrified, shared corridor where both high-speed and Caltrain trains share the corridor and provide a combined service on the peninsula. Caltrain today is primarily a two-track railroad with some four-track sections. The number of Caltrain and high-speed rail trains needing to travel on the corridor on a daily or hourly basis will determine what improvements will need to be made, including modern train control, strategically placed passing tracks, electrification, and other upgrades. The scope of improvements is still subject to further analysis and local dialogue. These upgrades will allow high-speed rail trains to run limited-stop express service originating in San Francisco and stopping in Millbrae and San Jose while also allowing Caltrain to run its usual mix of services for Caltrain customers on the Peninsula. The Authority is working with Caltrain and a broad range of Bay Area stakeholders on operational studies to identify what infrastructure might be required.

The Transbay Transit Center is the designated northern destination both for high-speed rail and the Caltrain system. Services into Transbay will be achieved as funding becomes available. “One-seat ride” blended services could initially operate to the existing station at 4th and King in San Francisco.

The one-seat ride to San Francisco (a blended approach) provides the opportunity to study and implement a smaller project on the San Jose to San Francisco segment at a cost savings that is still consistent with the capacity needs of high-speed rail and largely adheres to existing rights-of-way.

The 300-mile IOS-South/Central Valley to Los Angeles Basin extension, shown on Exhibit 2-4, will extend south through downtown Bakersfield to the San Fernando Station (Sylmar, Burbank, or Santa Clarita), with a short spur north of Fresno to Merced. **Importantly, it will close the existing gap in passenger rail service between northern and southern California.** Through a connection to Amtrak’s San Joaquin service at Merced, it will allow passengers from the Sacramento region to travel on high-speed rail to downtown Los Angeles with a single transfer, cutting travel time from what is now almost eight hours to just over five hours. Currently, that trip on Amtrak is made with a bus connection between Bakersfield and Los Angeles.



Completion of the IOS-South extension will cut Sacramento region to Los Angeles’ Union Station travel time by three hours.

Exhibit 2-4. IOS-South/Blended

The IOS-South/Central Valley to Los Angeles Basin section will connect with transit options allowing passengers to reach a wide range of regional destinations.

Seamless travel will be possible with HSR connecting to Metrolink and additional destinations.

Implementation of the IOS-South extension makes blended operations in the Los Angeles Basin possible, improving travel between the Basin, the Central Valley, and other parts of the state. A description of the cooperative efforts to develop these blended operations is provided later in this chapter. Arrivals and departures of high-speed trains can be timed to provide efficient transfers to regional and local services as seamlessly as possible without requiring the purchase of a new fare. Passengers arriving from the north could exit the HSR train, walk a few steps across a platform, and transfer to Metrolink trains or other connecting transit services to take them to their local or regional destinations. Early investments in grade crossings and other improvements will accelerate benefits, and implementation of positive train control safety systems will safely allow higher speeds.

The train will serve the following locations and make the following transit connections:

- Merced (The Bus)
- Fresno (FAX)
- Kings/Tulare (KART/TCAT)
- Bakersfield (GET Bus, Kern Regional Transit)
- Palmdale (Antelope Valley Transit Authority-AVTA, City of Santa Clarita Transit)
- San Fernando Valley (Los Angeles County Metropolitan Transportation Authority-Metro, Santa Clarita Transit)

In addition to local transit, a range of connecting regional rail and bus services to the new high-speed rail service will include connections in Palmdale and the San Fernando Valley to Metrolink and potential Amtrak "thruway" bus services that will allow passengers to continue their trip to destinations throughout the region.

Step 3: Bay to Basin/Blended

Step 3 connects California's two megaregions. The 410-mile Bay to Basin system will integrate directly with commuter rail services serving San Jose and the San Fernando Valley, providing the basis for blended operations in both metropolitan regions.

Bay to Basin will:

- **Connect for the first time the state's two megaregions with world-class high-speed rail service.** The success of Bay to Basin will be underpinned by connecting urban rail and bus services, and the ability to transfer to and from automobiles at key terminal and intermediate stations. The station at San Jose will be a key interchange with existing transit services on the San Francisco Peninsula.

Caltrain, operated by the Peninsula Corridor Joint Powers Board, provides direct connections to key peninsula stations and downtown San Francisco. A Bay Area Rapid Transit (BART) extension to San Jose will enhance access to Oakland and the East Bay area. At Merced, the HSR will provide an interchange with Amtrak rail service to the Sacramento region, as well as to connecting bus services. Throughout the Central Valley, connecting bus services will continue to serve a wide range of destinations, creating greater access and mobility for residents and business owners currently severely underserved by other transportation modes. The southern station for this step in the San Fernando Valley will provide a direct connection to an existing and extensive Metrolink rail system, which provides service to the entire Southern California Basin, including to Union Station in Los Angeles and to the Anaheim Regional Transportation Intermodal Center in Anaheim.

- **Link with commuter and intercity rail systems on both ends**, making blended operations with local and regional rail systems possible. This will expand the reach of the high-speed rail system, making it more attractive to potential riders throughout the Bay Area and Southern California. In addition to their own capital programs, these systems will see ongoing improvements through federal investments in those corridors. Cooperative planning and implementation between state and regional agencies will result in improved connections, more reliable service, and reduced travel times for travelers going beyond the Bay to Basin system.
- **Provide cost-effective service** that can be operated by a private party with no subsidy from the state.
- **Accelerate travelers' benefits in some "Phase 2" areas** by linking those areas with high-speed service through intercity or commuter rail services. For example, travelers from Sacramento or Oakland would be able to connect to high-speed service by using Amtrak to Merced and San Jose. Travelers in San Diego would have easy access to points north of Los Angeles by taking rail along the Los Angeles-San Diego corridor to northern Los Angeles County.

Step 4: San Francisco to Los Angeles/Anaheim (Phase 1)

Completion of the Bay to Basin system leads to Phase 1, the connection between San Francisco and Los Angeles/Anaheim. This 520-mile connection can be accomplished in two ways:

- Through a coordinated "blended system" that uses upgraded commuter rail systems to connect the metropolitan areas with the inter-regional high-speed system, and
- By expanding fully dedicated high-speed infrastructure to San Francisco and Los Angeles/Anaheim.

Artist's rendering of Transbay Transit Center

The coordinated "Blended System"

Similar to systems in Europe, it is anticipated that connecting service to one or both of the Initial Operating Sections, and to the subsequent Bay to Basin high-speed rail service, will be provided by partially sharing existing commuter rail infrastructure and facilities. This will result in a full rail connection from San Francisco to Anaheim, offering passengers a "one-seat-ride" from end to end. In the Bay Area, the high-speed rail trains will use existing Caltrain infrastructure between San Jose and San Francisco, and in the Los Angeles Basin, Metrolink infrastructure will provide the connection for high-speed trains between Anaheim/Los Angeles and the Central Valley. This infrastructure will require some upgrades to accommodate high-speed operations and added capacity with speeds through urban areas of up to 125 miles per hour. However, such improvements can likely be accomplished while staying substantially within the existing rights-of-way, resulting in substantially reduced impacts to the communities along the corridor.

Based on this approach, initial environmental reviews can focus primarily on the impacts of limited upgrades to the existing facilities, thus avoiding the mitigation requirements associated with an expanded dedicated high-speed system. Sharing existing commuter rail facilities in urban areas will not only materially reduce the environmental impacts of the planned full system, but will result in substantial cost savings as well. Recognizing that the ultimate goal for the voter-approved program is fully operational high-speed rail service between the two end points included as Phase 1 of the system, any expansion in the corridor to add additional capacity, accommodate dedicated tracks, significant structure or tunnel work, and additional right-of-way beyond what is defined in the blended system would have to be revisited through future environmental reviews. Investigations show that the coordinated blended solutions as envisioned can accommodate service levels for many years into the future.

Blended operations from San Jose to San Francisco

The "one-seat ride" to San Francisco was outlined in the description of the IOS-North earlier in this chapter. Through blended operations and/or implementation of Phase 1 improvements, high-speed service will be available to the following stations:

- Initially 4th and King terminal within San Francisco, and subsequently extend to the Transbay Transit Center (BART, San Francisco Municipal Railway Transit System (MUNI), Caltrain, Alameda-Contra Costa Transit District (AC Transit), and Golden Gate Transit)
- Millbrae (Caltrain, San Mateo County Transit District-SamTrans, and BART, providing a connection to San Francisco International Airport)
- A potential connection with a mid-peninsula station (Caltrain, SamTrans, and VTA)

Blended operations to Los Angeles and Anaheim

The ultimate HSR operation into the Southern California Basin, envisioned by Phase 1 and shown in Exhibit 2-5, requires establishing new high-speed rail right-of-way. Unlike Caltrain on the San Francisco Peninsula, there are currently no plans to electrify the Metrolink system. Therefore, while incremental improvements can be made within the existing rail corridors that will be shared with the HSR system, providing a one-seat ride to Los Angeles and Anaheim may require implementation of the full Phase 1 improvements there. However, as outlined in the description of the IOS-South earlier in this chapter, the connection made through the IOS-South makes blended operations possible. Connections in Los Angeles to Metrolink and Amtrak (Surfliner and other intercity routes), will allow passengers to continue their trip to destinations both east into the Inland Empire and south toward San Diego. Anaheim will also have connections to Amtrak's Surfliners and the Metrolink commuter rail service. Station enhancements to facilitate and improve these passenger connections could also be implemented, improving the passenger experience with faster, easier ticketing and baggage-handling processes.

Aimed at increasing cooperation, enhancing the rail service in the south, developing cost-effective solutions to infrastructure problems, and preparing for HSR system's entrance into Southern California, the Southern California Passenger Rail Planning Coalition has been formed. It is examining possibilities for joint planning, operations collaboration, and for early investment in the HSR corridors. This coalition will help ensure that the HSR planning is well coordinated in Southern California. Members include the major rail transportation providers in Southern California, along with the rail corridor owners and major transportation planning agencies, including the following:

- Amtrak
- Burlington Northern Santa Fe (BNSF) Railway
- Caltrans Division of Rail
- Los Angeles County Metropolitan Transportation Authority (Metro)
- North County Transit District (San Diego County)
- Orange County Transportation Authority (OCTA)

Exhibit 2-5. Phase 1 System—San Francisco to Los Angeles/Anaheim

This "one-seat ride" allows a passenger to ride high-speed rail all the way from San Francisco to Los Angeles and on to Anaheim.

- Riverside County Transportation Commission (RCTC)
- San Diego Association of Governments (SANDAG)
- Southern California Regional Rail Authority (Metrolink)
- Union Pacific Railroad (UP)
- California High-Speed Rail Authority (CHSRA)

Artist rendering of the Anaheim Regional Transportation Intermodal Center Station

Step 5: Extensions to Sacramento and San Diego (Phase 2)

This step will add a northern and southern extension, resulting in an 800-mile system. The northern extension will extend from Merced to Sacramento, allowing direct high-speed rail service from San Francisco and Los Angeles to Sacramento. Shown in Exhibit 2-6, the train will also serve Stockton and Modesto. A full range of rail and bus services connecting to these new high-speed rail extensions will include the following:

- In Sacramento, connections to Amtrak (Capitol Corridor), Amtrak Thruway buses, Sacramento Regional Transit, and a short bus trip to Sacramento International Airport
- In Stockton, connections to the Altamont Commuter Express (ACE) commuter rail and the local transit provider San Joaquin RTD
- In Modesto, connections to Amtrak (San Joaquin Corridor) and Modesto Area Express (MAX) transit service

Exhibit 2-6. Phase 2 System—Extensions to Sacramento and San Diego

Phase 2 will allow full HSR service from Sacramento to San Diego.

Extensive cooperative planning efforts have been underway in this area. The Central Valley Rail Policy Working Group is a collaboration consisting of the Authority, the U.S. Department of Transportation/Federal Railroad Administration, Amtrak California, the Altamont Commuter Express (ACE), the San Joaquin Regional Rail Commission, and regional and local public agencies in the Sacramento to Merced section. Its purpose is to serve as a partner with the Authority throughout the project-development process; provide guidance on local issues, development plans, and policies; assist in developing and evaluating alternative alignments; and develop consensus regarding project goals, objectives, and major elements.

The Central Valley Regional Rail Working Group has been working since 2006 to promote cooperative planning and development of integrated rail services. The Altamont Corridor Partnership Work Group is a collaboration of public agencies providing strategic guidance and planning for the Altamont Corridor Rail Project with the goals of integrating transit systems, maximizing efficiencies, and enhancing the regional transportation network between Stockton and San Jose.

To facilitate coordinated planning for the Merced-to-Sacramento extension, the Authority has entered into a partnership with the San Joaquin Regional Rail Commission (SJRRC) to plan for and implement improved "Super ACE" higher-speed regional rail service connecting Stockton and Modesto in the Central Valley with Fremont and San Jose in the Bay Area. The proposed Super ACE corridor will connect with the high-speed rail system in San Jose and Stockton and could serve as an east-west regional connector to both the Bay to Basin main line and the Merced-to-Sacramento extension. To enhance mobility, the ACE corridor could be designed to accommodate both ACE and high-speed trains.

The Merced-to-Sacramento corridor is being designed to host regional rail service. In partnership with the SJRRC, the Authority is looking to share high-speed rail infrastructure and tracks with the future Super ACE service to allow regional service to cities such as Elk Grove, Galt, Lodi, Manteca, and Turlock. This arrangement would improve regional mobility throughout Northern California.

Starting from the regional transportation hub at Los Angeles Union Station, the extension to San Diego will extend east through Los Angeles County to San Bernardino County, south through Riverside County, and ending in downtown San Diego. The Authority has executed various memorandums of understanding (MOUs) with local, regional, state, and federal organizations along the corridor to facilitate coordination efforts. In 2008, the Southern California Inland Corridor Group (Socal ICG) was formed with the following agencies:

- San Diego Association of Governments (SANDAG)
- Riverside County Transportation Commission (RCTC)
- San Bernardino Associated Governments (SANBAG)
- Southern California Association of Governments (SCAG)
- Los Angeles County Metropolitan Transportation Authority (Metro)
- San Diego County Regional Airport Authority (SDCRAA)
- Caltrans Districts 7, 8, and 11

Artist's rendering of Sacramento Station

The Los Angeles-to-San Diego extension will extend east through the Inland Empire to Riverside and then south to San Diego serving the following stations (some of which are optional stations) and their associated transit services:

- El Monte (Foothill Transit, Metrolink, Metro)
- West Covina
- Pomona
- Ontario Airport (Foothill Transit, Metrolink)
- San Bernardino (Metrolink)
- Corona/March ARB
- Murrieta (RTA)
- Escondido (NCTD)
- San Diego International Airport (MTS, NCTD)

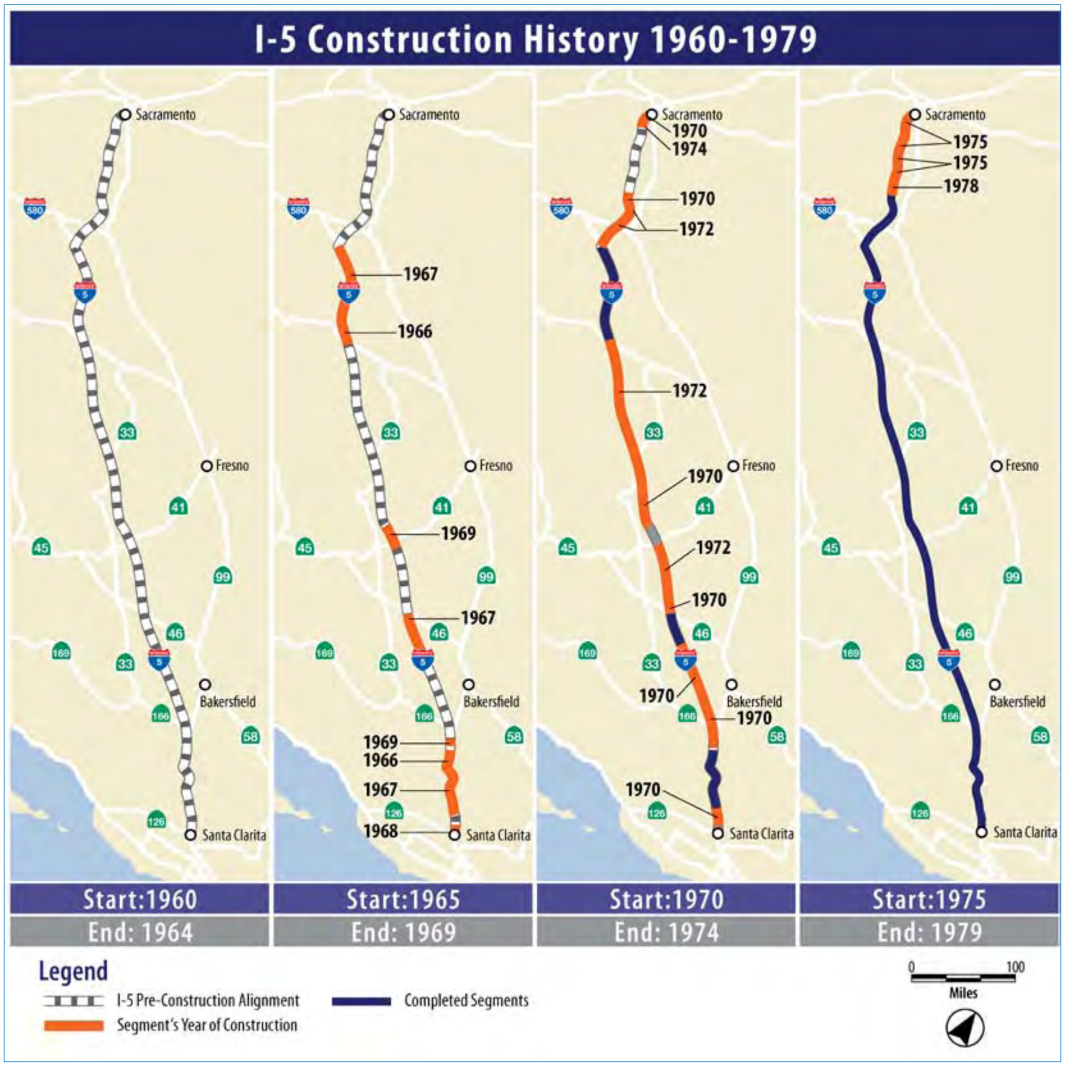
Artist's rendering of Ontario Station

California's experience with major infrastructure programs

The California highway and freeway system

Significant similarities exist between development of California's world-famous freeway system and the statewide HSR system. Today's 50,000 miles of California highways and freeways began with an initial bond issuance of $18 million in 1909, with another in 1919, after funding had been exhausted. Demonstrating leadership, California approved initial funding for the current freeway system in 1947, a decade before the federal government established the National Defense and Interstate Highway System. Since then, California has spent well over half a century building the system, bringing new sections, often not contiguous, based on factors such as funding and environmental clearance. Interstate 5 is a particularly interesting comparison to the HSR system as it covers 796 miles and forms one of the most critical "backbones" of the state's highway system. From its designation as a key highway in 1947, phased implementation of Interstate 5 was not completed until October 12, 1979. Exhibit 2-7 illustrates the phased implementation and progress in building Interstate 5 through the Central Valley.

Exhibit 2-7. Interstate-5 construction history 1960–1979



More than 100 years in the making, implementation of the state road system provides another example of how phasing a large-scale transportation program produces results.

Learning from other systems: does phasing work?

International high-speed rail systems

Constructing and operating HSR is new to the United States; however, California is drawing upon decades of international experience in its planning and decision making. High-speed rail services emerged in Japan in the 1960s, followed by France in the 1980s. High-speed rail development has now expanded across Asia and Europe, and the founding Japanese and French systems continue to expand. Exhibit 2-8 summarizes international high-speed rail implementation, including initial segments and expansions. Operating speeds have made consistent, incremental improvements such that speeds in excess of 200 mph are practical today. Speeds approaching 220 mph will become routine in a few years.

Exhibit 2-8. International high-speed rail phased implementation

Country	Initial Segment	Network Extensions	Under Construction
France–TGV (high-speed lines)	Paris–Lyon (1981)	Lyon–Valence/Marseille (1992/2001) Paris–Tours and Le Mans (1990) Paris–Lille and Calais (1993) Paris–Rheims/Strasbourg(2007) Paris Interconnection (1994) Perpignan–Figueres (2010)	Dijon–Mulhouse (2011) Tours–Bordeaux (2017) Le Mans–Rennes (2019)
Spain–AVE	Madrid–Seville (1992)	Madrid–Zaragoza/Barcelona (2003/2008) Madrid–Malaga (2007) Madrid–Valencia (2010)	Alicante (2012) Barcelona–Figueres (2012)
South Korea–KTX	Seoul–Daegu (2004)	Daegu–Busan (2010)	Daegu–Mokpo (2014)
Japan–Shinkansen	Tokyo–Shin-Osaka (1964)	Shin-Osaka–Hakata (1972-1975) Tokyo–Shin-Aomori (1982 -2010) Omiya–Niigata (1982) Takasaki–Nagano (1997) Hakata–Kagoshima–Chuo (2004–2011)	Shin-Aomori–Shin–Hakodate (2015) Nagano–Kanazawa (2014)
Taiwan–THSTC	Taipei–Kaohsiung (2007)	None planned	

Virtually all the world's large-scale intercity HSR systems have been developed through a phased implementation strategy. Using this approach, a portion of the system is constructed and opened for revenue service while the balance of the system has yet to be constructed. Few exceptions to this model exist, except in Taiwan where almost the entire system was opened at once. Exhibit 2-8 provides examples of this successful phasing.

In Europe, an incremental phased construction segment and revenue service start-up strategy was chosen for the high-speed rail systems in France (TGV), Germany (ICE), Spain (AVE), and Italy (TAV).

> The California High-Speed Rail Authority has concluded cooperation agreements with nine nations' governments that have deployed and operate HSR systems. Descriptions of the information exchanged and knowledge gained through a number of those agreements is provided in *International Case Studies*.
>
> www.cahighspeedrail.ca.gov/business_plan_reports.aspx

France initiated the first TGV service between Paris and Lyon in 1981 (Exhibit 2-9). This corridor was selected because of capacity constraints on the conventional rail lines. Service began after the construction of the initial two-thirds of the system; they completed the remaining portion some years later, with high-speed rail trains running on conventional rail lines in the interim. The challenges of constructing new high-speed track within Paris and Lyon require that the TGV trains continue to run on conventional rail lines at slower speeds before reaching high-speed (+180 mph) on the dedicated high-speed alignment outside of the cities. Following the success of the inaugural Paris-to-Lyon service, France has constructed additional TGV lines based on funding availability.

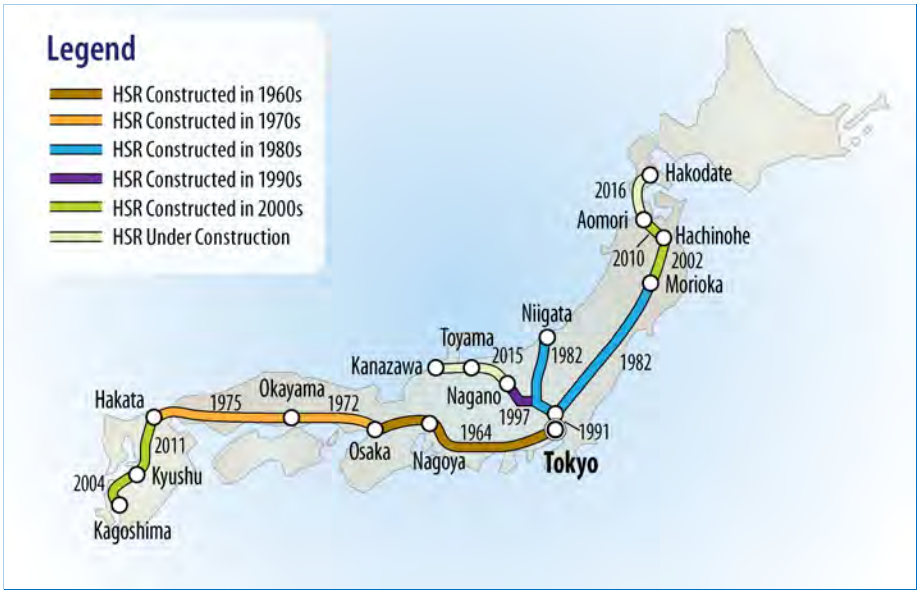
Exhibit 2-9. France's high-speed rail system and four decades of expansion

After three decades, France continues to expand its dedicated high-speed rail network building on the system's success. To date, seven segments have been constructed.

Spain and Germany planned, constructed, and placed into revenue service their HSR systems using implementation strategies similar to the French network expansion model. Each country constructed an initial segment, typically linking a large city and a moderately sized city, and using conventional rail lines in urban areas. High-speed rail trains typically also run on conventional rail to serve other markets and increase service viability. The owners extended the initial construction segment incrementally as funding became available. For example, Germany started the high-speed rail network using upgraded existing inter-city rail infrastructure. As ridership grew and funding became available, Germany developed dedicated high-speed rail corridors.

Similarly, the high-speed rail networks of Japan and South Korea have been developed incrementally. Japan pioneered development of high-speed rail technology and implementation planning. Japan has expanded the Shinkansen HSR system according to each corridor's capacity constraints and funding availability (Exhibit 2-10). Even today, the Shinkansen operates on certain lines in mixed operations with other rail traffic, while new sections dedicated to HSR are completed as funds become available. South Korea constructed a new HSR alignment between cities, but as in Europe, slower speeds are used on the approaches to the capital, Seoul.

Exhibit 2-10. Japan's high-speed rail system and six decades of expansion



In contrast to Europe and Japan, Taiwan's high-speed rail system was built in one phase, primarily because of the short distance between the system end points and because private capital was available to build the entire system from the outset.

Phased approach and private capital

As discussed elsewhere in this Business Plan, the phased approach also provides the most efficient means to attract private investment capital into the program. At the outset, before ridership levels and operational issues are proven, private risk capital would either be unavailable or prohibitively expensive. This Business Plan assumes—based on similar experience throughout the world and information from private infrastructure development interests—that upon completion of the Initial Operating Section, private-sector financing for future segments would become available and attractive. The phased approach set forth above represents the most efficient mix of public dollars and private funding.

End notes

[1] Note regarding depicted alignment between Bakersfield and Los Angeles: At its May 2011 meeting, the California High Speed Rail Authority Board authorized a conceptual study of the Grapevine (I-5) corridor between Bakersfield and the San Fernando Valley with a potential station at Santa Clarita that would include working with stakeholders (agencies, landowners, tribes, and other interested parties) in this corridor. The purpose of this study is to determine if a feasible Grapevine alignment alternative could be identified for potential inclusion as part of the Authority's and Federal Railroad Administration's project EIR/EIS environmental review processes. If a feasible Grapevine alignment is found, it will be brought back to the board for approval before detailed environmental analysis is conducted.

[2] *Source:* California Department of Transportation. March 2008. San Joaquin Corridor Strategic Plan. http://149.136.20.80/rail/dor/assets/File/SJCSPExecutiveSummary-032508.pdf).

[3] *Source:* California Transportation Commission. *Formula Shares for Commuter and Urban Rail Agencies. High-Speed Rail Passenger Train Bond Act.* http://www.catc.ca.gov/programs/HSR/HSR_Formulashare_Attachment_I_121709.pdf

[4] *Source:* California Transportation Commission. February 24, 2010. *High-Speed Passenger Train Bond Program Guidelines.*

[5] The estimates of jobs in this 2012 Business Plan are presented in job-years. One job-year is the equivalent of one person working a full-time job for one year. For example, a full-time job that lasts 20 years generates 20 job-years.

[6] *Source: Federal Register.* April 2010. "High Speed Intercity Passenger Rail (HSIPR) Program" (notice by the Federal Railroad Administration)

[7] *Source:* Public Policy Institute of California. June 2006. *California's Central Valley.* http://www.ppic.org/content/pubs/jtf/JTF_CentralValleyJTF.pdf

Chapter 3

Capital Costs

Introduction

The California High-Speed Rail Program (CHSRP) has progressed over the past decade from a programmatic concept to a detailed plan for the nation's first statewide high-speed rail (HSR) system. Working with public and elected officials, the California High-Speed Rail Authority (Authority) has developed a comprehensive understanding and approach to developing and constructing a high-speed rail system across California's mountains and valleys and through the downtowns of two dozen densely populated communities and cities.

This chapter presents the most recent capital cost estimates for constructing the Phase 1 HSR system connecting San Francisco/Merced with Los Angeles/Anaheim. These costs are consistent with each of the phased implementation steps discussed in Chapter 2, A Phased Implementation Strategy. This chapter also describes the Authority's approach to developing these cost estimates and outlines comparisons to other projects in the United States.

Additional information on the capital cost estimates in this Business Plan is available in *Cost Changes from 2009 Report to 2012 Business Plan Capital Cost Estimates*, which can be found at www.cahighspeedrail.ca.gov/business_plan_reports.aspx.

Approach and methodology

The following important programmatic considerations directly affect the cost estimates:

- **Program size**—The California HSR program is one of the largest infrastructure programs undertaken in the United States. This program includes installing 2,200 miles of rail weighing 276,000 tons; 3.5 million square feet of buildings and facilities; 6,500 miles of electrical wires and cables; and more than 200 grade separations. Some 37 to 43 percent of the Full Phase 1 alignment—189 to 220 miles—may be constructed on elevated structure or in tunnels.
- **Shared benefits and costs**—Many improvements included in the cost estimate will benefit other California rail and transit operators and the communities through which the high-speed alignment will be constructed. Tracks and systems in joint-use corridors will be rebuilt. Communities along the route will see significant investment in new (or replaced) transportation and civil infrastructure, including new grade separations, replacement of existing highway bridges, new transportation stations, and local road improvements to provide access to stations. In addition, transit agencies will experience very significant increases in ridership, and businesses around train stations will benefit from new economic activity. In cases where significant benefits accrue to other transit systems, some costs will need to be shared. Nonetheless, many costs for these joint-benefit improvements are included within the program budget. For example, in the San Francisco to San Jose corridor, electrified tracks will be shared with Caltrain commuter trains, requiring extensive construction to

In the Caltrain corridor, some joint-benefit costs will be shared.

expand the railroad to accommodate four grade-separated tracks in some areas. The current cost estimate includes the cost to modify or replace Caltrain stations affected by the additional track construction and the cost to construct new grade separations. It also covers the full cost for electrifying the Caltrain rail lines, including sections where high-speed rail and Caltrain diverge at Santa Clara.

Process overview

The development approach for project engineering typically advances in three broad steps:

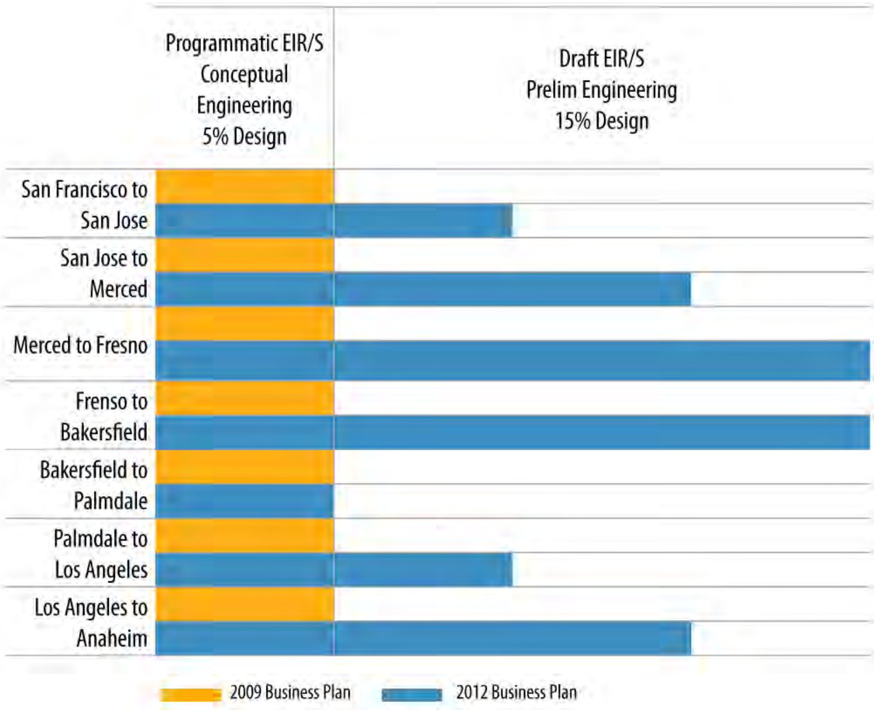
- Conceptual Engineering (5 percent) provides a comparative basis for evaluating different alignments and developing an order-of-magnitude cost estimate for cost-benefit analysis and budgeting.
- Preliminary Engineering (15 to 30 percent) provides a detailed approximation of project complexity, cost, and construction methodology that reflects actual field conditions and design changes required to mitigate environmental issues and community concerns. Consistent with standard practice, the engineering is at a level sufficient to transfer remaining design and subsequent construction to the private sector through design-build procurement.
- Final Engineering (100 percent) provides the documentation to build the final product.

Environmental review process

Information on the schedule and status of the environmental review process can be found on the Authority's website at www.cahighspeedrail.ca.gov/environmental_review.aspx

As the engineering progresses, a proposed project's costs become better defined, allowing for more accuracy. Typically, the most pronounced changes in a design and variations in cost occur between the Conceptual and Preliminary Engineering phases as the project team goes on-site to evaluate specific alignment conditions and environmental impacts and works with the affected communities. The Authority has now advanced beyond this point and is currently undertaking the Preliminary Engineering activities for the program approaching an overall 15 percent design completion, with the design approaching 30 percent for the Central Valley. Exhibit 3-1 shows the progression of design based on sections defined by the environmental documents. Thus, at this stage of the project, local conditions, stakeholder requirements, and engineering demands for the Phase 1 system are well understood. Barring major changes in scope or requirements, the level of contingency at this stage—a total of 15 to 25 percent of each construction category—should be sufficient to address reasonably foreseeable increases arising from the normal design process.

Exhibit 3-1. Status of environmental and engineering work



Development of cost estimate

The cost estimates described and presented in this chapter are based on site-specific route alignments developed during Preliminary Engineering. Although the costs for improvements have been calculated and reviewed, they are nonetheless subject to changes in economic conditions that occur over time and that can affect actual prices—either positively or negatively. The cost estimate is the product of two key items described below:

- **Quantities**—This is the quantity of materials required to construct the project's key elements from track to stations to trains. The materials quantity depends greatly on the ground conditions where the project will be built—land use and availability, geotechnical conditions, community and stakeholder impacts, and environmental challenges requiring realignment or special designs. These factors are highly site-specific and subject to significant change during the environmental process and as communities participate in key decisions. The Federal Railroad Administration (FRA) defines the categories that must be included in a cost estimate for federally funded rail projects. The major categories are as follows:
  - Track structures and track
  - Stations, terminals, intermodal
  - Site work, right-of-way, and existing improvements
  - Communications and signaling

- Electric traction
- Vehicles
- Professional services
- Unallocated contingency
- Finance charges

- **Composite unit prices**—These are the prices associated with the materials. Composite unit prices for complex items such as stations and electrical substations may include hundreds of elements, each of which must be separately priced. The prices also must reflect the specific market for each product and material, such as the underlying commodity and labor costs, at the time anticipated for procurement. Composite unit prices for more than 300 separate cost items have been developed for the cost estimates.

The costs and quantities were reviewed by two groups of experts. The regional consultant teams independently reviewed major cost items such as viaducts, tunnels, embankment, and retaining walls/ trenches. In addition, the Authority's program oversight consultant hired a contractor to generate a contractor bid price based on the draft 15-percent design for the Merced-to-Fresno and Fresno-to-Bakersfield sections. Both sets of experts found that costs and quantities fell within a reasonable range.

Costs have been presented in constant 2010 dollars to present a baseline for comparing alignment options and implementation phases. The estimates use 2010 dollars because that is the latest available compilation of actual unit prices. Over the last two years inflation has averaged 0.6 percent so the use of 2010 dollars has no material impact. Constant dollar cost data do not reflect inflation impacts on the material prices, equipment, and labor that may occur prior to completing construction. The effects of inflation are addressed in Chapter 8, Funding and Finance. This chapter and Chapter 8, Funding and Financing, contain small differences in costs due to rounding.

Chapter 2, A Phased Implementation Strategy, describes the implementation plan, including details on each of the incremental stages of development. The program's cost estimates have been developed on the basis of this phased approach. These incremental steps are as follows:

- **Initial Operating Section (IOS)**—The Initial Operating Section will be the state's first fully operational high-speed rail system. The first step in constructing the IOS is completion of the Initial Construction Section, or ICS, as described in Chapter 2, A Phased Implementation Strategy. The ICS will then be extended to complete the IOS, which could be operated by a proven private operator, and will generate sufficient revenues to contribute to construction of the next section. The IOS will have full independent utility and will then be expanded to create the ultimate full statewide system. It consists of the ICS in the Central Valley between Fresno and Bakersfield, and then extends either to the north or to the south:
    - **IOS-North/Central Valley to Bay Area**—IOS-North is approximately 290 miles long and will permit operation of high-speed rail from Bakersfield to Merced and San Jose.

- **IOS-South/Central Valley to Los Angeles Basin**—IOS-South is approximately 300 miles long and will permit operation of high-speed rail from Merced to the San Fernando Valley (for cost purposes the southern limit extends to Sylmar).

- **Bay to Basin (B2B)**—The B2B is the combination of the two Initial Operating Sections. It is approximately 410 miles long and includes construction of a complete HSR system from San Jose and Merced extending south to the San Fernando Valley. It connects the state's two mega-regions and provides the platform for blended high-speed and commuter rail operations in metropolitan areas.
- **San Francisco to Los Angeles/Anaheim (Phase 1)**—The Phase 1 alignment is approximately 520 miles long and completes the HSR system from San Francisco and Merced to Union Station in Los Angeles and the Regional Transportation Center in Anaheim. Chapter 2, A Phased Implementation Strategy, describes the two options—Phase 1 Blended and Full Phase 1.
- **Extensions to Sacramento and San Diego (Phase 2)**—Phase 2 extends the Phase 1 system to Stockton and Sacramento via Merced in the north and to San Diego via the Inland Empire in the south. This will complete the approximately 800-mile statewide CHSRP as originally proposed. Engineering has not advanced beyond Conceptual Engineering on the extension alignments. Accordingly, no cost data are presented below for the future Phase 2.

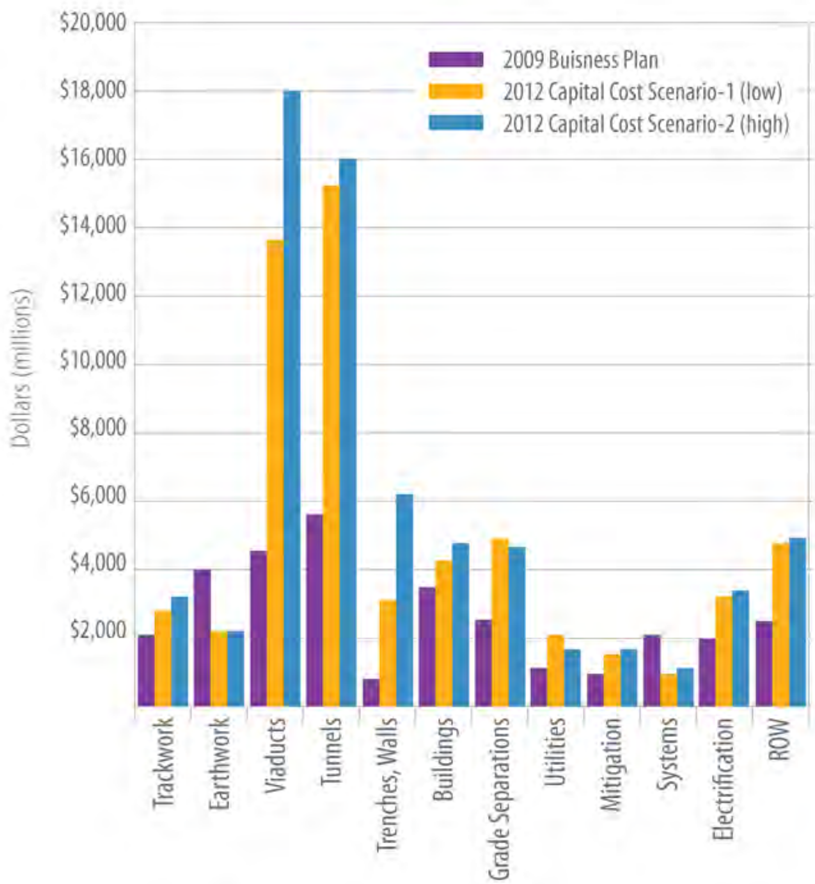
Capital costs

The current cost estimate has increased significantly since the last estimate in 2009, which was based on the programmatic conceptual design. That estimate, covering the Full Phase 1 between San Francisco and Los Angeles/Anaheim, was $36.4 billion in 2010 dollars. The 2012 Business Plan estimate ranges from $24.6 to $31.7 billion for the Initial Operating Sections, $40.8 to $48.3 billion for the Bay to Basin system, and $65.4 to $74.5 billion for the Full Phase 1 system. The Phase 1 Blended option was not included in previous cost estimates. Eighty to eighty-five percent of this increase is for additional viaducts, tunnels, embankment, and retaining walls/trenches directly attributable to changes in scope and alignment based on stakeholder input, environmental necessity, and improved knowledge of site conditions; the remaining 15 to 20 percent is attributable to increases in composite unit prices (Exhibit 3-2). Of the total Full Phase 1 costs, $11 billion are contingency protecting against cost increases.

California added nearly 5 million people between 2000 and 2010, with much of this growth along the project route. In many areas, the alignment has had to be relocated, elevated on bridges, or placed in tunnels to avoid severe community impacts and to navigate through densely populated urban areas.

The initial program planning predated much of California's real estate boom in the mid-2000s. Large expanses of vacant or under-utilized property, over which the system would have operated at-grade, have since become bustling communities, suburbs, and roadways. California added nearly 5 million people between 2000 and 2010, with much of this growth along the project route. In many areas, the alignment has had to be relocated, elevated on bridges, or placed in tunnels to avoid severe community impacts and to navigate through densely populated urban areas. In addition, more detailed investigations during Preliminary Engineering have identified challenging geologic and geotechnical conditions, floodplain areas, and differences in terrain that required realignment of the route or more expensive design approaches.

Exhibit 3-2. Capital cost changes since the 2009 Business Plan



The new development landscape has necessitated adding many miles of elevated structures, tunnels, and other infrastructure. The new designs permit access to major downtown population centers with less community impact and disruption. Approximately 37 to 43 percent of the Phase 1 system may be built on elevated structure or in tunnels, depending on alignment alternatives. The possible length of elevated structures increased from 77 miles in 2009 to between 138 and 168 miles, and tunnels increased from 32 miles to between 51 and 52 miles (with the ranges based on different alternatives still under consideration).

Taiwan's high-speed rail system operates on elevated structure to accommodate land use.

Composite unit prices for materials and components also have increased. Some of the increase reflects increased engineering design, providing more detailed material and component specification. Other changes simply reflect increases in the underlying cost of key materials required for HSR infrastructure. Although the recent economic recession has reduced pressure on some prices, the cost for steel, copper, concrete, and other basic commodities has not moderated and is expected to continue to increase due to domestic and international demand, particularly from China.

In summary, Phase 1 of the system still connects San Francisco, Los Angeles, and Anaheim via the Central Valley. However, the current system is very different from the one priced in the past because of the changes discussed above.

- **Alternative approaches to Phase 1**—As discussed above and in Chapter 2, A Phased Implementation Strategy, the Business Plan presents two incremental options for implementing the Phase 1 system—the Phase 1 Blended option and the Full Phase 1 option.
- **Cost scenarios**—The cost data are presented in the Business Plan using two scenarios: Capital Cost Scenario 1 (low) and Capital Cost Scenario 2 (high). Each cost scenario includes the combination of all the lowest feasible alignment options or the combination of all the highest feasible alignment options, including the costs associated with environmental mitigation. This is meant to convey the fact that until final environmental approval of all preferred alignments, stations, and maintenance facilities, there will be a number of key decisions that remain unresolved. When those decisions are finalized, the final costs will also be determined. For example, for the Central Valley alone, more than 20 alignment options have yet to be finalized. Each option carries different costs. To show the range of potential costs, Capital Cost Scenario 1 (low) includes the cumulative lowest cost options and Capital Cost Scenario 2 (high) includes the cumulative highest cost options; in between is a range of alternatives with associated costs falling between the high and low bookends.
- **Program cost by implementation step in 2010 dollars**—Exhibit 3-3 (Capital Cost Scenario 1 [low]) and Exhibit 3-4 (Capital Cost Scenario 2 [high]) provide the incremental costs for completing each step of system implementation.

Exhibit 3-3. Incremental capital costs by phase—IOS-North first (2010 dollars)

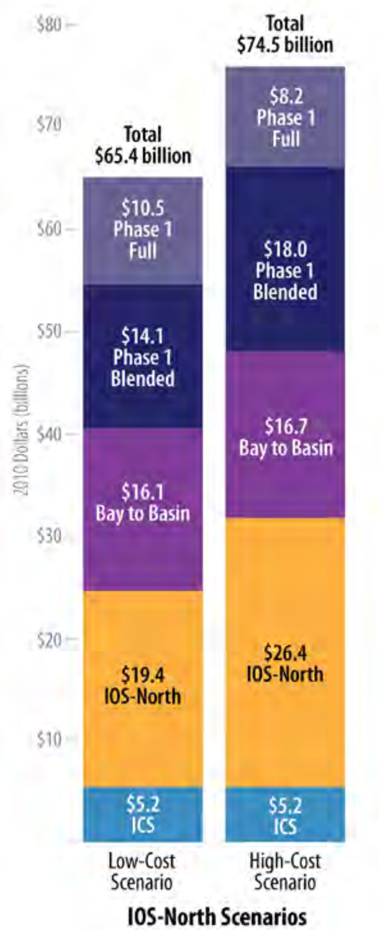
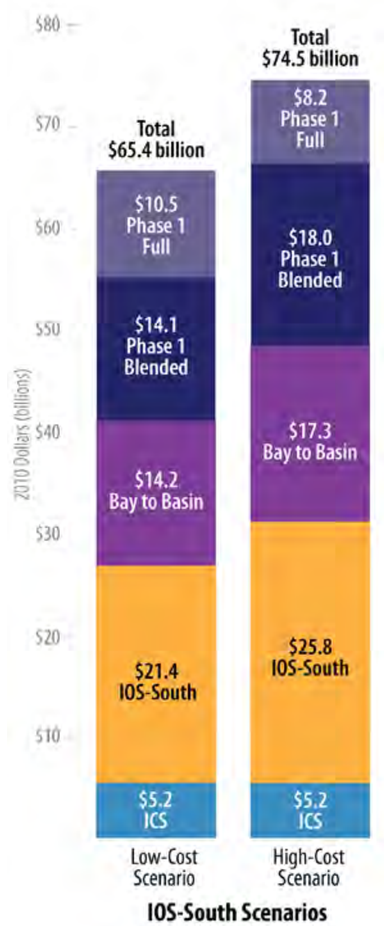


Exhibit 3-4. Incremental capital costs by phase—IOS-South first (2010 dollars)



Implementation steps by FRA category in 2010 Dollars

Exhibit 3-5 through Exhibit 3-8 provide the costs for the different steps in the implementation plan outlined in Chapter 2, A Phased Implementation Strategy, for both scenarios, broken out by FRA cost category. Contingency of between 15 and 25 percent is included in each cost category to protect against material cost increases, use of different components or parts, and minor quantities changes, depending on the category. A separate and additional "Unallocated Contingency" value of 5 percent is also included as a general reserve to address any unexpected changes. The costs for each step represent a project total at that step and include the cost for constructing prior sections. Both the IOS (north and south) and the B2B sections include construction of the approximately 130-mile ICS, stretching from just north of Fresno to approximately nine miles north of Bakersfield. The $5.2 billion cost to construct the ICS is included in each of the IOS cost summaries. For the two IOS options, an additional $250 million has been identified for costs related to pre-operating testing and commissioning of rolling stock, safety systems, and other capital equipment prior to revenue operations. As noted, there are two IOS options:

- **IOS-North/Central Valley to Bay Area**—IOS-North is approximately 290 miles long and will permit high-speed rail operations from Bakersfield to Merced and San Jose. In addition to constructing the ICS, it extends the tracks to Merced and San Jose. The IOS-North includes passenger stations, maintenance and support facilities, traction electrification systems, and train control and communication systems, as well as the necessary high-speed trains required for service.

