



# California High-Speed Rail Program Draft Revised 2012 Business Plan

APRIL 2, 2012

## Building California's Future





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## Acronyms and Abbreviations

ACE	Altamont Commuter Express
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
CAFE	corporate average fuel economy
CALPIRG	California Public Interest Research Group
CALTRANS	California Department of Transportation
CEO	chief executive officer
CHSRA	California High-Speed Rail Authority (see also “Authority”)
CHSRP	California High-Speed Rail Program
CTC	California Transportation Commission
DBB	design-bid-build
DBE	Disadvantaged Business Enterprise
DBF(O)M	design-build-finance-operate-maintain
DVBE	Disabled Veterans Business Enterprise
EIA	U.S. Energy Information Administration
EIR/EIS	environmental impact report/environmental impact statement
EPA	U.S. Environmental Protection Agency
ERR	economic rate of return
FAX	Fresno Area Express
FR	<i>Federal Register</i>
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
GDP	Gross Domestic Product
GET	Golden Empire Transit
GHG	greenhouse gas
HSIPRP	High-Speed Intercity Passenger Rail Program
HSR	high-speed rail
HUD	U.S. Department of Housing and Urban Development

ICE	InterCityExpress (German HSR)
IOS	Initial Operating Section
IRJ	<i>International Railway Journal</i>
IRR	internal rate of return
JR Central	Central Japan Railway Company
KART	Kings Area Rural Transit
LACTMA	Los Angeles County Metropolitan Transportation Authority
LDV	light-duty vehicle
Metrolink	Southern California Regional Rail Authority
MB	Microbusiness
MOU	memoranda of understanding
MPH	miles per hour
MPO	metropolitan planning organization
MTC	San Francisco Bay Area Metropolitan Transportation Commission
MTS	San Diego Metropolitan Transit System
MUNI	San Francisco Municipal Railway Transit System
NCTD	North County Transit District
NPV	net present value
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
RFEI	Request for Expression of Interest
ROW	right-of-way
RPA	Regional Plan Association
RRIF	Railroad Rehabilitation and Improvement Financing
RT	Sacramento Regional Transit District
RTA	regional transportation agencies
SANBAG	San Bernardino Association of Governments
SANDAG	San Diego Association of Governments
SB	Senate Bill
SB	Small Business
SCAG	Southern California Association of Governments
SDCRAA	San Diego County Regional Airport Authority
SHCC	Self-Help Counties Coalition

SJRRC	San Joaquin Regional Rail Commission
Socal ICG	Southern California Inland Corridor Group
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

for board consideration





## Executive Summary

### Better. Faster. Cheaper.

That has been the charge to the California High-Speed Rail Authority (CHSRA/Authority) in revising the Draft 2012 Business Plan (Draft Plan). Following release of the Draft Plan on November 1, 2011, Governor Jerry Brown affirmed the importance of moving forward with high-speed rail (HSR) as an important investment in California's future. But, he and others called for changes to the Draft Plan so that the utility of the system and its connectivity with regional/commuter rail systems will be improved; so that Californians will realize benefits sooner; and, so that the costs to taxpayers will be reduced.

The responsibility of the Authority, as established in Proposition 1A, is clear—to implement the program approved by the voters.

*It is the intent of the Legislature by enacting this chapter and of the people of California by approving the bond measure pursuant to this chapter to initiate the construction of a high-speed train system that connects the San Francisco Transbay Terminal to Los Angeles Union Station and Anaheim, and links the state's major population centers, including Sacramento, the San Francisco Bay Area, the Central Valley, Los Angeles, the Inland Empire, Orange County, and San Diego...*

The Draft Plan laid out a roadmap for how such a high-speed program could be implemented. Following its release, the Authority solicited, reviewed, and considered comments from a broad range of interested parties. Public meetings to receive comments were held in Sacramento, Merced, and Los Angeles. The Draft Plan was the focus of several legislative hearings that included public participation. Numerous meetings and discussions were held around the state with a wide range of stakeholders. Input was received from the California High-Speed Rail Peer Review Group, the Legislative Analyst's Office, and the Bureau of State Audits. More than 250 comments were submitted to the Authority's website and through letters.