Exhibit 3-5. Cost to construct IOS-North/Central Valley to Bay Area (2010 dollars)

FRA Standard Cost Categories Base Year FY 2010 Dollars (Billions)	IOS-North/Valley to Bay[1]	
	Capital Cost Scenario 1 (low)	Capital Cost Scenario 2 (high)
10 Track structures and track	$10.6	$15.7
Civil (10.04-10.06, 10.08, 10.18)	*$1.9*[2]	*$3.7*[2]
Structures (10.01-10.03, 10.07)	*$7.6*[2]	*$10.7*[2]
Track (10.09, 10.10, 10.14)	*$1.1*[2]	*$1.3*[2]
20 Stations, terminals, intermodal	$0.9	$0.9
30 Support facilities: yards, shops, administration buildings	$0.4	$0.4
40 Sitework, right-of-way, land, existing improvements	$6.4	$7.0
Purchase or lease of real estate (40.07)	*$1.5*[1]	*$1.5*[1]
50 Communications and signaling	$0.5	$0.5
60 Electric traction	$1.6	$1.8
70 Vehicles	$0.6	$0.6
80 Professional services (applies to categories 10-60)	$2.5	$3.4
90 Unallocated contingency	$0.9	$1.1
100 Finance charges	$—	$—
Total (includes $5.2 billion ICS)	**$24.4**	**$31.4**

[1]$250 million in testing/commissioning costs not included in total.
[2]Subtotal only for information.

- **IOS-South/Central Valley to Basin**—IOS-South is approximately 300 miles long and will permit operation of high-speed rail from Merced to the San Fernando Valley. In addition to constructing the ICS and extending the tracks to Sylmar, IOS-South includes passenger stations, maintenance and support facilities, traction electrification systems, and train control and communication systems (for the entire system including the ICS) as well as the necessary high-speed trains required for service.

Exhibit 3-6. Cost to construct IOS-South/Central Valley to Los Angeles Basin (2010 dollars)

FRA Standard Cost Categories Base Year FY 2010 Dollars (Billions)	IOS-South/Valley to Basin[1]	
	Capital Cost Scenario 1 (low)	Capital Cost Scenario 2 (high)
10 Track structures and track	$14.0	$16.9
Civil (10.04-10.06, 10.08, 10.18)	*$1.4*[2]	*$1.7*[2]
Structures (10.01-10.03, 10.07)	*$11.5*[2]	*$14.0*[2]
Track (10.09, 10.10, 10.14)	*$1.1*[2]	*$1.2*[2]
20 Stations, terminals, intermodal	$0.6	$0.6
30 Support facilities: yards, shops, administration buildings	$0.4	$0.4
40 Sitework, right-of-way, land, existing improvements	$4.6	$5.2
Purchase or lease of real estate (40.07)	*$1.4*[1]	*$1.5*[1]
50 Communications and signaling	$0.5	$0.5
60 Electric traction	$1.7	$1.8
70 Vehicles	$0.9	$0.9
80 Professional services (applies to categories 10-60)	$2.8	$3.2
90 Unallocated contingency	$0.9	$1.1
100 Finance charges	$—	$—
Total (includes $5.2 billion ICS)	**$26.4**	**$30.7**

[1]$250 million in testing/commissioning costs not included in total.
[2]Subtotal only for information.

- **Bay to Basin (B2B)**—The B2B system is approximately 410 miles long and includes construction of a complete HSR system from San Jose and Merced extending south to the San Fernando Valley. B2B includes all elements of a HSR system: civil infrastructure, passenger stations, maintenance and support facilities, traction electrification systems, and train control and communication systems, as well as the necessary high-speed trains required for service.

Exhibit 3-7. Cost to construct Bay to Basin (2010 dollars)

FRA Standard Cost Categories Base Year FY 2010 Dollars (Billions)	Bay to Basin	
	Capital Cost Scenario 1 (low)	Capital Cost Scenario 2 (high)
10 Track structures and track	$20.9	$26.2
Civil (10.04-10.06, 10.08, 10.18)	*$2.3*[1]	*$4.3*[1]
Structures (10.01-10.03, 10.07)	*$17.0*[1]	*$20.2*[1]
Track (10.09, 10.10, 10.14)	*$1.6*[1]	*$1.8*[1]
20 Stations, terminals, intermodal	$1.1	$1.1
30 Support facilities: yards, shops, administration buildings	$0.5	$0.5
40 Sitework, right-of-way, land, existing improvements	$7.8	$8.6
Purchase or lease of real estate (40.07)	*$1.9*[1]	*$2.0*[1]
50 Communications and signaling	$0.7	$0.7
60 Electric traction	$2.2	$2.4
70 Vehicles	$1.8	$1.8
80 Professional services (applies to categories 10-60)	$4.2	$5.1
90 Unallocated contingency	$1.4	$1.7
100 Finance charges	$—	$—
Total (includes ICS and IOS North and South Costs)	**$40.5**	**$48.1**

[1]Subtotal only for information.

- **San Francisco to Los Angeles/Anaheim—Phase 1 Blended**—Implementation of full Phase 1 service connecting the San Francisco Transbay Terminal in the north with the Anaheim Regional Transportation Intermodal Center in the south can take place in increments building off the Bay to Basin operating section described above. With the Phase 1/Blended increment, for example, it will be possible to provide "one-seat ride" service between San Francisco's Caltrain Station and Los Angeles Union Station and on to Anaheim, with dedicated high-speed service between Los Angeles and San Jose, and use of the existing Caltrain line to San Francisco. This will involve, at a minimum, some construction on the Peninsula to enhance the capacity of the existing two-track rail line, as well as electrification, train control, and communication system improvements, and construction of a new dedicated high-speed line connecting the San Fernando Valley terminus of B2B to Los Angeles Union Station and Anaheim. The incremental cost of the Phase 1/Blended one-seat ride option is estimated to range from $14.1 to $18.0 billion.

Exhibit 3-8. Cost to construct the Blended Phase 1 (2010 dollars)

FRA Standard Cost Categories Base Year FY 2010 Dollars (Billions)	Phase 1/Blended	
	Capital Cost Scenario 1 (low)	Capital Cost Scenario 2 (high)
10 Track structures and track	$24.7	$33.1
Civil (10.04-10.06, 10.08, 10.18)	*$3.3*[1]	*$5.5*[1]
Structures (10.01-10.03, 10.07)	*$19.5*[1]	*$25.2*[1]
Track (10.09, 10.10, 10.14)	*$2.0*[1]	*$2.4*[1]
20 Stations, terminals, intermodal	$2.1	$2.6
30 Support facilities: yards, shops, administration buildings	$0.6	$0.6
40 Sitework, right-of-way, land, existing improvements	$13.1	$13.6
Purchase or lease of real estate (40.07)	*$3.9*[1]	*$4.0*[1]
50 Communications and signaling	$0.9	$1.0
60 Electric traction	$2.9	$3.1
70 Vehicles	$3.2	$3.2
80 Professional services (applies to categories 10-60)	$5.4	$6.7
90 Unallocated contingency	$1.9	$2.3
100 Finance charges	$—	$—
Total (Includes Bay to Basin and Blended Phase 1 Upgrades)	**$54.6**	**$66.1**

[1]Subtotal only for information.

The Full Phase 1 Option would extend dedicated high-speed rail in full from San Jose to San Francisco and into Los Angeles/Anaheim. The Capital Cost Scenario 1 (low) and Capital Cost Scenario 2 (high) cost to construct the Full Phase 1 program is $65.4 billion and $74.5 billion, respectively. The Full Phase 1 cost estimate includes an alignment that is mostly at-grade. An alternative approach to place more infrastructure below grade has been developed as a result of public input. A decision to implement this option would have to be made based on cost-sharing agreements between the state and local entities.

From Union Station, passengers can connect to existing service to reach destinations south and east of Los Angeles.

Comparing the cost to other high-speed rail systems

To assess the reasonableness of the program's cost estimates, the Authority studied the most recent cost estimates against those of other operational HSR projects. These include worldwide costs evaluated by the World Bank and proposed improvements to the Northeast Corridor proposed by Amtrak. Of note, a cost comparison of different HSR projects can only provide an order of magnitude indication of the current estimate's reasonableness for the California program as every project has its own set of unique physical, environmental, and policy issues. This is particularly the case with European and Asian HSR programs, built in different political and environmental settings.

International HSR programs

A useful comparison is with a July 2010 report from the World Bank: *High-Speed Rail: The Fast Track to Economic Development?* The report provides lessons for countries considering implementing new high-speed passenger rail service. With respect to construction costs, the report found the following:

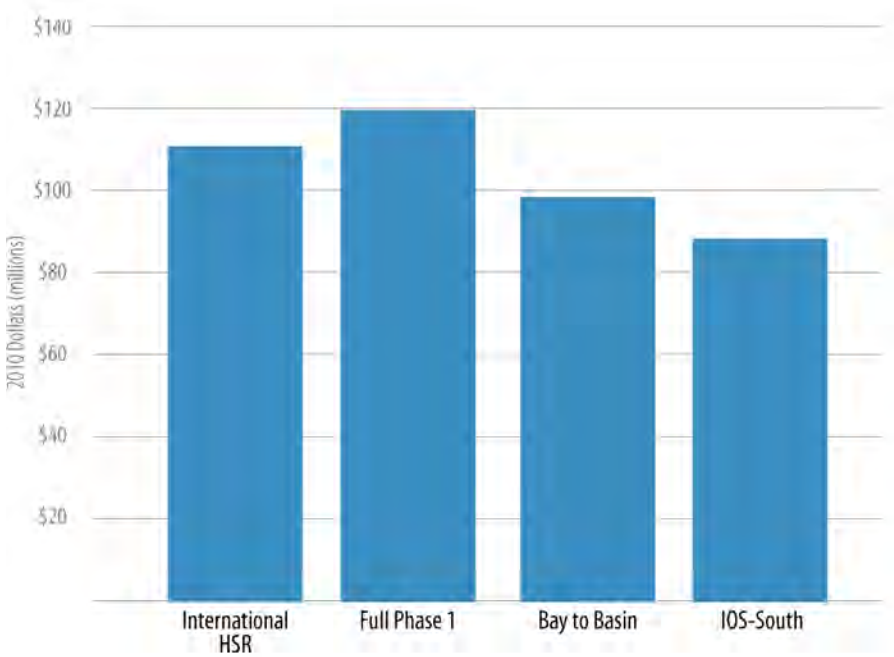
> *Experience internationally is that construction and rolling stock capital costs [excluding the purchase or lease of real estate and professional services] . . . typically range from USD [$56-$112 million/mile], depending on the complexity of civil engineering works, the degree of urbanization along the route and required total rolling stock capacity*.[1]

For the IOS-South section, the construction cost per mile (excluding real estate and professional fees will be $74 million to $87 million per mile. For the Bay to Basin section, the construction cost per mile (excluding real estate and professional fees) will be $84 million to $100 million per mile. Both fall within the international HSR cost range despite the following:

- The challenges of building through California's seismically active areas, an issue also faced in Japan and other countries
- U.S. labor and construction costs that are 30 to 75 percent higher than in other developed countries with existing HSR systems, such as France, Germany, Italy, the Netherlands, the U.K., and Japan[2]
- The lack of existing regional intercity or commuter rail networks providing access into congested downtown areas and existing grade-separated, electrified rail infrastructure that could be shared with the HSR system

For the 520-mile Full Phase 1 system, the construction cost per mile (excluding real estate and professional fees) will be $104 million to $119 million per mile (Exhibit 3-9).This lies within or just above the higher typical range for international HSR programs, despite the higher U.S. construction costs and challenges described above. The higher cost per mile of the Full Phase 1 over Bay to Basin underscores the complexities and expense of constructing in densely populated urban metropolitan areas.

Exhibit 3-9. Comparison—California versus international cost per mile to construct HSR



Amtrak Next Generation (Washington-NYC-Boston)

In September 2010, Amtrak announced its ambitious Next Generation HSR Program for the 460-mile Northeast Corridor (Exhibit 3-10).The program will reduce trip times to less than three hours and 30 minutes for a Washington-Boston express train and increase capacity to permit departures every three to five minutes. The FRA has initiated a programmatic environmental impact statement for improvements to the Northeast Corridor. Amtrak recently received funding to begin implementing elements of the upgrade program in New Jersey.

The projected cost for the improvements, prior to any engineering, is $117 billion (including real estate and professional fees) in 2010 dollars. This equates to $254 million per mile. Amtrak's "stair-step" incremental implementation approach assumes that it will take 40 years to construct the full system.[3]

In contrast, the current capital cost estimate for the Full Phase 1 of the CHSRP ($65.4 billion to $74.5 billion) equates to $126 to $143 million per mile (including real estate and professional fees).The capital cost for the Bay to Basin section ($40.8 to $48.3 billion) equates to $100 to $118 million per mile (including real estate and professional fees).

The higher cost per mile of the Next Generation Program reflects the fact that so much of the Northeast Corridor is in more densely populated urban areas requiring costly tunnels, elevated structures, and expensive property acquisition. When compared to the cost of California's system, it is comparable to the per mile costs of the segments that travel through California dense urban areas like Los Angeles and San Francisco.

Exhibit 3-10. Amtrak Next Generation

End notes

[1] *Source:* Amos, P., D. Bullock, J. Sondhi. July 2010. *High-Speed Rail: The Fast Track to Economic Development?* The World Bank. http://www.worldbank.org/research/2010/07/12582340/high-speed-rail-fast-track-economic-development

[2] *Source:* Engineering News Record (ENR). December 27, 2010. "The 2010 4th Quarterly Cost Report." http://enr.construction.com/magazine/2010/1227.asp

[3] *Source:* Amtrak. September 2010. "A Vision for High-Speed Rail in the Northeast Corridor." www.Amtrak.com

Chapter 4

Business Planning Schedule

Introduction

As described in Chapter 2, A Phased Implementation Strategy, California's high-speed rail system will be implemented in phases to manage the development process, costs, and funding. The system will be developed over a long period of time, and many future decisions will need to be made regarding alignment and profile (i.e., surface, elevated, and tunnel), environmental mitigations, and sequencing, among others.

This Business Plan does not attempt to evaluate all possible options presented in the system's environmental documents. Rather, the Authority identified a set of system development scenarios to illustrate a range of potential project phasing and other outcomes so that current policy leaders can assess the program and make appropriate near-term decisions. This chapter identifies the assumed project development schedule which serves as the basis for the financial analysis conducted for this Business Plan.

It is important to note that this project development schedule is illustrative and will depend on future decisions, the availability of funds, and other factors. The schedule does not represent or suggest decisions of the Authority's Board or other decision-makers; nor does it represent recommendations of Authority staff.

Project schedule

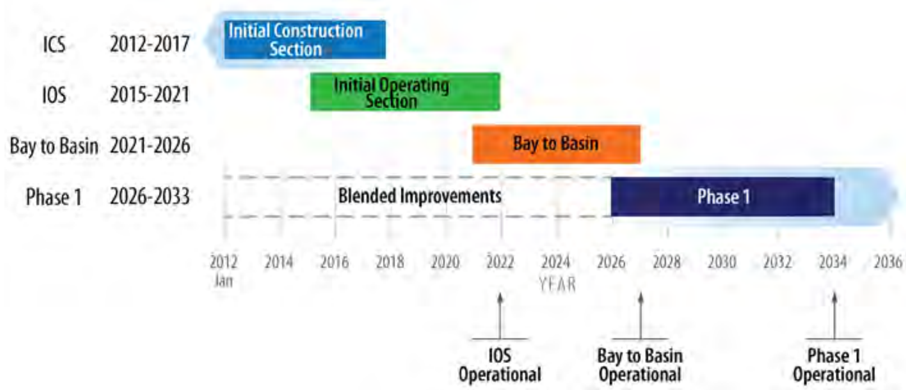
If substantially all of the project budget were available to allow multiple major contracts to begin simultaneously, the Full Phase 1 system from San Francisco to Los Angeles/Anaheim could be completed in approximately 12 years (by 2024). This represents a *financially unconstrained* schedule. However, this unconstrained schedule presents an unrealistic view of the likely project development schedule.

This chapter describes a phased implementation schedule that shows how the system might be implemented over time and results in a fully operational segment (the Initial Operating Section [IOS]) completed by 2021, that Bay to Basin is complete in 2026, and the Full Phase 1 is complete in 2033. This extends the completion of the Full Phase 1 by approximately nine years beyond the financially unconstrained schedule to allow for schedule, funding, and other factors.

This project-development schedule was used as a basis to inflate capital costs, revenues, and operating and maintenance costs to a year of expenditure (YOE). A standard inflation rate of 3 percent is used throughout this Business Plan.

The schedule for completing the various development sections is shown in Exhibit 1-1. The schedule identifies a construction timeline for each section as well as the year in which operations could commence by section.

Exhibit 1-1. Schedule by section



A consolidated schedule that combines the information above is shown in Exhibit 1-2 and is illustrated in subsequent chapters.

Exhibit 1-2. Consolidated schedule

The financial plan assumes that self-sufficient operating sections that do not require operating subsidies would be opened for passenger service beginning in 2022 with the completion of construction of the IOS (either IOS-North from the Central Valley to San Jose or IOS-South from the Central Valley to the San Fernando Valley). This will be followed by construction of the remainder of the alignment needed to provide full service from San Jose to the San Fernando Valley (Bay to Basin), which is estimated to be opened in 2027. The Full Phase 1 service will be completed in 2033 and opened in 2034. It is expected that incremental blended system improvements between San Francisco and San Jose and between San Fernando and Anaheim will be made during construction of the IOS and Bay to Basin sections.

This schedule is used throughout this 2012 Business Plan and is the basis for revenue, cost, and funding analyses.

Chapter 5

Business Model

Introduction

Implementing a transportation infrastructure project of the high-speed rail (HSR) system's scope and complexity requires a business model that is implemented over time, as organizational relationships mature, as funding options materialize and progress, and as the system develops. Overall, the goal of establishing a business model is to assign responsibilities to the appropriate entity that can carry them out most efficiently and effectively. There will be different models at different stages of program implementation; some responsibilities will shift, and some will remain constant. For example, governance—ownership, oversight, and policy-setting—remains a public-sector responsibility throughout the life of the program; operations will be a private-sector responsibility. Capital investment begins with the public sector and then becomes shared with the private sector.

This chapter identifies the overall business model on which the Business Plan and current system development activities are founded. The business model describes the overall roles of the key participants in managing, funding, developing, and operating California's HSR program. The Authority and the State of California will have the lead role by providing oversight and management for the delivery and ongoing operations of the system. The Authority will partner with the private sector through competitive procurement for the delivery, operation, and maintenance of system infrastructure and the operation of train service. As the Initial Operating Section of the system begins to generate cash flow, private-sector capital will become available to help build other portions of the system.

Five fundamental assumptions drive the business model:

- The high-speed rail system will neither be entirely a public works project nor will it be a fully privatized system. It will be a partnership between the public sector (federal, state, and local) and the private sector. This is an internationally proven business model and is common to substantially all recent high-speed projects in the world.
- The partnership between the public sector and private sector will evolve as the system is developed moving from service and construction contracts to complex concession agreements with underlying private capital investment.
- Competition in procurement is one of the strongest drivers of value and cost management available to the state. The financial scale of the HSR system requires a series of private-sector agreements at a reasonable financial scale promoting national and international competition.
- Consistent with federal requirements, the system and its key components will be built in the United States while leveraging international technology and experience. Employment and manufacturing will be focused in California and the U.S.
- Similar to other large infrastructure projects involving many public entities, successfully establishing the required intergovernmental agreements will promote private-sector confidence that translates into additional value and reduced costs when the public sector subsequently negotiates private-sector agreements.

Recent international high-speed rail projects

Transactions closed:

- **2011 France:** Tours to Bordeaux—public/private partnership—infrastructure and operations
- **2010 Portugal:** Poceiroa-Caia—public/private partnership—infrastructure
- **2010 U.K.:** HS1 London to Channel Tunnel—sale of infrastructure concession

Placed into service:

- **2007-11 People's Republic of China:** multiple routes—public-sector development and operations with technology transfer agreements with trainset manufacturers
- **2010 France and Spain:** Perpignan–Figueras—public/privatepartnership—design-build-finance and maintain in contract for tolled tunnel
- **2009 Netherlands:** Amsterdam to Belgian Border—public/private partnership-infrastructure
- **2007 Taiwan:** Taipei to Tainan—public/private partnership—infrastructure and operations

Similar to other large infrastructure projects involving many public entities, successfully establishing the required intergovernmental agreements will promote private-sector confidence that translates into additional value and reduced costs when the public sector subsequently negotiates private-sector agreements.

Business model principles

This business model was designed around several key principles:

- Compliance with Proposition 1A—Proposition 1A contains guidance on the roles of the public and private sectors for developing and operating the high-speed rail system.
- Integrate into a statewide rail plan—A key state and Authority goal is the HSR's integration within a larger statewide rail strategy. This business model includes working arrangements and agreements with other state agencies, regional transportation authorities, existing commuter rail systems, and other transit systems.
- Meet funding and financing needs—The system's funding and financing will include local, state, federal, and private sources that will become available at different times based on the development of the program. This business model reflects a variety of funding partners and their anticipated roles in its implementation.

Italy: NTV was granted an operating franchise and invested 650 million Euros in equipment to start high-speed rail service in 2011. (photo courtesy of Alstom)

- Leverage international precedents and successes—Successful high-speed rail systems around the world illustrate lessons learned and various options for public and private-sector roles. The Authority will rely on the private sector to construct, operate, and maintain infrastructure using models that have proven successful in other countries.
- Align with market sounding and requests for expressions of interest—As previously noted, to understand the private sector's specific interest in this program, the Authority issued a Request for Expressions of Interest and received more than 1,100 responses. The responses identified the capability and interest of private entities related to development, financing, operations, project scale, risk appetite, and other factors. These responses confirmed the Business Model approach selected by the Authority.

Based on these principles, the initial business model was defined.

Taiwan's high-speed rail system used public-private partnerships for infrastructure and operations.

Business model summary

California's program requires the combined capabilities of the public and private sectors. All high-speed rail projects in the world, including those in the People's Republic of China, have leveraged private-sector expertise. The significant scale of these projects, combined with the technical complexity of signaling, safety, and other systems and rolling stock requirements, requires experienced private-sector organizations even in countries with significant experience implementing high-speed rail. This business model leverages these experiences.

Similarly, successful international projects have had a strong government partner that has both governed and helped fund the project. Projects in Taiwan, the U.K., and most recently Brazil have demonstrated that a fully private-sector solution, where the project or its investors are responsible from the outset for construction risks, operation, ridership, and funding, have not been financially successful.

Public-private partnerships (PPPs) are contractual arrangements between the public sector and private-sector organizations to design, build, finance, operate, and/or maintain infrastructure over a period of time (commonly 30 years or more).

- DB—The private sector designs and builds the project or a portion of the project
- DBFO—The private sector designs, builds, finances, and operates the project or a portion thereof
- DBFOM—The private sector designs, builds, finances, operates, and maintains the project or portion thereof

Other structures include operating franchises, DBFM, and combinations of the elements above.

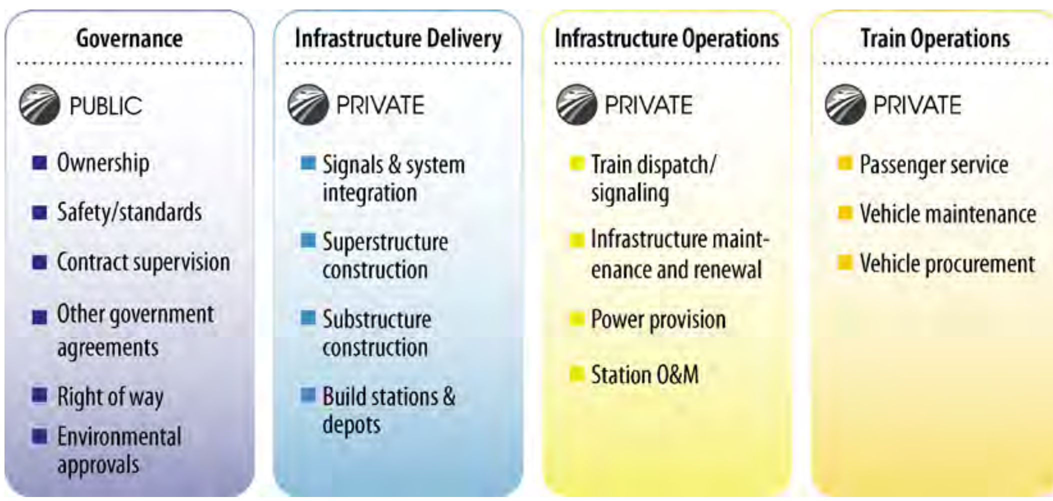
Taiwan transferred development, finance, and operating responsibility to the private sector. The system generated operating profits but capital depreciation and interest costs created losses for the private sector from 2007 until 2011.

The U.K. transferred development, finance, and maintenance responsibility for HS1 to the private sector in 1996. The U.K. government took back control of the operating system in 2009 due to insolvency. Subsequently, the government successfully sold an operating concession for HS1 to the private sector in 2010.

In 2011, Brazil attempted to transfer development, operating, and substantial financing responsibility to the private sector for a new 300-mile high-speed rail link from Rio de Janeiro to Sao Paulo. No bids were received due to the level of risks the government sought to transfer.

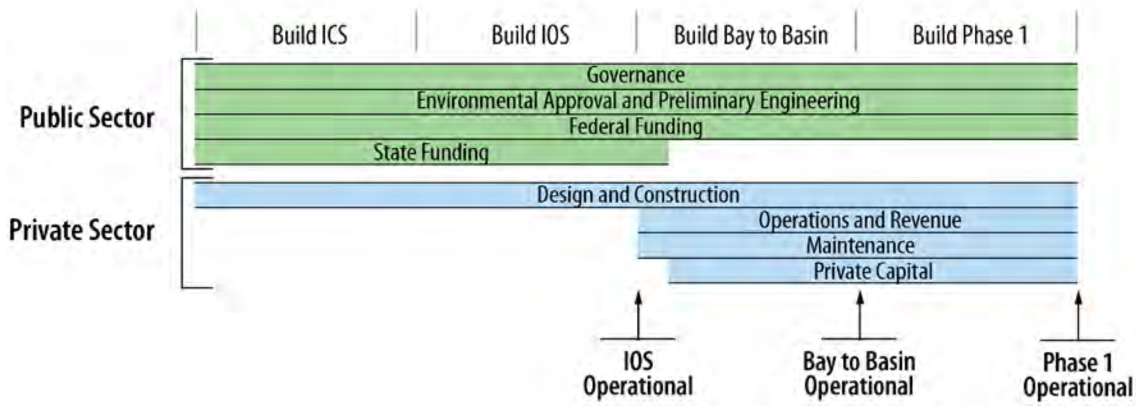
High-speed rail systems include four principal roles that are organized in different combinations around the world (Exhibit 5-1).

Exhibit 5-1. High-speed rail organizational model



As stated earlier, the Authority plans to rely on the private sector for infrastructure delivery, infrastructure operations, and train operations. The business structures under which these services will be provided by the private sector will change over time as the project moves from its early stages (construction of the Initial Construction Section) to more advanced stages (rail operations and system maintenance). The underlying financial model will also change over time as development risks are reduced and public funds can be augmented with private capital. Exhibit 5-2 illustrates the roles of the public and private sector as the program develops.

Exhibit 5-2. Public and private sector roles for program development



In California, the public sector (the Authority and the State of California) will have the lead organizational role, retaining ownership and governance functions. A number of other government organizations including the federal government, local governments, and others will provide funding, assistance, assets, and other support. A series of agreements are required to align the various public participants in a manner that will allow a private entity to develop or operate a portion of the system.

As described further in Chapter 8, Funding and Financing, this Business Plan assumes that construction of the Initial Operating Section will be government funded through federal funds, state bond funds, and local funds. Once the IOS is complete and revenue operations commence, the Authority plans to use the project's cash flows to attract private-sector capital to assist with further construction. While some private-sector capital may become available prior to completion of the IOS, it is expected to be quite expensive and has not been assumed in this Business Plan.

Consistent with high-speed rail systems in other parts of the world, the business model for delivery and operation of the system is an evolving one with the Authority and private sector playing critical roles. The governance and oversight of the HSR system will be performed by the Authority. The major delivery elements of the system will be performed by the private sector under contracts with the Authority. The Authority plans to contract with the private sector for infrastructure delivery, infrastructure operations and maintenance, rolling stock, and train operations under long-term concession agreements and other contracts with appropriate transfer of risks and financial responsibilities. In the initial years, the private sector is expected to be retained under design-build contracts with elements of cost overrun and other risks transferred to the private sector. Once revenue operations commence, the Authority will seek to incorporate private finance and other forms of risk transfer into more complex concession agreements.

The contracting models under which government contracts for these elements vary; based on international experience, there is no one standard structure. One common structure used in much of Europe is to separate the train operating and infrastructure maintenance contracts. In these models, the operator is responsible for passenger service and typically pays a track access charge for track usage, systems, and stations. The track access charge becomes a revenue source for the infrastructure maintenance company.

Governance

Under the business model, the Authority will have the lead governance role and will have overall responsibility for delivering the program and its operation. The business model recognizes that the California HSR program has a large number of public stakeholders and, as discussed further below, proposes to leverage the private sector's expertise in building and operations. This will require an inter-related set of complex contracts and other agreements that must be developed, procured, negotiated, and managed within a strategic framework for a long-term, financially successful program. While many elements of the state and federal government will have roles in program governance, it is critical for the Authority to continue to develop and obtain resources to provide the management and support structure to support a multi-billion program development and operating program.

Currently the Authority has approximately 54 state staff positions, although a number remain vacant. Completing the organizational development of the Authority is a key requirement of the business model and one of the risks identified in Chapter 9, Risk Identification and Mitigation.

Key to developing its resources is to hire those with experience with high-speed rail systems. Given the size and scale of the phased projects, the Authority will interact daily with senior leaders of private and public-sector agencies having significant high-speed experience. It is critical that the state retain the level of expertise within state service that allows it to plan, assess, negotiate with, and manage organizations with decades of high-speed rail experience.

Infrastructure delivery

Infrastructure delivery relates to the design and construction of the track, rail systems, and associated infrastructure elements. The overall structures for private-sector involvement in the business model are described later in this chapter, but for all options it is assumed that the private sector will provide the infrastructure delivery services either under design-build packages or under contracts that incorporate maintenance and potentially financing. The basis for determining the appropriate contracting strategy will depend on the scale, complexity, and timing of the relative construction works.

Infrastructure maintenance

Once complete, the infrastructure will need to be operated and maintained. The responsibilities for infrastructure maintenance could either be contracted under a separate maintenance contract or within a combined Design-Build-Maintain contract that could incorporate financing. The options for delivery by the private sector are considered in more detail later in this chapter.

Train operations

This relates to the direct service provider of train services to passengers. This private sector organization will be responsible for direct provision of passenger service. In addition, it could include the provision and maintenance of vehicles, although alternatively, vehicles could form part of the infrastructure operations and maintenance contract(s).

Public-sector partners

The Authority's role in providing program governance was described above. Additionally, a wide range of other public-sector entities also have a role in the program's development, such as the following:

- **Other California state agencies, including Caltrans, Department of Finance, State Treasurer's Office, and others**—The Authority is part of the State of California and will partner with a number of other state agencies to meet state transportation and environmental program goals and implement the program successfully.
- **U. S. Federal Railroad Administration and Department of Transportation**—The Federal Railroad Administration (FRA) is a key partner for funding and approvals. The Authority will continue to work closely with FRA in relation to safety and other development standards, environmental clearances, key statutory and regulatory provisions, required systems testing, funding programs, federal financing programs, and other support.
- **Regional transportation agencies**—The various regional transportation agencies (RTA) that connect with portions of the system are active program participants. In many cases, for example in Los Angeles, Orange County, and San Francisco, RTAs have development projects underway for multi-modal stations that can incorporate high-speed service. Based on asset ownership structures, joint-operating agreements for high-speed service to these multimodal assets will be developed, as required. These agreements also can address topics such as joint funding, cost sharing, right-of-way, and related opportunities to accelerate HSR and support related RTA projects.
- **Commuter rail systems**—The build-out of the high-speed rail system has a number of options in the urban areas currently served by existing commuter rail systems (see Chapter 2, A Phased Implementation Strategy). The Authority will work with local authorities to develop operating plans and supporting agreements to define the inter-relationships between existing and new rail systems and how they integrate into a larger statewide rail strategy.
- **Cities**—The various cities with proposed stations will also be important partners in the program. Decisions related to transit-oriented development, joint funding, cost sharing, and related opportunities to accelerate the development of high-speed rail will be documented over time in additional memoranda of understanding (MOU) and joint-operating agreements.
- **International governments**—Among the key partners in the planning of California's high-speed rail program are various international governments with successful high-speed rail programs. The Authority has existing agreements with nine international agencies with high-speed rail programs. The Authority will continue these relationships and over time become an exporter of knowledge related to California's successful program.

The working model for agreements between government participants is well defined and includes MOUs, operating agreements, and grant funding agreements. These processes and agreements are not further described in this Business Plan; however, they remain key activities in the program's development and are included in the program's work plan.

California High-Speed Rail Authority International MOUs and Cooperation Agreements

- UK Trade and Investment, United Kingdom, MOU on Cooperation, dated May 17, 2011
- Belgian Federal Public Service Foreign Affairs, Foreign Trade and Development Cooperation, Kingdom of Belgium, Cooperation Agreement, dated July 7, 2010
- French Ministry for Ecology, Energy, Sustainable Development, French Republic, Cooperation Agreement, dated August 28, 2009
- The Federal Ministry of Transport, Building, and Urban Affairs, Federal Republic of Germany, Memorandum of Understanding, dated March 9, 2010
- Ministry of Land, Transport and Maritime Affairs, Republic of Korea, Memorandum of Understanding, dated February 11, 2010
- Ministry of Railways of the People's Republic of China, Memorandum of Understanding, dated December 3, 2009
- Ministry of Land, Infrastructure and Transport of Japan, Memorandum Concerning Cooperation, dated September 28, 2009
- Italian Ministry of Infrastructures and Transportation, Italy, Cooperation Agreement, dated September 3, 2009
- Spanish Ministry of Development, Spain, Cooperation Agreement, dated July 31, 2003

Contracting approaches for the private sector

In general, large-scale private-sector involvement in the development and implementation of HSR in California should focus on attaining two broad objectives: (1) containing costs and mitigating risk, and (2) generating additional capital financing for system construction and expansion. The key to achieving the second objective is finding the point in the program where the project economics will allow a private-sector entity to make an investment in infrastructure and/or operations and be able to recover those costs through system-generated revenues.

Similar to the program implementation strategy described in Chapter 2, A Phased Implementation Strategy, the procurement model for each implementation section will be selected as phasing decisions are made.

Potential options for private-sector involvement

Exhibit 5-3 summarizes key private-sector contracting options based on the roles outlined above and on lessons learned from international experience.

Exhibit 5-3. Summary of potential private-sector contractual options

Contracting Option	Finance Based on Cash Flow	Cost Control	Key Constraints	International Precedents
Train operation franchise	Vehicles and train operator startup costs	Control train O&M costs	Can only have one TOC for length of franchise	Some U.K. rail franchises
Infrastructure O&M concession	Limited—via track access charge	• Contain infrastructure costs • Would include capital maintenance	• Interface with TOC and infrastructure construction company • Need non-“subsidy” payment stream	U.K. HS1 (Channel Tunnel Rail Link)
Infrastructure DBFO	Limited—via track access charge	• All Infrastructure costs • Can be segment or subsection (e.g., tunnel) • Can have several sequential DBFOs	• Scale—capped at $10 to $12 billion by bonding/construction market capacity • Need continuing appropriation to pay	• Perpignan-Figueras $2 billion • Tours-Bordeaux $11 billion • Dutch HSL $10 billion
Full System DBFO	All costs to extent revenues allow	• Most costs controlled • Integration risk transferred • Can assume O&M of DB segments	• Scale—limits to $10 to $12 billion of construction • Can only have one contract	• Arlanda Airport Link • Taiwan HSR

Train operation franchise

Under this option the private sector provides the service as described above (i.e., the provision of passenger train services along with possibly procuring and maintaining vehicles). This is a model used in the United Kingdom with private-sector operators. It is feasible to transfer revenue risk under franchise agreements once revenue operations have stabilized, although whether private-sector operators are able to assume full revenue risk would have to be confirmed during a competitive process. If the train operator is to retain responsibility for vehicles, the duration of the franchise would have to be for a longer duration (e.g., approximately 15 years). Shorter-term franchises (e.g., 7 years) would be more appropriate to the extent that vehicles are excluded from the role.

Infrastructure O&M concession

This role is as described in the section above. The key issue in executing this contract is managing the interface for the infrastructure delivery in relation to the construction quality and maintenance requirements of the infrastructure assets. The concession’s duration could be short (e.g., as low as 7 years) depending on the requirement to include capital maintenance obligations. It is feasible that separate concessions could be let for different parts of the system, although that would require greater oversight from the Authority to ensure standards were maintained consistently.

Infrastructure DBFO

Under this option, the private sector is responsible for the turn-key solution to design and build the infrastructure assets and provide asset maintenance, including capital maintenance under a long-term concession. Payments under this contract could come from track access charges payable by the train operator or direct asset availability payments from the Authority depending on the nature of the train operations contract. This structure has been used in a number of European high-speed public-private partnerships (PPP) projects. This model can include the requirement to finance the capital investment, although the model could work equally well without private-sector capital.

Full-system DBFO

This option includes the role of train operator within the scope of the services described above. It implies a full private-sector delivery model, including full or shared revenue risk.

Benefits of private involvement

Cost management

A significant factor in the choice of the Authority's business model is managing costs. To the extent possible, the Authority will seek to maximize the value of each contract by evaluating and transferring risks. Cost management risk will be a key risk the Authority will seek to transfer, and the Authority will aggressively manage costs using design-build contracts beginning with the initial construction contracts in 2012 and other PPP approaches in later phases.

In a conventional public procurement in California, such as the Bay Bridge project, the public sector uses a design-bid-build (DBB) contract. In this approach, the public sector takes the risk for the design, either doing parts itself or, in the case of high-speed rail where it does not have the expertise, under a design contract with the private sector. This type of contracting provides an initially low price and is flexible. However, it gives less price certainty when procuring a complex multi-layered system such as a high-speed rail line, as the public sector retains the risk for the interfaces between the design and build contract and into the eventual performance of the railroad.

International experience, especially on the Dutch high-speed line, shows that the largest cost and delay risk comes from system integration. A DBB approach leaves the public sector with this risk. For complex state-run projects over $300 million in California, this has contributed to cost overruns averaging approximately 60 percent.[1]

PPP approaches, on the other hand, bundle design, construction, finance, operations, and maintenance of all or part of the rail system in return for the right to passenger revenues or a fixed payment. Within the PPP arrangement there is a balance of risk transfer such that risks are managed by the entities best able to do so.

Access to financing

In a private-sector concession model, private partners have access to private-sector financial markets (i.e., debt and equity investment) that may be used to finance part of the capital cost of building the system or procuring its equipment. The amount of private financing that can be attracted for this project is a function of operating profit (i.e., the net amount that ridership revenue exceeds operating and maintenance costs). The extent to which the private sector can raise funds and the extent to which the private sector will accept responsibility for revenue generation are discussed further in Chapter 8, Funding and Financing.

The private sector also currently has access to two federal infrastructure financing programs -- the Transportation Infrastructure Finance and Innovation Act (TIFIA) and the Railroad Rehabilitation and Improvement Financing (RRIF) loan programs—both of which are discussed in Chapter 8, Funding and Financing.

Constraints on private-sector involvement

Scale of program

The scale of California's high-speed rail program presents some challenges for structuring private involvement. The largest high-speed rail public-private partnership, the French Tours to Bordeaux high-speed line, had a capital value of $11 billion. Given the financial and bonding constraints of large private-sector consortia—even one led by the world's largest construction company, Vinci—projects of this size would limit the number of bidders that can compete. Some respondents to the Authority's Request for Expressions of Interest indicated that the French project set a benchmark while others cautioned that the largest single public-private partnership contract they could accommodate could be lower depending on the contract scope.

Appetite for a pathfinder project

The California program is unique in many ways—not least being the first HSR system in North America. While having the attraction for the private sector in setting standards, there is also uncertainty regarding federal requirements, applicability of existing state standards, and governance requirements, as well as uncertainty regarding the rate at which ridership and revenues will grow. The potential impact of this standard setting concern is that the integration and completion risk will be seen as much higher on the initial sections.

Previous technology and PPP choices

Choices made in early phases can preclude other options in the future. Once the choice of vehicle and systems technology is made, constraints exist on the business model and options for future procurements. This is true for both the trains themselves and the signaling and power systems that support them. Similarly, a choice of procurement model, which can results in a 30-year contract, can be very expensive to renegotiate or cancel prior to the end of its term.

Planned approach by phase

Initial Construction Section

The approach for the Initial Construction Section is to procure the segment as a mix of five large design-build contracts and several small advance works design-bid-build contracts. The decision for this approach was primarily driven by the requirements associated with the American Recovery and Reinvestment Act process:

- The 2017 deadline on funds disbursement prevented the use of an availability payment structure (i.e., when payments are during operation of the system rather than during the construction period) involving federal funds.
- The exclusion of signaling, communications, power system, and vehicles from the scope removed the potential system integration risk transfer benefit.

Concern has been expressed at the potential lack of operator input to the design of the Initial Construction Section.[2] The Authority has included consultants with operations experience and has performed significant outreach with operators for input in the design, especially around the station locations and the infrastructure quality requirements. However, the Authority does not believe that the role of operator should be exclusive at this early point in the project. Including an operator early in the development process prior to the specific structuring of an operating approach and requirements that are bid on a fixed-cost basis removes a very powerful cost management tool from the Authority. The ability to receive fixed-cost bids from the private sector in competitive procurement environments will be retained wherever possible.

The use of design-build to provide high-speed rail infrastructure is a common contract delivery method across Europe, in particular dating back to the origination of the networks in France, Germany, and the completion of the Channel Tunnel Rail Link in the U.K.

Initial Operating Section

While the decision regarding the specific delivery model for the Initial Operating Section (IOS) does not need to be made at this time, some foundation requirements exist that must be present in the final service delivery system:

- The IOS will be constructed by the private sector under some form of fixed-cost contract that seeks to transfer design-build completion risk to an appropriate extent.
- A private-sector train operator must be selected as the IOS will initiate passenger service for the system. The procurement of this operating contract will be closely aligned with the long-term, future operating strategy.
- Management and maintenance of systems and other infrastructure for the IOS will require technical support and a potential long-term infrastructure management contract.

Importantly, a decision regarding the delivery model for the IOS will be required at least two years in advance of construction commencement to allow sufficient time for the procurement and contracting of a private partner. Factors that will have a bearing on private-sector participation are described below.

Scale of program

The scale of construction and engineering for the IOS is likely too large to be delivered by a single construction contracting venture. Given the scale of the IOS, multiple contracts may be required.

Future value from ridership revenue

The financial analysis presented in Chapter 8, Funding and Financing, illustrates that projected revenues exceed projected operating and maintenance costs. The IOS (north or south) generates an operating profit and excess cash flows once future capital maintenance is considered, although building IOS-South with blended operations to the Los Angeles Basin is expected to have stronger ridership and resulting cash flows than the IOS-North with blended operations. In either case, the ability to leverage significant amounts of construction financing from the future operating profit of the IOS is not considered likely prior to completion and proven performance and is therefore not incorporated in this Business Plan. A private sector investor, prior to making an investment, will want to ensure that the section demonstrates the level of economic and technical performance expected.

Preferred options

Based on the constraints above, construction of the IOS is expected to require continued state and federal funding until the section is completed and operational. The Authority anticipates that construction will continue under design-build contracts and private-sector contracts will be issued for vehicle provision, train operations, and infrastructure operations and maintenance.

Operation of the IOS is not expected to require any state or federal funding as operating costs can be covered by operating revenues.

Provision of vehicles

The vehicles' capital value at the IOS stage is $855 million (2010$) representing 12 trainsets. Based on international experiences, vehicle manufacturers may offer either lease-based financing or a long-term service contract to deliver and maintain the trainsets over time. This latter approach is a PPP structure that has been used internationally, for example in the U.K. for the procurement of rolling stock for London's Crossrail and Thameslink projects. The key to this approach will be the long-term outlook for completing the Bay to Basin and Full Phase 1.

Train operations

The principal role of the TOC is to provide a service designed to maximize revenue and benefit users. The role of the TOC would not involve any material capital investment and, therefore, would have no impact on the funding requirement of the IOS. The TOC would have input on the optimal service specification, the vehicles, and station designs. It is unlikely that the TOC would assume the full revenue risk associated with the IOS until the system is proven, although there is likely to be an interest in a mechanism to share a degree of revenue risk.

A well-established train operator market exists in Europe and includes SNCF, Deutsche Bahn, Virgin Rail, and others. The increasing liberalization of the passenger train market across Europe means train operators are experienced in a competitive commercial market.

A TOC franchise would be competitively procured, and there is likely to be a significant level of interest from international operators for such a role. This competitive pressure may result in train operators valuing the system's future revenue and exhibiting a willingness to assume a greater amount of revenue risk.

Infrastructure operations and maintenance

The organizational role of an infrastructure operations and maintenance provider was set out earlier in this chapter. The contract for infrastructure maintenance would be let on a term basis, probably with a duration of 7 to 10 years depending on the inclusion of capital maintenance as well as the future plans for the network. It will be important to develop sufficient flexibility in this contract if future sections of the system are to be possibly delivered under a design-build-finance-operate (DBFO) basis.

Bay to Basin/Blended

As with the IOS, the Bay to Basin phase consists of the development of an additional 110 or 120 miles of track and systems, depending on the northern or southern route selection, through at least one mountain range. Unlike the IOS, which only links the Central Valley to one large urban population center, the Bay to Basin system addresses three travel markets: Bay Area to Los Angeles Basin; Bay Area to Central Valley; and Los Angeles Basin to Central Valley. As a result it has much stronger ridership (and higher operating costs), as discussed in Chapter 6, Ridership and Revenue.

Scale of program

As with the IOS, the engineering and construction scale for the incremental section to complete the Bay to Basin system is too large for a single PPP; however, the crossings of the Diablo, Tehachapi, and San Gabriel Ranges are all significant enough to form viable potential infrastructure DBFOM PPP procurements.

Appetite for pathfinder project

Bay to Basin will have the benefit of the original IOS. Rolling stock, systems, and infrastructure will be in place and operating, and the system will have ridership and revenue experience. A significant number of risks will have been mitigated as the project moves to the Bay to Basin section.

Future value from ridership revenue

Ridership and financial projections illustrate that IOS revenues cover operating costs. In addition, there is an increase in the system's financial performance when the San Francisco Bay area is connected with the Los Angeles Basin. As identified in Chapter 8, Funding and Financing, revenues begin to support funding of capital costs (in addition to covering operating costs) and may support financing for those costs. While these revenues will not completely cover all future capital costs for build-out of the remainder of Phase 1 and Phase 2, they can be an important contributor. This project-based financing opportunity provides for additional flexibility in procurement models.

Current preferred options

Train operations franchise or concession

The role of a Train Operating Company was set out above. The option to offer a franchise for the new IOS service was also described above. Based on the preliminary financial analysis, a TOC will be able to generate some degree of revenue-based finance from Bay to Basin. It will be in a position to contribute to a portion of future capital costs. The timing of such a transaction will be evaluated at one or more key junctures following commencement of IOS blended operations. The completion of Bay to Basin provides a clear value opportunity. In addition, with significant industry interest, the potential exists to accelerate this decision point to help complete the final stages of the Bay to Basin capital construction. This TOC franchise will be competitively procured, and there is likely to be a significant level of interest from international operators for such a role. Through a gain/share requirement, the Authority will ensure that there is no loss of future value from the network through upside revenue sharing mechanisms within any concession-based agreement.

Consideration will be given to the fact that an operator for IOS will likely already have been selected and therefore the role to operate the Bay to Basin could either be an extension of the IOS blended operations role or a competition for a new operator. This will require sufficient flexibility in the initial train operating contract for the IOS prior to completing the Bay to Basin.

Subsection infrastructure DBF(O)M

The key benefit of the Infrastructure DBFOM would be cost containment. Similarly, the infrastructure operations for the completed IOS could be included at comparatively little additional cost; however, the risk transfer on the maintenance of the design-build sections may be limited. This will require the design-build packages to include sufficient ability to allow a future private-sector maintenance provider to assume full responsibility for the assets.

It is unlikely that the complete Bay to Basin section could be delivered under this model. It will, however, be possible to define a sub-section(s) of the segment for completion.

Secondary benefits of a DBFOM delivery mechanism include the following:

- Increasing the contract size significantly compared to design-build contracts to reduce the overall number of contracts to manage and reduce the interface risks
- Optimizing the whole life cost of the section versus focusing on the capital cost alone
- Involving the private-sector specialists early in design and system specification to provide cost savings earlier in the project development process
- Generating large interest from the PPP industry for an approach based on a familiar model, which would improve price competition

A full combination of the DBFOM could be achieved by letting a full concession to the private sector prior to completing the Bay to Basin segment. Under this option, the private sector would take responsibility for the complete operations and maintenance of the full system, assume full revenue risk for the existing and future network, and complete the final stage of capital works.

The use of DBFOM contracts under PPP has been used successfully in Holland and France, and a complete build-operate-transfer model was used to develop the Taiwan system.

Phased improvements to Bay to Basin/Blended and Full Phase 1

The phased improvements on the San Francisco Bay Peninsula and between the San Fernando Valley and Los Angeles' Union Station consist of the electrification of the 55-mile Caltrain corridor and improvement of 60 to 100 miles of track and systems, some of which belong to other regional public entities. The current schedule assumes that construction would commence in 2026.

The following factors will have direct bearing on the approach, in addition to the criteria for procurement decisions discussed above.

Scale of program

With Full Phase 1, especially if a phased approach is taken to improvements to Caltrain on the Peninsula and Metrolink in the Los Angeles Basin, the costs of the expansions are more within reach in terms of PPP market capacity.

Appetite for pathfinder project

For Full Phase 1 an inherent risk exists in the requirement to run on tracks owned by a third party (e.g., Caltrain/Metrolink) and the interface risk associated with this existing infrastructure.

Future value from ridership revenue

The projections of ridership revenue and costs at the Full Phase 1 stage illustrate that additional excess cash flows will be generated over those from a Bay to Basin blended operation. This provides a second opportunity to repay or finance future capital costs toward the completion of Phase 2.

Current preferred options

The option to complete the Full Phase 1 will be heavily influenced by the options ultimately selected for IOS and Bay to Basin. To the extent it had not already had been realized, it would be possible to monetize a fully operational Bay to Basin system by letting a concession for operation of the infrastructure in return for an initial payment. Such a structure was used on the U.K.'s HS1 (Channel Tunnel Rail Link) and resulted in a recovery of 25 percent of initial capital outlays.

The key benefit of this option would be similar to the option discussed above for Bay to Basin. It would allow the funds to be used for the system's phased improvements.

Conclusion

As has been discussed in previous chapters, California's HSR program will be implemented in stages, based in part on how and when funding becomes available. The timing and structure of private participation will evolve with the phasing plan, all under the governance of the state. The earliest section, which is well into design and for which funding is identified, has a well-defined business model. As the project progresses over time, flexibility has been retained within the larger business model structure. Likely approaches for each phase are as follows:

- **Step 1: Initial Construction Section**—This section, which is the initial construction element of the IOS, requires design and construction activities. To minimize cost risk and accelerate delivery, the selected business model is to deliver this section with private contractors under primarily design-build contracts.
- **Step 2: Initial Operating Section**—Whether starting with IOS-North/Central Valley to Bay or with IOS-South/Central Valley to Basin, this is the first section that will include high-speed rail operations. Construction will continue using Design-Build, and train operations and infrastructure maintenance will be performed under contract.
- **Step 3: Bay to Basin/Blended**—The system development will be mature enough to support greater private-sector participation in operations and maintenance and various forms of private finance. It is possible that the Bay to Basin section could include a sub-section to be completed using a PPP structure partly funded through the monetization of future operating profit from the IOS and Bay to Basin sections to be completed (i.e., obtaining an up-front payment in exchange for future revenues).
- **Step 4: San Francisco to Los Angeles/Anaheim (Phase 1)**—All operations and maintenance will be performed by private-sector third parties in tandem with private investment.
- **Step 5: Extensions to Sacramento and San Diego (Phase 2)**—All operations and maintenance will be performed by private-sector third parties in tandem with private investment.

End notes

[1] *Source:* Doyle Drive Public-Private Partnership. April 2010. “Re-envisioning Doyle Drive–Presidio Parkway.” Joint presentation to the California Transportation Commission by Caltrans and San Francisco Transportation Authority.

[2] PRG response to LAO Rept May 2011: “The importance of the operator's input into the details of the systems design cannot be overstated. The operator should have major input into the design and siting of the maintenance facility, siting of high-speed crossovers, line side signaling, and the layout of stations, among other features. Consequently it is the norm to let a concession contract for the operator several years prior to the start of commercial operations and before many critical engineering decisions are made. This is particularly important if the operator will also acquire the rolling stock for the project. Moving rapidly to construction now may well be important to spending Federal money before the 2017 deadline, but it might do so at the cost of disrupting the link between designer/constructor and operator. Among other things, this means that any design decisions that cause (or can be argued to cause) safety or efficiency problems will be the responsibility of Caltrans, or HSRA, or the designer/builder, but not the future operator.”

Chapter 6

Ridership and Revenue

Introduction

This chapter focuses on how ridership and revenue forecasts have been updated for the HSR program using peer-reviewed forecasting practices and describes the modeling methodology, assumptions and input data used in preparing these forecasts. Specifically, this chapter includes the following:

- Describes the findings and recommendations of the independent Ridership Peer Review Panel (Panel) commissioned to review the preparation of the updated forecasts. The Panel reviewed the forecast approach, the features of the ridership model, the data and assumptions, and the documentation supporting the forecasts.
- Describes updates made in key inputs, including population growth, reflecting information gathered through post-recession surveys.
- Presents ridership and revenue forecasts across a range of inputs and assumptions with a resulting range of possible outcomes as presented in three Business Plan scenarios—presented as high, medium, and low. This approach demonstrates how the forecasts change when key inputs are varied, such as changes in travel patterns.
- Discusses how input from international high-speed rail operators was incorporated into the ridership and revenue forecasts.

Additional information on the ridership estimates in this Business Plan is available in the *California High-Speed Rail 2012 Business Plan Ridership and Revenue Forecasting* and the *California High-Speed Train Ridership and Revenue Model Development, Application, and Project-Level EIR/EIS Forecasts,* which can be found at www.cahighspeedrail.ca.gov/business_plan_reports.aspx.

Approach/methodology

Ridership and revenue forecasts have been the focus of extensive discussion and debate. To provide independent assessment of the modeling and to improve the reliability of the forecasts, the Authority convened a panel of international experts in travel forecasting to examine and guide the forecasting effort. The Authority commissioned the Panel to perform three basic functions:

- First, the Panel evaluated data collection and model development used to support the forecast work performed to date that supported past planning and environmental work. Due to the level of debate surrounding forecasting (including model development and data collection), a rigorous review was conducted on issues of potential concern.
- Second, the Panel focused on guiding further work being performed to produce a range of scenarios to be used in the current Business Plan forecasts. As a normal process, forecasting depends on continued refinement of data and modeling function to address increasingly complex needs.

- Third, as a next step, the Panel is providing advice on further improvements to the forecasting model to support future decision making on initial operating sections and public-private investment strategies.

> **We are satisfied with the documentation presented in Cambridge Systematics (2011), and conclude that it demonstrates that the model produces results that are reasonable and within expected ranges for the current environmental planning and Business Plan applications of the model . . . . We were very pleased with the content, quality and quantity of the information.**
>
> *Ridership Peer Review Panel—April–July 2011 Review Period*

Charged with leaving-no-stone-unturned, the Panel first met in January 2011 to review the initial data collection and model development, as well as assumptions about future travel conditions. It was important to consider recent critiques by others, and the Panel initiated its own rigorous assessment of potential deficiencies or areas deserving further consideration. As a result, the Panel developed an extensive list of issues to be investigated and requested complete documentation of inputs and model validation results.

In response to the Panel's list of issues, detailed documentation on the behavior of the existing model was provided as they continued work through July 2011. During this six-month period, thousands of hours were invested by the Panel, Authority staff, and the consultant team to support this effort. As a consequence of this very detailed testing and review, the Panel concluded in its April–July 2011 Review Period Report that the existing model behaves reasonably, produces results within expected ranges, and is suitable for use in preparing environmental documents and current business planning.

The Panel supported the work in updating the state travel data in the following areas:

- Airfares and frequencies were updated to reflect the expansion of low-cost airlines to nearly all of the state's major markets.
- Recent long trip-making patterns in the current slow economic conditions were inventoried through a 15,000 person on-line survey in May 2011.
- The cost of driving was reviewed.
- Conventional rail service was updated to reflect current fares and schedules.

Other adjustments made in preparing the forecasts included the following:

- Based on advice from European, Japanese and South Korean operators and government agencies, the train frequencies were reduced to maintain higher load factors on the remaining trains and[1] to reflect capacity constraints in shared corridors.

- Population growth and population distribution were updated with post-recession state forecasts.
- Access to San Francisco International Airport at Millbrae was estimated as a result of alternatives analysis work conducted in 2010.
- The impact of adding dedicated, high quality bus coach feeder service to Merced from Sacramento and from Bakersfield to the Los Angeles area, and various service changes to improve operational load factors were added.

Ridership Peer Review Panel Members represent an independent international panel of respected experts.

Dr. Frank Koppelman, (Chair) Northwestern University, Professor Emeritus, Department of Civil Engineering

Dr.-Ing. Kay Axhausen, Swiss Federal Institute of Technology, Zurich, Institute for Transport Planning & Systems, Full Professor & Director; Editor-in-chief "disP" 2008–11, Editor "Transportation" 2005-present; current editorial board member of "Transportation Research" and "Journal of Choice Modelling"

Mr. Billy Charlton, TRB* Committee on Transportation Demand Forecasting, 2007-2010; Principal Planner, San Francisco County Transportation Authority, 2003-2011

Dr. Eric Miller, University of Toronto, Professor, Department of Civil Engineering; Chair, International Association of Travel Behaviour Research, 2008-Present; Editorial board member of "Journal of Transport and Land Use" and of "Transport Reviews," 2008-Present

Dr. Kenneth Small, U.C. Irvine, Professor Emeritus, Department of Economics; Current Fellow, Resources for the Future: Editorial board member of "Journal of Urban Economics," "Journal of Transport Economics and Policy," and "Transportation"

*TRB—National Academy of Sciences, Transportation Research Board, Washington, D.C.

As a result of the Panel's extensive analysis, it concluded that the model is not only appropriate for business planning purposes but provides a sound basis for additional model development to support future forecasting needs. This represented a significant milestone in validating the integrity of the present forecasting and establishes the current model system as a reliable and valuable tool for the state in its assessment of the high-speed rail program.

With the guidance resulting in a much higher degree of confidence in the model's function, ridership forecasts were then prepared using the updated assumptions. As described below, and consistent with statutory requirements associated with this Business Plan, "High," "Medium," and "Low" forecasts were prepared. Consistent with the implementation plan described in Chapter 2, A Phased Implementation Strategy, forecasts were prepared for each of the implementation steps up through Step 4, the completion of the Full Phase 1 system.

The model was set up to produce ridership projections for 2030 for each implementation step. To support financial planning efforts associated with this Business Plan, the 2030 forecasts were decreased by 1 percent per year to produce estimates for the years 2022 to 2029. To produce forecasts for the years 2031 to 2060, the 2030 forecasts were increased by 0.5 percent per year. These rates are based on the changes in results among three test forecasts using post-recession population and demographic information for the years 2020, 2030, and 2050.

Scenarios and specific assumptions

This section describes the specific inputs and assumptions used to prepare the ridership and revenue forecasts. It also includes the scenarios developed for testing their sensitivity to a range of key inputs and assumptions, including the following:

- Population growth
- Trip-making patterns/types of trips taken (e.g., long/short, commute/recreation)
- Gasoline prices and auto fleet efficiency
- Airfares

The three ridership and revenue scenarios shown in Exhibit 6-1 were created to develop a reasonable range of forecasts under a range of inputs and assumptions. As described in the following discussion, the modeling work conducted for this 2012 Business Plan takes a deliberately conservative approach. This was done to minimize the risk of inflated results for use in the financial plan.

Exhibit 6-1. Ridership and revenue scenarios

- Business Plan High
- Business Plan Medium
- Business Plan Low

The three scenarios form a Business Plan range with the "High," "Medium," and "Low" scenarios representing a reasonable expected set of outcomes. The three scenarios are defined by combinations of more and less favorable assumptions for each of the variable inputs described below. They serve as the basis for the financial analysis. These scenarios are applied to the implementation steps described in Chapter 2, A Phased Implementation Strategy.

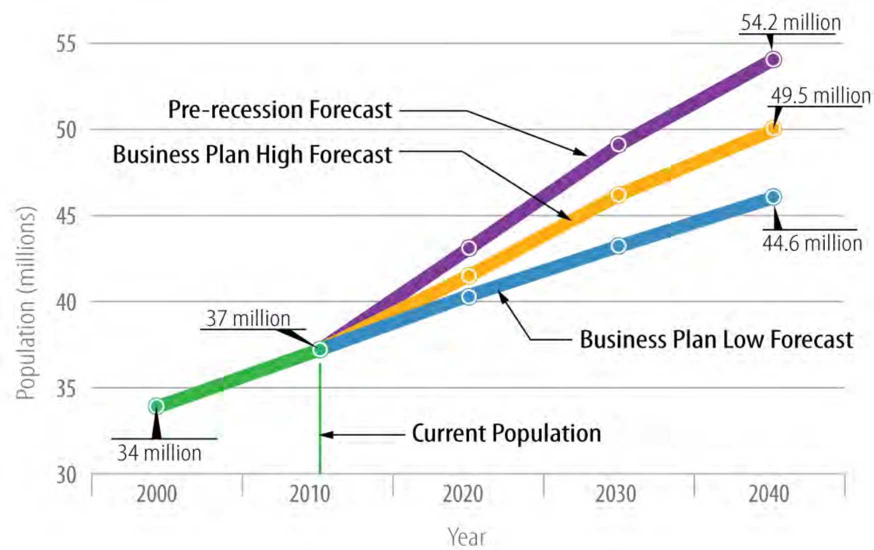
Key inputs

Population growth

California has grown from 30 to 37 million residents in the last 20 years, and its economy has continued to grow despite the recent recession. According to some private economic forecasts, California is projected to continue growing but at a slower rate than before the recession. Exhibit 6-2 shows how population grew through 2010. It also shows the pre-recession growth forecast used in prior ridership and revenue forecasts. An updated, post-recession growth forecast is used for the Business Plan High scenario. This conservative forecast is lower than the California Department of Finance (DOF) estimates.

An even more conservative growth forecast, which is 13 percent below the DOF estimate, was assumed for the Business Plan Low scenario. The Business Plan Medium scenario assumes population growth midway between the two. Population has a direct correlation with ridership. Therefore, assuming lower population has a direct impact in reducing projected ridership levels.

Exhibit 6-2. California population growth, actual and Business Plan forecasts



The purple line shows the pre-recession population forecast. A more conservative post-recession forecast is assumed for the Business Plan High scenario, and an even lower forecast for the Business Plan Low scenario.

Trip-making patterns in California

Patterns in trip-making are also a key input into the ridership and revenue forecasts. Assessments are made as to what kinds of trips are taken, with what frequency, and by what mode. This information is used with other factors to project future travel patterns and to distribute trips among various modes of transportation. How often long-distance trips are made and for what purpose have been estimated for both before and after the recession. The results of the May 2011 online survey indentified changes in trip patterns. The *proportion* of long-distance commuter trips was significantly lower in the post-recession survey, whereas there was an increase in personal and "other" trips.

This change in trip pattern resulted in a lower HSR forecast since personal and other trips, unlike business trips, tend to be made by groups who prefer to drive. It is unclear whether this trend represents a long-term change or is a product of the current economic climate.

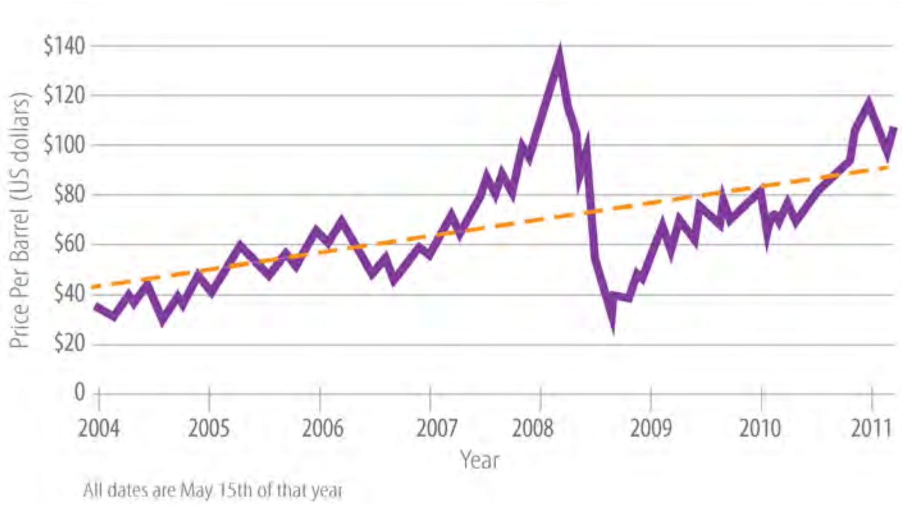
To test input assumptions fully, the Business Plan High scenario uses the *pre*-recession mix of trips, which is characterized as "Favorable." The Business Plan Low scenario uses the *post*-recession 2011 results and is characterized as "Unfavorable." The Business Plan Medium scenario lies midway between.

Driving costs/gas prices

The cost of driving is significantly influenced by the price of gasoline, which is primarily determined by the cost of a barrel of oil, which has been extremely volatile in the last several decades. In turn, the cost of driving has a significant impact on what mode of transportation people take. The less expensive, the more likely they are to drive; the more expensive, the more likely they are to take alternative transportation.

Exhibit 6-3 shows how oil prices have fluctuated since 2004.[2] However, the overall trend has been upward, resulting in an increase in gasoline prices even after accounting for general price inflation. It seems unlikely that this trend will reverse, although the costs of driving may decrease if significant improvements in fuel efficiency are made or drivers increasingly adopt hybrid, electric, or other technologies in their vehicles.

Exhibit 6-3. Weekly spot price of a barrel of crude oil, 2004–2011 (short-term volatility, price increasing over time)



In the forecast model, the cost of gasoline represents approximately half of the cost of driving. For purposes of these forecasts, a range of gasoline costs were created around the August 2011 California average of $3.80 per gallon of regular gasoline. To demonstrate the robustness of the model in response to earlier concerns, sensitivities have been run on a range of costs. The high end of driving cost is assumed to be 10 percent higher, from a combination of $5.50 per gallon of gasoline, a 25 percent improvement in fleet gas mileage, and no change in costs of tires, oil, and other routine maintenance. The low end is 20 percent lower, from a combination of $2.85 per gallon of gasoline, a 9 percent improvement in fleet miles per gallon, and no change in the other variable costs.

All three of the Business Plan scenarios use a middle assumption in which the cost of driving remains at current levels. By assuming an unrealistically very conservative future price for gasoline, the modeling limited mode shift from automobile to high-speed rail.

Airfares

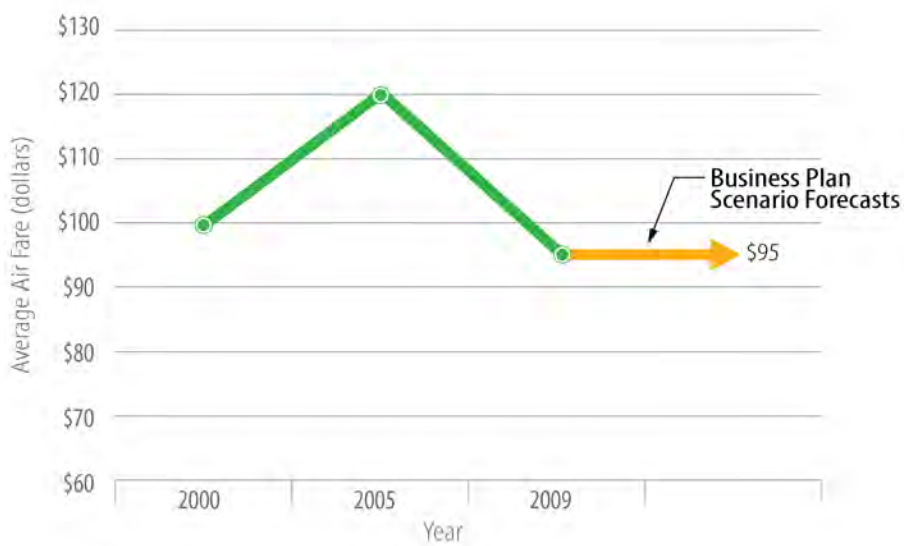
The potential range of airfares used to develop the ridership forecasts were based on an industry expert review by Aviation System Consulting, LLC, of recent and long-term trends in airfares in California markets, expected fuel costs, and historical changes as airports face capacity constraints. Key observations include the following:

- With low-cost air carriers (Southwest, Virgin America, and JetBlue) heavily present in all airport pairs, airfares are unlikely to decrease significantly.
- Capacity constraints on the region's airports and continued growth in long-distance demand will shift many airlines' priority to trans-continental and international flights, adding premiums to the remaining shorter distance intrastate flights.
- Air travel will become less predictable as weather and other delays are exacerbated by airport capacity constraints, despite additional planned investment in modern air traffic control systems.
- Jet fuel accounts for more than 30 percent of the operating costs for domestic U.S. airlines but increases in fuel efficiency will offset price increases.

> **"We believe that California is a market very well suited to High-Speed Rail (HSR) as it has several major population centers which could be connected by faster end-to-end train journey times than are possible by car. On some routes it would also provide a good alternative to air travel. The ridership potential and the scope to make a significant contribution to CO2 reduction are therefore substantial.**
>
> *Virgin Rail Group (RFEI submission)*

Exhibit 6-4 shows past trends in the average airfare between the San Francisco Bay area and the Los Angeles Basin and the fare assumed in the scenarios.[3] Similar to the cost of driving, all three Business Plan scenarios assume that airfares stay constant at 2009 levels, although airfares appear to have risen in 2010 and 2011. This has the effect of making air more competitive with high-speed rail and thereby constraining projected HSR ridership levels.

Exhibit 6-4. Average airfare: Los Angeles Basin to San Francisco Bay Area (2010$)



For purposes of evaluating the three Business Plan scenarios (high, medium, and low), airfares are assumed to remain constant at 2009 levels.

Summary of Business Plan scenarios

All three Business Plan scenarios assumed that the cost of a gallon of gas will be $3.80 and that airfare between Los Angeles and San Francisco will be $95 (one way). In sum, the variable inputs used for the three Business Plan scenarios are as follows:

- **Business Plan High Scenario**—Assumes California's population will reach 49.5 million in 2040 and trip-making patterns will be favorable.
- **Business Plan Medium Scenario**—Assumes California's population will reach 47.1 million in 2040 and that trip-making patterns are midway between favorable and unfavorable trends.
- **Business Plan Low Scenario**—Assumes California's population will only reach 44.6 million in 2040 and that trip-making patterns will be unfavorable.

Assumptions common to all scenarios and phased implementation steps

Total trips

In 2000, about 500 million trips were made each year among regions in California, the majority of them by car, with 20 million trips by air, and 4 million by existing intercity rail services. With population growth and changes in demographics, overall inter-regional trip making is expected to continue to grow by approximately 64 percent to 2030, reaching 900 million trips.[4] Over the same period, the rate of growth in highway capacity is not projected to keep pace with travel demand, which will make long-distance trips made by car slower with less reliable travel times

Rail passenger fares and speeds

For the purposes of this analysis, existing intercity Amtrak passenger rail fares and travel speeds are assumed to remain at 2011 levels.

High-speed rail fares

Fare levels are assumed to be comparable to those of other HSR services world-wide—somewhat below current airfares in the longer distance travel markets and well above the out-of-pocket cost of driving in the shorter distance travel markets. The primary objective associated with the assumed fare structure is to maximize passenger revenues and the net operating surplus.

As is the case with high-speed rail service around the world today, and is the case with airfares as well, California high-speed rail fares will vary by the following:

- **Time of day**—Peak vs. off-peak
- **Class of service**—First class vs. coach
- **Travel time**—Express/limited-stop vs. "making all stops" service
- **Timing**—How far in advance tickets are purchased[5]

Just as with flying today, high-speed rail travelers with more flexible schedules or limited budgets could save money by booking well in advance or traveling in the middle of the day when trains are less crowded. Travelers who have to make last-minute bookings and need to take express trains or travel during peak periods will typically pay a higher ticket fare.

Exhibit 6-5 illustrates how fares might vary around the average fare that was assumed for all forecasts within the model. HSR fares for stations such as Sacramento or San Diego that are not directly served in Full Phase 1 include the cost of rail or dedicated feeder service to reach the HSR system at the most convenient station.

Exhibit 6-5. Sample HSR fares (2010$ one-way)

Station-to-Station	Buy-ahead, off-peak, and/or multi-stop train	Average fare assumed in forecast	Last-minute, peak, and/or express train
San Francisco–Los Angeles	52	81	123
San Jose–Anaheim	52	81	123
Fresno–Millbrae	41	64	97
Sacramento–Fresno	45	71	107
Los Angeles–Kings/Tulare	42	66	100
Bakersfield–Merced	39	62	93
Palmdale–San Diego	46	57	73

To generate more conservative forecasts, the expected positive effects on revenues of this type of flexible "capacity management pricing" are not included in this forecast. Future upgrades of the ridership and revenue model will allow closer approximation of capacity management pricing to better capture potential positive net operating profit opportunities.

HSR schedules and travel times

Along with fares, the most important factors affecting the forecast relate to the quality of the service. This service focuses primarily on the travel time (how long the trip takes) and schedule (how frequent is the service).The forecasts for each implementation step are based on a schedule of train departures and a pattern of station stops that determine the frequency of service and how long the trip will take.

For Full Phase 1 service, up to seven trains per peak hour are assumed to operate between Los Angeles and San Jose. Most trains continue to San Francisco.

On the south end, three of the seven trains are assumed to continue past Los Angeles to Anaheim. This schedule allows one train per hour to operate as an "express/non-stop" with a trip of two hours and forty minutes from Los Angeles to San Francisco. This service level also assumes that there are other limited-stop trains that run express between other major markets.

The remaining "regional/local" trains would serve a multiplicity of intermediate points to maximize connectivity. Hourly service is also assumed in the forecast between Merced, Los Angeles, and points in between. In the off-peak hours, service is less frequent.

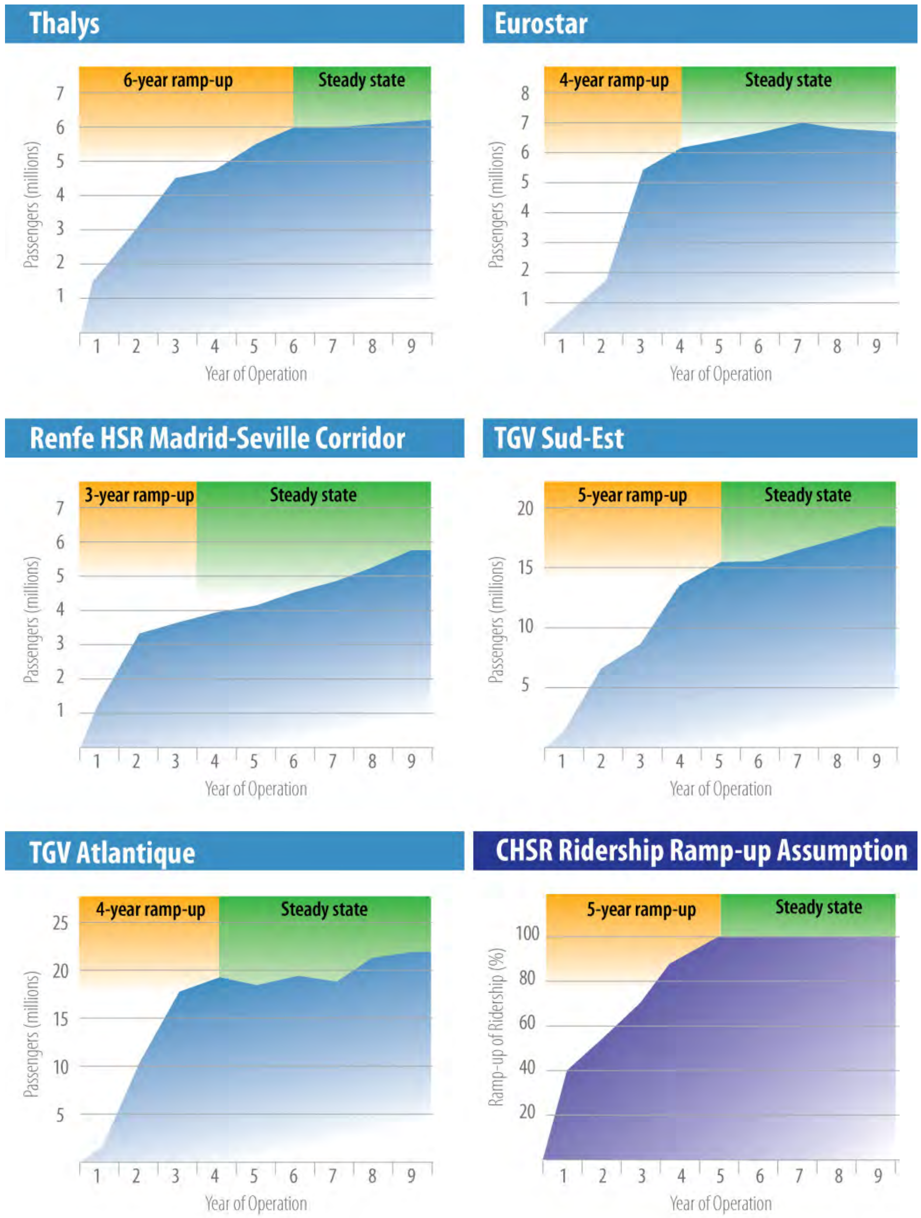
For the initial operating segments and the Bay to Basin, the schedules are less frequent because of lower expected travel demand.

Ridership "ramp-up" period

Whenever high-speed rail systems are implemented, it takes time to reach their full market potential. (i.e., ridership grows or ramps-up over time) (Exhibit 6-6). In developing its ramp-up assumption for the ridership forecast, the Authority learned from international experience (see additional discussion below). For the California forecast, a five-year ramp-up of ridership and revenue was assumed after each of the implementation steps is opened for revenue service according to the following schedule:

- 40 percent of the long-term ridership potential is achieved in year 1
- 55 percent in year 2
- 70 percent in year 3
- 85 percent in year 4
- 100 percent in year 5

Exhibit 6-6. Examples of ridership growth (ramp-up) in European HSR systems



Results

Given the importance of ridership and revenue to the underlying financial plan and the ability to accurately project operating performance and attract private-sector capital, a principle of conservative choices can be seen throughout this chapter. The use of an independent peer-review panel builds transparency and validation for model development. The use of post-recession population growth and trip-making patterns reflected today's economic realities. Strategically targeted conservative driving cost, airfares, and other assumptions create safeguards. Simply put, the goal was to use approaches, methodologies, scenarios, and assumptions that improve the level of confidence and reduce financial risks.

It is important to be able to consider the ridership projections in context. California's large population creates tremendous demand for mobility, and the usage levels of the state's many and diverse transportation systems demonstrates this fact. Some perspective on the ridership projections for California can be gained by comparing the markets that the statewide high-speed rail system will serve with markets being served by systems around the world, as shown in Exhibit 6-17 at the end of this chapter. As shown, the Spanish HSR system serves cities with a combined population of 7.9 million people and has annual ridership of 10 million; the French system serves a combined 15.1 million people and generates 31 million annual riders. California's system will serve a population base projected to be over 49 million in Full Phase 1. This comparison is not, in and of itself, dispositive, but it uses actual data to show the ridership levels that can be generated from given population levels.

Another perspective can be gained by considering the ridership levels of existing public transportation systems in California. Exhibit 6-7 shows 2010 ridership levels for various transit systems throughout the state in areas that will be served by the statewide high-speed rail system. These results show clearly that there is very high demand for and usage of public transportation in California, both in metropolitan regions and in the Central Valley, in spite of difficult economic times.

Exhibit 6-7. California transit systems 2010 ridership

Transit Agency	2010 Ridership
Los Angeles County Metropolitan Transportation Authority (LA Metro)	453,820,000
San Francisco Municipal Railway (Muni)	209,544,000
San Francisco Bay Area Rapid Transit District (BART)	108,275,000
San Diego Metropolitan Transit System	78,997,000
Orange County Transportation Authority	53,800,000
Santa Clara Valley Transportation Authority	42,088,000
Santa Monica Big Blue Bus	20,207,000
Sacramento Regional Transit District	14,454,000
San Mateo County Transit District	13,744,000
Fresno Area Express	13,295,000
Peninsula Joint Powers Authority Board (Caltrain)	12,213,000
North Coast Transit District, San Diego	11,129,000
Southern California Regional Railroad Authority (Metrolink)	10,534,000
Golden Gate Bridge, Highway and Transit District	8,641,000
Golden Empire Transit District	7,039,000
Visalia City Coach	1,517,000

Source: Public Transportation Ridership Report, Fourth Quarter 2010. American Public Transportation Association.
http://www.apta.com/resources/statistics/Documents/Ridership/2010_q4_ridership_APTA.pdf)

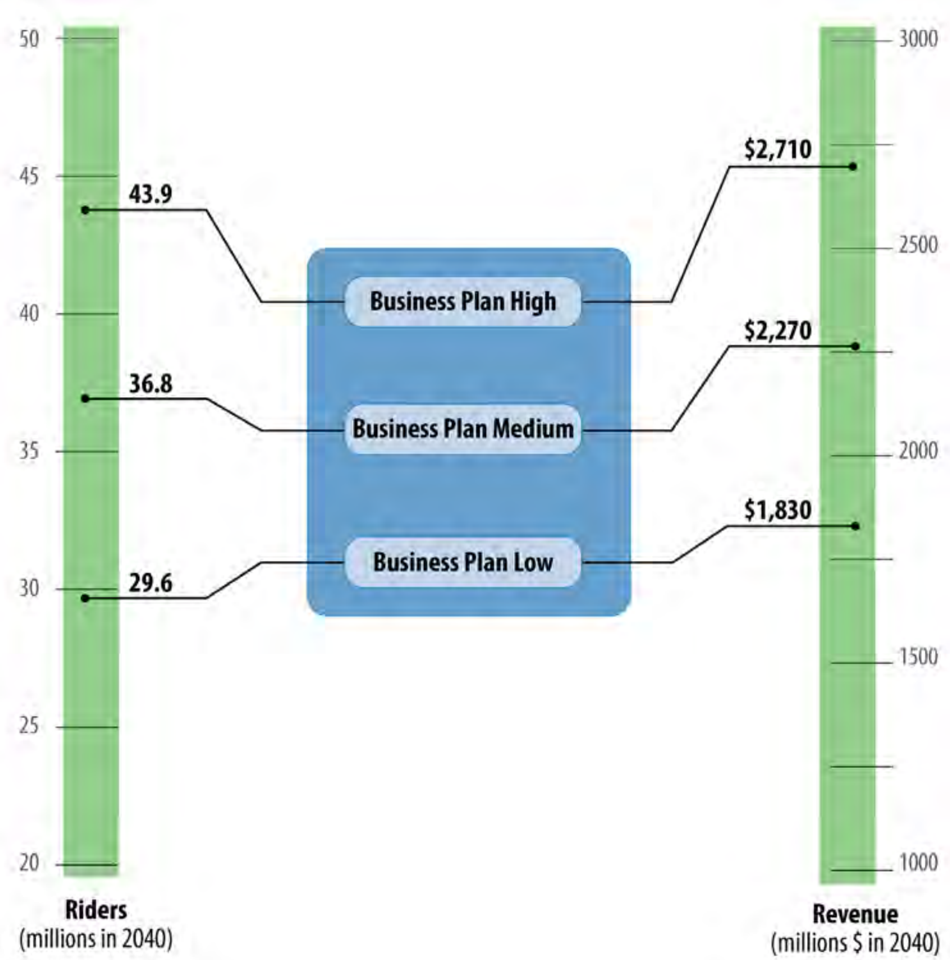
Exhibit 6-8 shows the annual Low and High ridership forecasts for each of the implementation phases starting with the Initial Operating Sections (either IOS-North or IOS-South), advancing to the Bay to Basin system, and then to the Full Phase 1 system between San Francisco and Los Angeles/Anaheim. The results are shown for year 2040.

Exhibit 6-9 shows the range of riders and revenues for the Full Phase 1 Business Plan scenarios in year 2040.

Exhibit 6-8. Business Plan Low and High ridership ranges of annual riders—year 2040 (in millions)

Implementation Step	Riders
IOS-North	7.6 to 11.2
IOS-South	9.5 to 14.0
Bay to Basin	16.1 to 23.7
Full Phase 1	29.6 to 43.9

Exhibit 6-9. Ranges of Full Phase 1 ridership and revenue across all Business Plan scenarios



This presents the range of Full Phase 1 ridership and revenue results for all three Business Plan scenarios analyzed.

Why are the Business Plan ridership forecasts different than the ridership forecasts in the Draft Environmental Impact Report/Draft Environmental Impact Statement (EIR/EISs)?

The ridership forecasts presented in this chapter represent a cautious view of future use of the HSR system for purposes of developing a conservative investment-focused business plan. The Draft EIR/EISs, on the other hand, present a more optimistic view of future use of the HSR system for purposes of the environmental analysis. As discussed in more detail at the end of this chapter, these two different purposes for ridership forecast lead to different results.

Ridership and revenue projections

This section illustrates the projected ridership and revenues of the system. Two analyses are shown illustrating system performance if the IOS-North is opened first followed by a second analysis if the IOS-South is opened first. In each case, it is assumed that segments are placed into operation on the schedule shown in Exhibit 6-10.

For both analyses, the High, Medium, and Low ridership and revenue scenarios are illustrated.

Revenue projections are in 2010 dollars to show the effect of growth without the impact of inflation. Revenue in 2010 dollars does not include the effect of inflation of ticket prices over time. The impact of inflation is addressed in Chapter 8, Funding and Financing.

IOS-North/Blended

Exhibit 6-11 provides the projected ridership for the high, medium, and low ridership cases in millions from IOS-North through Full Phase 1.

Exhibit 6-10. Schedule by section

Exhibit 6-11. Ridership, IOS-North first, through Full Phase 1 (in millions)

Scenario	2025	2030	2035	2040	2045	2050	2055	2060
High ridership	8.7	20.9	34.0	43.9	45.0	46.2	47.4	48.5
Medium ridership[1]	7.3	17.5	28.5	36.8	37.7	38.7	39.7	40.7
Low ridership	5.9	14.1	23.0	29.6	30.4	31.2	32.0	32.8

[1]Planning case

Exhibit 6-12 provides the projected revenues for the high, medium, and low ridership cases in 2010 dollars from IOS-North through Full Phase 1.

Exhibit 6-12. Revenues, IOS-North first, through Full Phase 1 (2010 dollars in millions)

Scenario	2025	2030	2035	2040	2045	2050	2055	2060
High ridership	$580.3	$1,528.4	$2,101.2	$2,711.9	$2,780.4	$2,850.6	$2,922.6	$2,996.4
Medium ridership[1]	$487.0	$1,280.0	$1,759.8	$2,271.3	$2,328.6	$2,387.4	$2,447.7	$2,509.5
Low ridership	$393.7	$1,031.6	$1,418.3	$1,830.6	$1,876.8	$1,924.2	$1,972.8	$2,022.6

[1]Planning case

Under the IOS-North Medium ridership scenario, the projected revenues are $487 million (in 2010 dollars) in 2025, which is the fourth year after completion of the IOS to San Jose. Revenues rise to $1.3 billion (in 2010 dollars) in 2030, the fourth year after completion of Bay to Basin. This represents a 167 percent increase in revenue as a result of the increased ridership once Bay to Basin is completed. Revenues rise to $1.8 billion (in 2010 dollars) in 2035, two years after the completion of Full Phase 1, and the 14th year of operations. This represents a 38 percent increase in revenue as a result of the increased ridership once Full Phase 1 is complete.

IOS-South/Blended

Exhibit 6-13 provides the projected ridership for the high, medium, and low ridership cases in millions from IOS-South through Full Phase 1.

Exhibit 6-13. Ridership, IOS-South first, through Full Phase 1 (in millions)

Scenario	2025	2030	2035	2040	2045	2050	2055	2060
High ridership	10.8	21.3	34.0	43.9	45.0	46.2	47.4	48.5
Medium ridership[1]	9.1	17.8	28.5	36.8	37.7	38.7	39.7	40.7
Low ridership	7.4	14.4	23.0	29.6	30.4	31.2	32.0	32.8

[1]Planning case

Exhibit 6-14 provides the projected revenues for the High, Medium, and Low ridership cases in 2010 dollars from IOS-South through Full Phase 1.

Exhibit 6-14. Revenues, IOS-South first, through Full Phase 1 (2010 dollars in millions)

Scenario	2025	2030	2035	2040	2045	2050	2055	2060
High ridership	$766.8	$1,556.9	$2,101.2	$2,711.9	$2,780.4	$2,850.6	$2,922.6	$2,996.4
Medium ridership[1]	$643.2	$1,303.9	$1,759.8	$2,271.3	$2,328.6	$2,387.4	$2,447.7	$2,509.5
Low ridership	$519.7	$1,050.9	$1,418.3	$1,830.6	$1,876.8	$1,924.2	$1,972.8	$2,022.6

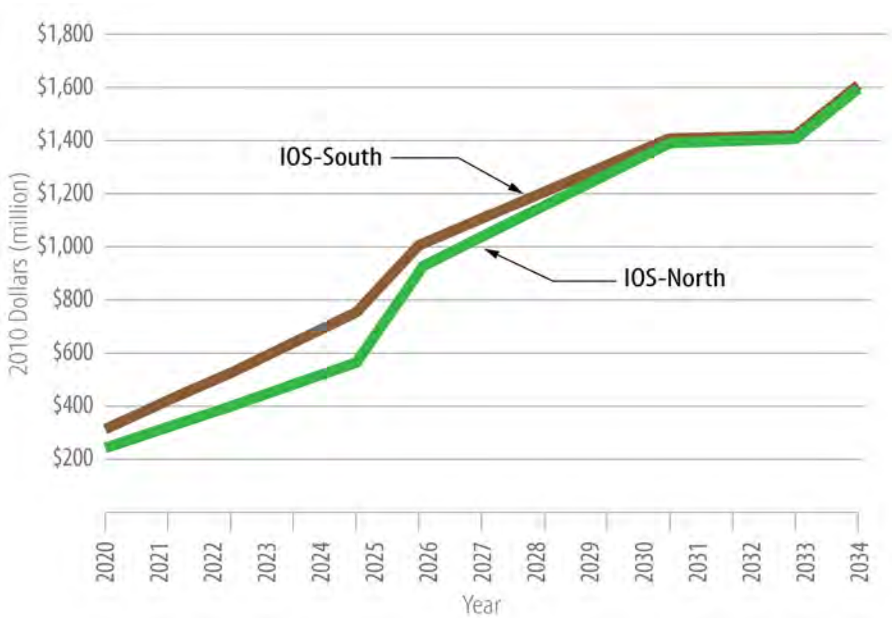
[1]Planning case

Under the IOS-South Medium ridership scenario, the projected revenues are $643 million (in 2010 dollars) in 2025, which is the fourth year after completion of the IOS to the San Fernando Valley. Revenues rise to $1.3 billion (in 2010 dollars) in 2030, the fourth year after completion of Bay to Basin. This represents a 102 percent increase in revenue as a result of the increased ridership once Bay to Basin is completed. Revenues rise to $1.8 billion (in 2010 dollars) in 2035, two years after completion of Full Phase 1, and the 14th year of operations.

IOS-North compared to IOS-South

Exhibit 6-15 illustrates projected ridership revenue growth for the Medium ridership case for IOS-North through Full Phase 1 and for IOS-South through Full Phase 1 in 2010 dollars.

Exhibit 6-15. Revenue growth for IOS-North and IOS-South (2010 dollars in millions)



Under the IOS-South Medium ridership scenario, revenues are $156 million more (or 32 percent) than the IOS-North Medium ridership scenario in 2025. In comparison, the IOS-South Medium ridership scenario revenues are only $24 million more (or 2 percent) than the IOS-North Medium ridership scenario in 2030. By 2035, revenues for both the IOS-North and IOS-South Medium ridership scenarios reach $1,760 million as Full Phase 1 is completed.

Different purposes for HSR ridership forecasts lead to different results

This Business Plan presents a range of ridership forecasts for the HSR system in 2040, with a focus on Full Phase 1 ridership. These forecasts differ from those presented in the Merced-to-Fresno and Fresno-to-Bakersfield Draft EIR/EISs, which forecast ridership for the HSR system in 2035, with a focus on full system ridership. The forecasts differ because they were developed for distinct purposes and are based on different assumptions.

The ridership forecasts for this Business Plan support the state's financial and investment planning for the HSR system. Most importantly, the orientation of the Business Plan is to assess potential positive cash flow from the operation of the HSR system to help estimate private-sector investment. In order to do this, HSR fares are assumed to be relatively high (83 percent of airfare), reducing potential ridership but increasing the net revenue that can attract a private operator and its private-sector funding. Other assumptions that contribute to reducing potential ridership include conservative assumptions about future population growth and trip-making patterns.

The Draft EIR/EIS ridership forecasts support the Authority's environmental analysis. The orientation of the Draft EIR/EIS forecasts is to identify reasonable, higher levels of ridership on the HSR system to ensure the environmental documents adequately identify and disclose potential environmental impacts and identify mitigation measures. The forecasts are based on more optimistic assumptions about future population growth than these Business Plan forecasts. In addition, the Draft EIR/EISs present a range of forecasts based on the relatively higher HSR ticket prices as assumed in this Business Plan (83 percent of airfare), as well as a lower fare assumption (50 percent of airfare) that generates more riders. The lower fare assumption forecast used in the environmental analysis ensures adequate and complete disclosure of the potential for environmental impacts from the HSR system.

Exhibit 6-16 compares the Draft EIR/EIS ridership forecasts in 2035 with the Business Plan's medium scenario forecasts in 2040, reduced to a 2035 forecast year for comparison purposes in this discussion. These results and comparisons are not used elsewhere in the Business Plan.

Exhibit 6-16. Business Plan and Draft EIR/EIS ridership forecast comparison (year 2035)

Ridership Forecast Purpose and Type	Full Phase 1[1]	Full System[1]
EIR/EIS low forecast (HSR ticket price = 83% of airfare levels)	40.2	69.3
Business Plan Medium Ridership scenario (HSR ticket price = 83% of airfare levels)	35.8	51.2
EIR/EIS high forecast (HSR ticket price = 50% of airfare levels)	57.0	98.2
Business Plan Medium Ridership scenario[2] (HSR ticket price = 50% of airfare levels)	53	77

Source: Table 2-14 in Merced to Fresno Section Draft EIR/EIS; Table 2-16 in Fresno to Bakersfield Section Draft EIR/EIS; and Table 6-9 in Draft 2012 Business Plan.