There was widespread acknowledgement that the Draft Plan was an improvement over previous versions; that it was realistic, transparent, and that it presented a logical and feasible means of delivering the program through phased implementation. That realism and transparency also meant that the public and decision-makers were confronted with higher cost estimates, longer time frames, and a frank assessment of the current funding outlook, which includes contentious issues at the federal level.

The critiques, commentaries, and suggestions yielded a number of consistent themes:

- Broad support was voiced for a phased implementation strategy to deliver the system
- The cost for the full-build system was too high
- A blended approach to both construction and operations, reducing costs and impacts, is the preferred path forward
- Near-term investment in the "bookends" (the Los Angeles and San Francisco Bay Area metropolitan regions) would produce immediate benefits and enhance the ultimate utility of high-speed rail

- Closing the intercity rail gap across the Tehachapi Mountains between Bakersfield and Palmdale should be a priority to connect the state via rail
- The benefits of the initial investment in the Central Valley were not clear enough and were seen by some as imposing a risk of stranded investment if the program did not continue
- Ridership estimates remain a question for some
- The opportunity to bring in private-sector investment earlier should be re-evaluated
- Some of the technical analyses, such as the presentation of the cost of alternative capacity on freeways and airports, were not clearly presented, leading to misunderstanding or skepticism
- The near-term federal budget scenario raises questions about when and how new federal funding will be provided to support the implementation of the next steps of the program

### ***Key changes from the Draft 2012 Business Plan***

The wide array of input, along with further analysis by the Authority, has resulted in significant changes to the Draft Plan. With these changes, the 2012 Revised Business Plan (Revised Plan) provides for an implementation strategy that delivers greater value, broader benefits, and earlier results by more quickly and effectively integrating HSR into an expanded, improved statewide rail network, as shown in Exhibit ES-1.

The overall passenger rail system will be significantly **better** because of two commitments in the plan. First is the commitment to build not just an initial construction segment but in fact an Initial Operating Section (IOS) of high-speed rail. This IOS, which can be completed within 10 years, will connect the Central Valley to the Los Angeles Basin. This segment will bring high-speed, electric passenger operations to California, tying together the Central Valley with the Los Angeles Basin as a first step toward a statewide high-speed rail system. Second, the Revised Plan provides for the integration, or blending, of high-speed rail improvements with existing and upgraded rail systems. Passengers will have more options, faster travel times, and greater reliability and safety. By leveraging new infrastructure and systems with existing and upgraded systems, taxpayers will benefit from greater cost efficiency and more effective use of state investments dollars.

Benefits will be delivered **faster** through the adoption of the blended approach and through investment in the bookends. Across the state, transportation systems will be improved and jobs will be created through the implementation of those improvements. The Central Valley will see the initial construction of the nation's first high-speed rail system and will benefit from an expanded and integrated passenger rail system that uses that infrastructure. The San Francisco Bay Area will see the benefits of improved safety, reliability, efficiency, and air quality through the long-awaited electrification of the Caltrain corridor, targeted by Caltrain for 2020. Southern California will see near-term improvements in the Metrolink system, better connectivity of transit and rail services in Los Angeles, San Diego, and the Inland Empire through cooperative early investments, using allocations from the \$950 million in Proposition 1A connectivity funds and other sources.