[1] 2012 Business Plan 2040 forecasts have been reduced by 0.5% per year to create 2035 forecasts for comparison purposes.

[2] Preliminary estimate of Business Plan Medium Ridership scenario assuming 50% of airfare—provided for illustrative purposes only.

Exhibit 6-16 illustrates that the different assumptions about fares in this Business Plan and the impact analysis in the Draft EIR/EISs (83 percent of airfare versus 50 percent of airfare) create a substantial difference in ridership forecasts. For example, the Business Plan medium scenario assuming 83 percent of air fare for Full Phase 1 is 35.8 million riders annually, and the correlating Draft EIR/EIS forecast for Full Phase 1 using 83 percent of air fare is 40.2. If a 50 percent of air fare assumption is applied, the Draft EIR/EIS forecast for Full Phase 1 is 57 million riders annually. As discussed above, some of the difference is attributable to updated and more conservative assumptions about the pace of population and travel growth in the next several decades, but the fare assumption is the strongest factor.

Another important distinction is that the environmental analysis in the Draft EIR/EISs uses 2035 forecasts assuming the entire HSR system is constructed (98.2 million riders annually assuming 50 percent of airfare), whereas this Business Plan analysis is based on Full Phase 1 ridership (35.8 million riders annually assuming 83 percent of airfare). A comparison of the most closely correlating forecasts for Full Phase 1 and Full System, using consistent assumptions about HSR ticket prices, shows that the EIR/EIS forecasts are somewhat higher than those in this Business Plan, but the difference is reasonable in light of the distinct purposes for which the forecasts have been developed.

International high-speed rail systems were studied—a key lesson learned is that it takes time to reach full ridership potential. (photo courtesy of Alstom)

Comparisons with international systems

Existing HSR corridors in other places provide several useful points of comparison to gauge the reasonableness of California's HSR forecast. These comparisons covered adjusting service frequencies, comparing fare levels, and developing ridership ramp-up assumptions.

A key lesson learned from international experience is that whenever high-speed rail systems are implemented it takes time to reach the full market potential.

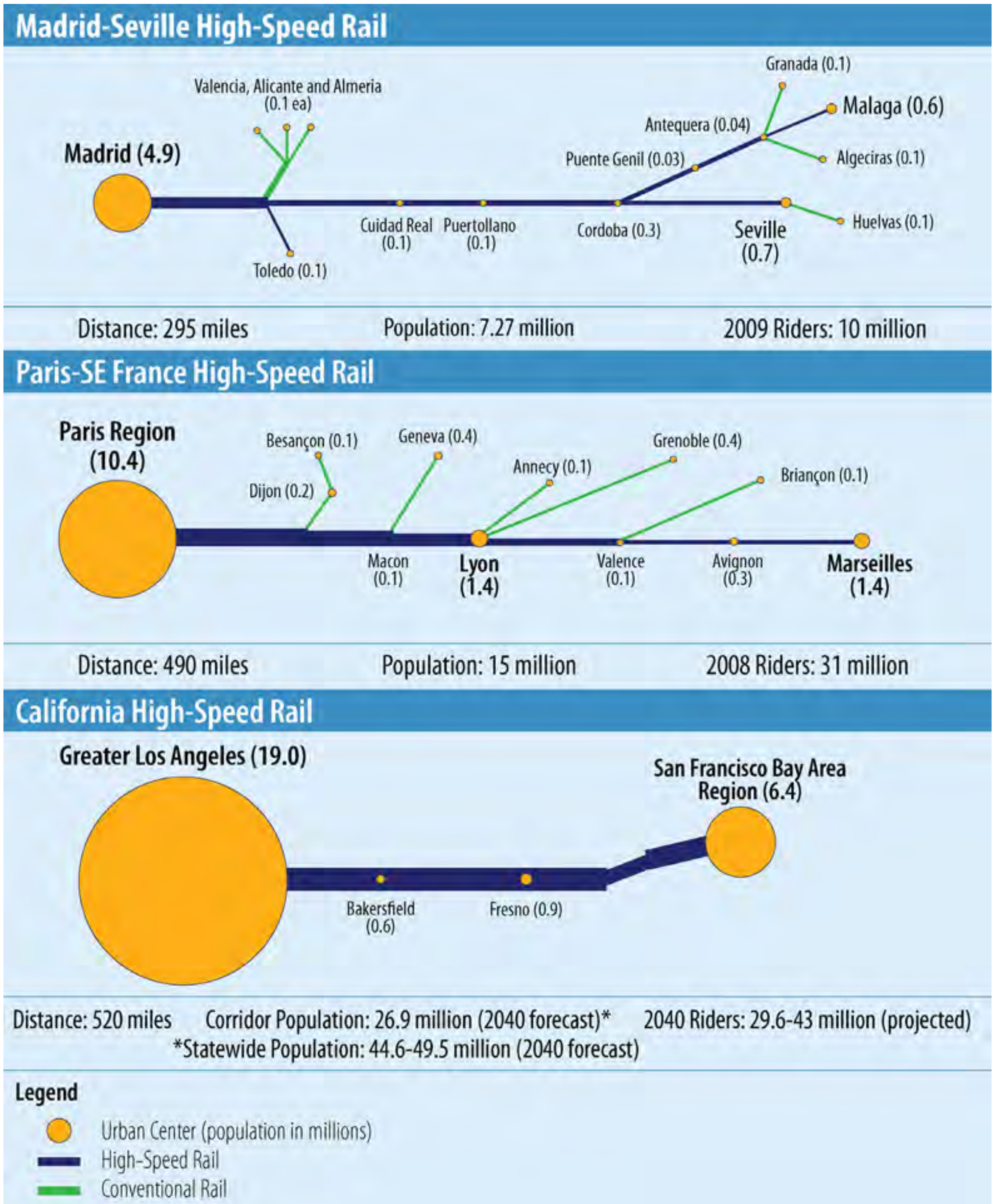
Exhibit 6-6 shows the growth in ridership for six European services from France (TGV), Britain (Eurostar), Spain (Madrid–Seville), and Belgium (Thalys).

- The fastest ramp-up was in the Madrid–Seville line with an increase over two years to a steady growth in ridership.
- The next fastest was the TGV between Paris and the Atlantic Coast regions, reaching "steady state" ridership in the third to fourth year, followed by a steady period, and then more growth reflecting further line improvements.
- At the slower end, the Thalys system—among Belgium, Holland, western Germany, and France—took six years to reach a fairly steady point.

Exhibit 6-17 compares the ridership *forecast* for the Full Phase 1 system (San Francisco/Merced to Los Angeles/Anaheim) 2040 to *actual* ridership on both the Madrid–Seville corridor and the Paris-Lyon/Mediterranean TGV corridor.

To compare the attributes of the California system to these two international systems, the figure compares the future *projected* population of the specific California cities along the corridor in 2040 (of approximately 27 million for purposes of comparison), to the *existing* population of the Spanish and French cities by circles that are proportional to their size. The total *statewide* population is projected to be higher—over 44 million—which is the basis for the ridership forecast. The lines are proportional in width to the size of ridership. The forecast population of the California HSR cities is almost twice the size of the French population served by the Mediterranean TGV line. Compared to the Madrid-Seville corridor, the California cities shown are forecast to have almost 4 times the population. Based on these and other comparisons, it would appear that the California forecasts are along the lines of international experience.

Exhibit 6-17. Population and ridership comparison of existing and forecast ridership



End Notes

[1] *Sources:*

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[2] Source: U.S. Energy Information Agency. July 2011. "Weekly United States Spot Price FOB Weighted by Estimated Import Volume (Dollars per Barrel)." http://tonto.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=WTOTUSA&f=W

[3] *Source: California High-Speed Rail 2012 Business Plan Ridership and Revenue Forecasting.*

[4] *Source: California High-Speed Rail 2012 Business Plan Ridership and Revenue Forecasting.*

[5] European and Asian HSR operators use the same "yield management" techniques to manage the price of seats as US airlines, and in some cases the same service providers (e.g., SABRE); Amtrak has expanded similar flexible pricing from its Northeast corridor services to the San Joaquin services in the Central Valley and the LA-San Diego services.

Chapter 7

Operating and Maintenance Costs

Introduction

In addition to the cost to build the high-speed rail (HSR) system, other expenditures will include on-going operating and maintenance (O&M) and capital asset renewal costs. The O&M costs comprise the cost of running the trains and maintaining the infrastructure and rolling stock in a state of good repair. Capital asset renewal is the cost of replacing worn out components at the end of their useful lives.

The O&M costs include the costs of train operations, which include a large labor element for train operators, station personnel, and the administrative staff required to provide full passenger services, including sales and services marketing. They also include the cost of maintaining the infrastructure (e.g., track, signaling, and stations), which includes both the labor and materials required to regularly maintain the system. The O&M costs included in this chapter are fully comprehensive and include allowances for necessary system power and operator insurance. Finally, the system will require capital asset renewal expenditures over its life reflecting the need to renew or replace assets over time.

This chapter describes the methodology and assumptions used to develop the O&M cost projections and the O&M cost projections associated with the Initial Operating Section (IOS) North, IOS-South, Bay to Basin, and Full Phase 1 sections of the system. This is followed by similar projections of the cost to replace HSR capital assets as they wear out.

Additional information on the O&M cost estimates in this Business Plan is available in *Estimating High-Speed Train Operating & Maintenance Cost for the CA HSRA 2012 Business Plan*, which can be found at *www.cahighspeedrail.ca.gov/business_plan_reports.aspx*.

O&M costs include costs for train operations as well as infrastructure maintenance.

O&M methodology

The O&M cost projections were developed by defining an operating plan that can accommodate the anticipated level of annual ridership presented in Chapter 6, Ridership and Revenue. The operating plan provides the number and frequency of trains required to serve the projected riders, as well as the number of employees and resources required to operate and maintain the system. Unit prices are developed and applied to calculate the cost for each activity included in the operating plan. While many of California's HSR O&M unit costs are similar to U.S. conventional rail operations and can be reliably estimated from U.S. practices and costs, the unit cost to maintain high-speed trainsets and dedicated high-speed rail infrastructure has no close analogy in the U.S. Therefore, international O&M unit costs from comparable HSR operations were applied to planned California operations levels and HSR technology. Where appropriate, adjustments were made for local unit cost levels and labor costs. International O&M information was derived from data generated by the International Union of Railways,[1] separate HSR analyses for Spain[2] and Brazil,[3] and a review of O&M costs by the Japan Railway Construction, Transport and Technology Agency.[4]

In addition, the Authority has validated its operations and maintenance plans and assumptions through discussions and comparison with international high-speed rail operators. In October 2010, the Authority compiled an abstract of its current operations and maintenance strategies, including a network overview, detailed service plans, rolling stock/infrastructure maintenance concepts, and staffing levels and sent it to eight international HSR operators. Seven respondents—Belgium, China, France, Italy, Japan, Korea, and Spain—provided the Authority with comprehensive commentary that helped shape and validate the Authority's methodologies.

> **TJR East has provided frequent input to the Authority regarding HSR planning, engineering, and funding. Recently it provided a Review on Operations and Maintenance.**
>
> *Masaki Ogata, Vice Chairman, East Japan Railway Company*

Exhibit 7-1 summarizes the major operating and maintenance categories on which the international operators consulted (note that where there is no check mark, the respondents did not comment). The Authority continues to consult with these and other members of the international high-speed rail community, especially within the European Union, Japan, and Taiwan, to learn from their experience and to help ensure that California's system is based on sound, proven technology and operating principles.

The O&M cost projections include data for a wide range of service levels and ridership. Using the O&M unit cost prices developed for each cost line item, O&M cost forecasts were developed on an annual basis for each operable section in 2010 dollars. Subsequently, an inflationary assumption was applied to produce annual O&M cost projections in year of expenditure dollars for use in funding and financial analyses developed for this Business Plan.

Exhibit 7-1. International counterparts the Authority consulted to improve O&M costs

Issue	Belgium	China	France	Italy	Japan	Korea	Spain
Shared use of tracks in congested urban corridors	✓	✓	✓	✓	✓	✓	✓
Trainset length/coupling multiple trains	✓		✓				✓
Schedule with clock-face operation	✓	✓	✓	✓	✓		✓
Number of trains per hour during the peak	✓		✓	✓	✓		✓
Dwell time at stations	✓				✓		
Hours of service operations	✓		✓	✓	✓	✓	✓
Approach for maintaining the rail line	✓	✓	✓	✓	✓	✓	

Assumptions

Exhibit 7-2 shows the base unit cost for each major cost item and the basis for each assumption. These assumptions were developed based on operating experience in France and review of energy costs, labor rates, station requirements, and insurance costs in the U.S. Costs in Exhibit 7-2 are presented in 2009 dollars but were inflated to 2010 dollars for standardization across the rest of the analyses in the Business Plan.

As noted, the maintenance unit cost estimates were primarily based on international HSR data and applied to California's planned HSR operations. Exhibit 7-3 compares the California unit values for infrastructure and equipment maintenance to published costs for overseas systems. As highlighted below, this Business Plan assumes a conservative (higher) infrastructure and equipment maintenance unit cost of $200,000 per route mile and $8.60 per trainset mile, respectively.

Exhibit 7-2. Cost categories and unit cost assumptions (2009$)

Category of Cost	Unit Cost	Basis
Train operations and maintenance	$20 per trainset mile, plus $83.33 per revenue service hour for feeder coach service	Operating crew costs from comparable U.S. operations and labor practices, electricity cost from power demand simulations and California large user rates with green surcharge, and train maintenance cost from French HSR experience. Feeder service cost based on review of similar systems in California and elsewhere in the U.S.
Maintenance of infrastructure	$200,000 per route mile	French HSR experience adapted to California requirements and benchmarked against other HSR systems
Stations	$4,100,000 per station per year	U.S. staffing for high-volume, access-controlled stations and reserved seating ticketing practices
Administration and support	10% of O&M costs excluding contingency	Standard industry allowance to cover management, accounting, sales, marketing, and control center
Insurance	$25,000,000 per year	Review of insurance costs for rail passenger service in the U.S.
Contingency	10% of total O&M costs	Contingency applied to account for unknowns
Inflation	3% per year, price base date of 2010	Long-term year-over-year percentage increase for the Consumer Price Index in the region

Exhibit 7-3. Comparison of California HSR maintenance costs with international HSR costs (2009$)

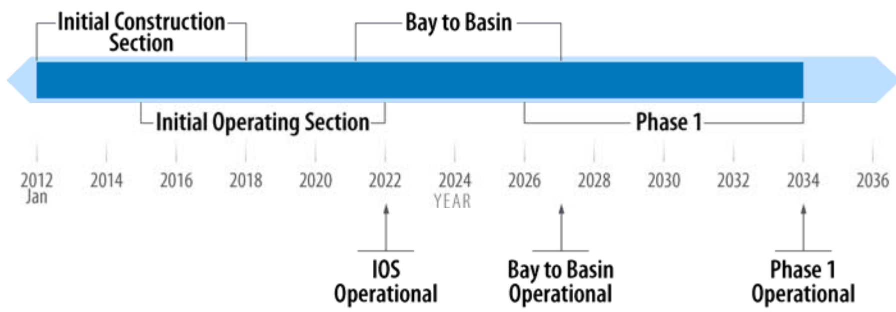
Cost Type	Unit	France[1]	Spain	JR Central	UIC Europe	Halcrow/ Sinergia	CAHSR 2012
Infrastructure	Per route mile	$175,000	$177,000	n/a	$145,000	$200,000	$200,000
Equipment	Per trainset mile	n/a	n/a	$7.20	$4.16	$5.75	$8.60

[1] Infrastructure maintenance figure represents an average cost per route mile.

Scenarios

This section illustrates the projected operating and maintenance costs of the system. Two analyses are shown illustrating system performance if the IOS-N is opened first followed by a second analysis if the IOS-S is opened first. In each case, it is assumed that operations by segment commence on the schedule shown in Exhibit 7-4.

Exhibit 7-4. Schedule by section



For both analyses, the Business Plan High, Medium, and Low ridership scenarios described in Chapter 6, Ridership and Revenue, were used to develop high, medium, and low operating and maintenance costs scenarios.

Operating and maintenance cost projections are shown in 2010 dollars to allow the reader to see the effect of real growth without the impact of inflation. The impact of inflation is addressed in Chapter 8, Funding and Finance.

O&M projections—IOS-North

Exhibit 7-5 provides the projected operating and maintenance costs for the High, Medium, and Low ridership cases in 2010 dollars in millions from IOS-North through Full Phase 1.

Exhibit 7-5. O&M costs, IOS-North first, through Full Phase 1 (2010 dollars in millions)

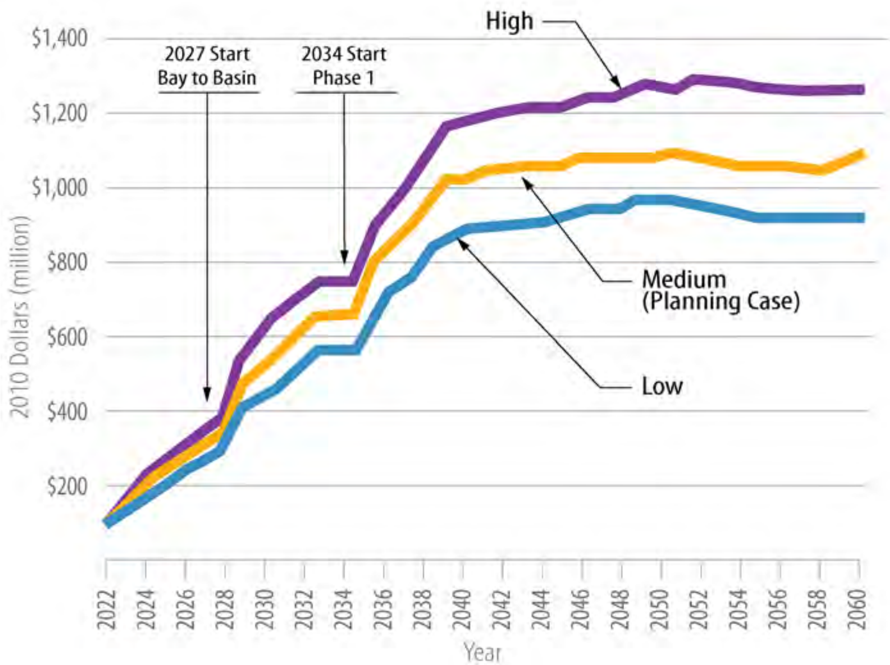
Scenario	2025	2030	2035	2040	2045	2050	2055	2060
High ridership	$344.3	$692.9	$958.5	$1,190.1	$1,238.5	$1,269.7	$1,266.8	$1,270.4
Medium ridership[1]	$304.0	$590.6	$835.9	$1,041.3	$1,076.2	$1,091.5	$1,062.8	$1,092.7
Low ridership	$260.8	$517.4	$722.3	$895.6	$949.9	$962.1	$924.0	$923.4

[1]Planning case

As each section becomes operational, the O&M costs for that section are phased in according to the ramp-up periods. For example, when Bay to Basin opens in 2027, the O&M costs increase quickly in the first five years and more slowly after operations reach a steady state on that section.

Exhibit 7-6 illustrates how the O&M costs illustrated above would change for the high, medium, and low cost scenarios.

Exhibit 7-6. O&M cost ranges, IOS-North first through Full Phase 1 (2010 dollars in millions)



O&M projections—IOS-South

Exhibit 7-7 provides the projected operating and maintenance costs for the high, medium, and low ridership cases in 2010 dollars in millions from IOS-South through Full Phase 1.

Exhibit 7-7. O&M costs, IOS-South first, through Full Phase 1 (2010 dollars in millions)

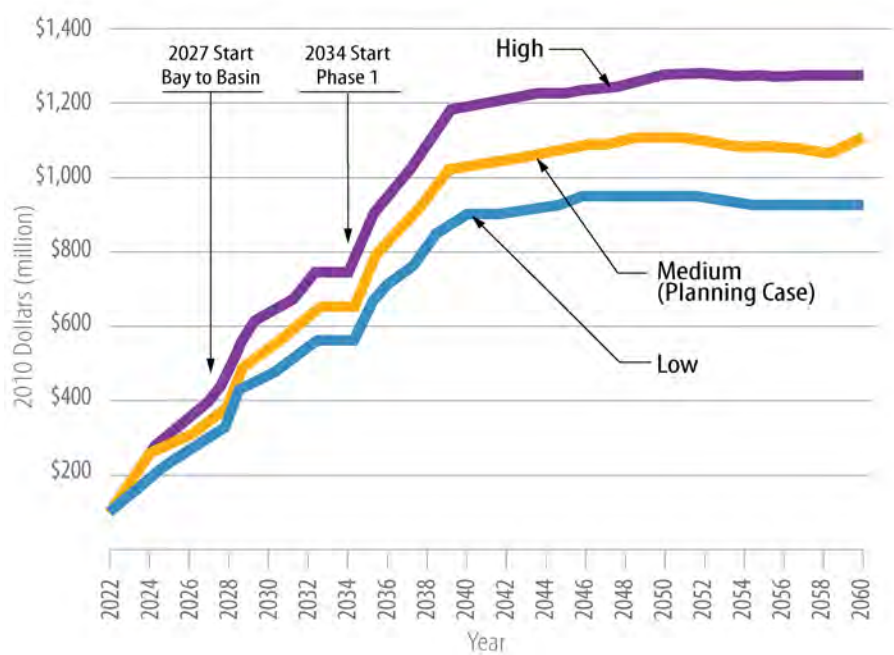
Scenario	2025	2030	2035	2040	2045	2050	2055	2060
High ridership	$393.1	$684.7	$958.5	$1,190.1	$1,238.5	$1,269.7	$1,266.8	$1,270.4
Medium ridership[1]	$345.7	$614.1	$835.9	$1,041.3	$1,076.2	$1,110.4	$1,081.8	$1,111.6
Low ridership	$293.8	$525.5	$722.3	$895.6	$949.9	$962.1	$924.0	$916.6

[1]Planning case

Similar to the IOS-N, as each section on the IOS-S becomes operational the O&M costs for that section are phased in according to the ramp-up periods. For example, when Bay to Basin opens in 2027, the O&M costs increase quickly in the first five years and more slowly after operations reach a steady state on that section.

Exhibit 7-8 compares the O&M costs illustrated above and how those costs would change for the high, base, and low ridership scenarios.

Exhibit 7-8. O&M cost ranges, IOS-South first through Full Phase 1 (2010 dollars in millions)



Capital asset renewal

An important element of O&M analysis is the rate at which assets—the trains, rail infrastructure, stations, and systems—wear out and must be renewed or replaced. This section discusses the methodology and assumptions used to develop the capital asset renewal cost projections.

Assumptions

Incremental capital asset renewal cost projections were developed for each HSR section. The need to replace an asset depends on when it is placed into service, the asset's useful life, and the extent to which the asset is used or consumed in train operations. Minor component replacement activities will be performed during the first five years of each segment's operating period and have been accounted for in the O&M cost projections discussed above. Incremental annual capital asset renewal activities begin for certain components in each section after about five years, consistent with U.S. and international HSR experience.

In general, each component's design life determines the magnitude of incremental annual capital asset renewal activities. Exhibit 7-9 shows the track structures and system components and their respective design lives based on design standards.

Exhibit 7-9. Component design life—track structures and systems

Component	Years
Civil structures	100
Track system	30–60
Facilities/yards/sidings	30–60
Signal/communication system	15
Traction power system	30
Catenary system	30
Stations	50

A similar analysis was performed for the capital asset renewal activities for replacing trainsets based on their useful lives. Trainsets will be put into operation for the IOS in 2022 and for the Bay to Basin section in 2027. Phased replacement will begin based on a 25-year useful life, and replacement expenditures are expected to occur based on progress payments through the delivery, testing, and warranty periods for the new trainsets. Exhibit 7-10 shows the timing that was assumed for trainset replacement for those trains placed into service for the IOS-North and IOS-South alignments. Exhibit 7-11 shows the trainset replacement timeline for those additional trains placed into service for the B2B section. Trainsets to operate Full Phase 1 and the Phase 2 extensions will be replaced under similar assumptions. Exhibit 7-12 provides the trainset capital asset renewal cost projections in every fifth year beginning in 2025.

Exhibit 7-10. Trainset replacement assumptions—IOS-North and IOS-South scenarios

Year	Percent of total	Description
2043	20%	Notice to proceed to the manufacturer of initial delivery and two years in advance of Year 2045 to allow for testing and commissioning
2045	55%	Initial delivery date
2048	20%	Final delivery date
2051	5%	Upon completion of the warranty period

Exhibit 7-11. Trainset replacement assumptions—Bay to Basin

Year	Percent of total	Description
2050	20%	Notice to proceed to the manufacturer of initial delivery
2052	75%	Final delivery date
2055	55%	Upon completion of the warranty period

Exhibit 7-12. Trainset replacement assumptions for IOS-North or IOS-South (2010 dollars in millions)

Segment	Opening	2025	2030	2035	2040	2045	2050	2055	2060
IOS-N	2022	$2.8	$38.3	$48.5	$48.5	$42.0	$15.8	$14.0	$14.0
Bay to Basin	2027	—	—	$68.3	$74.3	$74.3	$74.3	$18.7	$15.8
Phase 1	2034	—	—	—	$71.9	$72.6	$72.6	$72.6	$8.5
Total		$2.8	38.3	$116.8	$194.7	$188.9	$162.7	$105.4	$38.3

End notes

[1] *Source:* Union International des Chemins-de-Fer. 2010. *High-Speed Rail—Fast Track to Sustainability.* Paris, France. http://www.uic.org/IMG/pdf/20101124_uic_brochure_high_speed.pdf

[2] *Source:* Campos, J., G. de Rus, I. Barrón. October 2006. "Some Stylized Facts about High-Speed Rail around the World: An Empirical Approach." Paper presented at 4th Annual Conference on Railroad Industry Structure, Competition and Investment, Universidad Carlos III de Madrid (cited in Halcrow/Sinergia, 2009).

[3] *Source:* Halcrow/Sinergia Consortium. June 2009. "Brazil TAV Project—Volume 4, Rail Operations and Technology, Part 1: Rail Operations." http://www.tavbrasil.gov.br/documentacao/ingles/vol-4-operations&technology/operations/vol_4_pt_1_operations_final_report.pdf

[4] *Source:* Kikuchi, K. Japan Railway Construction, Transport and Technology Agency. 2011. "About the California High Speed Rail Reviews for O&M (California High-Speed Rail O&M Review)." Attachment to e-mail Kikuchi to Hanakura, Yu, September 2, 2011 (translated by Hanakura).

Chapter 8

Funding and Financing

Introduction

This chapter presents the funding and financing plan for California's high-speed rail (HSR) program. The initial part of this chapter focuses on funding sources followed by a discussion of operating projections and capital funding plans for the Initial Operating Section (IOS), for Bay to Basin, and for Phase 1 of the system.

This chapter includes several key findings. The analysis of potential operating sections identified three different incremental sections of the system that can be operationally self-sustaining and would not require operating subsidies. These sections are the IOS-North from the Central Valley to San Jose, the IOS-South from the Central Valley to the San Fernando Valley, or a combination of the two that is called Bay to Basin. As illustrated in this chapter, each of these configurations is projected to generate net operating profits. This was a fundamental finding that helped form the basis for the phasing strategy in this Business Plan.

As described in Chapter 3, Capital Costs, construction costs are significant and the project has been analyzed by the operationally self-sustaining sections to provide a basis for incremental decisions and development over time. In 2010 dollars, the total construction cost using the low cost alignment for the IOS-North is $24.6 billion. Bay to Basin is an additional $16.1 billion. The construction of a blended system, requiring the use of and enhancements to existing track to complete the route, would require an additional $14.1 billion with an additional $10.5 billion required to complete Phase 1 for a total through Phase 1 of $65.4 billion.

For the purposes of funding, it is necessary to calculate construction costs that include inflation until the year costs would be incurred. Chapter 4, Business Planning Schedule, illustrates a 20-year construction timeline that includes a nine-year extension to account for potential delays and funding availability. Using a standard 3 percent annual inflation estimate over the 20-year construction period, the total inflated (year-of-expenditure) cost of the IOS–N is $30.7 billion. Incremental costs to complete Bay to Basin in year of expenditure are $24 billion, with an additional $23.9 billion required to build out a blended system. A further $19.9 billion would be required to complete the Full Phase 1 system with dedicated high-speed rail on the sections between San Francisco and San Jose and from San Fernando to Anaheim due to their urban development constraints. The full Phase 1 in year of expenditure is $98.5 billion. Planning assumptions included in these estimates are as follows:

- **Cost contingency**— $16.0 billion is included in the year-of-expenditure dollar estimate
- **Inflation**—$27.5 billion in construction inflation costs are included in the year-of-expenditure estimate.
- **Schedule extension**—The nine-year schedule extension represents $16 billion or about 59 percent of the total construction inflation.

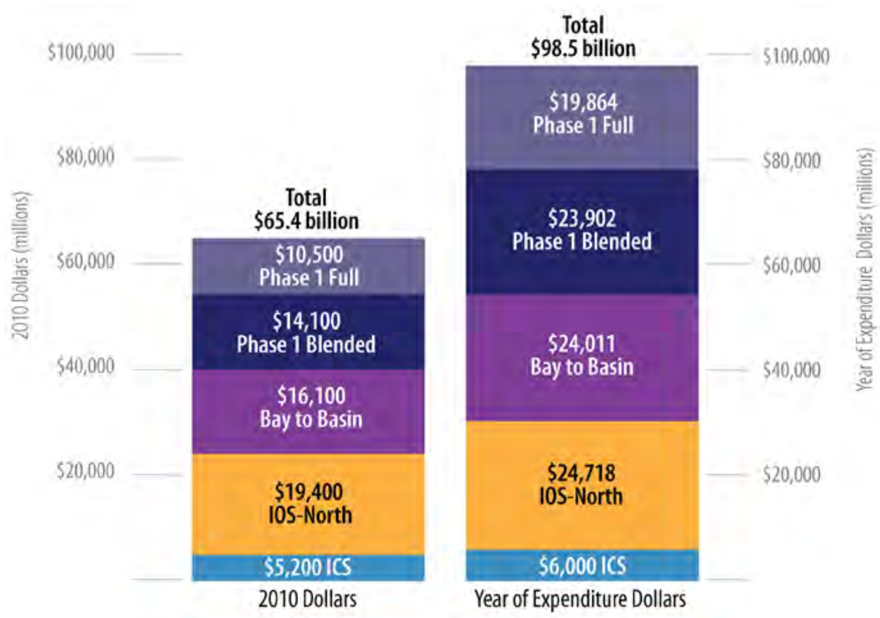
These assumptions have significant impact on year-of-expenditure costs and have been selected to add conservatism to the financial plan. As an example, actual inflation in 2011 and projected inflation for next year are significantly below 3 percent and are expected to be closer to 1 percent. The impact of using a 1 percent inflation rate for the years 2011 through 2013 instead of a 3 percent inflation rate decreases the total cost estimate by $5.5 billion, or nearly 6 percent.

To illustrate the effect that the additional schedule extension would have had on the cost estimates in the 2009 Business Plan, the 2009 construction estimate of $43 billion was inflated to the 2033 illustrative construction completion date discussed above and in Chapter 4, Business Planning Schedule. The effect of inflating the 2009 estimate to the 2033 completion date is to add $11 billion to the total 2009 cost estimate, increasing the $43 billion to $54 billion without any other changes.

To the extent that any of the three planning assumptions discussed above are lower, costs will be reduced.

Exhibit 8-1 illustrates costs in 2010 dollars and inflated costs in year of expenditure.

Exhibit 8-1. Capital costs IOS-North alignment—2010 dollars and year-of-expenditure dollars in millions



May not total due to rounding. Yellow bar equals IOS.

Chapter 3, Capital Costs, includes a discussion of capital costs if all environmental and planning decisions currently under consideration were made such that all of the highest capital cost alternatives were selected (Capital Cost Scenario 2). While not precluding or determining any environmental alternative or decision, the Authority does not believe that this will happen. The total YOE cost increase, if all of the more expensive alternatives were selected, could be an additional $19.1 billion, for a total of $117.6 billion. If 30 percent of this increase did occur ($6 billion), that increase could be offset by the adjustment for early inflation rates discussed above. Given the long-term planning horizon, this Business

Plan illustrates a funding plan for the low capital cost scenario (Capital Cost Scenario 1), including higher early inflation and conservative contingency rates, and it illustrates the funding impact of the higher cost alternatives in a sensitivity analysis presented later in this chapter.

Funding sources have been identified for the Initial Construction Section (ICS) totaling $6 billion. Additional bond funds are available under Proposition 1A. Project cash flows illustrate that the project can support nearly $11 billion in private capital through Bay to Basin and additional amounts for the full Phase 1 alignment. Federal sources of funds, including potential options for new federal programs, are discussed in the next section.

Funding sources

Capital funding will include funds from federal, state, local and private sources. These sources will be available to the Authority at different times based on the development of the system and the generation of project revenues. As described later in this chapter, the IOS will be constructed using public funds, including funds committed for the ICS, additional federal funds, state bond funds and local funds. Once an IOS is operational, private sources of capital will be available to augment public funding sources to complete the build out of Bay to Basin and Phase 1.

Known and potential funding sources for each phase are described below. Estimates of the capital costs and the contribution of public and private funding sources are illustrated later in this chapter.

Initiating the IOS—Funding for the Initial Construction Section

The ICS, as described in Chapter 2, A Phased Implementation Strategy, will be fully funded from the following sources, subject to satisfaction of the various conditions associated with each source:

- **Federal grants authorized under the American Recovery and Reinvestment Act (ARRA, www.recovery.gov/About/Pages/The_Act.aspx) and under the High-Speed Intercity Passenger Rail Program (HSIPR, www.fra.dot.gov/rpd/passenger/2243.shtml) for federal fiscal year 2010**—This includes $66 million for pre-construction period activities and $3.25 billion for construction period activities. Total federal grants funding to be applied to the ICS combines to $3.316 billion.
- **State general obligation bonds authorized under the "Safe, Reliable High-Speed Passenger Train Bond Act for the 21st Century" (Bond Act, voterguide.sos.ca.gov/past/2008/general/pdf-guide/suppl-complete-guide.pdf#prop1a) approved by California voters as Proposition 1A in 2008**—This includes $65.5 million for pre-construction period activities and $2.612 billion for construction period activities. Total state bond funding to be applied to the ICS combines to $2.684 billion.

Federal funding

The Passenger Rail Investment and Improvement Act of 2008 (PRIIA, www.fra.dot.gov/downloads/PRIIA%20Overview%20031009.pdf) established the framework for the national HSR and intercity passenger rail program. In February 2009, President Obama signed the American Recovery and Reinvestment Act of 2009 (Recovery Act or ARRA). Using PRIIA as a framework, Congress appropriated through ARRA an investment of $8 billion for new high-speed and intercity passenger rail grants.

Congress continued to build upon this ARRA funding by making available through annual appropriations in FY 2010 an additional $2.1 billion, bringing the total program funding to $10.1 billion. In 2011 Congress rescinded $400 million from the funds that were declined by Florida.

California's HSR program has received $3.5 billion or 34 percent of these federal funding sources. Of this amount, slightly more than $3.3 billion is committed to constructing the ICS.

State funding

The California HSR program has one state funding source. This is the proceeds from the Safe, Reliable High-Speed Passenger Train Bond Act for the 21st Century (the Bond Act approved by California voters as Proposition 1A in 2008).

Proposition 1A authorized the state to issue $9.95 billion of general obligation bonds, $9 billion of which will be used to develop a high-speed rail system. The remaining $950 million raised under Proposition 1A is allocated for capital improvements to commuter and intercity rail lines.

Bond proceeds may be used for preliminary engineering, right-of-way acquisition, and the construction of tracks, structures, power systems, and stations. Additionally, rolling stock and related equipment, as well as other capital-related facilities and equipment, can be purchased with these funds. Proceeds of bonds cannot be used for more than 50 percent of the total cost of construction of each corridor or usable segment of the system. In addition, Proposition 1A establishes caps on the amount of funds that can be expended for preliminary engineering, planning, and environmental studies.

The Authority will be requesting appropriation by the Legislature, as part of the fiscal 2012-13 budget process, of approximately $2.7 billion in bond proceeds for the ICS. A Funding Plan will be submitted to the Legislature as required by Proposition 1A.

Completing an IOS—known and potential funding sources

On completion of the ICS, constructing an IOS (either north or south), and placing it into operation as a self-sustaining operating segment will require an additional $24.7 to $27.2 billion in inflated, future dollars (capital costs inflated to the year of expenditure). **Once in operation, IOS projections show that ridership revenues from the segment(s) will cover operating costs and generate sufficient cash flow to attract private capital for subsequent construction.** Until revenue operations begin, public funds will be needed for construction of the system. Anticipated funding sources to complete the IOS include:

- Federal funding sources including existing programs and potential new programs related to tax credit bonds, reauthorization and others
- State funding from Proposition 1A bonds
- Local funding sources

The IOS will require a mix of funding from federal, state and local sources to support construction in the years 2015 to 2021. Committed funding for this future period is not fully identified. Several potential options exist to fund the completion of an IOS and provide the state with an operating high-speed rail segment.

Historically, federal funds have supported approximately 50 to 80 percent of many major transportation investments, including highway, transit, and aviation sector-related projects. Although California's HSR program is much larger than most transportation projects, there is precedent for substantial federal support for large and nationally significant transportation projects. For example, a federal share of 80 percent is authorized for most of the existing highway and transit capital grant programs. In addition, the authorizing grant program recently established in PRIIA sets the statutory maximum federal contribution at 80 percent.

Long-term reauthorization of the federal Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) has been delayed 30 months, and currently extended until March 2012. Concurrently, Federal Highway Trust Fund revenues (derived largely from federal fuel taxes) have become inadequate to meet SAFETEA-LU obligations. The absence of multi-year reauthorization and the decline in Trust Fund revenues have combined to require annual appropriations from the General Fund to maintain existing programmatic spending levels. Full reauthorization should be presumed to impact all aspects of federal surface transportation federal-aid programs, including high-speed rail.

There is substantial discussion in Congress related to reducing deficits and the federal government's role and scope. It is clear that continued uncertainties will exist and that prudent planning assumes that funding will be limited in the near term. Any congressional initiatives on infrastructure funding and short-term job creation may improve this situation, but the Plan does not rely on such measures. California has existing funding for the next three years, and the financial plan scenarios in this chapter assume no additional federal funds before 2015.

California is currently in the unique position as the only state ready to move to construction on a high-speed rail system and create jobs. Moving forward on the ICS enhances this leadership position and provides the state with a two-to-three-year window to work with the federal government on a longer-range funding plan for the next phases. By maintaining a leadership position, California is positioned to capture the largest share of any available HSR construction funding for several years until competing projects reach a development stage.

As part of a crucial program development strategy common to all of the federal programs identified below, the Authority will work closely with legislators, FRA, FTA, FHWA, and other stakeholders to support funding these important federal programs to benefit HSR and its local and regional partners:

- FTA New Starts Program
- Transportation Investment Generating Economic Recovery (TIGER) Discretionary Grants Program
- FHWA/FRA Rail Highway Crossing Hazard Elimination in High-Speed Rail Corridors
- FHWA Section 130 Railway-Highway Crossing Program
- FRA Rail Line Relocation and Improvement Capital Grant Program
- FHWA Congestion Mitigation and Air Quality Improvement Program
- FHWA Surface Transportation Program

In addition, the federal funding programs deemed most applicable to HSR are summarized below.

Federal Railroad Administration: High-Speed Intercity Passenger Rail Program and Passenger Rail Investment and Improvement Act of 2008

The High-Speed Intercity Passenger Rail Program (HSIPR) has been the single largest source of federal grant funding for HSR and has greatly accelerated delivery of HSR programs. It provides project grants to deliver transportation, economic recovery, livable communities, and certain project success factors. The program typically requires a non-federal match of approximately 20 percent.

Signed into law with bipartisan support on October 16, 2008, PRIIA included language creating the first grant mechanism for high-speed passenger rail. It authorized grants for high-speed rail corridor development to states or Amtrak to finance the construction and equipment for California and 10 other federally designated high-speed rail corridors. The federal share for these projects is capped at 80 percent. PRIIA's Section 501 represents the first federal grant program dedicated to high-speed rail funding. Both HSIPR and PRIIA are funded through the annual federal General Fund appropriations process, unlike other surface transportation funding programs, which come from dedicated trust fund revenues. The appropriations process makes the timing and amount of funding more uncertain at best. The cancellation of HSR projects by Florida, Ohio, and Wisconsin—each of which were to receive FY 2010 HSIPR funding—afforded opportunity to redistribute those funds and strengthen HSR projects in other states. To support continued funding for these programs, the Authority and other California officials will need to team with other states and high-speed rail stakeholders across the nation to promote high-speed rail as a program of national interest. Furthermore, working with stakeholders to identify and achieve a dedicated, recurring nationwide funding source, as exists for the Highway Trust Fund, is a strategy the Authority will pursue to increase the potential for sufficient, timely funding for high-speed rail in California and across the nation.

New federal transportation funding and financing programs

The unique nature and size of HSR calls for federal solutions that are both tailored to meet the unique needs of HSR and of sufficient size to make a difference in accelerating the delivery of high-speed rail service. The Authority's federal assistance strategy is to identify federal funding and financing programs that recognize the long-term, multi-phase nature of high-speed rail programs. The Authority acknowledges that it may take several years working with other stakeholders in the high-speed rail sector to obtain passage of the desired federal legislation. This constraint was considered in the illustrative business planning schedule for completing the system described in Chapter 4, Business Planning Schedule.

Because the ICS is fully funded, additional federal funding will not be needed in the near term. The next round of federal funding will be needed at such time as preparations must begin for construction of an IOS, which is anticipated to commence construction in 2015 under the schedule outlined in Chapter 4, Business Planning Schedule. *Thus, California can make progress on initiating the HSR program based on existing funding for the ICS over the next two to three years while continuing to pursue the long-term solutions needed for ultimate system build-out.*

The potential federal initiatives that appear most beneficial to the future success of high-speed rail in the nation include the following:

- Dedicated trust fund structure—Establishing a new, long-term dedicated funding source for high-speed rail investments rather than relying on year-to-year General Fund appropriations would enable HSR project sponsors to make investment decisions on complex, phased improvements that span many fiscal years between commencement and completion.
- Availability payments —An availability-based payment approach for HSR, similar to approaches used in other countries, would provide a long-term federal funding commitment to amortize capital expenditures financed by private investors and accelerate access to private capital.
- Qualified tax credit bonds (QTCB)—QTCBs are a tax-advantaged borrowing tool that leverages state and local investment capacity through a federal subsidy of interest on long-term debt; this approach would be a particularly useful tool for California, where voters have already approved the issuance of General Obligation bonds for the program.

Each of these potential federal assistance tools could help meet the targeted federal share of the IOS and Phase 1. Brief summaries of these three approaches follow below:

Dedicated HSR Trust Fund

The President's FY 2012 budget request for the Department of Transportation outlined the Administration's $556-billion six-year reauthorization proposal. One of the key structural features proposed is establishing a comprehensive Transportation Trust Fund comprised of subaccounts for highway, transit, an infrastructure bank, and high-speed rail. The plan designated $37 billion for new rail network development, at an average level of $6 billion per year.

The Administration acknowledges that current revenues in the Highway Trust Fund are insufficient to support its proposal, and it is committed to working with the Congress to identify a way to achieve these funding levels.

The creation of a trust fund and dedicated revenue source available for a national high-speed and intercity rail program would extend to HSR some of the existing benefits accorded to the nation's highway system. An HSR trust fund would allow project sponsors to undertake major capital projects with greater predictability of federal funding support over the long-term development period for such projects.

It was noted above that California has received just over one-third of the discretionary HSR grants authorized by Congress in recent years. If California were able to receive just 20 percent of the HSR funding at the President's proposed funding levels, the Authority's targeted federal share for the IOS would be satisfied for the six-year financial planning period beginning in 2015.

Availability Payments

Availability Payments (AP) are multi-year funding commitments in which a government undertakes to make annual payments to a private party that agrees to construct, maintain, and finance infrastructure, provided the asset meets certain specified performance standards over the contract period. AP mechanisms have been used for HSR projects in France and are planned in Portugal as well as many other types of infrastructure projects in other European countries. In each case, the central governments have entered into long-term contracts with private companies to finance, deliver, and operate infrastructure assets.

For the European HSR projects, the AP approach is used in conjunction with a design-build-finance-maintain (DBFM) structure. The APs compensate the infrastructure service provider for its delivery of the infrastructure, its ongoing performance to maintain it, and the cost to repay debt and equity financing of the infrastructure construction costs. In this regard, an AP approach can be viewed both as a procurement method and a financing tool that could be useful to accelerate private-sector capital investment.

In the United States, the AP approach has been successfully applied to P3 projects both for transportation facilities (e.g., Port of Miami Tunnel, I-595 Managed Lanes, and Denver Eagle Commuter Rail) and civil infrastructure (e.g., Long Beach Courthouse). An AP approach is being implemented in California for the Presidio Parkway backed by Caltrans funding. To date, there have not been any AP structures supported by federal funding in the U.S.

An ongoing challenge in seeking to arrange predictable long-term federal support for large-scale projects is the federal government‘s lack of a capital budget. This means that major capital investments—either for the federal government’s own use or on behalf of state and local project sponsors—must be “expensed” in the year the capital outlays occur.

However, there is longstanding precedent for the federal government to support availability of capital assets under the federal operating lease rules. Provided certain financial tests are met, the government can enter into a long-term (20-plus year) leasing commitment with annual payments, with the budget impact spread over time.

The two HSR projects that are furthest along in planning are California and the Northeast Corridor. They share similarities in terms of populations served and distances covered. In June 2011, House Transportation and Infrastructure Committee chair John Mica and Railroad Subcommittee Chair Bill Shuster introduced the Competition for Intercity Passenger Rail in America Act. (http://republicans.transportation.house.gov/Media/file/112th/Railroads/Rail_Competition_Bill_Section_by_Section.pdf). Among other things, this bill calls for Amtrak to convey its ownership of the 457-mile Northeast Corridor to USDOT, which in turn would lease it to the private sector for construction, operation, and maintenance.

This bill provides a conceptual framework for designing a broader federal program that would support investment in dedicated right-of-way for HSR systems meeting uniform nationwide standards. This type of approach would result in substantial risk transfer to the private sector for construction completion and long-term asset performance.

If a federal AP program was available, a similar approach could be considered for California’s HSR. Subject to an appropriate ownership and governance structure, the federal government could make annual payments under an operating lease structure to a private party, conditioned upon certain performance standards being met. If the availability standards weren’t satisfied, the federal payments could be reduced and in certain circumstances suspended. The private party would arrange debt and equity financing secured by the annual stream of federal availability payments.

Although this AP approach requires substantial further discussion and refinement, it could enable the Authority and other HSR project sponsors to obtain ongoing federal support for private financing of infrastructure costs and accelerate the private capital available for HSR.

Qualified tax credit bonds

Qualified Tax Credit Bonds are a relatively new form of tax-advantaged debt financing that allows borrowers to maximize the capital investment supported by state, local, and project-based revenue streams. In the context of California, it could allow the state to leverage its existing Proposition 1A commitment to high-speed rail while obtaining a form of federal subsidy with a much more favorable federal budgetary treatment than direct grant funding.

QTCBs are state and local bonds authorized under Section 54A of the Internal Revenue Code for which the federal government pays all or most of the interest expense through granting annual tax credits in lieu of cash interest. In recent years, federal policymakers have turned to this tool as a means to induce private and other non-federal sources of capital to finance major projects without direct federal spending or growth in the federal government workforce. Over the last decade, Congress has authorized in excess of $35 billion of QTCB programs for schools, energy conservation, renewable energy projects, and other purposes.