## Exhibit ES-1. Summary of key changes in Revised 2012 Business Plan

Revision from Draft Plan	Description	Benefits
Commitment to blended system	Focuses new high-speed infrastructure development between the state's metropolitan regions while using, to the maximum extent possible, existing regional and commuter rail systems in urban areas.	Cost reduction, reduced community impacts, better leverage of resources/ investments
Commitment to blended operations	At all phases of development, seeks to use new and existing rail infrastructure more efficiently through coordinated delivery of services, including interlining of trains from one system to another, as well as integrated scheduling to create seamless connections.	Maximizes benefits of all investments, accelerates improvements, provides seamless travel for users, enhances connectivity to system
Investment in bookends	Makes improvements in existing rail systems in the metropolitan regions prior to or, in some cases, in lieu of, high-speed infrastructure. Connects high-speed rail to already existing modes of transportation.	Delivers improved service—reliability, safety, efficiency—to users of existing rail systems, providing tangible benefits in the near-term and building rail ridership for the long-term
Initial Operating Section (IOS)—South	<p>Based on factors including ridership and revenue forecasts, capital and operating costs, public input, and potential for private-sector investment, the Revised Plan identifies the IOS-South as the preferred implementation strategy. This will close the gap between Bakersfield and Palmdale and connect the Central Valley to the Los Angeles Basin at San Fernando Valley, creating the first fully operational high-speed rail system. This will be coupled with investments in Northern California to provide near-term benefits and lay the foundation for high-speed rail service to San Jose and San Francisco. Upgrades to the existing San Joaquins service will provide further time savings.</p> <p>Cap and trade funds are available, as needed, upon appropriation, as a backstop against federal and local support to complete the IOS.</p>	<p>Clarity of focus for development work, development of funding strategies, engagement with private sector interests, connecting the regions via a statewide rail network.</p> <p>Close the rail gap between Northern and Southern California, the state's highest priority for intercity rail.</p> <p>Connect the state's largest population (Los Angeles Basin) with the fastest growing part of the state (Central Valley).</p>
IOS First construction segment—put into service	Through collaborative planning and implementation with the California Department of Transportation (Caltrans), Amtrak, Altamont Commuter Express (ACE), BNSF Railway, and Union Pacific, the San Joaquin rail service (fifth busiest in the nation) will be shifted to the first construction segment upon its completion, resulting in a 45-minute time savings; through complementary improvements, this will tie with ACE to provide new, expanded, and improved rail service throughout northern California, connecting the Central Valley with the San Francisco Bay Area and Sacramento regions.	Enhanced utility of initial investment, providing improved service to the more than 1 million San Joaquin riders, and opening up regional rail service

The benefits of investing in high-speed rail will be delivered far *cheaper* than previously estimated. Through the adoption of a blended approach, the Authority has confidence that the cost of delivering the San Francisco-to-Los Angeles/Anaheim system, in accordance with Proposition 1A performance standards, is reduced by almost \$30 billion, now estimated at \$68.4 billion. Under the phased approach, and consistent with Proposition 1A, construction of any segment would only proceed when funding is identified and the Legislature has approved the use of additional state funding.

### ***A blended system with broader, earlier benefits***

The most consistent and widespread recommendation from those commenting on the Draft Plan was to fully adopt the “blended” approach in which existing metropolitan rail infrastructure would be used as much as possible and upgraded as needed to provide connections into the urban areas. For example, the legislatively mandated California High-Speed Rail Peer Review Group, in its January 3, 2012, letter to the Legislature ([www.cahsrprg.com/index.html](http://www.cahsrprg.com/index.html)), stated the following,

*We congratulate the CHSRA on its recognition of the viability of the blended option. Given the adamant environmental opposition to the full build-outs on either end of the system and the enormous added costs involved, we question the value of retaining the full Phase 1 build-out at all in any of the CHSRA’s more immediate plans.*

The implementation strategy in the Revised Plan draws on international experience in building high speed rail systems and has been tailored to address the unique circumstances in California through collaboration with state, regional, local, and private transportation partners. It is a phased strategy with three key elements:

- “**Blending**” high speed with existing rail systems to accelerate and broaden benefits, improve efficiency, minimize community impacts, and reduce construction costs while enhancing rail service for travelers throughout the state
- Making **early investments** in the “bookends,” or San Francisco Bay Area and Los Angeles Basin regions, to upgrade existing services, build ridership, and lay the foundation for expansion of the high-speed system
- Delivering **early benefits** to Californians by using and leveraging investments as they are made

For Phase 1, as described in Proposition 1A, the blended system means building the “Bay-to-Basin” system, with new, dedicated HSR infrastructure connecting San Jose and the San Fernando Valley, and then to Los Angeles’ Union Station. Improvements will be made to the existing Amtrak/Metrolink rail corridor between Union Station and Anaheim to improve safety, reliability, capacity, and travel times in that corridor. In the San Francisco Bay Area, the existing Caltrain corridor will be upgraded through grade separations, passing tracks, and electrification to provide the connection north from San Jose to the new Transbay Transit Center in Downtown San Francisco. This blended system will allow a one-seat ride (meaning passengers will not have to change trains) between San Francisco and Los Angeles and provide greater connectivity with existing regional and local transit systems. These benefits will be the foundation for implementation of a high-speed program in phases, as described in detail in Chapter 2, The Implementation Strategy: Blending, Phasing, Investing in Early Benefits, as follows:

- (1) **Early investments/statewide benefits**—First construction of the IOS, improvements to existing regional/commuter systems, new Northern California unified passenger service, and an accelerated closure of the rail service gap between Northern and Southern California
- (2) **Initial high-speed rail operations**—Completion of the IOS and operation of the first high-speed rail revenue service in the United States
- (3) **The Bay-to-Basin system**—Linking the state’s major metropolitan areas with high-speed rail service while incorporating improved regional service
- (4) **The Phase 1 system**—Connecting San Francisco, the Central Valley, and Los Angeles/Anaheim through a combination of dedicated high-speed rail infrastructure blended with existing urban systems
- (5) **Phase 2 expansion**—Bringing high-speed rail to Sacramento, San Diego, and the Inland Empire. Through the blended approach to Phase 1, these areas will see improvements in rail service and access to high-speed rail service far earlier than previously planned.

#### **What does “blended” mean?**

The 2012 Business Plan refers to blended systems and blended operations, which describe the integration of high-speed trains with existing intercity and commuter/regional rail systems via coordinated infrastructure (the system) and scheduling, ticketing and other means (operations).

#### **Blended systems—*integrated infrastructure investments***

Existing rail systems already serve intercity, commuter, and regional trips throughout California. A blended system would leverage these systems by tying them together with a HSR backbone through the Central Valley and connecting to major metropolitan areas. Although improvements to the regional and commuter rail systems are intended to improve or facilitate connections and integration with the high-speed rail system, they do not need to be implemented sequentially. Regional or local improvements to the existing systems, such as elimination of at-grade crossings and the addition of new passing tracks, have independent utility that will benefit regional and commuter passengers prior to connection to the high-speed rail system. Where possible, these improvements should move ahead independently and as quickly as feasible to accelerate benefits to California travelers.

#### **Blended operations—*integrated service***

The blended system will allow rail operators to take advantage of new and improved infrastructure to enhance existing service, delivering benefits sooner. Blended operations will evolve over time, as infrastructure is developed. Utilization will progress from the operation of existing services over new high-speed rail infrastructure prior to the initiation of revenue service, to the coordination of high-speed and conventional rail services, to the interoperability of high-speed and conventional rail over shared infrastructure. In each phase, the goal will be to maximize and accelerate the benefits of investments in the most cost-effective manner.

**Early investments, statewide benefits**

Under the Draft Plan, the initial investments of Proposition 1A bond proceeds and matching federal funds were focused primarily in the Central Valley, with subsequent extensions reaching other areas of the state in phases. This Revised Plan retains the start of construction of new high-speed infrastructure in the Central Valley but introduces simultaneous investments to produce immediate benefits throughout the state (Exhibit ES-2). Working collaboratively with regional transportation partners, advanced investments will be made in the existing Los Angeles Basin and San Francisco Bay Area rail systems. These early improvements will accomplish two key goals:

- First, these improvements will lay the foundation for the high-speed rail system as it expands to reach those areas and connect the state.
- Second, because these improvements can proceed independently of the high-speed rail system, they will provide near-term benefits to travelers in metropolitan areas.

Benefits will be realized sooner and more efficiently, not only in metropolitan Los Angeles and the San Francisco Bay Area, but also in the Los Angeles–San Diego corridor, the Inland Empire, and the Sacramento region—all of which would see improvements much earlier than under any previous plan. This approach represents a significant evolution of thinking about how high-speed rail best fits into California’s transportation system and best serves the people of the state. More specifically, rather than being planned, designed, and implemented largely as a stand-alone system, high-speed rail in California will be integrated into a comprehensive and seamless statewide passenger rail network. Leveraging and partnering with intercity and regional systems results in a wide range of benefits, including the following:

- Accelerated delivery of advantageous investments
- Expanded early benefits for rail passengers
- Reduced costs
- Greater cost-effectiveness
- Fewer construction and operating impacts on communities
- Coordinated planning and investments among state, regional, and local agencies
- Improved transportation and reduced congestion in metropolitan areas
- Reduced air pollution, including greenhouse gas emissions

Exhibit ES-2. Early investments/statewide benefits



**Early Investments/Statewide Benefits**

- ◆ Begin construction of IOS HSR infrastructure
- ◆ Start Northern California unified service
- ◆ Invest in the “bookends”
- ◆ Advance early priority:
  - Close rail gap to LA Basin

**New Northern California Unified Service**

The first construction segment of the IOS will be put into use immediately upon completion for improved service on the San Joaquin intercity line. This service, the fifth busiest Amtrak line in the nation, already serves more than 1 million riders a year and will link with other systems, such as ACE and Caltrain, to create a new, improved network reaching from Bakersfield to the San Francisco Bay Area and Sacramento. Immediately, California’s rail network will be able to carry passengers faster and more reliably than ever before.

**Begin building the Initial Operating Section**

The IOS of the California high-speed rail system will connect the Central Valley near Merced to the San Fernando Valley gateway to Los Angeles. This facility will be transformational in creating a passenger rail nexus between one of the fastest growing regions in the state with the state’s largest population center. Among its many benefits will be the realization of the state’s highest intercity passenger rail priority—closing the state’s single largest gap in intercity rail service—linking north and south at Bakersfield to Palmdale. Immediate steps toward this goal include the prioritization of environmental clearance and other preliminary work necessary for this gap closure.

### Improve service in the “bookends”

This will be achieved by putting the \$950 million in Proposition 1A funding for connectivity to work. The Authority will work with the California Transportation Commission, Caltrans, and regional rail systems to gain approval this fiscal year for funds that can be used to make near-term improvements that will tie to eventual HSR service. Millions of travelers throughout the state will benefit from faster, more frequent, and more reliable services associated with the expansion of key transit investments throughout the state.

Additionally, the Authority is working with regional transportation agencies through memoranda of understanding and other mechanism to identify and implement additional improvements beyond the \$950 million in connectivity funds that can provide near-term benefits to commuters on Metrolink and Caltrain and pave the way for the future HSR system.

### Electrify the Caltrain corridor

Electrifying Caltrain will result in a faster, more efficient, and more environmentally friendly rail system that will eventually allow for a one-seat ride between San Francisco and Los Angeles.

Electric trains can stop and start faster than diesel trains, which will reduce the time it takes to travel between San Francisco and San Jose. As Caltrain has already demonstrated, decreased travel time results in increased ridership. As more people ride Caltrain, congestion on freeways and surface streets in the San Francisco Bay Area will be reduced. In addition, the switch to electric power will lower air pollutant emissions from trains by up to 90 percent while significantly reducing power consumption. Electric-powered trains also are significantly quieter, which will benefit those living and working near the rail corridor.