On July 28, 2011, Sens. Wyden (D-OR) and Hoeven (R-ND) co-sponsored the introduction of S. 1436, the Transportation and Regional Infrastructure Project Bonds Act of 2011 (TRIP, thomas.loc.gov/cgi-bin/query/z?c112:s1436:#). This bill would establish a new $50 billion assistance program for surface transportation projects (including high-speed intercity passenger rail), using QTCBs. Under the TRIP proposal, principal would be repayable from a portion of federal customs revenues. Other QTCB proposals, such as the America Fast Forward initiative supported by the American Public Transportation Association, contemplate state or local revenue streams securing principal repayment.

The proposed tax credit bond program for transportation would allow state or local issuers to sell long-term QTCBs, with the federal government subsidizing all of the annual interest cost, making these comparable to zero-interest loans from the state or local project sponsor’s perspective. Moreover, Congress allows QTCBs to be set up with internal debt service sinking funds that can be reinvested up to a federally prescribed rate (the current maximum allowable yield is about 4 percent), which enables investment returns to contribute substantially to repayment of the QTCB principal at maturity. These two features could allow the State’s planned Proposition 1A bond payments to secure 3.5 times the total Proposition 1A bond principal without additional cost to the state.

A statutory condition of the existing QTCBs is that the borrower identifies a revenue stream (non-federal) to secure the principal repayment. This funding mechanism could benefit HSR due to the ability to use proceeds from Proposition 1A as such a revenue stream. While valuable, the availability of QTCBs for HSR could be limited by a cap on allocation and the need to optimize the use of this tool to advance other initiatives, such as America Fast Forward. To the extent possible, it would be advantageous for California to devote a substantial portion of the voter-approved Proposition 1A general obligation bonds, such that the fiscal commitment (debt service) associated with bonds could serve as the revenue stream to secure the QTCB principal. The feasibility of this approach is dependent upon Congress enacting a new federal tax credit bond program for transportation purposes similar to S. 1436 with the capacity and structure to support the nation's HSR program and be acceptable to the market. The Authority will collaborate with other agencies in California to advance such a program to the benefit of the entire statewide transportation system.

This chapter includes illustrative funding scenarios. For the purpose of the analysis, a combination of QTCBs and federal grants are shown as an example. This is an example only as, with the exception of construction funding for the ICS, the mix, timing, and amount of federal funding for later sections of the HSR is not known at this time. The total amount of funding projected as required from the federal government remains the same, regardless of the specific funding mechanism.

State funding sources

As discussed, the state funding source for the California HSR program is the general obligation bond program under Proposition 1A. For planning purposes, these bond proceeds are assumed to be available when needed to provide the matching funds required to secure federal funding, until the bond proceeds are exhausted.

A total of $5.3 billion in bond funds will be available for completion of the IOS and for subsequent phases. As discussed, much of this would be available to leverage with the passage of a QTCB program. To date, $300 million of bonds has been issued. An additional $2.7 billion has been identified for the ICS, and $700 million is assumed to be reserved for administration and certain other preliminary engineering, planning, design, environmental, and other program requirements before revenue operations commence.

Locally generated revenues

An important element of revenue planning for the Authority and its local partners relates to station-area development using Transit-Oriented Development (TOD) principles. Most local area revenues are under the control of local municipal partners or cities and counties. The Authority will work with these agencies to determine opportunities for the following:

- Cost-sharing with local agencies
- Contribution of right-of-way
- Cooperative funding arrangements with local transportation agencies
- Revenues from innovative use of right-of-way/system facilities/equipment (e.g., renewable energy and telecom)

The Authority and its local municipal partners will also work together to target stable private revenues from passenger stations. These opportunities include the following:

- Tenant rents from retailers, office space, residential housing, and hotel rooms
- Parking charges and fees

- Naming rights for the stations or plazas
- Advertising and sponsorships
- Taxes—retail sales, transient occupancy tax, and parking tax. Other private revenues may include special events, sub-leases of space, or use fees

Station-related revenues will provide the Authority and its local partners with potential funding sources that can be leveraged for development or to provide offsets to operating and maintenance (O&M) costs. Most of these revenues are driven by operations and will be available once an IOS is operational.

Consistent with other systems internationally, commercial and mixed use real estate surrounding station areas is expected to increase in value as the system is developed and becomes operational. Assessment of the impact of developing the system on local real estate values and potential revenue or cost sharing will be incorporated in future business plans.

Once an IOS is in operation, the Authority will have the ability to attract private capital to leverage public funds to complete construction of future sections. As discussed in the analysis following this section, cash flow projections illustrate that operations will be profitable and private sources can contribute funds for future capital construction. Consistent with other high-speed systems in the world, it is not anticipated that cash flows will support all capital needs for future construction. Public funds, while declining in proportion, will continue to be a part of the funding equation as the system expands.

While the IOS segment relies heavily on state bond funds to match federal funds, private funds are expected to play a key matching role in completing the Bay to Basin (B2B) and subsequent phases. Private sources and federal borrowing programs that may be leveraged are discussed in this section.

Private sources

As discussed in Chapter 5, Business Model, the Authority will pursue public-private partnerships to attract private-sector investment at the point when the appropriate conditions exist. The private sector will be leveraged throughout all stages of the program through design-build construction contracts, for operations contracts, for rolling stock, and for capital maintenance. Small investments of various types will be included in these transactions. Based on other high-speed rail transactions internationally and discussions with private-sector companies through the Request for Expression of Interest process, private investors will have stronger interest in capital investments based on the future cash flows of the program after completion of an IOS when ridership demand has been proven. While it is possible that a strategic investor may make an earlier investment based in part on future revenues, this investment is expected to be priced much higher for risk considerations.

The Business Plan assumes that the private sector would be a source of system financing once operations have commenced. Some early vendor financing may be available for rolling stock but would draw on the same project revenues for security as other private-sector revenue-backed financing.

In addition, opportunities to attract other private-sector revenues through locally generated commercial and land-use activities are expected at the future high-speed rail stations. These transactions will be jointly considered with station owners.

Federal transportation financing programs

Key to the efficient use of available cash flows to support private sector investment is the ability of the private sector to leverage equity investments with borrowed funds (debt). The federal government has several low-cost debt programs (borrowing tools) that may be accessed by the private sector to help reduce financing costs of the program. Much like the funding programs discussed above, reauthorization of SAFETEA-LU and federal budgetary discussions may impact these financing programs.

Transportation Infrastructure Finance and Innovation Act of 1998 (TIFIA)

TIFIA (www.dot.ca.gov/hq/innovfinance/tifia.htm) is an established federal credit assistance program for eligible transportation projects of national or regional significance. These include transit and passenger rail facilities, such as the California HSR program. Under TIFIA, the U.S. Department of Transportation can provide three forms of credit assistance to eligible projects: secured (or direct) loans, loan guarantees, and standby lines of credit.

The fundamental goal of TIFIA is to leverage federal funds to attract substantial private and other non-federal investment into projects that provide critical improvements to U.S. surface transportation. Principal amounts of credit assistance provided by TIFIA are limited to 33 percent of eligible project costs. Additionally, interest rates for TIFIA loans generally reflect the government's borrowing costs, and the loan terms generally are favorable to project sponsors (e.g., flexibility to defer interest and tailor principal repayment to cash flows).

The Authority envisions the use of the TIFIA loan program as subordinate debt during later stages of the program implementation when surplus cash flows can be "monetized" to provide a contribution to expansion of the system. The Funding Needs Analysis section of this chapter provides further details on possible monetization of revenues.

Railroad Rehabilitation and Improvement Financing Program (RRIF)

The RRIF (www.fra.dot.gov/Pages/177.shtml) program is a revolving loan and loan guarantee program administered by the FRA. The program originally was established by the Transportation Equity Act for the 21st Century and was extended and substantially expanded by SAFETEA-LU. It is legislatively authorized to make up to $35 billion in loans. To date, only $1.6 billion of loans have been approved.

Funding from RRIF may be used to acquire, improve, or rehabilitate intermodal or rail equipment or facilities, including track, components of track, bridges, yards, buildings, and shops. Funds also may refinance outstanding debt incurred for those purposes listed previously or may be allocated to develop or establish new intermodal railroad facilities.

Attractive interest rates, similar to those available under TIFIA, also exist under RRIF. This program is able to fund up to 100 percent of a project's costs, allows for a five-year grace period, but, unlike TIFIA, requires the borrower to pay an up-front risk premium.

A RRIF loan could be combined with a TIFIA subordinate loan and private-sector investment and financing. Both RRIF and TIFIA are loans and will need to be secured by project revenues and repaid.

Private activity bonds

Private Activity Bonds (PAB, www.fhwa.dot.gov/ipd/p3/tools_programs/pabs.htm) are tax-exempt bonds issued by a state or local government entity on behalf of a private entity. Their purpose is to facilitate private investment for projects that generate public benefit. PABs allow for the private sector to borrow at tax-exempt rates resulting in lower overall financing costs.

Currently, PABs issued for HSR facilities are limited to infrastructure; rolling stock is not eligible. To the extent the rail facilities are owned by a state or local entity, the bonds are not subject to the $95 per capita annual PAB volume cap of the respective state.

Congress created a new category of exempt facilities under SAFETEA-LU that allows certain projects to qualify for PABs within a separate $15 billion nationwide volume cap. The Secretary of Transportation is responsible for the allocation of this volume cap. To date, $6.3 billion has been issued or allocated to projects. As with TIFIA and RRIF loans described above, PABs must be secured by revenues and repaid, generally incrementally over a period of 30 years.

PABs may be attractive to private investors in conjunction with a public-private partnership (PPP) business model. PABs could be used in conjunction with TIFIA/RRIF.

Financial analysis

The financial analysis presented below addresses three key objectives:

- Understanding the operational viability of the system over time
- Developing an estimate of the funding necessary for system development
- Estimating the amount of private-sector investment that may be achieved in the completion of the system

Operational Viability

This section illustrates the projected revenues, operating and maintenance expenses, and net operating profit of the system. Two separate profitability analyses are shown, with the first illustrating system performance if the IOS–N is opened first, and the second analysis showing results if the IOS-South is opened first. In each case, it is assumed that all operating segments are opened on the schedule shown in Exhibit 8-2.

Exhibit 8-2. Consolidated schedule

For both analyses, the high, medium and low revenue and operating and maintenance cost scenarios described in Chapter 6, Ridership and Revenue, and Chapter 7, Operating and Maintenance Costs, are evaluated. These chapters describe revenues and operating and maintenance costs and illustrate projections in 2010 dollars to show the effect of real growth without the impact of inflation. For the purposes of the funding analysis, it is necessary to also view the projected financial needs on an inflated, future basis. To arrive at estimates in future year dollars (called year of expenditure or YOE dollars) the 2010 dollar projections shown in previous chapters were inflated by a standard 3 percent compound annual inflation rate. The analyses in the remainder of this chapter are in future or Year of Expenditure dollars using the 3 percent inflation assumption.

IOS-North Alignment

Ridership and revenues

Ridership and revenue forecasts are presented in Chapter 6, Ridership and Revenue. These revenues were estimated using 2010 price levels, which have been escalated by 3 percent per year, to produce the year of expenditure (YOE) revenues presented in this chapter.

The forecasts of revenue were produced for high, medium, and low ridership cases, each of which is more fully described in Chapter 6, Ridership and Revenue. The high ridership case includes key assumptions that are conservative based on the current economy, including future gas prices at $3.80 per gallon. The medium case, which is used as the planning case later in the funding section, generates approximately 15 percent less in projected revenue than the high case, with a similar incremental difference to the low case.

The initial year ridership is assumed to be 40 percent of the steady state projection that would be reached after a four-year ramp-up period. As illustrated later in this chapter, the breakeven revenue level in the first year is $267 million, or an additional 35 percent below the first year revenue estimate for the high ridership case. Breakeven revenue in five years is 73 percent below the steady state estimate that would be reached at that point.

Exhibit 8-3 provides the projected revenues for the high, medium and low ridership cases in YOE dollars from IOS–N through Phase 1.

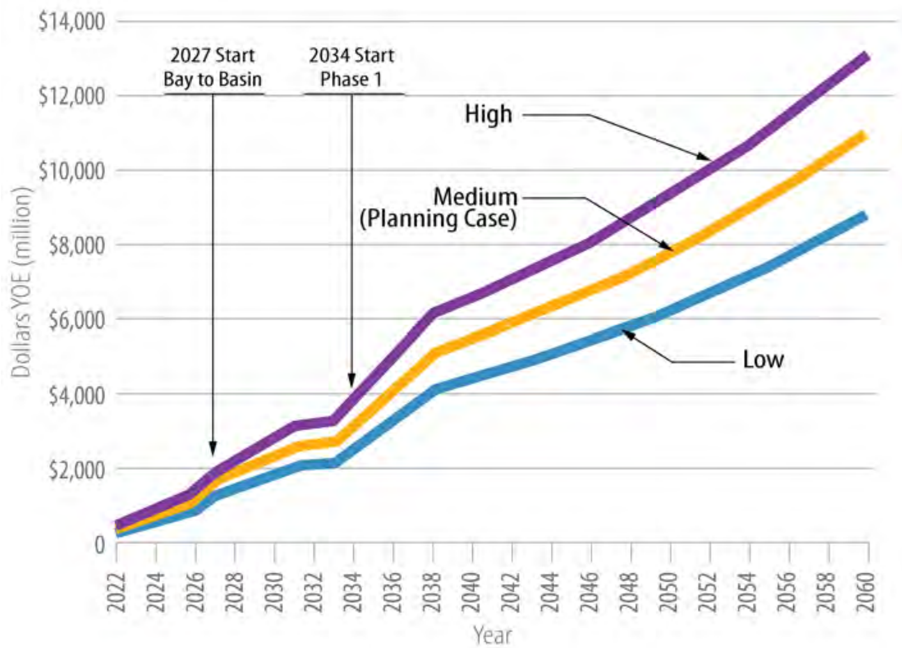
Exhibit 8-3. Revenues, IOS-North first, through Phase 1 (YOE dollars in millions)

	2025	2030	2035	2040	2045	2050	2055	2060
High ridership	$904	$2,762	$4,402	$6,571	$7,829	$9,306	$11,062	$13,097
Medium ridership (planning case)	$759	$2,313	$3,686	$5,503	$6,557	$7,794	$9,264	$10,969
Low ridership	$614	$1,864	$2,971	$4,435	$5,285	$6,282	$7,467	$8,840

Under the IOS-North medium ridership scenario, the projected revenues are $759 million in 2025, which is the fourth year after completion of the IOS to San Jose. Revenues rise to $2.3 billion in 2030, the fourth year after completion of Bay to Basin, and to $3.7 billion in 2035, two years after the completion of Phase 1, and the fourteenth year of operations.

Exhibit 8-4 illustrates projected ridership revenue growth from IOS-North through Phase 1 for all three revenue cases.

Exhibit 8-4. Revenue growth, IOS-North first, through Phase 1 (YOE dollars in millions)



Operating and maintenance costs

Operations and maintenance forecasts are presented in Chapter 7, Operating and Maintenance Costs, using 2010 price levels. These estimates were escalated by 3 percent per year, to produce YOE operating and maintenance costs.

The forecasts of operating and maintenance costs were produced for high, medium, and low cases, each of which is more fully described in Chapter 7, Operating and Maintenance Costs.

Exhibit 8-5 provides operating and maintenance costs in YOE dollars from IOS-North through Phase 1.

Exhibit 8-5. Operations and maintenance costs, IOS-North first, through Phase 1 (YOE dollars in millions)

	2025	2030	2035	2040	2045	2050	2055	2060
High ridership	$537	$1,252	$2,008	$2,884	$3,488	$4,145	$4,795	$5,553
Medium ridership (planning case)	$474	$1,067	$1,751	$2,523	$3,030	$3,563	$4,023	$4,776
Low ridership	$406	$935	$1,513	$2,170	$2,675	$3,141	$3,497	$4,036

As operations and maintenance costs are closely aligned with ridership, they trend in a similar manner to revenues. Operations and maintenance costs will have a similar ramp up as revenues as ridership demand and service expands in early years.

Net Operating Profit

Exhibit 8-6 provides net operating profit in five-year increments for each ridership scenario in YOE dollars from IOS-North through Phase 1. Net operating profit is calculated by subtracting operating and maintenance costs from revenues.

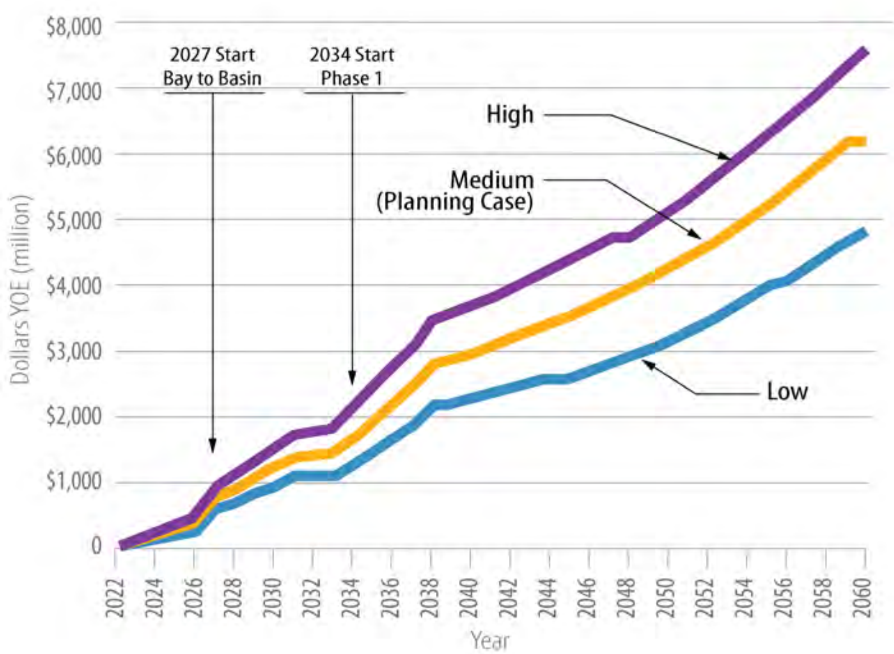
Exhibit 8-6. Net operating profit, IOS-North first, through Phase 1 (YOE dollars in millions)

	2025	2030	2035	2040	2045	2050	2055	2060
High ridership	$368	$1,510	$2,394	$3,687	$4,342	$5,161	$6,267	$7,544
Medium ridership (planning case)	$285	$1,246	$1,935	$2,980	$3,527	$4,231	$5,242	$6,193
Low ridership	$207	$929	$1,458	$2,265	$2,610	$3,141	$3,969	$4,804

Projections illustrate that the three revenue and operating and maintenance cost scenarios generate net operating profits from the initial year of operations. This includes scenarios where revenues have been assumed to be lower than the high ridership case by more than 15 percent (medium case) and 30 percent (low case) in early years and subjected to further reductions during a four-year ramp-up period. Based on the planning case scenario, net operating profit is projected to be $1.3 billion in year 2030, four years after commencement of Bay to Basin operations. Net operating profit rises to $3.0 billion in 2040, six years after commencement of Phase 1 operations and to $4.2 billion in 2050.

Exhibit 8-7 presents net operating profit growth for each scenario from 2022 to 2060 in YOE dollars from IOS-North through Phase 1.

Exhibit 8-7. Net operating profit growth, IOS-North first, through Phase 1 (YOE dollars in millions)



Break-even analysis

A break-even analysis was performed on revenues and operating and maintenance costs to analyze the sensitivity of operating profitability to a reduction in revenue. The break-even analysis calculates the minimum revenue needed on an annual basis to cover operating and maintenance costs.

Exhibit 8-8 shows which costs are assumed to be fixed and which are variable based on the level of ridership.

Exhibit 8-8. Relationship of O&M cost categories to ridership

O&M Cost Category	Relationship to Ridership
Maintenance of equipment	Variable in steps
Maintenance of infrastructure	Fixed
Stations	Fixed
Insurance	Fixed
Administrative costs	Variable
Contingency	Variable
Other	Variable

Exhibit 8-9 presents the first year of revenues under high, medium (planning case), low and breakeven scenarios followed by the fifth year of revenues. 2022 represents the first year of IOS operations and the year most sensitive to changes in ridership. 2026 illustrates the estimates after ramp up.

Exhibit 8-9. Revenue break-even analysis for IOS–N

Ridership Scenario	2022 Revenue	Percent of 2022 High Ridership Revenue	2026 Revenue	Percent of 2026 High Ridership Revenue
High	$408	100%	$1,095	100%
Medium	$347	85%	$917	84%
Low	$286	70%	$739	67%
Breakeven	$267	65%	$300	27%

Exhibit 8-9 shows that projected ridership could fall 35 percent in year one and maintain a positive cash flow. As the project progresses through operations, the percentage difference increases. In 2026, the breakeven revenue is 73 percent below the projection for the high ridership case.

IOS—S Alignment

Ridership and revenues

Ridership and revenue forecasts are presented in Chapter 6, Ridership and Revenue. Revenues were estimated using 2010 price levels, which were escalated by 3 percent per year, to produce YOE revenues.

The forecasts of revenue were produced for high, medium, and low cases, each of which is more fully described in Chapter 6, Ridership and Revenue. The medium case, which is used as the planning case later in the funding section, generates approximately 20 percent less in projected revenue than the high case, with a similar incremental difference to the low case. Consistent with results in other countries that experienced significant ridership growth on commencement of operations, a four-year ramp-up period is assumed into the projections.

Exhibit 8-10 provides the projected revenues for the high, medium and low ridership cases in YOE dollars from IOS–S through Phase 1.

Exhibit 8-10. Revenues, IOS-South first, through Phase 1 (YOE dollars in millions)

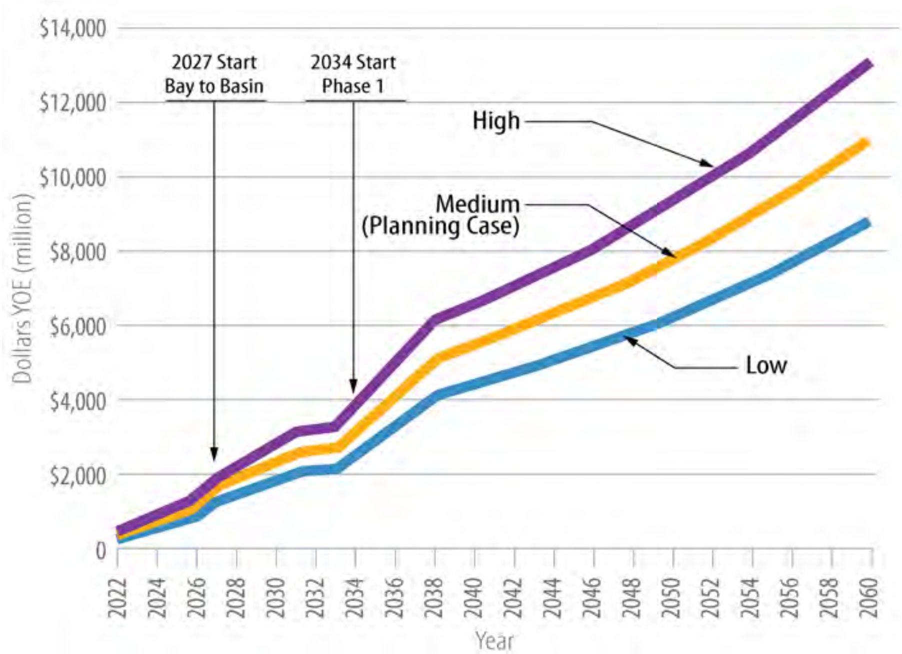
	2025	2030	2035	2040	2045	2050	2055	2060
High ridership	$1,195	$2,813	$4,402	$6,571	$7,829	$9,306	$11,062	$13,097
Medium ridership (planning case)	$1,002	$2,356	$3,686	$5,503	$6,557	$7,794	$9,264	$10,969
Low ridership	$810	$1,899	$2,971	$4,435	$5,285	$6,282	$7,467	$8,840

Under the IOS-South medium ridership scenario, the projected revenues are $1.0 billion in 2025, which is the fourth year after completion of the IOS to the San Fernando Valley. Revenues rise to $2.4 billion in 2030, the fourth year after completion of Bay to Basin, and to $3.7 billion in 2035, two years after the completion of Phase 1 and the fourteenth year of operations.

Over the period from 2022 to 2027, total revenues in the planning case are $1.1 billion greater in aggregate for IOS-South compared to the equivalent revenue forecast under the IOS–N phasing scenario. The forecasts illustrate that the IOS-South phasing scenario is expected to produce greater initial revenue than the IOS-North phasing scenario. The forecasts converge by 2035 due to the fact that the cumulative Bay to Basin ridership reaches the same level under both scenarios after ridership has stabilized on both the north and south sections of Bay to Basin.

Exhibit 8-11 illustrates projected ridership revenue growth from IOS-South through Phase 1 for all three revenue cases.

Exhibit 8-11. Revenue growth, IOS-South first, through Phase 1 (YOE dollars in millions)



Operating and maintenance costs

Operations and maintenance forecasts are presented in Chapter 7, Operating and Maintenance Costs, using 2010 price levels. These estimates were escalated by 3 percent per year, to produce a YOE operating and maintenance costs.

The forecasts of operating and maintenance costs were produced for high, medium, and low cases, each of which is more fully described in Chapter 7, Operating and Maintenance Costs.

Exhibit 8-12 provides operating and maintenance costs in YOE dollars from IOS-South through Phase 1.

Exhibit 8-12. Operations and maintenance costs, IOS-South first, through Phase 1 (YOE dollars in millions)

	2025	2030	2035	2040	2045	2050	2055	2060
High ridership	$613	$1,237	$2,008	$2,884	$3,488	$4,145	$4,795	$5,553
Medium ridership (planning case)	$539	$1,110	$1,751	$2,523	$3,030	$3,625	$4,095	$4,859
Low ridership	$458	$950	$1,513	$2,170	$2,675	$3,141	$3,497	$4,006

As operations and maintenance costs are closely aligned with ridership, they trend in a similar manner to revenues. Operations and maintenance costs will have a similar ramp up as revenues as ridership demand and service expands in early years.

Exhibit 8-13 provides the net operating profit in five-year increments for each scenario in YOE dollars from IOS-South through Phase 1. Net operating profit is calculated by subtracting operating and maintenance cost from revenues.

Exhibit 8-13. Net operating profit, IOS–S first, through Phase 1 (YOE dollars in millions)

	2025	2030	2035	2040	2045	2050	2055	2060
High ridership	$582	$1,576	$2,394	$3,687	$4,342	$5,161	$6,267	$7,544
Medium ridership (Planning case)	$464	$1,246	$1,935	$2,980	$3,527	$4,169	$5,170	$6,110
Low ridership	$352	$949	$1,458	$2,265	$2,610	$3,141	$3,969	$4,834

Projections illustrate that the three revenue and operating and maintenance cost scenarios generate net operating profits from the initial year of operations. This includes scenarios where revenues have been assumed to be lower than the high ridership case by nearly 20 percent (medium case) and 40 percent (low case) in early years and subjected to further reductions during a four-year ramp-up period. Based on the medium scenario, net operating profit in year 2030 is projected to be $1.3 billion, 4 years after commencement of Bay to Basin operations. Net operating profit rises to $3.0 billion in 2040, six years after commencement of Phase 1 operations and to $4.2 billion in 2050.

Projections illustrate that the three revenue and operating and maintenance cost scenarios generate net operating profits from the initial year of operations.

Exhibit 8-14 presents net operating profit for each scenario from 2022 to 2060 in YOE dollars from IOS-South through Phase 1.

Exhibit 8-14. Net operating profit growth, IOS-South first, through Phase 1 (YOE dollars in millions)

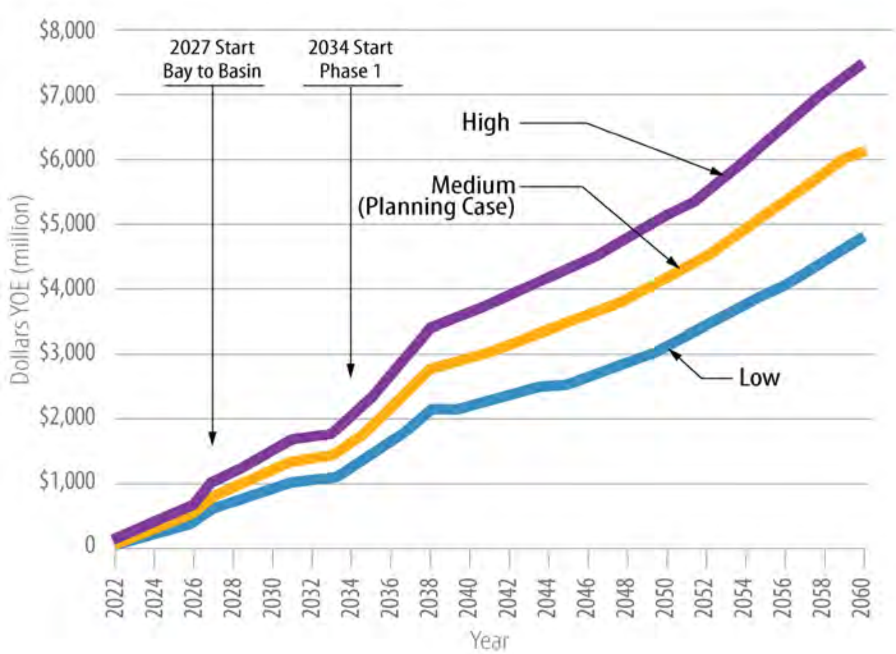
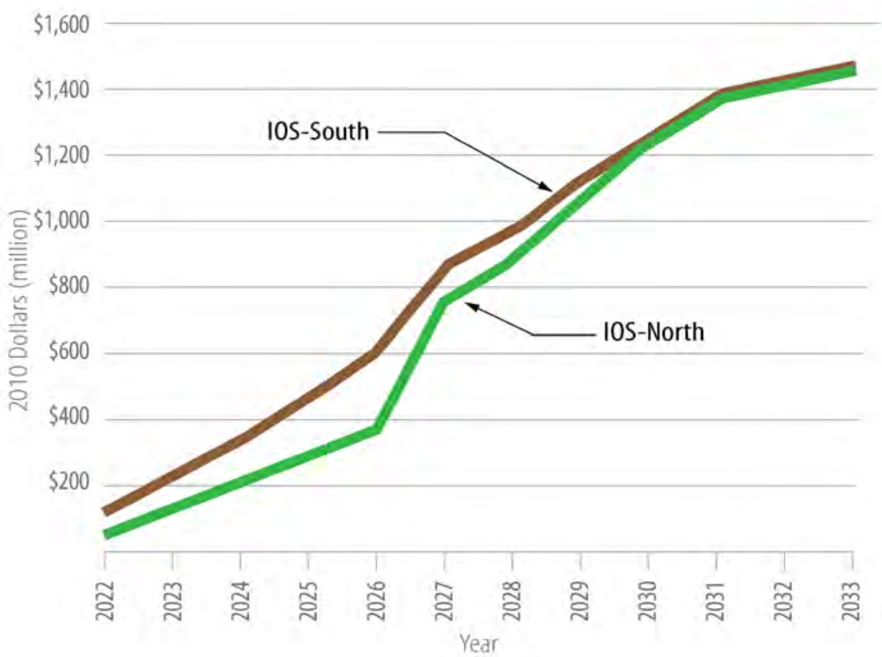


Exhibit 8-14 demonstrates growth in net operating profit in all scenarios from the commencement of operations in 2022 to the analysis period end in 2060.

Comparing IOS-North and IOS-South

Exhibit 8-15 compares net operating profits between 2022 and 2033. Due to the higher ridership and revenues from IOS-South, net operating profits are higher for the system in early years if IOS-South is developed first. The space between the lines below is additional operating profits that is available to the system in early years should IOS-South be built first.

Exhibit 8-15. Planning case net operating profit by section (YOE dollars in millions)



Breakeven analysis

Exhibit 8-16 presents the first year of revenues under High, Medium (planning case), Low, and breakeven scenarios followed by the fifth year of revenues. 2022 represents the first year of IOS operations and the year most sensitive to changes in ridership. 2026 illustrates the estimates after ramp up.

Exhibit 8-16 shows that projected ridership could fall 59 percent in year one and maintain a positive cash flow. As the project progresses through operations, the percentage increases. In 2026, the breakeven percentage is 83 percent below the high projection.

Exhibit 8-16. Revenue breakeven analysis for IOS-South

Ridership Scenario	2022 Revenue	Percent of 2022 High Ridership Revenue	2026 Revenue	Percent of 2026 High Ridership Revenue
High	$531	100%	$ 1,450	100%
Medium	$451	85%	$ 1,214	84%
Low	$370	70%	$ 979	68%
Breakeven	$218	41%	$ 247	17%

Net operating profit summary

As illustrated in Exhibit 8-17, projections indicate that no operating subsidy will be required for either the IOS-North or IOS-South sections under high, medium, or low ridership assumptions. This is consistent with the results of other high-speed projects across the world.

Exhibit 8-17. 2025 net operating profit summary (YOE dollars)

Year 2025	Revenue	Operating Cost	Net Operating Profit	Operating Subsidy?
IOS-North				
High	$904	$537	$368	No
Medium	$759	$474	$285	No
Low	$614	$406	$207	No
IOS-South				
High	$1,195	$613	$582	No
Medium	$1,002	$539	$464	No
Low	$810	$458	$352	No

Funding needs

This previous section evaluated cash flow projections from the HSR system and their ability to cover operating and maintenance costs. The remainder of this chapter discusses capital requirements for construction and asset replacement followed by a discussion of the availability, timing, and magnitude of the various sources of funding for each phase of the project.

Construction costs

Capital construction estimates were provided in Chapter 3, Capital Costs, in 2010 dollars for two construction scenarios:

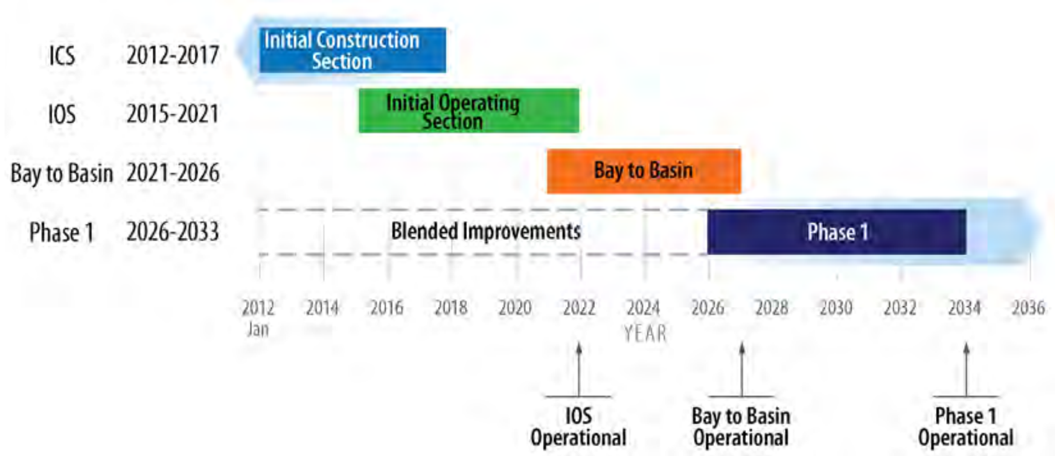
- Scenario 1 includes the cumulative lowest cost options for feasible alignment alternatives.
- Scenario 2 includes the cumulative highest cost options for feasible alignment alternatives.

For the purpose of the financial analysis, Scenario 1 is illustrated in the primary tables and the impact of the increased costs of Scenario 2 is shown in the sensitivity analysis at the end of this section.

Chapter 3, Capital Costs, and Chapter 7, Operating and Maintenance Costs, include capital construction cost and capital replacement cost projections in 2010 dollars to demonstrate the effect of real growth without the impact of inflation. For the purposes of funding analysis, it is necessary to also view the projected financial needs on an inflated, future basis. To arrive at estimates in future year dollars, the 2010 dollar projections shown in previous chapters were inflated by a standard 3 percent compound annual inflation rate. The analyses in the remainder of this chapter are in future or Year of Expenditure dollars using the 3 percent inflation assumption.

The capital construction schedule used for financial planning purposes was shown in Chapter 4, Business Planning Schedule, and illustrated in Exhibit 8-18.

Exhibit 8-18. Schedule by section



Net operating profit and resulting project cash flows that may be available for funding and financing purposes are based on the medium ridership scenario discussed earlier in this chapter.

To illustrate the potential contribution of a Qualified Tax Credit Bond Program, an assumption is made that such a program is available by 2015 as a form of federal support. In the event this does not occur, the federal grant line item that represents other types of federal support would be increased in the analysis. Under either mix, total combined federal support is the same in the analysis.

The IOS-North alignment is presented first, followed by the IOS-South alignment.

Phase 1 capital costs—IOS-North alignment

As more fully described in Chapter 3, Capital Costs, the Scenario 1 base year 2010 dollar capital cost estimates for the ICS, IOS, Bay to Basin, and Phase 1 sections are based on a preliminary level of design. In 2010 dollars, the estimated cost to construct the system to provide Bay to Basin connectivity is $40.8 billion, including pre-operational costs for testing and commissioning. The comparable total cost for Phase 1 is estimated to be $65.4 billion, which includes $14.1 billion for the blended operations system and a further $10.5 billion for the Full Phase 1 system.

Based on the planning schedule and inflation assumptions discussed above, the 2010 dollar estimates were inflated to the year they may be incurred. The estimated cost to complete Bay to Basin assuming inflation from 2010 to 2026 is $54.7 billion in future year of expenditure dollars. The completion of a blended system that would run on both HSR and existing lines would cost a further $23.9 billion. Completing the full San Francisco to San Jose and San Fernando to Anaheim urban sections on dedicated HSR tracks could cost an additional $19.9 billion, bringing the total Phase 1 cost to $98.5 billion if costs are inflated until 2033. Exhibit 8-19 provides incremental and cumulative capital costs in year of expenditure dollars if the IOS-North is developed first.

Exhibit 8-19. Capital costs, IOS-North first, through Phase 1 (YOE dollars in millions)

	ICS	IOS	Bay to Basin	Phase 1/ Blended	Phase 1
Incremental capital cost	$6,000	$24,700	$24,000	$23,900	$19,900
Cumulative capital cost	$6,000	$30,700	$54,700	$78,600	$98,500

Cumulative figures may not sum due to independent rounding.

Phase 1 capital costs—IOS-South alignment

Similar to the IOS–N costs above, completing Bay to Basin by 2026 is projected to cost approximately $54.3 billion in year of expenditure dollars. Even though the IOS-South costs more to complete than IOS-North, the combined Bay to Basin costs are slightly lower under the IOS-South alignment scenario as less inflation is assumed overall if the higher-cost south section is constructed first. Exhibit 8-20 illustrates capital costs in YOE dollars for the IOS-South through Phase 1.

Exhibit 8-20. Capital costs, IOS-South first, through Phase 1 (YOE dollars in millions)

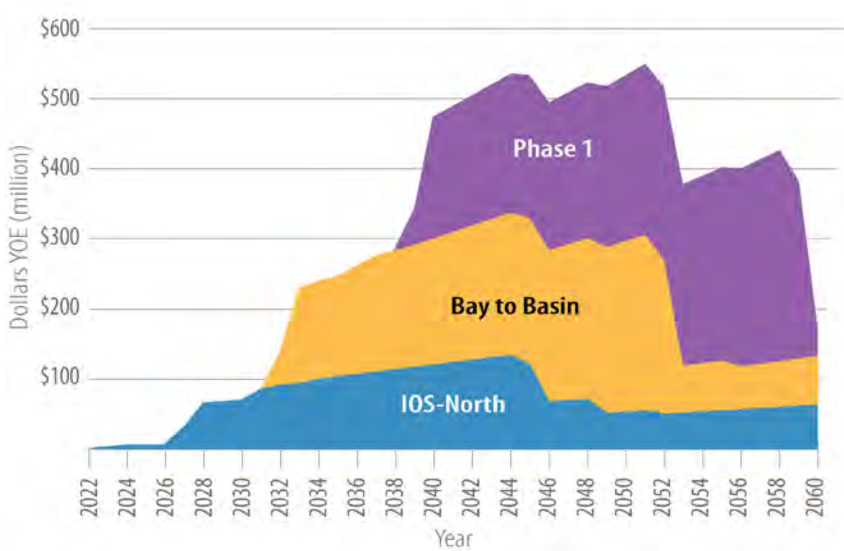
	ICS	IOS	Bay to Basin	Phase 1/ Blended	Phase 1
Incremental capital cost	$6,000	$27,200	$21,100	$23,900	$19,900
Cumulative capital cost	$6,000	$33,200	$54,300	$78,200	$98,100

Cumulative figures may not sum due to independent rounding.

Capital renewal costs

As discussed in Chapter 7, Operating and Maintenance Costs, capital renewal costs have been estimated to reflect the long-term asset management required for the system. The estimated capital renewal cost profile over time for the incremental sections from IOS through to Phase 1 is illustrated in Exhibit 8-21.

Exhibit 8-21. Annual capital renewal profile through Phase 1



Funding plans

Initial Construction Section

As noted previously, the ICS will be fully funded from the following sources, subject to satisfaction of various conditions associated with each of the following sources:

- State general obligation bonds authorized under the Bond Act approved by California voters as Proposition 1A in 2008
- Federal grants authorized under ARRA and HSIPR for federal fiscal year 2010

Total capital costs are $6 billion in YOE dollars. The amount of each of these funding sources allocated to the development costs of the ICS (including planning and construction costs) is shown in Exhibit 8-22.

Exhibit 8-22. Initial construction section funding sources (YOE dollars in millions)

	Total	2013	2014	2015	2016	2017
Uses						
Capital expenditure	$6,000	$1,061	$1,181	$1,216	$1,252	$1,290
Capital asset maintenance	—	—	—	—	—	—
Pre-operating costs	—	—	—	—	—	—
Total uses	$6,000	$1,061	$1,181	$1,216	$1,252	$1,290
Sources						
Net operating profit	—	—	—	—	—	—
Federal grants: secured	$3,316	$586	$653	$672	$692	$713
Federal grants	—	—	—	—	—	—
QTCB proceeds	—	—	—	—	—	—
State bonds (Prop 1A)	$2,684	$474	$528	$544	$560	$577
Other funds	—	—	—	—	—	—
Total sources	$6,000	$1,061	$1,181	$1,216	$1,252	$1,290

Subject to rounding
2013 represents the first full year of construction

Initial Operating Section

As presented in Chapter 5, Business Model, the development of the IOS will need to continue to be funded through state and federal funding sources. Significant private-sector investment for construction of the IOS is not considered likely due to the magnitude of the construction work required to complete the IOS along with the uncertainty around commissioning what likely will be the first true high-speed rail system in the U.S. Furthermore, the valuation of future ridership revenue is likely to be significantly discounted until the system becomes operable.

Under both the IOS-North and IOS-South phasing scenarios, the Authority has assumed that the percentage of federal funds and matching state or other funds provided will be 80 percent and 20 percent, respectively, consistent with the current HSIPR program. As described below, once an IOS has been completed and is in operation, the opportunity for private investment is greatly increased, and the expected percentage of match that could be provided for federal dollars increases substantially. As described later in this chapter, when private investment is considered in the completion of the total Bay to Basin phase, the total federal contribution is projected at just over 61 percent, while state, local, private, and project sources contribute 39 percent.

The financial analysis assumes that state funds will be provided by means of the Proposition 1A bond proceeds to support construction up to the maximum amount of $8.325 billion (with the remaining amount reserved for non-construction costs). Once the bond funds have been used, the required matching funding is assumed to be provided from other locally generated revenues or contributions (such as the types discussed in the section on Funding Sources, above).

For illustrative purposes, the funding assumptions include an estimate of the split in federal funding resulting from the potential issuance of QTCBs as presented earlier in this chapter. Whether QTCBs become a viable option or not, the total federal support remains the same. To the extent that they are not available as a resource, other federal sources will be sought.

Overall, based on the capital cost estimates for completing the IOS-North section of $24.7 billion in YOE dollars, the federal and state funding based on the assumptions above would be $19.8 billion and $4.9 billion, respectively, from 2015 through 2021. Pre-operating costs are costs related to testing of capital equipment and systems and related capital costs. This is shown on an annual basis in Exhibit 8-23.

Exhibit 8-23. Sources and uses for completing IOS-North (2015 to 2021) (YOE dollars in millions)

	Total	2015	2016	2017	2018	2019	2020	2021
Uses								
Capital expenditure	$24,376	$2,664	$2,742	$2,826	$4,366	$4,497	$4,629	$2,651
Capital asset maintenance	—	—	—	—	—	—	—	—
Pre-operating costs	$342	—	—	—	—	—	$134	$208
Total uses	$24,718	$2,664	$2,742	$2,826	$4,366	$4,497	$4,763	$2,859
Sources								
Net operating profit	—	—	—	—	—	—	—	—
Federal grants: secured	—	—	—	—	—	—	—	—
Federal grants	$7,415	$799	$823	$848	$1,310	$1,349	$1,429	$858
QTCB proceeds	$12,359	$1,332	$1,371	$1,413	$2,183	$2,249	$2,382	$1,429
State bonds (Prop 1A)	$4,944	$533	$548	$565	$873	$899	$953	$572
Other funds	—	—	—	—	—	—	—	—
Total sources	$24,718	$2,664	$2,742	$2,826	$4,366	$4,497	$4,763	$2,859

Subject to rounding

Capital costs to complete construction of IOS-South are $27.2 billion in YOE dollars or approximately $2.5 billion higher than IOS-North costs. Potential funding sources by year are shown in Exhibit 8-24.

Exhibit 8-24. Sources and uses for completing IOS-South (2015 to 2021) (YOE dollars in millions)

	Total	2015	2016	2017	2018	2019	2020	2021
Uses								
Capital expenditure	$26,880	$2,937	$3,024	$3,116	$4,815	$4,959	$5,104	$2,923
Capital asset maintenance	—	—	—	—	—	—	—	—
Pre-operating costs	$342	—	—	—	—	—	$134	$208
Total uses	$27,222	$2,937	$3,024	$3,116	$4,815	$4,959	$5,239	$3,131
Sources								
Net operating profit	—	—	—	—	—	—	—	—
Federal grants: secured	—	—	—	—	—	—	—	—
Federal grants	$8,488	$881	$907	$935	$1,444	$1,488	$1,572	$1,260
QTCB proceeds	$13,290	$1,469	$1,512	$1,558	$2,407	$2,480	$2,619	$1,244
State bonds (Prop 1A)	$ 5,316	$587	$605	$623	$963	$992	$1,048	$498
Other funds	$128	—	—	—	—	—	—	$128
Total sources	$27,222	$2,937	$3,024	$3,116	$4,815	$4,959	$5,239	$3,131

Subject to rounding

Bay to Basin

The development of the Bay to Basin section will be undertaken in parallel to the operation of the IOS. The IOS will be generating revenue, as set out in the financial analysis above, and a net operating profit. In Chapter 5, Business Model, the Authority set out the strategy to leverage the value of the future revenue from both the IOS and the Bay to Basin sections, once complete, through a PPP concession arrangement.

Two funding scenarios are illustrated in this section to show the impact of a private-sector investment during the construction period or upon completion of Bay to Basin. It is the Authority's plan to obtain private-sector investment prior to completion of B2B.

Under a scenario where no private-sector investment is made until completion of Bay to Basin construction, development costs would continue to be funded by federal and state resources but reduced by the net operating profit from IOS operations in each year. This is, in effect, a "pay as you go" basis. This scenario is illustrated below. Within the financial analysis for the funding of the Bay to Basin the same assumptions have been made around the level of federal and state and other funding (i.e., 80 percent to 20 percent, respectively).

Based on the analysis, the state Proposition 1A bond proceeds will be fully used by the end of 2021, and an additional $3.9 to $4.2 billion in local or other funds will be needed to match federal funds to complete construction of the B2B. This illustrates the need to structure a transaction to monetize the net operating profit of the IOS, and potentially B2B, as part of the completion of the B2B. This is shown on an annual basis in Exhibit 8-25 and Exhibit 8-26 for the IOS-North and IOS–S phasing scenarios, respectively.