### Investing for California’s next generations

The need for a new generation of transportation improvements in California is clear. Today, the state’s transportation systems are straining to meet current demand. Congestion on 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 an hour or more.

Continued population and economic growth will place even more demands on California’s already overburdened mobility systems. 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* those investments can provide the greatest benefits.

As has been proven around the world, high-speed rail, when integrated into a balanced transportation system, can meet a significant portion of increased demand in a manner that is sustainable and cost-effective.

As detailed in this Revised Plan, a statewide HSR system can be delivered to the citizens of California that will produce economic benefits, enhance and support environmental and energy goals, create near and long-term employment, improve mobility, and save money. Such a system also advances the state toward the attainment of goals established by landmark legislation such as California Senate Bill 375, the Sustainable Communities and Climate Protection Act of 2008, and Assembly Bill 32, the Global Warming Solutions Act of 2006. In its scoping plan for implementation of AB 32, the California Air Resources Board supports implementation of a high-speed rail system as “part of the statewide strategy to provide more mobility choice and reduce greenhouse gas emissions.”<sup>1</sup>

Chapter 9 of this Revised Plan, Economic Analysis, shows that the benefits of high-speed rail far outweigh the costs of building, operating, and maintaining it. Californians will begin to see these benefits next year, when initial construction of the IOS will provide a much needed economic boost to the Central Valley, the fastest growing part of the state and the region hardest hit by unemployment. Almost 100,000 job-years of employment will be generated by the initial construction work. The \$2.7 billion initial investment will give the state a net economic impact of \$8.3 to \$8.8 billion—a 3:1 return on its initial investment—and state and local governments would earn more than \$600 million back in tax revenue, or nearly 25 percent of how much the state will spend.

It also has become clear that the key to a successful high-speed rail program is to focus on putting an operational, high-speed segment in place and then using that segment as a building block for the full system. The IOS can be built within 10 years, generating positive cash flows from operations, carrying millions of riders, and serving as a launch pad for private participation in the construction and operation of the system.



**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*

The two keys to cost-effective and timely achievement of a statewide high-speed rail system are as follows:

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



### **Phasing the California State Water Project: “50 Years and Counting”**

The California State Water Project is the largest state-built and state-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.

By implementing the program in phases, work can be matched to available funding. Each segment can be delivered through a business model that transfers significant design, construction, cost, and schedule risks to the private sector and maximizes efficiency by capturing the advantages of private-sector innovation. Importantly, the phased approach means that decisions made today will not tie the state’s hands tomorrow. With the state’s success in securing over \$3 billion in federal funding, the first step can be taken now toward construction of the IOS. This money will be used to 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 as outlined in this Revised Plan. 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. HSR systems in other countries have been delivered this way as well. In Japan, for instance, initial plans provided an outline for full development, but implementation took place in segments, sometimes with years between the completion of one segment and the initiation of the next.

This Revised Plan has been developed by applying this and other successful implementation strategies that have evolved over the last half-century of experience throughout the world.

**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?

### ***Economy***

High-speed rail will bring significant benefits to California, both in the near term and in the long run. Benefits will be realized statewide and will encompass both economic and environmental concerns.

The Central Valley will experience the earliest positive impacts of this investment. Indeed, the economic growth associated with construction of the first segment of the IOS will create jobs in a region that is home to the highest unemployment rate in the state. As noted earlier, moving forward with initial construction will generate approximately 100,000 job-years of employment for people who need them most.

Along these lines, California's construction industry, the sector hardest-hit by the economic recession, will see a boost in business associated with high-speed rail construction.