Exhibit 8-25. Sources and uses for IOS-North first phasing scenario—completing Bay to Basin (YOE dollars in millions)

	Total	2021	2022	2023	2024	2025	2026
Uses							
Capital expenditure	$24,011	$2,235	$4,835	$4,980	$5,124	$5,283	$1,555
Capital asset maintenance	$14	—	—	$1	$4	$4	$4
Pre-operating costs	—	—	—	—	—	—	—
Total uses	$24,025	$2,235	$4,835	$4,981	$5,128	$5,288	$1,559
Sources							
Net operating profit	$1,043	—	$52	$130	$209	$285	$367
Federal grants: secured	—	—	—	—	—	—	—
Federal grants	$17,455	$857	$3,826	$3,881	$3,935	$4,002	$954
QTCB proceeds	$931	$931	—	—	—	—	—
State bonds (Prop 1A)	$372	$372	—	—	—	—	—
Other funds	$4,224	$75	$957	$970	$984	$1,000	$238
Total sources	$24,025	$2,235	$4,835	$4,981	$5,128	$5,288	$1,559

Subject to rounding

Exhibit 8-26. Sources and uses for IOS-South first phasing scenario—completing Bay to Basin (YOE dollars in millions)

	Total	2021	2022	2023	2024	2025	2026
Uses							
Capital expenditure	$21,085	$1,963	$4,245	$4,373	$4,499	$4,640	$1,365
Capital asset maintenance	$ 14	—	—	$1	$4	$4	$4
Pre-operating costs	—	—	—	—	—	—	—
Total uses	$21,100	$1,963	$4,245	$4,374	$4,503	$4,644	$1,370
Sources							
Net operating profit	$1,748	—	$122	$229	$336	$464	$598
Federal grants: secured	—	—	—	—	—	—	—
Federal grants	$15,481	$1,570	$3,299	$3,316	$3,334	$3,344	$618
QTCB proceeds	—	—	—	—	—	—	—
State bonds (Prop 1A)	—	—	—	—	—	—	—
Other funds	$3,870	$393	$825	$829	$834	$836	$154
Total sources	$21,100	$1,963	$4,245	$4,374	$4,503	$4,644	$1,370

Subject to rounding

Private-sector investment in Bay to Basin

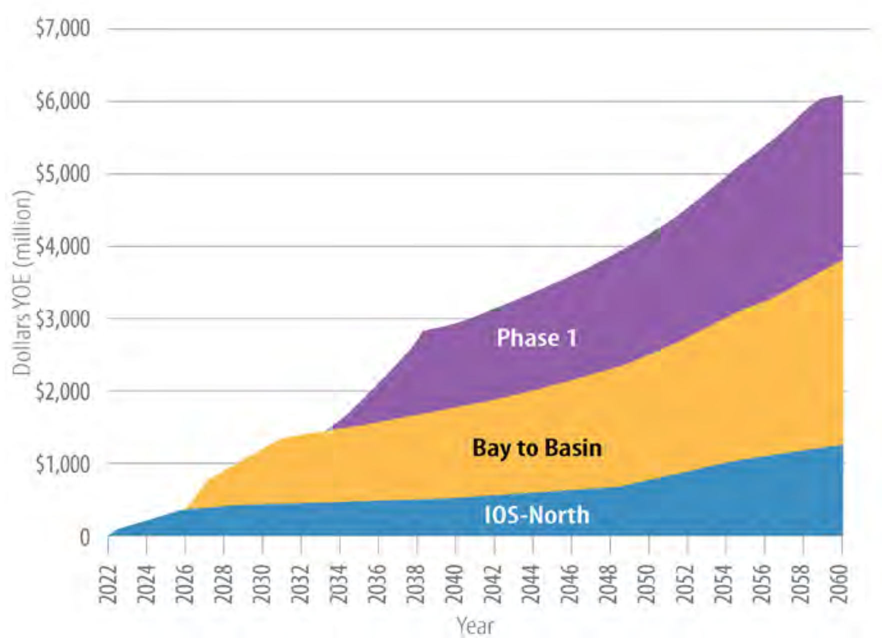
As discussed in Chapter 5, Business Model, as the system develops over time it will generate implicit value through the generation of future positive cash flows resulting from the net operating profit over the system's life. A critical decision for the state will be when those future cash flows could offer the greatest value to the state. One structure the Authority may choose is to let a concession contract to the private sector to monetize the future cash flows and transfer responsibility for train operations and/or the infrastructure maintenance to the private sector.

The private-sector valuation of those cash flows is expected to be greatest once the system is operational and the Business Plan assumes private investment based on cash flows after an IOS is operational. IOS-South is projected to have a material value to a potential private-sector investor as a standalone service.

If the IOS is demonstrating strong ridership and revenues, as forecast, along with overall strong asset operational performance, the private sector may also have the appetite to value the future benefit of the Bay to Basin network prior to its completion. The cash-flow scenario below is based on the Authority awarding a concession to a private-sector developer and investor based on an upfront capital contribution from the private sector to the Authority. The upfront contribution would be calculated based on the private sector's valuation of the future cash flows from the system. The financial analysis has provided a range of estimates of what that potential contribution from the private sector could be based on a range of discount rates of such a transaction.

Exhibit 8-27 below demonstrates growth in net operating profit in all sections of the Planning Case scenario from the commencement of operations in 2022 to the analysis period end in 2060.

Exhibit 8-27. Planning case net operating profit by section, IOS-North first, through Phase 1 (YOE dollars in millions)



The analysis has been based on the discounting of the net operating profits at three illustrative discount rates, namely 8 percent, 11 percent, and 14 percent. In general terms, it is considered more likely that the private sector would use a higher discount rate for any net revenue from future sections yet to be completed, as opposed to proven cash flows from existing operational sections, which would support a lower discount rate.

Given the possible magnitude of value inherent in future cash flows, it would be possible to incorporate the letting of a concession with a contract to complete a final part of the construction work for the Bay to Basin. This approach would allow the private-sector investment to reduce the total government funding required to complete the Bay to Basin section. This would be achieved under a DBFO type of arrangement, which was discussed in greater detail in Chapter 5, Business Model.

The financial analysis has been used to provide a revised value of the required federal and state funding assuming a private-sector concession is let three years prior to the end of the completion of Bay to Basin. Using the medium-case revenue scenario, discounted cash flows were calculated based on the discounts rates described above, reflecting a range of perceived risks associated with those future cash flows. This present value serves as a proxy for the estimated proceeds the Authority could anticipate receiving from a full concession transaction at that point in time. The analysis was based on the assumption that private investment occurs close to the end of 2023, three years prior to completion of the Bay to Basin section.

Exhibit 8-28. Discounted cash flows for medium revenue scenario—IOS and B2B (YOE dollars in millions)

	Discount Rate			
	PV date	8%	11%	14%
Bay to Basin	End 2023	$15,685	$10,983	$8,140

For the purpose of illustrating the effect that a private investment of capital could make, an 11 percent discount rate was selected. The implication of this exercise is that the estimated proceeds of a concession at that point in time (nearly $11 billion under the 11 percent discount rate assumption), would enable the state and federal government to reduce their contributions for completion of the Bay to Basin by a cumulative like amount. This analysis for the IOS–S phasing scenario is presented in Exhibit 8-29.

Exhibit 8-29. Sources and uses for IOS-South first phasing scenario—Bay to Basin assuming private-sector investment at end of year 2023 (YOE dollars in millions)

	Total	2021	2022	2023	2024	2025	2026
Uses							
Capital expenditure	$21,085	$1,963	$4,245	$4,373	$4,499	$4,640	$1,365
Pre-operating costs	—	—	—	—	—	—	—
Total uses	$21,085	$1,963	$4,245	$4,373	$4,499	$4,640	$1,365
Sources							
Net operating profit	$351	—	$122	$229	—	—	—
Private capital	$10,983	—	—	$479	$4,499	$4,640	$1,365
Federal grants: secured	—	—	—	—	—	—	—
Federal grants	$8,534	$1,570	$3,299	$3,665	—	—	—
QTCB proceeds	—	—	—	—	—	—	—
State bonds (Prop 1A)	—	—	—	—	—	—	—
Other funds	$1,217	$393	$825	—	—	—	—
Total sources	$21,085	$1,963	$4,245	$4,373	$4,499	$4,640	$1,365

Subject to rounding

The illustrated total reduction in federal and other funding of approximately $6.9 billion and $2.6 billion, respectively, resulting from the private-sector investment are also offset by over $1.3 billion in reduced “pay-go” funding. These figures would vary depending on the actual value invested by the private sector.

Summary of Bay to Basin funding plan

Exhibit 8-30 illustrates a complete funding plan for ICS, IOS-South and Bay to Basin from 2013 until 2026. This is based on leveraging private capital during the completion of B2B.

Show Bookmarks

Exhibit 8-30. Total sources and uses for IOS-South first phasing scenario—Bay to Basin assuming private-sector investment in year 2023 (2013 to 2026) (YOE dollars in millions)

	Total	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Uses															
Capital Expenditure															
ICS	$6,000	$1,061	$1,181	$1,216	$1,252	$1,290	—	—	—	—	—	—	—	—	—
IOS–S	$26,880	—	—	$2,937	$3,024	$3,116	$4,815	$4,959	$5,104	$2,923	—	—	—	—	—
Bay to Basin	$21,085	—	—	—	—	—	—	—	—	$1,963	$4,245	$4,373	$4,499	$4,640	$1,365
Pre-operating costs	$342	—	—	—	—	—	—	—	$134	$208	—	—	—	—	—
Total uses	$54,307	$1,061	$1,181	$4,154	$4,276	$4,407	$4,815	$4,959	$5,239	$5,094	$4,245	$4,373	$4,499	$4,640	$1,365
Sources															
Net operating profit	$351	—	—	—	—	—	—	—	—	—	$122	$229	—	—	—
Private capital	$10,983	—	—	—	—	—	—	—	—	—	—	$479	$4,499	$4,640	$1,365
Federal grants: secured	$3,316	$586	$653	$672	$692	$713	—	—	—	—	—	—	—	—	—
Federal grants	$17,022	—	—	$881	$907	$935	$1,444	$1,488	$1,572	$2,831	$3,299	$3,665	—	—	—
QTCB proceeds	$13,290	—	—	$1,469	$1,512	$1,558	$2,407	$2,480	$2,619	$1,244	—	—	—	—	—
State Bonds (Prop 1A)	$8,000	$474	$528	$1,132	$1,165	$1,201	$963	$992	$1,048	$498	—	—	—	—	—
Other funds	$1,346	—	—	—	—	—	—	—	—	$521	$825	—	—	—	—
Total Sources	$54,307	$1,061	$1,181	$4,154	$4,276	$4,407	$4,815	$4,959	$5,239	$5,094	$4,245	$4,373	$4,499	$4,640	$1,365

Subject to rounding
2013 represents the first full year of construction

Total capital costs for completing Bay to Basin are $54.3 billion in YOE dollars. The funding plan in Exhibit 8-31 summarizes the relative levels of funding required from the various sources, including federal grants and financing tools (including QTCB proceeds), state bonds, and other funds (state, local, and private development). This is summarized in the chart below.

Exhibit 8-31. Relative amounts of sources of funding for Bay to Basin (IOS-South first phasing scenario)

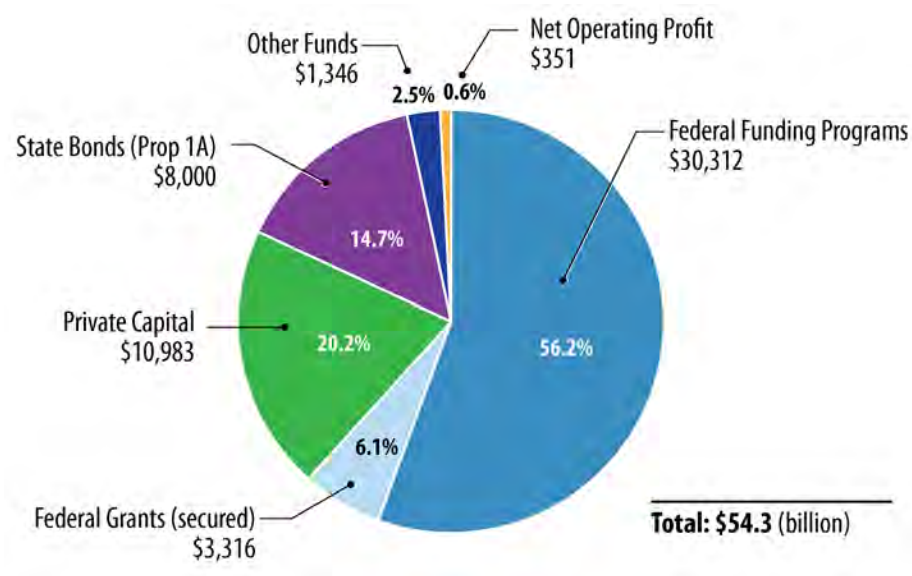


Exhibit 8-31 assumes a private-sector concession provides $10.9 billion. The federal funding in total through Bay to Basin (including grants and QTCBs) is approximately $30 billion in addition to the current federal commitment of $3.3 billion. State, local, private, and project sources would contribute $20.7 billion. The federal contribution is 61 percent and the matching contribution for all other sources is 39 percent. The key to reducing the total funding from government is the private-sector concession assumption that occurs in 2023. While $10.9 billion represents a significant value in 2023 terms, in 2010 terms it is the equivalent of $7.2 billion.

The commercial arrangements underlying this transaction would be developed as the procurement strategy develops. In today's dollars, $7.2 billion represents a significant private-sector investment within infrastructure. However, it can be compared to a range of international infrastructure investment transactions, such as the acquisition by Macquarie of the French toll roads APRR valued at $10 billion; Ferrovial's acquisition of BAA (airport owner/operator) in the U.K. for $14 billion; and the CKI acquisition of the EdF distribution network assets for $9 billion in the U.K. in 2011. Furthermore, following the sale of the HS1 high-speed line in the U.K. for around $3 billion in 2011, the U.K. government has made a clear statement it intends to develop the next line HS2 using government funds and will sell the asset upon completion. A recent study suggests the value of the sale could be around $9 billion.

The Business Plan recognizes that the amount to be financed is very large in current private-sector investment terms and the transaction would likely need to encompass low-cost federal debt programs, such as RRIF, and be staged to allow for market capacity and competition.

As the program develops, the Authority will carefully consider the appropriate transaction structure, including the merits of a single concession incorporating infrastructure and operations or the more common European approach of separating infrastructure management from train operations through a track access charge structure. This was discussed in greater detail in Chapter 5, Business Model.

Sensitivity analysis

The Authority has considered the Bay to Basin funding analysis under a range of different scenarios to understand the sensitivity of the key outputs to changes in input assumptions. The key variables considered are as follows:

- Low revenue forecasts
- The increased Scenario 2 construction costs as defined in Chapter 3, Capital Costs
- A higher discount rate applied to the private-sector valuation of future project cash flows that increases in the cost of private capital

Exhibit 8-32 shows the how the impact of changes in certain key variables affects the various funding sources.

Exhibit 8-32. Sensitivity analysis of total sources and uses of funds—IOSS first, (through Bay to Basin) (YOE dollars in millions)

	Planning Case	Low Revenue Scenario	High Capital Cost Scenario	High Discount Rate for Private Investment
Bay to Basin capital cost (YOE)	$54,307	$54,307	$66,200	$54,307
Revenue scenario	Medium Ridership	Low Ridership	Medium Ridership	Medium Ridership
Discount rate for private-sector investment	11%	11%	11%	14%
Sources of Funds				
Net operating profit	$351	$270	$130	$351
Private capital	$10,983	$8,021	$10,473	$8,140
Federal grants	$20,338	$22,535	$30,653	$22,351
QTCB proceeds	$13,290	$13,290	$13,290	$13,290
State bonds (Prop 1A)	$8,000	$8,000	$8,000	$8,000
Other funds (state, local, private)	$1,346	$2,191	$3,654	$2,175
Total sources	**$54,307**	**$54,307**	**$66,200**	**$54,307**

Subject to rounding
Changed variables
Impacted funding sources

Column one above is the planning case illustrated earlier in this chapter.

Reducing the estimated ridership to the low projection (see column 2) reduces the private investment amount by nearly $3 billion that in turn requires a $3 billion increase from federal and other public sources of funds.

The higher cost construction alternative in column 3 requires 50 percent more in federal funding over the planning case due to the fixed limits of the state bond funds and private investment.

If an investor were to require a higher discount rate (reflecting higher return on capital) the amount that could be raised from the private sector would decline approximately $2.9 billion. This would need to be offset with additional federal funds

In each case, lower revenues, higher costs or more expensive private capital, the result is the need for additional public funds. Should additional public funds not be available, the project phasing, scoping or schedule would be negatively impacted.

Phase 1

The Phase 1 system with blended operations is estimated to cost an additional $14.1 billion in 2010 dollars. A further $10.5 billion in 2010 dollars would be required to complete the Full Phase 1 system with dedicated high-speed rail. The blended system construction period is from 2026 to 2030 with construction completed on the Full Phase 1 system in 2033. This would equal $43.8 billion in year-of-expenditure dollars ($23.9 billion for the blended system and $19.9 billion for the Full Phase 1 system) assuming inflation at 3 percent per year from 2010 to 2033. This development would require further federal and state or other funding to allow completion of the network. (It is noted that there are a range of technical solutions to completing Phase 1 with varying associated costs, as set out in Chapter 3, Capital Costs.)

Furthermore, the ability to source investment from the private sector during the Phase 1 build-out will depend on the decision made during the development of the Bay to Basin (i.e., the future system cash flows up to Phase 1 may already have been secured against a concession, as discussed in the section above).

It is instructive to consider the value of the incremental revenues from Phase 1. Considering the Phase 1 incremental contribution in isolation, the range of present value in 2010 dollars would be $4.8 billion to $8 billion. Comparing these ranges to the incremental cost to complete Phase 1, the future value represents 19 to 32 percent of the incremental Phase 1 cost in 2010 dollars. Therefore, even if the cash flows from IOS and Bay to Basin are awarded as a concession, it would be feasible for additional Phase 1 cash flows to provide a potential funding source for developing Phase 1 as described above for Bay to Basin. From a commercial perspective, this would need to be considered carefully in advance of letting a concession for the Bay to Basin section to ensure future development was adequately addressed within the contract.

Exhibit 8-33. Sources and uses—Phase 1 (YOE dollars in millions)

	Total	2026	2027	2028	2029	2030	2031	2032	2033
Uses									
Blended Phase 1	$23,902	$3,957	$5,706	$5,869	$6,054	$2,317			
Total Phase 1	$19,864	—	—	—	—	$3,918	$6,422	$6,604	$2,920
Pre-operating costs	—	—	—	—	—	—	—	—	—
Total Uses	$43,766	$3,957	$5,706	$5,869	$6,054	$6,235	$6,422	$6,604	$2,920
Sources									
Net operating profit	—	—	—	—	—	—	—	—	—
Federal grants: secured	—	—	—	—	—	—	—	—	—
Federal grants: Blended Phase 1	$19,122	$3,165	$4,564	$4,695	$4,843	$1,854	—	—	—
Federal grants: Total Phase 1	$15,891	—	—	—	—	$3,134	$5,138	$5,283	$2,336
QTCB proceeds	—	—	—	—	—	—	—	—	—
State bonds (Prop 1A)	—	—	—	—	—	—	—	—	—
Other funds	$8,753	$791	$1,141	$1,174	$1,211	$1,247	$1,284	$1,321	$584
Total Sources	$43,766	$3,957	$5,706	$5,869	$6,054	$6,235	$6,422	$6,604	$2,920

Subject to rounding

Having considered the future value of Phase 1, much of the development costs will have to be provided by the state and federal government. This funding requirement will be many years into the future and will be dependent on new federal government programs. It is not possible to provide specific details on future funding programs. However, it may well be that a number of the funding sources discussed in the opening section of this chapter may remain or become viable.

Summary

The financial analysis has used the cost and revenue estimates for the system and has been used to examine the overall economics and funding requirement of the program. The results demonstrate the following:

- The network is forecast to produce a net operating profit immediately following commencement of operations, even under a low revenue scenario. Breakeven revenues for the IOS-North and IOS-South are estimated at $267 million and $218 million in 2022, respectively which is 35 percent and 41 percent below the first year high estimate and 5 percent and 29 percent below the low estimate, respectively.
- The funding plan for each section has been considered. The state Proposition 1A bond funding could be used to build out to substantial completion the IOS, subject to the federal government supporting Qualified Tax Credit Bonds, which would allow a multiplying effect on the state bond proceeds

- Private-sector development and operation of the system is expected from the outset of construction and operations. Private-sector investment is anticipated once revenues are proven through completion of an IOS, and is a potential option to fund the final several years of construction under the Bay to Basin section if a PPP structure is introduced at that time. Private-sector investment could exceed $10 billion in year of expenditure terms.
- On the basis of such a private-sector transaction, the federal government funding requirements will be reduced significantly to represent approximately 61 percent of the total funding to achieve Bay to Basin connectivity.

Chapter 9

Risk Identification and Mitigation

Introduction

Undertaking a program as large as the California high-speed rail (HSR) system involves risk from both the program and project-level perspectives. It is critical to identify, manage, and mitigate risks at each stage of the HSR system's life cycle.

This chapter identifies high-level risks associated with the system's successful execution and a description of the specific risk mitigation and management approach that the Authority is applying to each of those risks. In addition, this chapter discusses risk mitigation and allocation strategies as well as the risk management plan being administered by the Authority. In summary, this chapter provides the following:

- **Identification of key risks**—This section discusses key system risks identified to date. Individual risks have been consolidated into risk categories for presentation purposes. It is likely that additional risks will arise and may become critical path items as the program moves forward to implementation and operation. The purpose of identifying risks is to assess and understand them so that mitigation plans, risk allocation strategies, and risk management processes can be applied in an appropriate manner.
- **Risk mitigation and allocation strategies**—This section discusses initial risk mitigation strategies for the key risks. Each risk is unique and is often linked to other risks; a tailored risk mitigation strategy is required to address them proactively. In some cases, risk mitigation approaches can and will be applied to a range of specific risks within risk categories. In determining and implementing the most appropriate risk mitigation strategies, the Authority has drawn heavily on international precedent and lessons learned. These general approaches include procurement contracting and delivery strategies with associated risk transfer.
- **Risk management plan and processes**—This section discusses approaches to manage and monitor risk throughout the HSR system's life cycle. The first step in identifying and tailoring risk management processes is occurring as part of the risk process for delivery of the Initial Construction Section (ICS).

Approach

The Authority's risk management process involves five key steps, as illustrated in Exhibit 9-1. This chapter discusses outputs from the "Identify" and "Manage" activities described in Exhibit 9-1.

Exhibit 9-1. Authority's risk management process

Key risks

The Authority has already taken a range of steps to reduce and mitigate risk to the program. An overall risk management plan and organization have been established, as described in the Risk Management Plan section later in this chapter; foreseeable risks have been identified that may threaten the program's viability; and the causes of each risk have been investigated to determine the underlying driver and cause. This process is integral in guiding the risk assessment and analysis described in the Risk Mitigation and Allocation Strategies section of this chapter. This process also helped in the identification of the relevant and effective mitigation and management strategies described below. Discussed below are key high-level program risks that have currently been identified. In addition, the Authority has developed numerous tools to identify and manage all foreseeable project risks in considerably more detail. It is not the purpose of this chapter to detail all of the potential risks the program will face but rather to highlight key categories of risks.

Cost and schedule

Description

The current cost estimating system is based on static inputs, such as unit prices and inflation. Thus a risk exists that projected costs and schedule could fluctuate as these underlying inputs are refined or change in the world markets. Although current plans on the ICS have progressed toward the 15 percent design stage, and many cost and schedule updates and changes have been incorporated to reflect more detailed design, to incorporate environmental mitigation measures, and to refine contingencies, the design and environmental process for the project is not complete. Two draft environmental impact reports/statements have been distributed for public and agency comment. Capital costs could further change until design is finalized, the environmental clearance process is complete, and construction is underway. This is a very broad category of risks and covers a large number of project-specific risks.

The schedule is tied directly to the availability of funding. An illustrative delivery schedule has been presented in Chapter 4, Business Planning Schedule. While this has been discussed with a range of stakeholders, the actual schedule will be different. In the event that funds are provided over longer periods of time, capital costs likely will rise from inflation.

Potential impact

The impact to the program could be wide ranging and include the following:

- Delay or inability to complete the program
- Increase in construction and operations costs
- Loss of stakeholder support
- Delay or inability to receive funding

Mitigation and management approach

Recently, the Authority has re-evaluated and updated unit costs and procedures. Realizing that increases to costs and schedule are a risk to the program, the Authority has been heavily focused on managing these risks and has implemented a variety of mitigation measures, including the following:

- Developing and implementing the HSR in a phased approach, beginning with the ICS and Initial Operating Section (IOS). Developing the system in phases allows individual, stand-alone projects to be implemented and decisions to be made incrementally on when and how to proceed. This phased approach reduces both delivery and cost overrun risk by reducing the size and scope of individual projects to be delivered. For more detailed information, see Chapter 2, A Phased Implementation Strategy.
- Including significant contingencies, inflation estimates and schedule extension in the financial plan. The Full Phase 1 construction cost in 2010 dollars includes contingency of between 15 and 25 percent to protect against material cost increases, use of different components or parts, and minor quantities changes, depending on the cost category. In addition, $33 billion in cost escalation is factored into the Full Phase 1 year-of-expenditure estimates representing a 3 percent compound inflation rate. A nine-year schedule extension is factored into the plan, which results in $16 billion of the $33 billion in inflation over time. These assumptions individually and collectively are significant mitigations for the risk that the financial plan costs are materially understated.
- Adopting an aggressive cost-management strategy that leverages private-sector delivery models that transfer risk of cost increases and schedule delay where appropriate. These models include design-build and other concession structures such as a train operating company franchise public/ private partnership (PPP) for the delivery of the train vehicles; an infrastructure operating and maintenance (O&M) concession for infrastructure operations and maintenance; or broader PPP arrangements. These contracting methodologies have the ability to provide greater price certainty and transfer the risk of cost and schedule overruns, contract interface, and performance of the HSR system or its components to the private sector. For a detailed discussion of PPP delivery models, see Chapter 5, Business Model.

- Advancing the ICS procurement to take advantage of favorable construction pricing, maintaining project schedule, and resolving issues before implementing system-wide operations. Additionally, as the development of the IOS nears completion, the IOS will be the initial segment for resolving regulatory and technical issues, extensive systems and train set commissioning, and operational development common to any initial construction segment of HSR. This will allow subsequent extensions to be implemented in a simpler and more cost-efficient manner.
- Continuing to investigate alternative alignments and design alternatives for more efficient program delivery, particularly for the segments between San Francisco and San Jose and between Anaheim and Los Angeles.
- Continuing to review and validate construction cost estimates, including the underlying cost (e.g., unit prices). Two peer reviews—a selected cost item peer review by regional consultants and a contract bid peer review for the Fresno-Bakersfield section—were conducted to assess the accuracy and validity of the cost estimating methodology applied to current cost estimates. The selected cost item peer review investigated the unit prices being used to build up the cost estimates and found that the unit prices were consistent with appropriate standards. The contract bid peer review for the Fresno-Bakersfield section found that the cost estimating methodology was producing reasonable results. For a more detailed discussion of capital cost estimating methods, see Chapter 3, Capital Costs.
- Continuing to review and validate O&M cost projections, including the underlying unit prices, international precedent comparables (e.g., European and Japanese HSR systems), and local California context (e.g., local labor and cost levels). "High," "medium," and "low" O&M cost projections were developed to analyze the impact to O&M cost projections based on fluctuations in ridership levels. In addition, the O&M cost projections contain a 10 percent contingency to account for unknowns and future changes to the underlying O&M cost assumptions. Chapter 7, Operating and Maintenance Costs, discusses this in more detail.
- Continuing to incorporate value engineering to reduce overall program cost without compromising quality or safety as engineering proceeds to the 30 percent design level.
- Developing construction cost estimates based on a range of alternative alignments, underlying cost assumptions, escalation factors, and implementation timing to understand impacts to the program's commercial and financial viability. As noted above, the construction costs and associated contingencies have been refined to reflect additional design work and the steps required for environmental mitigation.
- Procuring several specialist contractors and consultants who will mitigate the risk of schedule delay. The Authority plans to contract a right-of-way (ROW) procurement firm, construction management services firms for the ICS and component design-build contracts, and design and construction management firms on an indefinite delivery/indefinite quantity basis in the short-term for smaller design-bid-build contracts on the ICS. In addition, the Authority has a schedule to issue a number of small design-bid-build construction contracts in conjunction with the large design-build packages. The Authority anticipates completing environmental work for the Merced to Fresno and Fresno to

Bakersfield sections in early 2012. For a more detailed discussion, see Chapter 3, Capital Costs, and Chapter 5, Business Model.

- The schedule is highly dependent on funding availability. If all of the funding required to complete the program were available, it could be built as early as 2024. For the purposes of financial planning, a schedule was developed to illustrate program completion (see Chapter 4, Business Planning Schedule) that results in a completion date of 2033. This additional time in the financial plan schedule would mitigate most schedule-oriented risks. Funding risks would remain.

Staffing and organizational structure

Description

Implementation of a high-speed rail program is a complex undertaking. The scale, size, and technical complexities necessitate a robust internal program management team, complemented by external resources, with the specific skills and expertise necessary to manage this unique program. For example, during the peak construction years, the annual construction outlay will be several billion dollars. This volume of effort alone warrants attention on the size and capabilities of the Authority's staffing and organizational structure. The Authority will be negotiating daily with the heads of organizations that have been part of the world's most successful high-speed programs. In-depth high-speed rail industry expertise and experience is critical within state service.

Without appropriate mitigation, the Authority faces the risk that it will not have the number of experienced staff necessary to meet the demands of the program from an internal management perspective. For example, without the addition of management roles at the financial, funding, procurement, legal, and risk functions, the risk exists that work streams related to these roles may not be adequately covered within the Authority's structure.

The Authority has increased staffing and capacity, and expanded its organizational structure with a heavy focus on staffing. This focus will continue to be required to meet the future demands of the program. The Authority supplements its internal staff with full-time and part-time consultants with particular areas of expertise, including a Program Management Team (PMT). As in many large-scale public works programs and projects within California, the U.S., and internationally, the PMT augments Authority staff in specific project-related functions, such as planning, engineering, and construction management, project administration, risk management, and procurement/contract administration. Coordinated Authority staff augmentation will continue to be critical for a program of this magnitude since it will be difficult for the state to have ready access to the breadth and depth of expertise required and address the significant peaks and valleys in workforce requirements inherent in the development, design, construction, and initial operation of the project components. Staff augmentation does not relieve the need to build the Authority's management and support team as consultants are not in a position to establish strategy and make management decisions on behalf of the state. Authority management and staff, the PMT, other key Authority consultants and supporting state agencies must coalesce into a seamless, integrated structure for successful implementation of this program.

Potential impact

The impact to the program could be wide ranging and include the following:

- Loss of stakeholder support
- Delay or inability to receive funding
- Delay or inability to complete the program
- Increase in construction and operations costs

Mitigation and management approach

The Authority has implemented and will continue to implement measures aimed at mitigating and managing risk related to staffing and organizational structure. Some of these mitigation measures include the following:

- Recognizing the need to transition from a planning organization to one equipped to implement the HSR program, the Authority commissioned an organizational study in 2009. It has since taken steps to implement many of the study's recommendations regarding enhancing its in-house capabilities.
- The Authority has been actively soliciting candidates to fill open positions to lead major work streams, including a designated Authority risk manager, chief financial officer, and chief program manager. Additional positions also have been created and filled in communications and outreach at both the headquarters and regional levels, such as general counsel, as well as a variety of planning, right-of-way, contracts, and financial control positions, including a funds manager who will interface with the Federal Railroad Administration (FRA) for American Recovery and Reinvestment Act (ARRA) funds, and a Caltrans master agreement coordinator. Areas targeted for additional expansion include grants management and procurement, reflecting the growing demands and opportunities in these areas. The Authority continues to obtain the requisite approvals to fill open positions and meet the salary requirements of appropriately qualified individuals.
- The Authority is engaging the PMT and other consultants to provide supplemental expertise in areas necessary to develop and implement the ICS. An integrated organizational structure has been developed to support that effort.

In addition to the measures described above, the Authority is considering and investigating business and commercial structures aimed at transferring risks associated with certain administrative and management functions during the construction and operation phases. For a more detailed discussion of these structures see Chapter 5, Business Model.

Approvals

Description

Delay in or inability to receive environmental approvals is a program risk. The approvals process for a project of this size and nature are complex and involve a large number of agencies at the federal, state, and local levels. Coordination both within and outside the Authority must be managed daily and is inextricably linked to staffing and organizational structure risk.

The environmental approvals process also has implications for public support of the program as the public's reaction is largely dependent on the transparency and quality of information disseminated during the environmental approval process. In addition, compliance with technical and operational standards as they continue to develop has implications on receiving the approvals necessary to construct and operate the program.

Potential impact

The impact to the program could be wide ranging and include the following:

- Loss of public funding (ARRA) and increase to amount of state funding required for the program
- Increase in costs associated with schedule delay
- Inability to secure necessary environmental clearances and approvals

Mitigation and management approach

The Authority understands the risk related to the approvals process and is taking the requisite steps to mitigate this risk, including the following:

- The risk of delay in or inability to obtain approvals is linked to the internal management of these processes. Given the complicated nature and magnitude of agencies involved in these processes, the Authority is increasing its internal staffing and is soliciting individuals for related management roles.
- A planning schedule has been developed to evaluate funding needs that extends Full Phase 1 completion nine years from 2024 to 2033. This extension of time in the financial plan will address and mitigate most schedule-oriented risks. The option for phasing and early implementation of an IOS also would provide additional time to address development issues in urban areas.
- Continuing to coordinate with federal agencies to further the Authority's interagency collaboration efforts. For example, in July 2011 the California High-Speed Rail Authority was joined by the FRA, the U.S. Department of Housing and Urban Development, the U.S. Department of Transportation, and the U.S. Environmental Protection Agency to establish a partnership for sustainable planning. Continuing to coordinate with FRA staff on regulatory requirements, particularly the environmental requirements for the ICS, including implementing a schedule with deadlines and an accountability matrix that assigns ownership of each approval process. The Authority continues to coordinate with FRA regarding technical and operational safety standards. The Authority has funded positions with a number of resource agencies to ensure timely review of submissions to meet program deadlines.

- Focusing on compliance with all the underlying legal requirements and approval processes, including the right-of-way acquisition and environmental processes. Currently the Attorney General's office monitors the environmental approval process and assists in the submission of environmental documents and reports in order to mitigate potential legal issues. Legal and regulatory compliance and due process will be a key responsibility of the newly appointed legal counsel to ensure, in so far as possible, the Authority is not subject to legal claims and litigation.

Demand/ridership and revenues

Description

The financial viability of the program is dependent on public funding for early construction and ridership revenues to support access to private capital as the program matures. Given that the program is entirely new and no HSR currently operates in the U.S., a risk exists that the actual ridership demand and revenue will differ from the projections currently being used. In other international jurisdictions, the private sector has been unwilling to accept the full demand and ridership risk from the outset of a new system, although willingness to accept this risk increases as ridership becomes proven based on actual results.

Potential impact

The impact to the program could be wide ranging and include the following:

- Decreased commercial and financial viability
- Lower than expected project revenue
- Increase in the public funding required
- Loss of stakeholder support

Mitigation and management approach

The Authority has acknowledged the risk related to demand and ridership and has begun taking steps toward mitigating this risk. These steps include the following:

- Developing a range of revenue and ridership projections, including low, medium, and high scenarios to understand the impact on the operational and financial viability of the program under a variety of scenarios. The updated projections are based on post-recession economic and population growth. Inputs for gas and airline prices for the high scenario are current price levels. Startup phasing for revenue and ridership projections are based on input from international HSR operators and use conservative assumptions. See Chapter 6, Ridership and Revenue, for more information.
- Commissioning an independent, international Ridership Peer Review Panel comprised of experts on travel forecasting to review the forecast approach, assumptions, documentation, data, and model that generated the revenue and ridership projections. The Panel focused specifically on the ridership model's suitability for the business planning and performed three basic functions: (1) evaluated forecast work performed to date; (2) focused on guiding further work being performed; and

(3) advised on further improvements as the Authority moves to a "best-in-class" modeling tool. See Chapter 6, Ridership and Revenue, for more information.

- Actively assessing innovative ways to transfer risk related to demand and revenue to the private sector. The Authority has undertaken initial market sounding exercises with potential private-sector participants to gauge the level of interest in accepting some or all of this risk at appropriate stages of program development. For more information, see Chapter 5, Business Model.

Funding

Description

A number of risks exist related to funding. Failure to receive the anticipated amount of public funding at the requisite time could threaten the pace of development and ultimately the viability of the full program. In addition, the amount and timing of the public funding has an impact on many other aspects of the program, including the chosen business model, project schedule, phased implementation, staffing and management approach, and technical aspects such as operating speed and travel time.

Potential impact

The impact to the program could be wide ranging and include the following:

- Delay or inability to complete the program
- Significant increase to program costs
- Loss of stakeholder support

Mitigation and management approach

The Authority acknowledges the risk associated with the receipt of public funding and has taken a number of steps to mitigate and manage this risk. The Authority's risk mitigation and management approach includes the following:

- Developing the system in functional phases. The phased implementation of the system will allow flexibility within the program should there be gaps in funding availability. For example, the completion of the ICS offers a discrete milestone. Should further funding not be available for the IOS, the ICS could be used to operate an Amtrak San Joaquin service and the asset will be available for further development in the future. Similarly, once the IOS is commissioned there will be fully operational high-speed service that is forecast to generate a strong level of net operational profitability from the start of operations. This would allow the timing of the schedule to deliver Bay to Basin to be flexible to match the availability of funding.

- Focusing on maintaining stakeholder support for the program by completing the environmental documentation for the statewide program, achieving 15 percent design for selected ARRA program sections and environmental processing leading to issuance of the environmental clearance for two program sections early next year.

- Performing a full economic analysis report, as well as technical reports, to demonstrate the need for public funding for such an important program. The benefit-cost analysis calculated a benefit-cost ratio of 1.57 to 1.78, reinforcing the value of investing in the high-speed rail system in California and in the resulting job creation and economic growth. See Chapter 10, Economic Analysis, for an in-depth discussion of the economic benefits of the program.
- Undertaking a phased implementation approach to the program to align project costs better with public funding and provide flexibility for a change in funding mechanisms or delivery approach. For more information, see Chapter 2, A Phased Implementation Strategy.
- Initiated preparation of a state appropriations request and Funding Plan to use the Proposition 1A bonds to meet a portion of the funding needed for the ICS. This is a federal funding requirement that also is aligned with the Authority's guiding principle of efforts to achieve benefits quickly, especially increasing employment and minimizing inflation risk.
- Continuing to work closely with legislators, the FRA, the Federal Transit Administration (FTA), the private sector, and other stakeholders to maintain funding support for the program is important not only for California HSR but also for all HSR projects across the country. Engaging in dialogue with private-sector entities to discuss the ability of private financing mechanisms to complement or supplement public-sector funding. For more information, see Chapter 5, Business Model.
- Leveraging incremental success to build support for future funding. The Authority believes the demonstrated success of initial HSR segments will build considerable institutional, stakeholder, and public support for future funding requirements. This demonstrated success will also be a critical component in maximizing the value of private-sector participation.

Financing

Description

While the program will require significant public funding, third-party financing is anticipated to be available once revenue service is stabilized. The ability to finance the program, or a specific portion of the program, is largely dependent upon the risks associated with the revenue source used for repayment and the availability of significant amounts of capital in the market.

Potential impact

The impact to the program could be wide ranging and include the following:

- Delay or inability to complete the program
- Increase in the public funding required
- Re-scoping of project segments or contract approaches
- Loss of political support
- Increase in program costs

Mitigation and management approach

The Authority understands the potential need for supplementary private financing to deliver the HSR system and has begun mitigating and managing risk related to potential financing. The Authority's risk mitigation and management approach includes the following:

- Understanding the risks associated with the ridership and associated revenues in high, medium, and low scenarios and the effect on the operational viability of the system. A key risk measurement for private investors is the accuracy of projections, and missed projections are a significant concern. The Authority has carefully evaluated ridership ranges and operating scenarios and has had the projection model evaluated by an expert peer review panel. Prior to initiating a private-sector financing transaction, additional ridership projection work will be undertaken to develop investment-grade projections. See mitigation approaches to demand and ridership and cost and scheduling for more information.
- The analysis presented in Chapter 8, Funding and Financing, was based on an assumption that private-sector capital will be sought prior to the completion of the Bay to Basin section. The ability of the private sector to procure the level of capital associated with the future value of the revenue is a risk that will be managed by considering how this value could be separated into a number of different transactions. The valuation of the revenue will also depend on the perceived view of the project and market risk at the time of the investment. It should be noted that the transaction is estimated to occur in 2023 and hence the status of the markets, inflation, and fiscal policy is likely to be very different from that of today. The financial market environment will continue to be monitored through the program.
- Considering the use of innovative delivery models that leverage private finance to deliver the program. The Authority has tested the private finance market and reached out to potential private financiers who may be interested in investing in the HSR system though the Requests for Expressions of Interest process. The feedback has been incorporated into the business model. For detailed information, see Chapter 5, Business Model.
- Considering the use of Qualified Tax Credit Bonds (QTCB) as an additional form of financing by leveraging a portion of California's Proposition 1A bonds as a source to secure additional federal funding. A new national program, such as QTCBs, could be implemented for surface transportation generally or high-speed rail programs specifically. See Chapter 8, Funding and Financing, for a more detailed discussion.
- Considering the use of innovative commercial mechanisms and ancillary revenue sources that may help reduce any perceived risk of repayment associated with the underlying revenue source. Examples of ancillary sources of revenue are retail and commercial property rents, parking charges and fees, signage and advertising revenue. In some situations these ancillary revenues may be used to offset specific costs that may otherwise be borne by the Authority or other public-sector bodies. For more information, see Chapter 8, Funding and Financing.

- Developing a statewide strategy for passenger station development and operations requirements to secure local funding commitments. The Authority is investigating implementation of a variety of Transit-Oriented Development initiatives that would incentivize private-sector participation. For a more detailed discussion, see Chapter 8, Funding and Financing.
- Working to align state leaders and stakeholders. This will help reduce the perceived risk associated with public financing as lenders carefully review public leaders' commitment to a program. Key to this confidence is continuity of support and demonstrated actions to advance the HSR system. This will also help reduce the perceived risk associated with private financing as lenders and financiers carefully evaluate public-sector partners prior to making investments.
- Performing sensitivity and scenario analysis to assess the financial viability of the program and impact to financing requirements if revenue and cost projections fluctuate.
- Continuing outreach and communication with potential private partners. The Authority undertakes ongoing outreach to the private sector to keep them updated as to the HSR program progress and to seek input to ensure the program reflects and protects the future interest of private-sector participants. This will provide long-term value to the state and other stakeholders. For more detailed discussion, see Chapter 5, Business Model.

Right-of-way

Description

Acquiring ROW for a program of this nature is normally the responsibility of the procuring authority. A risk exists with regard to the estimated cost and schedule of acquiring ROW. This is partly because of opposition to certain alignments of the program and the schedule required to meet conditions of federal funding sources.

Potential impact

The impact to the program could be wide ranging and include the following:

- Delay or inability to complete the program
- Increase in program costs
- Schedule delays
- Loss of political support
- Increase in the public funding required

Mitigation and management approach

The Authority is working toward mitigating and managing the risk associated with ROW in a variety of ways, including the following:

- Soliciting a qualified ROW firm or firms with significant experience in the Federal Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, as amended (Uniform Act), along with other federal and state requirements established for uniform and equitable land acquisition policies for public projects and demonstrated success in delivering property rights for large-scale, design-build transportation projects. The Authority anticipates engaging a qualified ROW firm or firms by spring 2012.
- Developing a comprehensive ROW acquisition strategy aligned with program milestones such as selection of a preferred alternative for the Merced to Fresno and Fresno to Bakersfield segments, and FRA's issuance of the Record of Decision, and the Authority's issuance of a Notice of Determination.
- Continuing communications with the Union Pacific Railroad, BNSF Railway, and other stakeholders potentially affected by the HSR alignments.
- Peer reviewing ROW estimates and the use of a formal approval process after the review to improve accuracy and accountability.
- Identifying ROW risk and uncertainty early in the process to focus design efforts that mitigate ROW cost and setting a contingency amount that reflects these risks and uncertainties to allow for the appropriate understanding and communication of estimate accuracy.
- Implementing ROW cost-control mechanisms founded on the baseline ROW cost estimate and documentation supporting estimate updates to provide the Authority with the information to make timely decisions.
- Continuing cost control throughout the appraisal and acquisition process to monitor actual ROW expenditures for comparing forecast ROW costs with the updated baseline budget.

Stakeholder agreements, interface, and integration

Description

Given the complex, multi-jurisdictional nature of this program, many interface agreements and integration risks exist associated with both construction and operation activities. For example, a system integration and interface risk exists related to the Union Pacific Railroad (UPRR) and BNSF Railway. Other entities will also have an interface with the program, including Caltrain, Amtrak, Caltrans, and other local transportation and transit agencies. This includes discussion on the potential for the joint use of ROW and the joint use of stations and ancillary facilities with other rail operators and local transit agencies.

Important to the success of the program is its integration within a larger statewide rail and transportation strategy. The program must integrate with and support local transportation systems to allow travelers to move long distances and then within metropolitan areas to their destinations. The program must be part of a larger statewide strategy for transportation that includes airports and highways to allow efficient investment of transportation funds. The Authority must be an active participant within the larger statewide transportation planning structure.

Interface management is an Authority risk. In addition to integration and interface risks with other agencies and entities, an integration risk related to the rail infrastructure, vehicles, and operating companies also exists. Given the experiences of other high-speed rail projects with system integration risk, the Authority is focused on mitigating and managing this risk from both a technical (e.g., system) and stakeholder (e.g., Caltrain, UPRR) perspective.

Potential impact

The impact to the program could be wide ranging and include the following:

- Delay or inability to complete the program
- Increase in program costs
- Decrease to demand and ridership
- Loss of political support

Mitigation and management approach

The Authority is mitigating and managing integration and interface risk in a variety of ways, including the following:

- Increasing Authority staff dedicated to third-party agreements/interface and developing detailed cooperation agreements/memorandums of understanding with UPRR, Caltrans, relevant cities, Caltrain, and other local transit agencies.
- Drafting technically detailed utility agreements and finalizing them with utility owners, as well as seeking exemption from the state utility process.
- Proactively managing utility design and construction requirements and working closely with the affected utility companies. Considering adoption of open standards to minimize the interface risk between the system and vehicles given that the system and vehicles will likely be procured separately. For additional information, see Chapter 5, Business Model.
- Implementing a verification and validation approach that employs independent verification and validation based on proven international practice in HSR and internationally accepted standards. This approach provides full transparency and ensures that all requirements in the procurement documents provided to the contractor can be traced back through the requirements development process to state and federal codes, industry standards, and international guidelines. In addition, fewer hold-points are created, resulting in a positive impact on delivery schedule and cost while placing liability with the contractor to demonstrate compliance.

- Implementing a phased approach to the HSR system allows commissioning and testing of high-speed trainsets and control technologies, staff development, and operational development to mitigate technical integration and interface issues before the full system becomes operational.
- Using innovative delivery models that transfer system integration risk (vehicle, signaling, communications system, and track infrastructure) to the private sector, where appropriate.
- Initiating discussions with transit agencies, Caltrain, and Amtrak about optimizing future operations, including coordination on schedules, ticketing, station operations, and parking.

Risk mitigation and allocation strategies

The previous section identified key programmatic risks, as well as the specific mitigation and management approach. This section describes those strategies that the Authority has implemented to mitigate many types of risks.

Principles

The Authority's risk mitigation approach is based on four key principles:

- **All project personnel are part of the risk management process**—Risk management is integrated with other program management processes and aligned with the Authority's goals and values. As such, everyone is involved, and risk management is every team member's responsibility.
- **Key risks must be documented and monitored**—All key programmatic risks are documented in a risk register that contains relevant information about the risk, including underlying causes, probability of occurrence, potential impact, mitigation strategy, and status. The risk register is discussed in more detail below.
- **Risk ownership**—All key risks are assigned a named owner within the team responsible for monitoring and control of the risk. Additionally, specific mitigation actions are assigned to named team members who are in the best position to execute these actions, with due dates for their completion. Specific responsibilities are discussed in the Organizational Structure section below.
- **Regular communication and review**—The risk register is reviewed weekly and updated to reflect the current status of the program and its risk management efforts. Progress on mitigation actions, status of key program risks, and mitigation actions along with any new risks that have arisen is reported monthly.

The Authority has developed and will continue to develop tailored mitigation strategies based on the nuances of a particular risk. Some general, overarching themes exist, such as balanced risk transfer and contracting strategies.

Balanced risk transfer

The Authority is considering the benefits of aligning technical and operational risk transfer with commercial and financial risk transfer to understand the benefits of a balanced risk transfer approach. For example, transferring the responsibility of construction and operation to a private-sector partner insulates the procuring authority only to the extent that the private-sector partner also bears the appropriate level of financial risk. See Chapter 5, Business Model, for more detail on business models being considered.

Contracting strategies

The Authority is also planning to capture the benefits of innovative contracting strategies to transfer risk to a private-sector partner. Other jurisdictions implementing a HSR system have used innovative contracting strategies that place the responsibility for risks on a private-sector contractor to reduce the risk borne by the procuring authority. Such contracting methods include the design-build model, and the design-build-finance-operate-maintain model. See Chapter 5, Business Model, for more detail on contracting strategies being considered.

Risk management plan

The Authority has implemented an ongoing risk management program with the objective of reducing the risk through formal processes and procedures. These processes allow the Authority to understand and manage the key risks and their impact on the program's objectives. The Authority manages risk using industry standard risk management tools, as discussed below. The risk management plan is continually reviewed and refined to take account of current information, program development, and stakeholder feedback. The primary objectives of the process are as follows:

- Minimizing differences between project plans and objectives
- Determining risks and costs of proposed project changes
- Increasing transparency regarding challenges to project plans and objectives
- Exploring project opportunities
- Using priorities to identify project alternatives
- Minimizing unknown risk through brainstorming, analysis, and research
- Estimating resource requirements, cost, and duration
- Rationalizing allocation of resources
- Reporting progress to key stakeholders

Organizational structure

The Authority has implemented an organizational structure to manage risk internally, on both a programmatic and project level. The program risk manager is responsible for establishing and overseeing risk analysis methodologies and procedures; coordinating risk management activities among the Authority, program management, and regional consultant teams; and reporting on status of overall program risk management activities.

The engineering risk manager is responsible for overall coordination of technical risks, including informing the program risk manager of any gaps in the current risk register relating to risks identified by the engineering management team and ensuring implementation of appropriate mitigations to technical risks.

Regional managers are responsible for ensuring that risks identified in the program risk register provide a current and comprehensive representation of the risks associated with their scope of work, motivating response planning, supporting quantitative risk assessment preparing for quantitative risk analysis, and incorporating the resources and time required to execute specified mitigations in their work plans.

Regional risk managers work with regional teams to identify and assess risks to the program's scope, cost, and schedule objectives and develop appropriate mitigation strategies and actions; facilitate quarterly risk workshops; coordinate with risk owners and regional consultant risk managers to monitor risks and implement risk response strategies; and report on progress monthly to the program risk manager.

Regional consultant risk managers coordinate with the regional consultant risk owners to monitor risks and implement risk response strategies and mitigations; report on progress updates for regional consultant-owned risks and response actions as part of the regional consultant's monthly progress report; and coordinate with the regional risk manager on risk management activities.

Risk owner (regional consultant, PMT, or Authority team members) develop and update the assigned risk response strategy, as necessary; monitor the assigned risk; inform the regional manager, regional risk manager, and regional consultant risk manager of any changes to its status; and execute agreed upon response strategy and associated action items for assigned risk.

In addition to the above dedicated risk management staff, the Authority intends to augment the program's risk management organization further with an Authority risk manager, as discussed in the Staffing and Organizational Structure section, above.

At the regional level, risk management process and protocols are documented in a technical memorandum, *Risk Register Development Protocol for Regional and Core Systems Teams TM 0.6*.

To complement its internal risk management procedures, the Authority has the benefit of external project reviews that help provide additional perspective and guidance on appropriate risk management processes. The Authority also has extensive interaction with the funding agencies and, as such, is subject to those agencies' rigorous risk programs and oversight.

Risk workshops

Risk workshops are conducted regularly by the Authority and its consultant team to assess identified risks, mitigation strategies, and management plans. The risk manager facilitates the identification of risks and appropriate management strategies and mitigations through workshops and ongoing risk reviews with key personnel with Authority staff and consultant teams. Risk workshops take place at project milestones (i.e., 15 percent design, 30 percent design, start of final design and construction, or start of a critical contract package procurement) with the frequency of formal reviews increasing as the program advances. Formal program-level reviews, including the Authority, its staff, and consultants, are held quarterly. For non-ICS regions, workshops are also held quarterly. For ICS regions, formal reviews are held monthly.

In addition to formal risk management workshops and risk review sessions with key personnel, there are also monthly meetings with senior project management to discuss key programmatic risks, management strategies, and progress on continuing mitigation actions. As indicated above, at the regional level, each section also has a dedicated two-person team who continually review individual risks with team members, monitor progress on mitigation actions, and update the register to reflect the current status and risk environment.

Risk register

The risk register is the tool that integrates risk identification, assessment, management, and mitigation status with the data and information on risks. It is an iterative and dynamic document, continually changing as the program and project advances and new information about risks is developed and refined. In addition, a risk register is an input into and aids in the estimate of contingency levels and quantitative risk adjustments, as discussed below. The program risk register contains a description of the risk, including primary cause and potential impact on cost and/or schedule elements, risk owner, management strategy, and planned mitigations. Both ownership/responsibility and specific mitigation actions are assigned to named individuals based on which regional consultant, PMT, or Authority member is in the best position to manage the identified risk. If applicable, identified risk can trigger development of contingency plans for specified risks. The risk register serves as a communications tool, identifying and prioritizing the program challenges, and as an action plan, specifying actions to be taken by the identified team members to limit the project’s risk exposure.

Monte Carlo simulation

Using the information developed in the risk register as a key input, quantitative risk analysis is employed at a program level. Such a quantitative risk analysis aggregates risks numerically that are assessed for probability of occurrence and potential cost or schedule impact. Based on this information and the underlying cost and schedule estimates, it simulates possible project cost and schedule outcomes. The Authority will employ Monte Carlo simulation for quantitative cost and schedule risk analyses to model the likelihood of particular cost and schedule outcomes given the identified risks and other uncertainties. Monte Carlo simulation quantifies the probability that the project and its phases will finish within objectives, identifies key risks and uncertainties driving cost and schedule estimates, and motivates monitoring and control of available cost and schedule contingency against risk exposure. This tool is particularly helpful in quantifying the likely financial impact of multiple program/project risks and associated risk contingencies that are an input in to the total project costs.

Summary

The Authority has implemented a detailed risk management process with the objective of reducing the risk through formal processes and procedures. These processes allow the Authority to understand and manage key risks and their impact on the program's objectives. An overall risk management plan and organization has been established, and foreseeable risks have been identified that may threaten the program's viability. In addition, the causes of each risk have been investigated to determine the underlying driver and cause.

This process is integral to the development of the program and will continue to be refined as the program progresses. This will allow further detailed analysis of the high-level program risks identified in this chapter. Furthermore, detailed risk analysis will be carried out for each segment, and this process has already commenced with the detailed technical risk register for the ICS.

The risk analysis will be used as a key foundation in the development of commercial agreements with the private sector both for the ICS construction and future sections.

The program's development plan has been structured to help mitigate the following key risks:

- **Schedule and approval**—The program has been analyzed assuming a schedule extension due to funding availability. A nine-year extension is illustrated in the Business Plan that should mitigate many of the schedule and approval risks.
- **Project cost**—Significant on-the-ground engineering assessment has been completed in the last two years to reduce the risk in planning estimates. The risk of construction overruns is significant in government projects, and it is critical that portions of this risk be transferred to the private sector through design-build, DBFOM, and other structures described in the business model.
- **Demand and ridership**—Estimates have been reduced and peer reviewed and a range of revenue scenarios have been evaluated for sensitivity. High, medium, and low revenue estimates all illustrate that the project will generate an operating profit.
- **Financing**—Financing strategies align with successful high-speed rail projects in other parts of the world, including HS1 in the U.K. Financing is timed to align with project cash flows to enhance project value.

While all of the risks identified in this chapter are significant, two require the special focus of the Authority and other state agencies and officials:

- **State staffing**—The Business Plan is predicated on having an organization with experienced staff who can execute it. Funding and filling the needed positions with professionals with high-speed rail experience are perhaps the single best investment that the state can make toward reducing costs and accelerating development of the program. Any delay in filling positions increases the risks in all of the other categories.

- **Funding**—The amount and timing of funding for the program is the single largest risk. The two mitigations to this unknown are phased development and maintaining the developmental head start that California has over other national projects. This Business Plan has identified three stand-alone high-speed rail projects (IOS-South/Blended, IOS-North/Blended, and Bay to Basin/Blended) that provide fully functional systems and potential delay or off-ramp points. The ability to develop the program through a set of self-sufficient, stand-alone projects allows funding risk to be addressed incrementally rather than on a full program basis. This allows individual decisions to be made on the merits and benefits of each incremental phase. The project currently is well ahead of any other national project in terms of the potential to draw federal funds for construction. Consistent with recent history, a federal funding program for high-speed rail would most benefit those states that are ready to build and create jobs. Moving forward with the ICS will help cement California's high-speed rail leadership position for many years.

Chapter 10

Economic Analysis

Introduction

The investments made by our predecessors helped fuel the economic success that California has experienced in the 20th century. From the Interstate system to the state water project to the 10 campuses of the University of California system, these investments provided the foundation that allowed the state to become a global economic powerhouse. Connecting California's mega-regions with a fast, reliable, and comfortable high-speed rail system will be California's transformational investment for the 21st century.

When evaluating an investment, decision makers must determine if the benefits outweigh the costs. The magnitude of the statewide high-speed rail (HSR) system makes the costs high. However, the program benefits are even greater—as detailed in the benefit-cost analysis—between 57 percent and 78 percent more than the investment cost. Many positive impacts will be felt statewide, ranging from near-term positive construction impacts, with approximately 100,000 job-years created with the Initial Construction Section, to long-term efficiencies that will transform California's economy to make it more competitive. This chapter provides these analyses.

> One job-year is the equivalent of one person working a full-time job for one year. For example, a full-time job that lasts 20 years generates 20 job-years.

A statewide HSR system will create the following economic, social, and environmental benefits for California:

- Rail users will benefit from faster, more reliable, and safer options that connect the state's major metropolitan areas.
- All travelers will benefit from reduced highway and aviation congestion, and from external benefits such as reduced air emissions and less dependence on imported oil.
- Construction will create direct employment and earnings, and generate positive spin-off or indirect economic effects within the California economy.
- System operations and maintenance will create permanent jobs and associated indirect benefits.
- Businesses will have greater access to skilled labor and other markets, creating broad and permanent economic impacts and leading to regional economic transformations across existing and future economic sectors.
- Cities will experience significant local economic development benefits as higher development land use densities and businesses cluster around stations and corridors, following local development plans, as have European and Asian cities with high-speed rail.

In 2011, the Authority undertook a comprehensive and well-vetted economic impact and benefit analysis on the high-speed rail system. The economic analysis draws on domestic and international experience with high-speed rail and the current state of practice documented in academic and applied literature. This chapter of the Business Plan summarizes the methods and key findings of this analysis. This work is documented in the *Economic Impact Analysis Report* and the *California High Speed Rail Benefit-Cost Analysis (BCA) Report*. The full report includes detailed explanations, sources, assumptions, and methodologies. These reports are available at www.cahighspeedrail.ca.gov/business_plan_reports.aspx.

Strong benefit-cost ratios demonstrate that the net benefits to society greatly outweigh the cost of building and maintaining the system.

The Authority evaluated its analytical methodology through a series of workshops with leading academics; planning professionals from local, regional, state, and federal agencies; and representatives of other policy and planning groups. The input received through workshops, written comments, and follow-up questions provided a high level of confidence regarding the methodology. In addition, the economic analysis relied on the results of peer-reviewed travel-demand models, cost estimates, and best practices shared by federal and state review agencies. Chapter 3, Capital Costs; Chapter 6, Ridership and Revenue; and Chapter 7, Operating and Maintenance Costs, provide additional information about these topics and sources.

The primary economic studies covered by the Business Plan are as follows:

- Benefit cost analysis
- Employment and other economic impacts from construction
- Employment and other economic impacts from operations and maintenance
- Wider economic impacts
- Station area economic development impacts

As with any infrastructure program, economic impacts will not be distributed uniformly. Some areas will benefit from a greater influx of economic activity and new development than others. In the environmental impact reports/environmental impact statements (EIR/EIS) being prepared for the program, some localized negative impacts have been identified that would entail economic losses. For example, in the Draft EIR/EIS issued on August 12, 2011, it was noted that the system could limit access to parts of farmland in the Central Valley, potentially reducing the output of affected farmlands. In addition, land acquisition for right-of-way and stations would entail some loss of local property tax revenues. Many of these impacts would be even greater if highways were expanded to meet the demands of the state's growing population.

Economic impacts of high-speed rail—international experience

New travel patterns demonstrate that high-speed rail can support the development of economic relationships:

- In France, a two-hour trip time has been critical to diverting air passengers to rail. High-speed rail generated a significant amount of new trips that reflect new economic activities and synergies between Paris and Lyon.[1]
- Nearly 50 percent of the additional traffic between Paris and Lyon in the first four years was newly generated, not merely a redistribution of the existing travel market.[2]
- Research from Europe suggests that the contribution to total European Union Gross Domestic Product (GDP) from high-speed rail investment may be 3 percent of GDP—significant impacts from one set of infrastructure investments.[3]

Major cities with large economies and global reach are the most beneficial to connect:

- The economic impacts of high-speed rail in Japan are concentrated in the larger metro areas with international economies.[4]
- In Germany, smaller intermediate cities connected by high-speed rail to Frankfurt and Cologne experienced a 2.7 percent increase in GDP resulting from increased market accessibility to larger cities.[5]

European and Japanese high-speed rail projects have demonstrated that a station can be a catalyst for new development in the surrounding area:

- Spain's high-speed rail increased property values when improved access to other parts of the region was achieved and when intensified land uses were valued by the market.
- Zaragoza, which is roughly half-way between Madrid and Barcelona, created a new business district centered on its high-speed rail station.
- Lille has been able to generate urban development, in part because of its central location on the network. Lille sits at the intersection of high-speed rail lines connecting three major economic and political hubs: Paris, London, and Brussels.
- Evidence from Japan's Shinkansen system shows strong premiums in development and employment densities around stations compared to similar areas not served by high-speed rail.

Consistent with federal and state laws, the Authority is committed to minimizing localized negative impacts while working to capture the broad public benefits. Negative impacts will be identified and mitigated wherever possible as part of the project's planning and design. As noted in Chapter 3, Capital Costs, 80 percent of the growth in the cost estimate since 2009 is tied to increases in viaducts, tunnels, embankments, and retaining walls/trenches, much of that incorporated to avoid or minimize negative impacts. High-speed rail right-of-way and farm access roads will be grade-separated; noise barriers will be constructed; and increases in station area property values and development should offset property tax base losses from direct acquisitions. The Authority is committed to ensuring that any real estate that is necessary for the high-speed rail system will be acquired in accordance with applicable laws and regulations, with owners treated fairly.

Benefit-cost analysis

A benefit-cost ratio is a measure widely used in the evaluation of proposed infrastructure investments. A benefit-cost ratio in excess of 1.0 indicates that a project will generate more benefits to society than its costs. The benefit-cost ratio is a comparison of the discounted present value of societal benefits versus project costs. It is measured by comparing the societal impacts of building the system to a no-build scenario. Other related measures produced by a benefit-cost analysis, which are also reported, include the net present value and the economic rate of return.

What is a benefit-cost analysis?

A benefit-cost analysis (BCA) compares a project's lifetime benefits to society against its construction and operating costs. The BCA is conservative in nature and includes only those benefits that are most-readily identified and quantified. The BCA conducted for this Business Plan follows industry best practices as set out by the U.S. Department of Transportation and the California Department of Transportation. A benefit-cost ratio greater than one means that the societal benefits outweigh societal costs.

It is important to distinguish between the benefit-cost analysis and wider, or indirect, economic impacts. The benefit-cost analysis measures the societal benefits that are most readily quantifiable. Benefit-cost analysis adheres to formal definitions that are conservative in nature. In particular, the analysis does not include a range of indirect economic benefits that can be forecast and that would arise from increased business productivity, greater market access, and improved integration of economic exchanges. These effects can lead to increased economic output and employment across California. If even a fraction of these indirect economic benefits were included in the analysis, the program's benefit-cost ratio, while robust, would be much greater.

Approach and inputs

The benefit-cost analysis methodology follows industry best practices adopted by the U.S. Department of Transportation and Caltrans, as well as consensus among transportation economists. These methods are conservative in their assumptions and are intended to produce results that do not overstate net benefits. The Authority undertook the benefit-cost analysis for the Bay to Basin/Blended and the Full Phase 1 systems and for a range of cost scenarios, as presented in Chapter 3, Capital Costs. Capital Cost Scenario-1 represents a combination of all of the lowest cost alternatives, and Capital Cost Scenario-2 represents a combination of all of the highest cost alternatives. Exhibit 10-1 summarizes the results of the four studies. The results section below highlights five benefit categories; the full benefit-cost analysis includes more than a dozen additional benefit categories that contribute to the system's overall benefit-cost ratio.

Exhibit 10-1. Benefit-cost analysis results summary

System and Capital Cost Scenario	Discounted Total Benefits (2010$ in millions)	Discounted Total Costs (2010$ in millions)	Net Present Value (2010$ in millions)	Economic Rate of Return	Benefit-Cost Ratio
Bay to Basin					
Scenario-1	$64,983	$39,066	$25,917	6.83%	1.66
Scenario-2	$62,934	$43,002	$19,932	5.94%	1.46
Phase 1					
Scenario-1	$90,659	$50,884	$39,775	7.10%	1.78
Scenario-2	$84,279	$53,673	$30,606	6.22%	1.57

The benefit components of the benefit-cost analysis are all driven by the ridership forecasts presented in Chapter 6, Ridership and Revenue. Since high-speed rail travel has fewer negative impacts than automobile or air travel (e.g. less pollution, fewer accidents, etc.), the more riders on the HSR system, the more benefits exist. For purposes of the benefit-cost analysis, the Business Plan Medium Ridership estimate of 37 million riders in 2040 was used. This is explained in Chapter 6, Ridership and Revenue. Although all benefits depend on riders, many benefits, such as time savings, will actually accrue to non-riders from reduced travel by plane and automobile. The costs are drawn from the capital and operating and maintenance (O&M) costs presented in Chapter 3, Capital Costs, and Chapter 7, Operating and Maintenance Costs, as well as rehabilitation costs based on the useful lives of individual system components. For this analysis, two other key assumptions come into play: a 40-year operating period of analysis after the Full Phase 1 investments are in place and a 4 percent real discount rate. Both of these assumptions are consistent with guidance from the U.S. Department of Transportation.

Results

The Bay to Basin benefit-cost ratio ranges from 1.66 (Scenario-1) to 1.46 (Scenario-2), while the Phase 1 system has a benefit-cost ratio from 1.78 to 1.57. The ranges represent the range of capital costs presented in Chapter 3, Capital Costs, and the timing of benefits, which is based on the completion date for each step as presented in Chapter 4, Business Planning Schedule. These are strong benefit-cost ratios, showing that the net benefits to society greatly outweigh the cost of building and maintaining the system. Additionally, the benefit-cost ratios indicate that while the Bay to Basin system will bring substantial benefits, significant additional benefits accrue from completing the Phase 1 system. As the BCA shows, the investment in the Phase 1 HSR system yields a return on the investment—in terms of benefits—that exceed the costs by 57 to 78 percent.

The BCA uses the capital and O&M costs from Chapter 3, Capital Costs, and Chapter 7, Operating and Maintenance Costs, respectively, and discounts those costs and all of the benefits using a 4 percent real discount rate, as recommended by the Office of Management and Budget, based on the implementation schedule in Chapter 4, Business Planning Schedule. The real discount rate accounts for the opportunity cost of making this investment versus other investments. Note: the capital costs in the above figure and in Exhibit 10-2 appear lower than in Chapter 3, Capital Costs, because of the discounting. The benefits are discounted by the same rate as the costs, but because they go out further, the discounting has even more of an effect. Undiscounted, the benefits would be several hundred billion dollars while the costs would be as presented in Chapter 3, Capital Costs, net 80 percent of the cost of real estate.

Exhibit 10-2. Benefit-cost analysis results (2010$)

Category	Bay to Basin		Phase 1	
	Capital Cost Scenario 1	Capital Cost Scenario 2	Capital Cost Scenario 1	Capital Cost Scenario 2
Benefits				
Benefits for HSR users	$35,409	$34,143	$48,790	$45,037
Benefits from reduced driving	$26,421	$25,737	$37,470	$35,149
Benefits from reduced flying	$3,153	$3,054	$4,399	$4,093
Total benefits	$64,983	$62,934	$90,659	$84,279
Costs				
Construction costs, net of real estate	$26,752	$31,336	$37,242	$41,166
Operating and maintenance costs	$12,309	$11,811	$13,934	$13,106
Periodic rehabilitation costs	$726	$743	$955	$855
Salvage value	$722	$888	$1,247	$1,456
Total costs, net of salvage value[6]	$39,066	$43,002	$50,884	$53,673
Net present value	**$25,918**	**$19,932**	**$39,774**	**$30,606**
Benefit-cost ratio	**1.66**	**1.46**	**1.78**	**1.57**
Economic rate of return	**6.83%**	**5.94%**	**7.10%**	**6.22%**

Source: California High-Speed Rail Benefit-Cost Analysis (BCA)—October 2011
Although Scenarios 1 and 2 are driven by the capital cost estimates in Chapter 3, Capital Costs, Scenario-2 leads to fewer benefits because it delays the opening of each step of the system, delaying the benefits that each step generates.

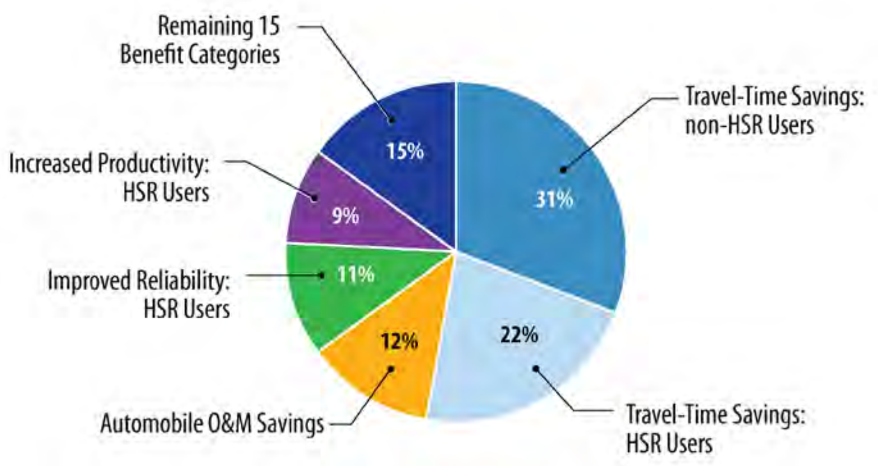
Net present value and the economic rate of return also reflect similar life-cycle analysis of costs and benefits. Net present value is the total dollar value of discounted benefits minus discounted costs; the economic rate of return represents the project's (real) rate of return and provides a means to compare the returns of this project against other competing public investments.

The benefit-cost analysis generates 20 benefit categories:

- Four of those benefit categories accrue directly to system users, accounting for 54 percent of all of the benefits.
- The other 16 benefit categories accrue to all California citizens, and these account for 46 percent of the benefits (Exhibit 10-3).

- Most benefits accumulate within California, although if the system were to be connected to other regional high-speed rail networks currently planned, the benefits would increase and extend to other parts of the United States.
- Five major benefit categories account for almost 85 percent of the benefits.

Exhibit 10-3. Percent breakdown of the main benefit categories



More than half the benefits from CAHSR will come from the travel-time savings for users who switch to high-speed rail and from faster highway travel from reduced congestion.

Definition of Terms

Net present value (NPV) is the sum of total discounted benefits minus the sum of discounted costs. Discounting accounts for the difference between the value of money today versus in the future. A positive NPV means that benefits outweigh costs and that the benefit-cost ratio is greater than 1.

The **real discount rate** accounts for the opportunity cost of making this investment versus other investments.

The **economic rate of return (ERR)** measures the social or economic return on investment. The economic rate of return is the discount rate that makes the present value of all benefits equal to the present value of all costs. An investment with a positive NPV will have an economic rate of return higher than the real discount rate, meaning that this investment produces more societal benefits than the foregone opportunities assumed in the discount rate.

The benefit-cost ratio, NPV, and ERR are interrelated metrics that help evaluate the benefits of a project against its costs and against other potential projects.

Travel time savings for highway users

California has some of the most congested highways in the country. Five out of the top 10 and 20 out of the top 50 most congested stretches of highway are in California.[7] Delays and poor highway travel reliability cost the California economy billions of dollars. As noted in Chapter 1, High-Speed Rail's Place in California's Future, it would cost approximately $114 billion (2010) (or $171 billion in YOE) to expand California's highway and aviation systems to achieve levels of capacity comparable to what the high-speed rail system will offer. Much, if not most, of that cost would be borne by California residents. However, even if it could be afforded, expanding highway and airport capacity in urban areas is often not physically, environmentally, or politically feasible.

High-speed rail will take thousands of cars off the roadways, which will reduce state vehicle miles traveled by more than 390 billion miles between opening in 2022 and 2080. This is more than a year's worth of total automobile travel in the state today. By reducing congestion, HSR will save Californians 6.8 billion hours. The reduced vehicles miles traveled and congestion will benefit millions of California drivers who may never travel on high-speed rail. Thus HSR will make travel faster and more reliable both for its train passengers and for the millions of Californians on the roads. This travel time savings represents the largest benefit category and accounts for 31 percent of benefits.

Provide travel time savings for riders

Transportation between California's cities is often slow and onerous. HSR will offer Californians faster travel speeds than cars and shorter access and egress times than planes. High-speed rail will allow Californians to spend less time traveling *to* their destinations and more time *at* their destinations. In addition, the time spent traveling will be both more reliable than current modes and, for business travelers, more productive, as trains provide a more comfortable and conducive work environment.

Over the 40 year period used as the basis for this analysis, from 2040 to 2080, Californians will save an average of 38 million hours per year by using high-speed rail. For some, this might mean more time for meetings and collaboration. For others, it may mean more time with family and friends. Regardless of trip purpose, HSR will bring California's population centers closer together and allow the state to be more connected. Travel time savings for riders account for 22 percent of the benefits.

Save automobile operating and maintenance costs

People switching to high-speed rail will drive less, thereby saving on the direct costs of using their cars. O&M savings include depreciation, fuel, maintenance, and tires. Together, these four savings elements account for 12 percent of the system's economic benefits. (Note: The HSR O&M costs are included in the system's costs and account for approximately 25 percent of the discounted total costs with capital costs accounting for almost 75 percent).

Improve reliability for high-speed rail users

When making trips by automobile, Californians know when they will leave their origins but they face substantial uncertainty as to when they will arrive at their destinations. This uncertainty is due to a variety of factors, such as congestion, accidents, weather, road repairs, and variations in traffic volumes. Considerable research demonstrates the value premium that travelers place on increased reliability.

Most international high-speed rail systems have reliability unrivaled by any highway or airport. In Spain, 99 percent of high-speed trains arrive within three minutes of schedule, and if a train is more than five minutes late, all passengers get complete refunds.[8] The operating plans presented in Chapter 7, Operating and Maintenance Costs, and modern train operating systems are designed to maximize reliability so riders can predict not only their departure times but also their arrival times. The reliability benefits of high-speed rail account for 11 percent of the system benefits.

Increase productivity for high-speed rail users

Time spent traveling by automobile or airplane is not as productive as it would be when traveling by high-speed rail. Driving limits one's ability to conduct in-vehicle work. For persons flying, with airport check-in, security clearance procedures, boarding, take-off, and landing, little time exists to work on short flights. HSR travel is more conducive to work, as it will be more comfortable, less interrupted (e.g., riding HSR will not require travelers to turn off their electronic devices), and will include Internet access and other amenities needed by business travelers. With these advantages, time spent on HSR will increase business travelers' productivity while on board. Increased productivity accounts for 9 percent of all of system benefits.

Benefits for airlines and air passengers

California's airports are just as congested as its roads. As discussed in Chapter 1, High-Speed Rail's Place in California's Future, the Los Angeles Basin to San Francisco Bay area is the country's busiest short-haul air market. However, increasing delays and unpredictability are making California air travel more arduous. High-speed rail can relieve some airport congestion by replacing short-haul flights between California's cities. With more room at the gates, runways, and airspace, the airlines will be able to fly more to destinations around the country and the world instead of around the state. Additionally, passengers switching to high-speed rail also will save the airlines millions of dollars in fuel as airlines will be able to focus on more efficient longer haul markets.

Benefits to public and private sectors

The benefits from HSR investment will be shared between the public and private sectors. The majority of the benefits will be felt by the public, including time and cost savings for travelers, increased safety, and improved air quality. Other benefits, such as increased productivity from travel time savings and more productive business travel, will accrue more directly to private-sector businesses. However, even some of those benefits ultimately improve public well being. For example, as businesses become more productive and grow, benefits flow to the public in the form of increased employment opportunities and higher incomes. The benefit-cost analysis excludes these benefits but they are described in the wider economic impact analysis.

Construction jobs

Building the HSR system will employ thousands of California's construction workers.

Approach and inputs

In 2010, the Authority compared job creation estimates from several sources, including the American Public Transportation Association (APTA) and the President's Council of Economic Advisors, to develop an average figure of 20,000 job-years per $1 billion in capital investment, with approximately one-third of those jobs the result of direct employment and approximately two-thirds the result of multiplier effects. In economics, multiplier effects capture the impact that an initial amount of spending will have as the expenditure travels through the economy. For example, a factory will hire its own workers, buy products from its suppliers who will hire their own workers, and those workers will go to local restaurants, stores, etc. so those businesses will be able to pay their employees.

For this Business Plan, the Authority reevaluated the previous analysis, consulted with new outside sources, and concluded that the 20,000 employees/$1 billion number is still a reasonable and accurate estimate of the job creation impact. The results presented below are based on the cost estimates presented in Chapter 3, Capital Costs, less the cost of the real estate. It is important to note that purchasing real-estate is considered an investment, not a source for job creation. As such, these costs are excluded from the analysis. However, since 20 percent of total right-of-way costs are assumed to include administrative and professional service fees associated with real estate purchases, these costs are included in the analysis.

Results

Constructing HSR will infuse billions of dollars into the California economy and put thousands of Californians back to work at a critical time when unemployment is high (12 percent statewide and 18 percent in the Central Valley).[9] Starting in the Central Valley in 2012, construction of the Initial Construction Section will create 100,000 jobs over the next five years.[10] The Central Valley has some of the lowest incomes and highest unemployment rates in California, so early investment in that region will have a greater relative impact than anywhere else.

Building the Full Phase 1 system will generate an additional 1.15 to 1.3 million jobs over the next two decades (Exhibit 10-4). The program's long-term nature means that the employment impacts in construction will continue for years. Throughout that time, the system will continue to generate jobs in construction and through multiplier effects in the wider economy. These thousands of well-paying jobs will be a critical investment in California's citizens and the state's economic vitality.

> Construction of the high-speed rail will employ thousands of Californians and provide economic benefits.

Exhibit 10-4. Construction job-years and multipliers by step, spread over the implementation schedule

Step	Total Employment Jobs
Initial Construction Section	100,000
IOS-North/Central Valley to Bay Area	450,000–600,000
IOS-South/Central Valley to Los Angeles Basin	500,000–600,000
Bay to Basin	800,000–950,000
Full Phase 1	1,250,000–1,400,000

Potential for domestic HSR rolling stock manufacturing

Large and consistent demand has been the driver of railcar manufacturing, both abroad and domestically. Given the nascent nature of the U.S. high-speed rail industry, the U.S.does not currently produce high-speed railcars.

Signs that the U.S. is potentially moving closer to domestic production of HSR rolling stock include the recent opening of a plant by Siemens to manufacture fabricated "trucks" in Sacramento. These trucks are the undercarriage assembly for railcars and incorporate the wheels, suspension, brakes, and traction motors. They are used in HSR as well as other railcars and require complex equipment and special skills.

The market for railcars in the U.S. is characterized by pent-up demand and, as such, has potential for the foreign makers of HSR cars to invest or for U.S. companies to emerge. Whether the pent-up demand is accompanied by adequate funding will be a key factor in determining if/when the U.S. develops the capability to produce its own HSR cars.

Operations and maintenance jobs

In addition to the jobs created during construction, operating and maintaining the HSR system will depend on permanent public and private-sector employees. From train operators and maintenance yard workers to station managers and operations planners, these are permanent California jobs that will always remain in the state. These direct system employees will also generate further multiplier effects that will help employ more Californians.

Approach and inputs

The staffing requirements for operating the service and maintaining the infrastructure and rolling stock were developed from the operating plan which is discussed in Chapter 7, Operating and Maintenance Costs, U.S. and California labor practices and requirements, and international high-speed rail experience. Staffing was estimated for Phase 1, Bay to Basin, and the Initial Operating Section based on the Business Plan High Ridership forecast (see Chapter 6, Ridership and Revenue) for the following four employment categories:

- Passenger services and administration/management—Manage passenger service sat stations, such as ticketing and security, as well as general management of the HSR system
- Operations—Operate and dispatch the trains, manage the power supply and train routings, and serve the on-board passengers
- Equipment maintenance—Clean trains and regular light and heavy maintenance of the trainsets for safety and reliability
- Infrastructure maintenance—Maintain the physical elements, including structures, bridges, buildings, tracks, signaling and communications systems, and traction power system

Results

Once fully operational, the Bay to Basin system will directly employ approximately 2,900 people, and the Full Phase 1 system will employ about 4,500 as shown in Exhibit 10-5. Following international system experience, as ridership increases more employees will be required. Most employees will work aboard the trains and at stations, and many will be located at the heavy maintenance facility in the Central Valley. Additional jobs will be generated in the utility sector from required large electrical purchases and from multiplier effect across the state's entire economy.

Exhibit 10-5. Permanent O&M jobs by implementation phase

Step	Estimated Staffing Level (Year 2040)
IOS-North/Central Valley to Bay Area	1,300
IOS-South/Central Valley to Los Angeles Basin	1,600
Bay to Basin	2,900
Full Phase 1	4,500

Other benefits

Cities' economies across the world have become far more integrated as advances in transportation and communications technology have effectively brought them closer together and expanded their economic reach. As global cities such as Los Angeles, New York, San Francisco, London, and Tokyo have emerged, they have drawn adjacent communities into their economic sphere. To maintain California's prominent role in this new economic landscape and to spin off the benefits of its two major urban regions more fully to other parts of the state, California will need to continue to innovate and evolve. This section describes the wider economic impacts that might be realized from the HSR system.

Approach and inputs

In California, HSR has the potential to help create a new economic geography. In the past, the Los Angeles and San Francisco Bay metropolitan areas have acted as prominent but generally separate economic engines. However, adding HSR to the state's transportation network will create new opportunities for collaboration and innovation that are currently more difficult to achieve. While advances in communications technology help to reduce effective distance and facilitate the flow of information and ideas, many businesses—including some of the most crucial high value-added sectors—require substantial in-person interaction. Connecting California's urban areas with efficient and reliable HSR will create economic synergies critical for success in the knowledge-based industries of today and tomorrow.

What are the state's high-value added sectors?

High-value added sectors include technology, financial, and other business services; medical services and biomedical engineering; and creative businesses.

High-speed rail will increase productivity and specialization by giving businesses access to larger labor markets. Larger labor pools lead to better matching of skills, which means that firms are better able to find workers with the right qualifications.

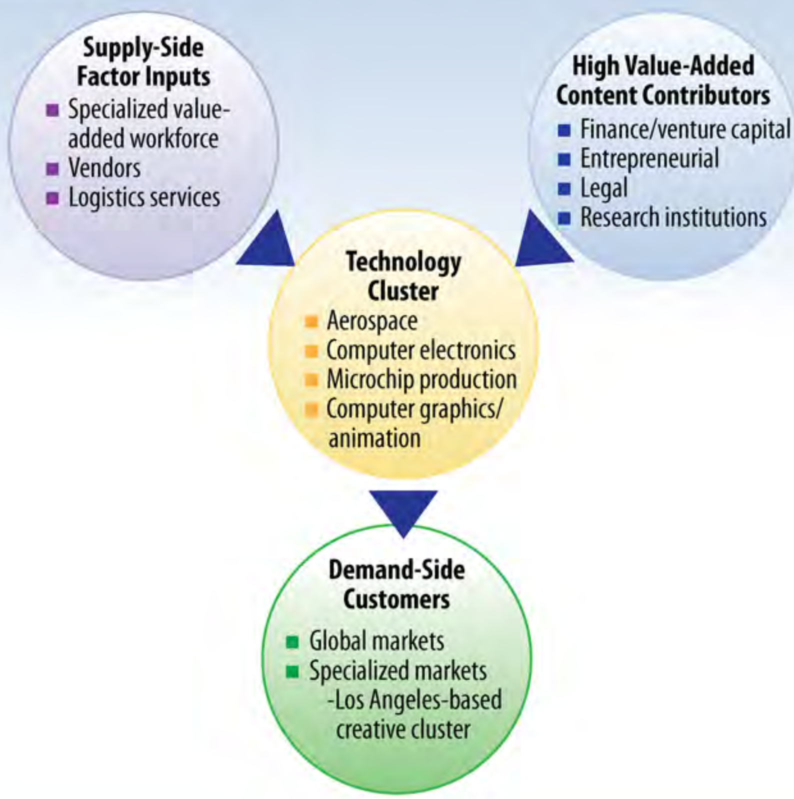
High-speed rail service will improve market access; companies that operate locally or regionally will be able to expand their operations statewide. The increased market size will subsequently increase competition among businesses, lowering production costs and improving market efficiency. Research indicates that high value-added sectors benefit from the increased access and proximity brought about by HSR. Economists have identified business clusters within high value-added sectors that comprise combinations of businesses that benefit from increased interaction and proximity.

Through these processes, transportation economists have increasingly focused on these wider economic impacts, referred to as "agglomeration economies." This refers to benefits of bringing economic activities and markets closer by reducing travel times. As an example, if the available labor market within a one-hour travel time can be increased, the potential pool of workers grows, and workers have more employment options.

How key California industry clusters will benefit—the example of Silicon Valley

High-speed rail will bring activities closer, especially creating stronger links within Silicon Valley and between the San Francisco Bay area and the Los Angeles Basin. This will result in the following:

- Create a denser technology cluster—Internal economies of scale within the technology cluster as a whole will benefit all technology firms. Sharing of resources and the knowledge base will be enhanced.
- Increase access to a wider variety and number of skilled workers within the same fields and improve access to other important inputs, such as product vendors and logistics services.
- Increase the availability and access to high value-added "content contributors" such as entrepreneurial resources, research and development, financial, and legal services; many of these resources exist in the Los Angeles Basin.
- Better connect Silicon Valley producers to new markets and potential customers, such as the creative-industry cluster centered in the Los Angeles Basin.
- Reduce business costs, enhance and expand the quality of inputs (labor, financing, and ideas), and link new and expanded markets.



Results

The HSR system will provide greatly improved connectivity and reduced congestion and, as a result, California's economy will become more efficient, productive, and competitive, and businesses will have much greater access to labor and other markets. Key economic sectors and clusters, such as technology, will expand output and hire more workers as businesses gain better access to legal, financial, and other services, and can work more effectively with research institutions, vendors, suppliers, and others. Job impacts will increase over the long term as highway and aviation congestion worsen and the travel benefits of high-speed rail service increase. The research is generally, but not uniformly, positive with respect to major long-term economic impacts, but methods and results can vary widely.

While results and methods vary greatly and cannot be considered precise, some consistency can be identified. For example, an oft-cited study conducted by the U.S. Conference of Mayors estimated creation of about 55,000 jobs in the Greater Los Angeles metropolitan area from the full California HSR investment.[11] That study did not provide a complete estimation of job creation for the entire California HSR corridor, but if it's extrapolated based on the Los Angeles Basin's share of the corridor's economy, that study finding would imply a full corridor economic impact of about 100,000 to 150,000 jobs.

Other studies, indeed the majority of studies that attempt to estimate these impacts numerically, lead to similar conclusions while also indicating the variability in estimates and results. For example, a report by the APTA, *The Case for Business Investment in High-Speed and Intercity Passenger Rail,* cites the U.S. Conference of Mayors Report as well as academic studies[12] to try to estimate impacts. One report noted prominently in APTA's business case is a case study of HSR impacts in the Frankfurt-Cologne corridor in Germany. As noted in the lessons from international experience above, Ahlfeldt and Feddersen of the London School of Economics in *From Periphery to Core: Economic Adjustments to High-Speed Rail, 2010,* the following two findings are reported by APTA:

- Counties that are adjacent to intermediate rail stations in the Frankfurt-Cologne corridor were found to have a 2.7 percent premium in GDP compared to areas not having rail access.
- For the much larger economic area served by the Frankfurt-Cologne HSR, the researchers found 0.25 percent growth in GDP for every 1 percent increase in access.

The initial finding, if assumed applicable in California and then extended to the entire California HSR economic impact area, would yield estimates of around 400,000 jobs created. The second finding—with the 0.25 elasticity—closely mirrors the estimate of about 100,000 jobs, as extrapolated from APTA's results.

Station area development

High-speed rail projects in Europe and Japan demonstrate a station's ability to be a catalyst for new development in the surrounding area. For example, the land value around the station in Marseilles, France, increased before service even started on the TGV Mediteranée line. Local station area development, which can include higher property values, more and denser development, and higher employment densities, relies on existing land uses, availability of connecting transit and transportation services, and local planning policies. Most important, strong background market demand, including not just passenger demand but also strong development forces within the larger surrounding region, must already be present for increased station development to occur.

Experience with other international high-speed rail systems shows that major hubs and intermediate stations see significant economic development around stations. Common characteristics include their offering competitive advantages, such as preferable locations and available inexpensive land.

Observations from high-speed rail systems in Europe and Asia indicate that the largest cities, such as Tokyo, Paris, and Madrid, can leverage their role as major rail hubs to regenerate surrounding areas. In Japan, for example, partnerships between developers and the HSR operating subsidiaries combined to create major station joint developments. Evidence from Japan's Shinkansen shows strong premiums in development and employment densities around stations compared to similar areas not served by HSR.

In addition, smaller cities within two hours of travel from major economic centers can receive significant economic benefit from HSR service. For example:

- Zaragoza, which is located approximately half-way between Madrid and Barcelona, created a new business district centered on its high-speed rail station.
- Lille has been able to generate significant development, in part because of its central location on the HSR network. Lille sits at the intersection of HSR lines going to three major economic and political hubs—Paris, London, and Brussels. In planning for HSR, Lille used publicly owned land to redevelop its downtown into a mixed-use intermodal international business hub.
- Malaga, Spain's high-speed rail station became a major retail destination.

In these and other comparable cases, active local planning and partnering with the private sector helped create the conditions for station area development. In other cases in Europe, similar-sized cities benefited less, as plans were not as aggressively promoted.

This experience has important implications for Bakersfield, Fresno, and other Central Valley cities, all of which will be within two hours by rail of both San Francisco and Los Angeles. However, city/station visioning, planning, and investment will be critical to realizing such positive benefits in station areas.

The high-speed rail station in Malaga, Spain, a city of about 550,000, has become a major retail destination, spurring further development around it.

Areas of evaluation

As part of the station-area analysis for this Business Plan, individual stations were evaluated across an array of relevant criteria that are likely to influence station-area development potential. These include the following:

- Regional employment and population growth, which is indicative of the strength of underlying market forces
- Multimodal connectivity, a critical factor in accessibility of the station, which contributes positively to growth potential
- Ridership potential, including both inter-city and intra-city trips, indicative of actual projected market demand for rider-related station activity and accessibility
- Development capacity, which reflects the carrying capacity of surrounding land parcels for redevelopment
- Advanced station area and/or downtown planning, which reflects public and private-sector interest and determination to develop

Key characteristics of HSR station areas, including development plans and potential:

- **San Francisco Transbay Terminal**—Preliminary construction work has begun on redevelopment of the old Transbay Terminal into the Transbay Transit Center. Plans call for a new inter-modal hub and several new towers that will expand the Financial District south of Market Street. The plan includes 2,600 residential units, 3 million square feet of commercial space, and 100,000 square feet of retail. The Transbay Transit Center is located in a mature area of San Francisco where very dense office, retail, and residential development already exists.
- **San Francisco (4th and King)**—The City of San Francisco is currently studying development opportunities in the 4th and King Station area.In 2010, the City embarked on a "Fourth and King Street Railyards" study which, to-date, has published a draft Opportunities and Constraints Report. However, San Francisco is delaying completion of the analysis pending the completion of the high-speed rail environmental process, which includes the 4th and King station area.
- **Millbrae**—The Millbrae station is part of the Millbrae Station Area Specific Plan which promotes transit-oriented development (TOD) around the Bay Area Rapid Transit (BART) and Caltrain station in Millbrae. The plan lays the groundwork for successful station-area development but does not currently include HSR .In the immediate station area there are several surface parking lots and underdeveloped parcels totaling about 16 acres that could be developed at medium to high densities under a TOD plan. BART, Samtrans, the City of Millbrae, and the California HSR project team have been conducting a detailed access study of the site to understand better the transportation issues and how they could be affected by additional development and transportation options at the station.
- **Mid-Peninsula**—Redwood City, Palo Alto, and Mountain View are all under consideration as potential HSR station locations. Each of the cities has investigated, to some degree, the implications of having an HSR station in their downtowns.
- **San Jose Diridon Station**—San Jose has developed the Diridon Station Area Plan, which proposes the creation of a new multi-modal station and business center at the location. The plans call for a maximum development scenario of 4,950,000 square feet of office/commercial, 420,000 square feet of retail/restaurant; 2,588 residential units; and 900 hotels rooms. This aggressive plan will require a significant amount of redevelopment of underutilized sites, including parcels currently containing residences.
- **Gilroy**—The station location has not been finalized. The options being evaluated are either a downtown station or a greenfield station outside of Gilroy.
- **Merced**—The HSR line through Merced is located in an industrial portion of the city that the city wishes to redevelop. The City has applied for station area development funding and will put up local funds for the planning effort.
- **Fresno**—The city has developed a Downtown Plan centered on the HSR station. Plans call for an increase in density and new mixed-use development with up to 141,000 square feet of retail, 320,000 square feet of office space, and 705 new residential units.

- **Kings/Tulare**—The station location has not been finalized. Visalia, Hanford, and Tulare are possibilities so no concrete station plans have been developed. This is a unique case where the station is not viewed as promoting TOD but rather will become a multi-modal hub for bus and ultimately rail service for Visalia, Tulare, Hanford, Lemore, and even Corcoran.
- **Bakersfield**—Current plans call for the station to be located at the site of the existing Amtrak station on Truxtun Avenue. The plans point out the potential for concentrating business development in the area but stop short of identifying specific sites for development Plans that are now somewhat aged suggest redevelopment areas that total more than 1 million square feet of development, which would probably occur over a long horizon.
- **Palmdale**—As with Gilroy, two alternative station locations are being considered. TOD plans exist for the Metrolink Station about 2.5 miles away, but they do not encompass HSR plans.
- **San Fernando Valley**—The station location has not been finalized. Current plans call for a station in the San Fernando Valley or near Burbank Bob Hope Airport. The Bob Hope Airport is currently creating development plans for available land next to the airport that may include HSR. Research indicates that HSR stations can leverage locations serving airports to increase both ridership and development potential.
- **Los Angeles Union Station**—Catellus, a private development LLC and former owner of LA Union Station, sold the 38 acres and development rights totaling close to 6 million square feet of TOD to the Los Angeles County Metropolitan Transportation Authority in 2011 for approximately $75 million. Currently three buildings totaling 728,000 square feet of office development and a small amount of multifamily residential development are located on the site. HSR service in this market could drive further demand for development, but the relative (to San Francisco) lack of highly utilized local transit services in Los Angeles and the generally less dense development pattern may cause redevelopment in the station area to be spread over a longer period of time.
- **Gateway Cities**—The station location has not been finalized. Options include the Norwalk/Santa Fe Springs or Fullerton Metrolink station sites. While at least some small-scale industrial redevelopment opportunities exist, the magnitude of large-scale redevelopment potential in certain Gateway Cities communities may be very limited.
- **Anaheim**—The Anaheim Station (ARTIC intermodal station) is planned as part of the 20-plus million square feet Platinum Triangle redevelopment project, which currently has 15 projects at or past the design stage totaling more than 8,000 new residential units, 600,000 square feet of commercial space, and 130 hotel rooms. The 17 acre portion of the Platinum Triangle in the ARTIC zone is expected to be office-oriented with some retail and residential space, specifically allowing for 520 residential units, 2.2 million square feet of office space, and 360,000 square feet of retail. Overall, the Platinum Triangle redevelopment program has momentum and is expected to continue regardless of HSR access. One major attribute that the Anaheim station and HSR ridership will benefit from is the concentration of recreational destinations within close proximity to the station, including Disneyland, Angeles Stadium, and the Honda Center.

Key findings

Based on international experience, it is possible to conclude that high-speed rail will lead to greater and more rapid capture of regional development projections around stations, as well as premiums for land value, employment, and local taxes. Additionally, the following changes can occur after high-speed rail service starts:

- High-speed rail stations can accelerate planned development, attract additional development, increase commercial and employment densities, and enhance property value around stations.
- The majority of development will occur at selected major downtown stations in the San Francisco Bay area, such as the Transbay Terminal, around Union Station in Los Angeles, and in cities that are close to these hubs, such as San Jose.
- Central Valley cities have taken some of the most active steps in planning for the arrival of HSR service. Central Valley stations can attract significant development, depending on how well integrated they can become with the major metropolitan areas. Although they will likely attract less total development than the major metropolitan stations, they can capitalize on advantages from lower land and labor costs. Some new manufacturing, recreational, tourism, residential development, and back office uses can be especially suitable for Central Valley locations.

End notes

[1] *Source:* Nash, C. December 2009. "When to Invest in High-speed Rail Links and Networks?" Institute for Transport Studies, University of Leeds. Paper given at the International Transport Forum Symposium on Transport Economics, Madrid, November 2009.

[2] *Source:* Bonnafous, A. 1987. "The Regional Impact of the TGV." *Transportation,* Volume 14, Number 2, 127-137.

[3] *Source:* Preston, J., A. Larbie, and G. Wall. 2006. "The Impact of High Speed Trains on Socio-Economic Activity: The Case of Ashford (Kent)." Paper for the 4th Annual Conference on Railroad Industry Structure, Competition and Investment. Universidad Carlos III de Madrid.

[4] *Source:* Albalate,D. and G. Bel. 2010. "High-Speed Rail: Lessons for Policy Makers from Experiences Abroad" (working paper). GiM-IREA Universitat de Barcelona.

[5] *Source:* Ahlfeldt, G. M. and A. Feddersen. September 2010. "From Periphery to Core: Economic Adjustments to High-speed Rail" (working paper). The London School of Economics and Political Science and University of Hamburg.

[6] Salvage value is the discounted value of the remaining useful life of the system at the end of the analysis period. For example, tracks that were laid in 2020 and have a 100-year useful life would have 40 years or 40 percent of their useful life remaining at the end of the analysis period in 2080.

[7] *Source:* INRIX. 2011. "2010 Annual Report: 100 Most Congested Corridors." *INRIX National Traffic Scorecard*. http://scorecard.inrix.com/scorecard/Top100Corridors.asp (accessed August 1, 2011).

[8] *Source:* Administrator of Railway Infrastructures (ADIF). 2009. *Memoria Económica y de Actividad 2009* (2009 Financial Report). http://www.adif.es/en_US/conoceradif/memoria.shtml (accessed September 7, 2011).

[9] *Source:* U.S. Bureau of Labor Statistics. 2011. "Unemployment Rates for States." http://www.bls.gov/web/laus/laumstrk.htm (accessed July 29, 2011).

[10] The term job-years represents the equivalent number of one-year-long, full-time jobs that will be created.

[11] *Source:* U.S. Conference of Mayors. 2010. "The Economic Impacts of High-Speed Rail on Cities and Their Metropolitan Areas."

[12] *Source:* American Public Transportation Association (APTA). February 2011. "The Case for Business Investment in High-Speed and Intercity Passenger Rail."

Chapter 11

Updates since the 2009 Report to the Legislature and a Look Ahead to the 2014 Business Plan

As with any major program, the statewide high-speed rail program will change over time as it moves from planning to design to construction to operations and maintenance. As a result of this progression, this 2012 Business Plan differs in significant ways from previous plans, including the 2009 Report to the Legislature. Among the key factors driving change are the following:

- An increase in information regarding site conditions
- Additional information and lessons learned from international operators of high-speed rail systems
- Input from peer reviews
- Advancement of design beyond the 5 percent level in 2009
- Progress in the environmental review process
- The success of the state in securing additional federal funding
- Enhanced collaboration with regional and local rail partners
- Changes in the board and executive staff of the Authority

These changes are reflected throughout this Business Plan. This chapter briefly summarizes some of the most significant changes from the 2009 Report and identifies some key issues that are expected to change in the next version of the Business Plan, in 2014.

Changes from 2009 Report

Phased implementation

What has changed?

The 2009 Report noted that "over the coming two years, the project will begin transitioning from the planning stage into the implementation stage." A comprehensive roll-out plan for delivering the high-speed rail (HSR) system was held in abeyance as funding levels and timing of the American Recovery and Reinvestment Act (ARRA) Program work were seen as key drivers for how soon construction could start and which sections were to be built first.

For planning purposes, the 2009 Report identified four sections as the highest priorities in the schedule for environmental approval and preliminary engineering:

- Los Angeles to Anaheim by March 2011
- Merced to Fresno by September 2011
- Fresno to Bakersfield by September 2011
- San Francisco to San Jose by September 2011

This 2012 Business Plan, for the first time, lays out a detailed implementation strategy for constructing the high-speed rail in functional increments taking into account available funding as well as Proposition 1A requirements for operational and financial performance. This delivery plan implements the high-speed rail system in phases with each phase providing independent functionality leading to the full Phase 1 System connecting San Francisco/Merced with Los Angeles/Anaheim. The phased implementation also considers the business case for operating a revenue service without subsidy, and establishes a basis for private investment opportunities.

The implementation strategy presented in this Business Plan begins with construction of the "spine" of the system in the Central Valley and then expands north and south. There are five basic steps that, when fully constructed, will provide for the full 800-mile HSR system connecting Sacramento/San Francisco to Los Angeles/Anaheim/San Diego. The five steps are as follows:

- **Step 1**: Initial Construction Section—Approximately Madera to Bakersfield
- **Step 2**: Initial Operating Section-North Option—San Jose/Merced to Bakersfield, allowing blended operations within metropolitan areas, or
- Initial Operating Section-South Option—Merced to San Fernando Valley, allowing blended operations within metropolitan areas
- **Step 3**: Bay to Basin—San Jose/Merced to San Fernando Valley, connecting megaregions and allowing blended operations within metropolitan areas
- **Step 4**: Phase 1—San Francisco/Merced to Los Angeles/Anaheim, with Phase 1/Blended allowing a one-seat ride within metropolitan areas
- **Step 5**: Phase 2—Sacramento/San Francisco to Los Angeles/Anaheim/San Diego

Why has it changed?

The challenge for all mega-projects is selecting an implementation strategy that recognizes national and local strategy and funding constraints, best fits the funding profile for the project, and provides immediate benefits. Since 2009, following the federal government issuance of a blueprint for high-speed rail in the U.S., nearly $3.5 billion in federal funding has been allocated to the California high-speed rail program to begin construction.

The first question in developing the implementation strategy is, where to start? The decision to begin construction in the Central Valley was confirmed by the California High-Speed Rail Authority (Authority) Board in late 2010 following award of the ARRA grant funds. With construction starting in the Central Valley, the next goal is to advance high-speed rail service between the San Francisco Bay area and the Los Angeles Basin as soon as practicable. This rail service may commence in a variety of ways—high-speed rail service, an intermediate speed service, or extension of existing rail service running at higher speed—depending on factors such as travel demand, adjacency of other operators, shared operations with other operators, and availability of suitable rail equipment. The five-step implementation strategy is designed to provide flexibility and deliver incremental improvements in high-speed rail service consistent with the requirements of Proposition 1A and existing and future funding programs.

How has this change affected the California High-Speed Rail Program?

Adoption of a phased implementation strategy breaks the statewide program into a series of projects that can be advanced according to availability of funding, environmental clearances, and other factors. It gives decision-makers the ability to move forward incrementally and avoids over-committing the state at any given point in the process.

Confirmation of the initial construction section in the Central Valley has set the way forward for the remainder of the California HSR project schedule. Global experience indicates that a realistic implementation strategy for California is to construct an initial segment of high-speed rail alignment in the Central Valley, which will connect with major population centers through the existing transportation network. This will immediately enhance connections throughout the state and improve mobility, and will be followed by extensions of high-speed rail alignment in segments to the north and south as additional funding becomes available. The relatively long, flat, and straight alignment in the Central Valley is also the only location suitable for a test track facility where the high-speed train technology can be tested at speeds in excess of 220 miles per hour.

This 2012 Business Plan lays out a new framework for cooperation between the state and regional and local agencies in implementing a statewide system. Under this framework, there is a clearer delineation of responsibility, with regional and local transportation agencies taking the lead for providing the intra-regional improvements, and the state taking the lead in advancing the inter-regional connection between major metropolitan areas. Through blended operations, the inter-regional and regional systems work in tandem to take travelers within and between urban areas. Under the framework of this 2012 Business Plan, the state and regional/local agencies will coordinate efforts to develop a long-term strategy for a statewide rail system, including the pursuit of federal support.

Blended operations

What has changed?

Tied to the phased implementation described above, this Business Plan proposes to develop the high-speed rail system in a way that more clearly and effectively integrates it with regional and local rail systems to create a statewide rail network. The commitment to a blended system has been initiated through extensive cooperative planning among state, regional, and local partners. Blended operations will begin at the Initial Operating Section stage. For example, passengers arriving on a northbound high-speed train into San Jose would be able to connect quickly and easily with a Caltrain train; schedules and ticketing would be coordinated, providing passengers with a seamless transfer to their final destination. The same would apply to southbound high-speed rail passengers arriving in the San Fernando Valley, connecting to coordinated Metrolink service. Sacramento-area passengers would see similar benefits, connecting via the San Joaquin service at Merced to the high-speed train.

As further improvements are made, blended operations progress to the point where transfers would not be necessary and passengers could have a “one-seat ride” on a train that is able to travel over both the high-speed line and upgraded regional rail lines. This would be in advance of, or, in some cases, in lieu of, the construction of dedicated high-speed lines in the metropolitan areas served by the commuter agencies.

It is important to note that, although improvements to the regional and local rail systems are intended to improve or facilitate connections with the high-speed system, they do not need to be implemented sequentially with it. As with the stages of the HSR system, these improvements, such as grade-crossing eliminations, have independent utility that will benefit riders even before the connection to the high-speed system is complete. Where possible, they could and should move ahead independently and as quickly as feasible.

Why has it changed?

Improved collaboration with regional and local partners has led to the advancement of planning for blended operations. Proposition 1A recognized the importance of connecting the high-speed system with regional and local rail systems by authorizing both $9 billion in bond funds for HSR and $950 million for complementary improvements in the state's connecting rail systems. With connections at all new high-speed rail stations to existing regional and local transit systems, HSR will significantly enhance the passenger transportation network across the state. Blended services linking statewide high-speed rail service with regional and local transit systems will benefit travelers in the near term and provide the platform for continued improvement in rail transportation over the longer term. Connectivity and mobility will improve significantly across the state by expanding the network of inter-connected public transportation systems.

How has this change affected the California High-Speed Rail Program?

This Business Plan suggests a framework for establishing the partnerships and coordination to develop the statewide system that is needed in California. It recognizes that metropolitan areas have existing rights-of-way and rail service, as well as the transportation agencies that fund and provide those services. While those services and entities exist within the metropolitan areas, there is no comparable entity that exists between them to connect them. The state is the appropriate entity to fill that void and provide the connection between Northern and Southern California. Through a formal cooperative arrangement, the agencies within the metropolitan areas can take the lead in planning, initiating, providing, and improving the intra-regional services that connect to the statewide high-speed rail service, and the state can take the lead in developing and implementing the inter-regional connection.

To ensure that such progress can be achieved, the Authority will work with state, regional, and local agencies to establish formal processes to:

- Identify and advance mutually beneficial investments that can proceed quickly using authorized Proposition 1A funding
- Identify additional sources of funding that can be agreed upon and put to use for early investments in improvements in the regional/local systems in anticipation of high speed rail
- Develop operational procedures to ensure seamless integration of inter-regional and intra-regional transportation services, including coordinated schedules, ticketing, marketing, and other activities
- Identify potential opportunities for improving financial performance of the various services through improved coordination, potential leveraging of resources, joint purchases, and other steps

- Develop proposals for institutional arrangements that will facilitate cooperative actions
- Develop a cooperative and complementary agenda for pursuing federal support

Ridership and revenue

What has changed?

Ridership and revenue forecasts are now presented in a range to reflect varying inputs and assumptions. In the 2009 Report, Phase 1 service between San Francisco/Merced and Los Angeles/Anaheim was projected to be 41 million passengers and nearly $3.0 billion in revenue per year for the year 2035. The 2012 high case projects slightly more riders and less revenue, and the low case projects significantly less ridership and revenue, as shown in Exhibit 11-1.

Exhibit 11-1. Year 2035 HSR riders and revenue forecasts, 2009 and 2011

Phase One: San Francisco and Merced to Los Angeles and Anaheim	Riders (millions)	Change vs. 2009	Revenue (billions, 2010$)	Change vs. 2009
2009 Report	41.0	—	$3.0	—
2012 Business Plan High	42.9	+5%	$2.6	-11%
2012 Business Plan Low	28.9	-30%	$1.8	-40%

The ridership model was extensively reviewed by an independent peer review panel of leading industry experts who provided guidance and recommendations to improve the capability of the model. After these improvements were implemented, the peer review panel found that the model behaves reasonably, produces results within expected ranges, and is suitable for use in preparing environmental documents and business planning. The 2012 Business Plan ridership projections are the product of updated data reflecting post-recession expectations and more conservative assumptions on high-speed rail operations. However, the current forecasts use the same basic ridership and revenue model that was used for the 2009 Report.

Why has it changed?

The data used in the forecasting have been updated to reflect post-recession expectations for current and projected population, economic conditions, airline fares, and driving costs.

The updated forecasts have been made for a range of possible outcomes: low, medium, and high. This approach demonstrates how the forecasts change when key inputs are varied, such as the rate of population growth, and more realistically reflect the potential for variation in external factors.

To approximate real world economics, assumptions in the cost of high-speed rail ticket prices are studied relative to HSR’s primary competition, air and auto travel. Generally, for distances of 200 miles and greater, airlines are the primary competitor with respect to total time travel and customer convenience. In 2009, high-speed rail ticket prices were assumed to be 83 percent of airfare for the purpose of business planning and 50 percent of airfare for purpose of assessing environmental impacts. For this 2012 Business Plan, high-speed rail ticket prices were maintained at 83 percent of the price of airfare.

The primary reason for the lower revenue, even in the high case with more riders, is the lowering of high-speed rail ticket fares in the Los Angeles Basin to San Francisco Bay area market to react to the changes in current and expected airfare. Since 2005 airfares have declined in this market as the result of low-cost carriers establishing strong service in almost all of the airport-to-airport pairs.

In addition to the high-speed rail ticket prices, four other important variables affecting ridership forecasts were adjusted:

- **The projected cost of a gallon of gas**—A fuel price range of $3.80 per gallon was used to replace the assumption of $3.00 per gallon in the 2009 Report. A range of $2.50 to $5.50 was tested to demonstrate the model's sensitivities
- **Projected airfares**—Ticket prices for San Francisco to Los Angeles were reduced and range from $86 to $130 for a one-way ticket to replace a single-cost assumption of $126 in the 2009 Report.
- **Changes in trip-making patterns**—Reduction in long-distance commuters and increase in recreational users based on new survey results.
- **Population forecasts**—Reduced from a pre-recession forecast of 54 million to 44 to 49 million total California population by 2035.

For purposes of ridership modeling, a single ticket price is established to reflect a low, medium, and high scenario. In actual practice, on existing operating high-speed rail systems around the world, the price of a ticket varies with the day of the week and the time of day, with the highest fares charged during the peak travel times and peak travel seasons. It is not uncommon for high-speed rail ticket prices to actually exceed the costs of airfare during such peak travel periods. Typical in the transportation and hotel industries, this is often referred to as "Yield Management" where a system of calculating fares based on the supply of available seats versus the demand is used. As seats fill up, fares increase. Conversely, if seats are not selling, the system will reduce fares to attract passengers.

It should be noted that the ridership assumptions for the environmental review process maintains the high-speed rail ticket price at 50 percent of airfare to provide a more extensive (i.e. higher ridership and higher impact) assessment of the impacts of the operating system on the environment and ensure that these impacts are not understated.

How has this change affected the California High-Speed Rail Program?

The bottom-line effect of this change is that the operational revenue (dollars collected from ticket sales), is now assessed as a range based on a set of variables. This approach allows the Authority to assess the risk associated with the assumptions and to determine when and under what conditions the system is projected to operate at a profit. This is particularly beneficial as the Authority looks to a phased implementation of the high-speed rail operational service.

Using the updated model, net operating profits (revenues minus operating and maintenance costs) in the year 2035 are projected to range from $0.7 to $1.2 billion in 2010 dollars. This compares to the 2009 Report that projected net operating revenues of $1.8 billion in 2010 dollars (based on $3.9 billion in year of expenditure for 2035, at 3 percent annual escalation).

Capital costs

What has changed?

In December 2009, the Authority submitted a report to the Legislature in which it estimated that the cost to implement Phase 1 of the California High-Speed Rail Program between San Francisco and Los Angeles/Anaheim was $35.7 billion in 2009 dollars ($36.4 billion in 2010 dollars). This cost estimate was based on the initial Conceptual Engineering of the proposed route alignment, as reflected in the statewide programmatic Environmental Impact Report/Environmental Impact Statement (EIR/EIS) completed in 2005.

The cost for completing Phase 1 of the program now ranges between $65.2 billion and $74.2 billion in 2010 dollars, with interim steps that can be implemented as independent sections of viable high-speed rail service. The current estimate incorporates ranges to reflect lower cost and higher cost scenarios based on key alignment decisions that have yet to be finalized.

Key program cost drivers

- Land use and availability
- Environmental impacts
- Stakeholder issues
- Engineering conditions

Why has the cost increased?

Cost estimates are derived directly from project engineering. As the engineering progresses, a proposed project's costs become better defined, allowing for more accuracy. The development approach for project engineering typically advances in three broad steps:

1. Conceptual Engineering (5 percent) provides a comparative basis for evaluating different alignments and developing an order-of-magnitude cost estimate for cost benefit analysis and budgeting.
2. Preliminary Engineering (15 to 30 percent) provides a detailed approximation of project complexity, cost, and construction methodology, reflecting actual field conditions and design changes required to mitigate environmental issues and community concerns. Design is sufficient at this stage to transfer responsibility for final design to the private sector through a design-build procurement.
3. Final Engineering (100 percent) provides the documentation to build the final product.

The cost estimate included in the 2009 Report was based on Conceptual Engineering completed between 2003 and 2005 to support the then pending Program EIR/EIS. Lack of funding prevented the Authority from advancing to Preliminary Engineering (except for the Los Angeles-Anaheim segment) until 2009. Consequently, the 2009 cost estimate relied on the older engineering data without comprehensive site-specific analysis of the many pending alignment options. The initial program planning predated much of California's historic real estate boom in the mid-2000s. Large expanses of vacant or under-utilized property, over which the system would have operated at-grade, have since become bustling communities, suburbs, and roadways. California added nearly 5 million people between 2000 and 2010, with much of this growth in cities along the project route. In addition, composite unit prices and quantities lacked the specificity that could only come through site-specific engineering.

The cost estimate in the 2012 Business Plan is based on the Preliminary Engineering work that began in 2009 and continues today. It reflects site-specific engineering and current conditions on the ground, including very significant impacts resulting from California's real estate development and population boom, as well as from the hundreds of meetings held to address concerns with the public, city and community officials, affected stakeholders, other transit agencies, and multiple state and federal agencies.

Preliminary Engineering includes very significant changes to the alignment to address the following:

- Land use and availability (e.g., development)
- Environmental impacts (e.g., noise, traffic, wetlands, and endangered species)
- Stakeholder issues (e.g., restrictions on the use of existing freight railroad rights-of-way, community comments)
- Engineering requirements (e.g., on-site analyses, design criteria)

The new landscape has necessitated adding many miles of elevated structures, tunnels, and other infrastructure. This accounts for approximately 80 percent of the cost increase since 2009. The new alignments permit access to major downtown population centers with less community impact and disruption. Approximately 37 to 43 percent of the Phase 1 system may be built on elevated structure or in tunnels. The length of elevated structures increased from 77 miles in 2009 to between 138 miles for Scenario 1 and 168 miles for Scenario 2, and tunnels increased from 32 miles to between 51 and 52 miles. In addition, more detailed investigations during Preliminary Engineering have identified challenging geologic and geotechnical conditions, floodplain areas, and differences in terrain that required realignment of the route or more expensive design approaches. These conditions either were unknown or not fully evaluated when the 2009 report was developed.

Composite unit prices for materials and components also have increased. Some changes reflect increased engineering design, providing more detailed material and component specification. Other changes simply reflect increases in the underlying cost of materials and the very significant cost increase of construction in California.

Phase 1 still connects San Francisco, Los Angeles, and Anaheim via the Central Valley. However, the alignment through nearly every area has changed; large stretches of joint-use rail corridors will be rebuilt to accommodate the high-speed rail system, and much more of the system will be elevated or below-grade in trenches or tunnels.

Examples of significant cost drivers and design changes, detailed in the technical memorandum on cost, available on the Authority's website, include the following:

- **Land use and availability**—Significant changes have been required in the original program-level alignment used for Conceptual Engineering as a result of real estate development over the past decade. This has required additional tunneling and elevated sections to avoid new communities and development.

  - In the Southern California HSR sections, there has been significant single-family residential and retail development since the early to mid-2000s to the southeast of Santa Clarita generally following the SR 14 corridor. Single family and ancillary commercial development has also occurred through the foothill communities of Acton and Agua Dulce, and through the Antelope Valley communities of Palmdale and Lancaster. Alignment changes to accommodate these new developments required additional viaducts and tunnels.
  - In the Central Valley, significant alignment changes have been made to accommodate community concerns. At Hanford, the original alignment route was west of the city. Because of stakeholder concerns about impact of the HSR on development between Hanford and the community of Armona, and the desire to locate a potential station in the vicinity, the alignment was moved to the east side of Hanford. The east side alignment required elevated structures and higher embankments to cross over the Kings River Complex, the San Joaquin Valley Railroad, and SR 198 freeway, as well as to mitigate effects within the Kings River floodplain.
  - In Northern California, additional tunnels are being considered to avoid direct impacts to existing and newly planned residential developments in Millbrae.

- **Environmental impacts**—A number of major environmental concerns have emerged during development of the Project's National Environmental Policy Act/California Environmental Quality Act environmental documents in each of the sections. Where adverse environmental impacts are identified, mitigation becomes necessary, particularly where specific federal or state permits must be issued by resources agencies. For example:
  - Between Palmdale and Los Angeles, the original alignment went through Soledad Canyon. However, this alignment was eliminated from further consideration due to adverse impacts discovered during the environmental assessment process for protected species and habitats. The alignment alternative was relocated northward in mountainous areas and requires additional tunnels due to the steep, rugged terrain. In addition, access for a high-speed route into downtown Los Angeles requires a tunnel approach under the Los Angeles River to avoid impacts to the existing Cornfields State Park.
- **Stakeholder interests**—In the EIR/EIS, large sections of the HSR alignment were planned to be entirely co-located within existing transportation corridors such as railroad and highway rights-of way, thus resulting in significantly reduced construction costs and environmental impacts. In addition, much of the Central Valley alignments from Wye to Bakersfield were to be directly adjacent to existing railroad corridors. Co-location also was planned for the more densely populated areas, including the following:
  - San Francisco south through Gilroy (approximately 70 miles)
  - The cities of Fresno, Tulare, and Bakersfield
  - San Fernando Valley (approximately 15 miles between Sylmar and Media City)

Stakeholder concerns resulted in the need to relocate the alignment off these existing transportation rights-of-way in some areas. In other cases, the large radius curves required to maintain high-speed rail operations made use of existing freight railroad and highway rights-of-way—with much sharper curves designed for slower speeds—impractical requiring shifting of the HSR off the alignment into residential and commercially developed areas. These changes have resulted in an increase in elevated viaducts to minimize local impacts and facilitate crossing of existing railroad lines and highways. For example, the Program EIR/EIS alignment into Bakersfield followed the Burlington Northern Santa Fe alignment through an existing oil refinery. During Preliminary Engineering, this was determined to be infeasible due to conflicts with oil refinery equipment and piping. The alignment has been shifted south of the refinery and is now elevated over the Westside Parkway freeway from Calloway Drive to the station area. The original alignment only included elevated structures to cross the Kern River and SR 99, and for an elevated downtown station.

- **Engineering requirements**—On-site investigations, as well as improved understanding of seismic, geologic, and geotechnical conditions, have had a significant impact on the design and resulting costs.
  - Alignments in the Central Valley, originally planned to be at-grade, have been raised on an embankment or placed on structures as a result of site-specific analysis of floodplain limits and mitigation requirements.
  - The number of tunnels planned between San Jose and Merced has increased to avoid identified slip plain geologic conditions.
  - The alignment on the north side of Madera, originally planned to be at-grade, is now elevated along the Union Pacific Railroad line in order to maintain a rail spur into the Azteca Milling Company.
  - For tunnels, in addition to cost increases due to the total number/mileage, costs increases are driven following consideration of the tunnel lengths, expected soil conditions, and construction methods.
  - For aerial structures, seismic design criteria under development to address specific California conditions have resulted in increases in composite unit prices, particularly for taller structures (40 to 50 feet tall and higher).

How will costs be contained?

Costs will continue to become more precise as the project continues to advance from Preliminary Engineering to Final Engineering and construction. Additional design changes may be required to address issues discovered on the ground and through continuing dialogue with stakeholders, particularly in constrained urban corridors such as San Jose to San Francisco and the Los Angeles Basin. However, with engineering continuing to advance, few additional major changes in design or large swings in the cost estimate are anticipated. The Authority is implementing aggressive efforts to control and reduce costs, such as the following:

- **Value Engineering**—This continuing effort, involving project staff and international industry experts, already has led to significant cost reductions and more can be expected. This work includes efforts to bring elevated sections back to grade, analysis of cost-saving alternative construction approaches, efforts to reduce the height of structures and the length of tunnels, and new bridge designs and construction techniques to reduce width and weight.

- **Change control**—All future changes in the design must be adequately estimated, reviewed, and approved by the Authority prior to inclusion in the program.
- **"Snapshot" cost estimates**—In conjunction with the stronger Change Control process, the Authority will require quarterly snapshot cost estimates to monitor design change issues and to determine appropriate actions through the remaining environmental review process.
- **Procurement and construction efficiencies**—The cost estimate has not been adjusted to reflect possible savings resulting from economies of scale and construction competition for a project of this magnitude. The Authority will aggressively seek to optimize the packaging of the procurement to maximize and incorporate these types of savings.

The estimates are presented as information to the public and decision makers to assist with actions that must be taken in the coming years to complete the HSR Program. The current Program cost estimate is not the final constructed costs for the HSR system. While construction is due to start in the next two years, the Program is still in the Preliminary Engineering and environmental phase and will continue to evaluate the need for mitigation, how best to deliver the desired system performance, and ways to reduce costs.

A look ahead to the 2014 Business Plan

The 2014 Business Plan will include updates to all major areas of the 2012 Business Plan. Not all changes that may affect the 2014 Business Plan can be anticipated. However, areas that can reasonably be expected to experience some level of change—and affect the program—include the following:

- Initial Construction Section as first step of Initial Operating Section:
  - Progress in construction, including job creation
  - Private-sector engagement through design-build procurement
- Environmental review and approval process
- Coordination of state and regional/local priorities and initiatives—potential acceleration of regional/local improvements
- Economy—Changes that could significantly affect federal and state budgets
- Federal elections—Impacts on programs and funding levels
- Advancement of procurement strategy for the Initial Operating Sections, including evaluation of private-sector interest and value for money assessments
- Station area and other development opportunities

Chapter 12

Frequently Asked Questions

Any investment of public funds should be scrutinized to ensure, among other things, that it is consistent with policy goals, provides measurable benefits, and that risks associated with the investment are identified and mitigated. Such reviews can be conducted in a variety of ways. The environmental review process, both federal and state, is a critical means of raising and addressing issues. Legislative and budgetary reviews, public meetings, and other forums provide additional opportunities to do so. In the case of the high-speed rail program, the requirement for a business plan provides another important opportunity to consider questions about the program and how they are being addressed.

Because of its scale and statewide significance, the high-speed rail program understandably attracts a great deal of attention and scrutiny. Throughout this Business Plan, key issues that need to be considered by decision-makers are discussed in detail. This chapter summarizes the key issues and responses to them in order to assist the public and other stakeholders in their review of those issues.

Ridership

Are forecasts too optimistic? Is the modeling used to provide forecasts appropriate and up to date? Are assumptions that go into the modeling appropriate? When will forecasts be updated? What if actual ridership is below estimates?

As described in the plan, the ridership model, inputs, and forecasts were thoroughly evaluated by an independent peer-review panel of international experts, who have reported that, *"… the model produces results that are reasonable and within expected ranges for the current environmental planning and Business Plan applications of the model… We were very pleased with the content, quality, and quantity of the information."* Assumptions about economic growth, population, and other factors have been updated and are consistently conservative, providing a greater degree of confidence in the results. Each of the assumptions in the four key external areas of the ridership forecast is intentionally conservative to avoid creating results that could be seen as overly optimistic.

- Population, which has a direct correlation with ridership, is assumed to be 9 to 18 percent below the Department of Finance projections.
- Trip-making characteristics (long, short, business, other, etc.) skew toward shorter-distance trips, which do not favor high-speed rail.
- The price of gasoline, which is a major factor in travel decisions, is assumed to be $3.80 a gallon and not increase over time, which minimizes the mode shift from automobile to high-speed rail.
- Airfares are assumed to be at relatively low 2009 levels, in spite of increases during 2010 and 2011, minimizing the competitive advantage of high-speed rail.

Comparisons with international high-speed rail systems and the markets they serve provide some basis for assessing the potential market for high-speed rail. California's Phase 1 system will serve cities with a combined 2040 forecast population of more than 27 million people in 2040. The French high-speed rail line between Paris and Marseilles links cities along the route with approximately 15 million people and generated 31 million riders in 2008.

Costs

How are costs calculated? Are they realistic? Have they been updated? Do they take into account reasonably anticipated changes? How do they take into account unknown changes? How will costs be managed/contained?

Unlike previous plans, capital costs are presented in ranges to reflect the reality that a number of significant decisions on routing, mitigation, and other factors that will affect the final costs are yet to be made. Costs have been updated to reflect the actual results of several years of engineering and environmental work, as well as extensive community outreach that have affected designs and costs. The more detailed analysis that has been completed to-date reflects conditions on the ground along much of the corridor to provide an accurate estimate of the construction costs. Costs have been reviewed and validated by two separate assessments, including one by an independent construction contractor. The cost-per-mile of the system falls within international ranges for high-speed rail systems. The revised estimates include significant specific contingencies, ranging from 15 to 25 percent for the various components of the costs, as well as an overall "unallocated" contingency of 5 percent.

The Authority is implementing a comprehensive cost-control program, which includes the following:

- **Value engineering**—Identifies and analyzes the potential for savings through alternative construction approaches, changes in design, or scope
- **Change control**—A rigorous process to ensure that any changes, especially ones that increase costs, are thoroughly reviewed and approved prior to being incorporated
- **Quarterly "snapshot" estimates**—To provide regular and ongoing information to identify changes in cost and take appropriate actions
- **Procurement and construction efficiencies**—Estimates do not take into account potential savings and efficiencies that can be gained through alternative financing and delivery mechanisms. Experience in California and elsewhere shows that large transportation programs delivered through traditional processes, in which the public agency is responsible for all design and then contracts with the private sector for construction, incur significant cost overruns. Alternative methods, such as design-build, in which responsibility and risk is shifted to the private sector earlier in the process, and public-private partnerships, which engage the private sector not only in earlier stages of design but also financing, can mitigate against such cost growth. Every stage of the HSR program will incorporate these non-traditional delivery methods, starting with design-build on the ICS.

Schedule

How is the schedule for delivery of the system determined? Is it realistic? What will drive the schedule? How does schedule affect cost?

Experience and information gained over the last few years, along with the incorporation of current budgetary and economic realities, make it clear that previous assumptions of full Phase 1 system completion by 2020 is unrealistic. More realistic schedules are provided in this Business Plan, and costs adjusted to align with the longer time frames.

The phasing plan described in this Business Plan includes smaller operating sections, which are capable of generating operating profits and can act as potential “off-ramps” for the state to create useable infrastructure that will generate benefits to the state without committing to much larger investments. The schedule used in this Business Plan is illustrative, and the actual timing of construction will be driven by a number of factors, including availability of funding and financing sources and environmental reviews and approvals.

An annual inflation rate of 3 percent has been assumed in this Business Plan and built into the financial plan and the cost estimates. This is extremely conservative and translates directly into higher cost estimates. Inflation has averaged 0.6 percent in the last two years and 2.3 percent over the last decade.[1] This inflationary adjustment accounts for $27.5 billion of the Phase 1 YOE costs—almost 30 percent of the total cost.

Subsidies

What is the experience with operational subsidies of high-speed rail systems internationally? How do California’s ridership forecasts and operating costs compare to those systems?

Proposition 1A requires that operation of the high-speed rail service not require a subsidy and that the Business Plan make it clear that this will be the case, even at the lowest ranges of ridership for each stage of high-speed revenue service.

There have been highly publicized claims that the International Union of Railways (UIC), the organization representing high-speed rail operations globally, said that most high-speed rail systems do require an operational subsidy. The UIC director-general has specifically rejected such claims as false, saying, *“These remarks are incorrect and biased; they neither reflect how business models for high-speed rail are applied in Europe and Japan, nor UIC’s overall stance on the matter. The remarks are clearly part of a campaign to discredit railway transport to benefit other interests.”*

In fact, high-speed rail systems around the world cover their operating costs, which is a key reason why 13 nations have built almost 10,000 miles of high-speed rail lines in the last few decades and why 24 countries are planning and building another 16,000 miles. The financial analysis of the California system, described in detail in this Business Plan, clearly demonstrates that the ridership and revenues are well able to cover the costs of operating the system, meaning that no operational subsidy will be required. This is true starting with the first stage of high-speed rail operations and under the conservative assumptions made in the ridership forecasting.

Implementation

How have other high-speed rail systems been implemented? What factors determine the most appropriate strategy? How are risks, such as funding delays, addressed? If California starts the program, is it committed to finishing it, no matter what it costs or how long it takes?

The central element of this Business Plan is the phased implementation of the program, breaking down the 800-mile statewide system into a series of smaller, discrete projects that can stand on their own, be matched to available funding, and be delivered through the most efficient business models. This phased approach provides the state's decision-makers with the ability to determine when and how the next steps should proceed, while putting into place a fully operational and viable legacy of transportation infrastructure and economic benefits.

This phased approach is based on the experience of implementing large-scale infrastructure programs, ranging from high-speed rail systems in other countries to the California water project and freeway system. In each of these cases, the program was begun based on a long-term vision and plan but without all funding in place. Segments were built and opened based on availability of funding, clearance of regulatory reviews, and other factors.

Under the phased approach for high-speed rail, California can begin work next year, creating jobs and laying the foundation for future expansion and benefits. At the same time, the state will never start any step of the system until and unless it has the ability to finish it. While the economic and financial analyses demonstrate the viability of a statewide high-speed rail system and the transportation, environmental, and job-creating benefits are clear, moving forward with the Initial Construction Section does not commit the state to future obligations. Those decisions will be made at the appropriate time, based on readiness, availability of funding, and other factors.

Funding

What assumptions are being made about additional funding? What are the potential sources? What needs to be in place before starting? If the state starts the program, is it committed to finishing it, no matter what it costs or how long it takes?

Many, if not most, major infrastructure programs begin without all of their funding in place at the start of construction and move forward based on a clear long-term plan, the availability of funding, and other factors. For example, Interstate 5 began as small stretches of highway through the Central Valley and was completed over 40 years as funding became available. The state water project began 50 years ago with an initial bond program and continues to expand through funds from the various contracting agencies that deliver water locally. Japan, the country that pioneered high-speed rail, opened its first line in 1964 and continues to expand the system, with the most recent addition opening earlier this year.

California has been extremely successful in winning federal high-speed rail grants, obtaining close to 40 percent of the money available for the country as whole. This initial federal funding allows California to move forward with the first step in the high-speed rail program. The Initial Construction Section in the Central Valley, which will be fully funded upon appropriation of state bond funds to match federal grants, becomes the platform for expansion into the Initial Operating Section—the first high-speed rail service in California and the nation—and can be used to greatly improve the Amtrak San Joaquin service that currently serves one million passengers per year.

The Business Plan identifies a number of funding and financing tools that can leverage the Proposition 1A bond funds approved by voters in 2008. The phased implementation approach takes these options into account, and the Business Plan identifies private-sector investment that can be brought into play through phasing.

Private-sector involvement

How will the private sector contribute to the financing and construction of the system? When is it reasonable to expect participation? What has been the experience internationally? How is private-sector interest gauged?

The private sector will play an important role throughout the system implementation process. There are two broad goals for gaining private-sector engagement: cost and schedule control through alternative delivery mechanisms that shift risk from the public sector, and direct investment in expansion of the system.

The public will gain from private-sector engagement starting with the first contracts for the Initial Construction Section. The ICS will be delivered through a design-build procurement under which the responsibility for completing design and then constructing the project is given to the private sector for a set price. Under this approach, the private sector has clear incentives and flexibility to use innovative techniques to bring the project in on-time and on-budget.

As the first IOS moves to completion, the private sector will be engaged to operate service and, based on revenues, contribute to the completion of the subsequent sections. Following international precedents, once the system is up and running, the infrastructure can be bid to a concessionaire for a long-term lease that will generate funding that can be used to repay the initial public investment or to construct subsequent phases.

Business model

What are the roles of the public and private sector in delivering the high-speed rail system? How does international experience inform California's decision-making? What are the goals of various business models?

Overall, the goal of establishing a business model is to assign responsibilities to the appropriate entity that can carry out those responsibilities most efficiently and effectively. There will be different models at different stages of implementation; some responsibilities will shift, and some will remain constant. For example, governance—ownership, oversight, and policy-setting—remains a public-sector responsibility throughout the life of the program, and operations will be a private-sector responsibility. Capital investment begins with the public sector and then becomes shared with the private sector as profitable revenue service begins.

While the public sector will always maintain its ownership, oversight, and policy role, some other elements might achieve greater efficiency by leveraging private-sector expertise. There are two main reasons why other countries have chosen to use public-private-partnerships in their high-speed rail systems: the generation of capital and the containment of cost. The amount of private financing will be closely tied to the risks that the private sector is asked to take on—the private sector will require higher returns for riskier investments, decreasing the financing potential. Potential benefits to both sides lie in areas where the private sector will be able to more easily mitigate risks or generate more revenue than would a public entity. As such, the business models for California high-speed rail will change for different implementation phases to take advantage of different areas of private-sector expertise and produce the right risk environment for both public sector and the private-sector investors.

Integration with other transportation systems

How will the HSR system connect with regional and local transit systems? What is being done to promote efficient planning? How will redundancies be avoided? Will investments in high-speed rail replace highways or aviation?

Proposition 1A recognized the importance of making a statewide high-speed rail system an integral and integrated part of a broader, balanced transportation network. It authorized $950 million in funding for improvements to 10 regional and local rail systems that will connect to the high-speed system, along with the $9 billion for the high-speed system. The integration of high-speed rail with these other systems is critical to its success. Significant efforts are underway to enhance coordination and planning and to develop cost-effective approaches to the implementation of high-speed rail and its integration with existing regional and local services. This Business Plan—and the blended approach discussed in it—signals a strengthened effort to advance this coordination and ensure that systems and services are well integrated.

By 2050, California is expected to add more than the equivalent of the state of New York to its population. To maintain quality of life and economic competitiveness, significant new capacity must be added to its infrastructure, including transportation. The statewide high-speed rail system will provide a significant solution to this capacity challenge. To provide the same capacity as Phase 1 of the high-speed rail system, approximately $171 billion would have to be invested in highways and aviation: 2,300 miles of new freeway, 115 new airport gates, and 4 new runways. Not only would such investments be much more costly than the HSR system, they would run counter to state policies such as AB32, the Global Warming Solutions Act of 2006, and SB375, the Sustainable Communities and Climate Protection Act of 2008.

Some level of investment in highways and airports will be needed to meet future travel demand. However, high-speed rail is a more cost-effective and sustainable addition to the state's transportation network and by investing in it, a major highway expansion will not be needed.

Risk management

What is in place to identify and manage risks? How is this done elsewhere? What are the greatest risks?

The Authority has implemented a detailed risk management process with the objective of reducing risk through formal processes and procedures. These processes allow the Authority to understand and manage key risks and their impact on the program's objectives. An overall risk management plan and organization have been established, and foreseeable risks have been identified that may threaten the program's viability. In addition, the causes of each risk have been investigated to determine the underlying driver and cause. The phased implementation strategy is itself a major risk mitigation, limiting the state's commitment and tying investments to viable operations. While all risks identified by the Authority are significant, two require the special focus of the Authority and other state agencies and officials:

- **State staffing**—This Business Plan is predicated on having an organization with experienced staff who can execute it. Funding and filling the needed positions with professionals who have high-speed rail experience are perhaps the single best investment that the state can make toward reducing costs and accelerating development of the program.
- **Funding**—The two mitigations to this unknown are phased development and maintaining the developmental head start that California has over other national projects. This Business Plan has identified three stand-alone high-speed rail projects (IOS-North, IOS-South, and Bay to Basin) that provide fully functional systems and potential off-ramp points.

Private-sector involvement can provide a solution to the financing of the program but also as a way to mitigate clearly identified risks. International examples lead the Authority to realize that an early involvement of the private sector in the program will effectively address issues around risk transfer. International experience reveals that optimal risk sharing is achieved when risks are born by the party most able to mitigate them.

Job creation and economic benefits

What has the experience been internationally with economic development? How would that translate to California? How are job estimates calculated?

As has been the case internationally, implementation of a high-speed rail system will create jobs in two broad categories. In the near term, as the program moves into delivery, direct and indirect jobs are tied to construction. Starting next year, the Initial Construction Section will create 100,000 jobs, focusing on the Central Valley, which has the highest unemployment rate in the state, and on the construction industry, the hardest-hit sector of the economy. Over the course of construction of the Full Phase 1 System, 1.2 to 1.3 million jobs will be created. These figures are based on commonly used estimates derived from the President's Council of Economic Advisors and the American Public Transportation Association, among others.

In the longer term, high-speed rail will increase the efficiency of the California economy and allow it to successfully compete against regions around the world. These long-term benefits could result in as many as 400,000 jobs added to the state's economy. The positive long-term economic impacts of high-speed rail are key reasons why so many countries around the world are building high-speed rail systems. By bringing cities and markets closer together, high-speed rail creates synergies and connections that are not currently possible. A variety of studies, including ones by the London School of Economics and the U.S. Conference of Mayors, have provided the basis for these long-term job estimates.

Ticket prices

How are prices determined? What would cause them to change? Who will ultimately set the prices?

For the ridership forecasts developed as part of this Business Plan, average high-speed rail fares were set at just over 80 percent of prevailing airfares for trips between the Los Angeles region and Bay Area. This fare is designed for high-speed rail to successfully compete for passengers with airlines. Trips between the Central Valley and the metropolitan areas, which currently are extremely expensive by air, are priced to be more competitive with the cost of driving. Overall, ticket prices are assumed in the ridership forecasts to be in the range of approximately $60 to $80 one way, in 2010 dollars.

Once operations begin, the private operator will set fares under parameters set by the Authority and according to a yield management system where ticket prices will vary based on a number of factors. For example, someone buying a non-refundable ticket two weeks ahead of time for an off-peak train will pay a lower fare than someone buying a ticket last minute for a peak-hour train. Additionally, most international systems include special discount prices for seniors, students, members of the military, and frequent travelers.

Starting construction in the Central Valley

What are the key reasons for starting there? Can federal funds be used elsewhere? What plan is in place for the use of subsequent rounds of funding?

Starting in the Central Valley allows the state to use its available funding to build the backbone of the system, the Initial Construction Section. Subsequently, the ICS can be expanded north or south to create the first operating high-speed rail system, and then the Bay to Basin system connecting Northern and Southern California. Additionally, by starting in the Central Valley, the state will be able to secure the needed right-of-way in the state's fastest growing region before land values increase further (there are existing rights-of-way on both ends that high-speed rail will be able to share without requiring the purchase of new land). The section in the Central Valley is the only part that can be used to test the high-speed rail equipment at its maximum 220 mile per hour operating speed. The ICS also has independent utility. In the event that progress on the Initial Operating Section is delayed, it can be put into service to improve Amtrak's San Joaquin service, the fifth busiest Amtrak line in the country, with more than a million riders annually. Without any other improvements, use of the ICS would decrease travel times on the San Joaquin line by approximately 45 minutes.

The federal funding being used in the Central Valley has three important criteria that affect where and how it can be used: a funded project must be completed by September 30, 2017; a funded project must have operational independence; and funding is limited to "rail passenger transportation except commuter rail passenger transportation." Based on these criteria, the Authority and the Federal Railroad Administration determined that the Central Valley was the appropriate place to use the federal funds.

Management and oversight

Is the California High-Speed Rail Authority sufficiently staffed to oversee this program? What oversight is there of the program, beyond the Authority?

Plans have always assumed that the Authority will be a lean organization with a relatively small number of experienced and qualified staff overseeing private-sector contractors. The Authority's Board provides oversight and policy direction to the staff. The Department of Finance provides budgetary oversight, and the Legislature has oversight as it does of any state agency.

The Authority has identified inadequate staffing as a significant risk to the success of the program. Over the last year, with support from the Governor and the Legislature, the Authority has increased its staffing and has filled some key positions. A priority for the senior management team is to fill open positions to lead major work streams, such as chief financial officer, chief program manager, and risk manager.

End notes

[1] *Source:* United States Department of Labor, Bureau of Labor Statistics. *Consumer Price Index.* ftp://ftp.bls.gov/pub/special.requests/cpi/cpiai.txtd)