Connecting the Los Angeles and San Francisco metropolitan areas will generate approximately 800,000 to 900,000 job-years and will eventually result in more than 1 million job-years. High-speed rail is a major job generator, both in the short and long terms.

### ***Transportation infrastructure***

With the completion of high-speed rail, California's drivers will see significant relief in traffic congestion. HSR will lead to 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.

**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*

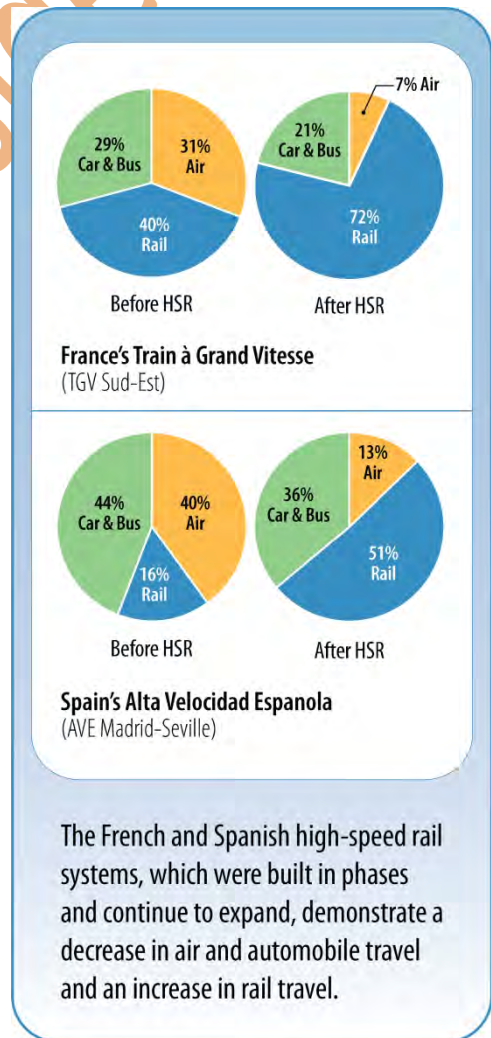


When high-speed rail service was introduced between Madrid and Seville, Spain, the share of trips taken by plane was reduced from 40 percent to 13 percent, and rail trips grew from 16 percent to 51 percent. This reduction in air travel means that limited airport capacity can be used more efficiently 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 also has 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.

### Funding and finance

Funding for the system will come from a mix of federal, state, and private sources and will benefit from innovative program delivery models that allow the private sector to design, build, and operate the system. Specific funding approaches are detailed in this Revised 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 concession to operate the full system and private capital to support construction of future phases. This private-sector involvement is feasible because each of the operating sections generates a positive cash flow from operations. Chapter 4, Business Model, includes a discussion of proven delivery and financing methods applicable to the high-speed rail program. Based on projected cash flows from operations, over \$10 billion in potential private-sector capital is anticipated once the 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.
- Risk is reduced for each subsequent section because of 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.

Funding for the initial construction of the IOS will be a combination of federal funding and Proposition 1A funding. As the program proceeds, the state will continue to see significant federal support and private-sector capital investment once operations have commenced. Cap and trade funds are available, as needed, upon appropriation, as a backstop against federal and local support.

### Exhibit ES-3. Service descriptions for phased sections

Section	Length (approx)	Endpoints	Service Description
Initial Operating Section	300 miles	Merced to the San Fernando Valley	Begins with construction of up to 130 miles of track and structures in Central Valley. Supports 220-mile-per-hour HSR service; includes trains and systems. Ridership and revenues sufficient to attract private participation. Connects with regional/local rail for blended operations.
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.
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.

### ***Planning scenario***

This Revised Plan includes a planning scenario for use in projecting performance of the system. In order to generate key performance data, this planning scenario includes several basic assumptions regarding the Bay-to-Basin and Phase 1 Blended operating sections:

- The system will be completed by 2028.
- The average ticket fare between San Francisco and Los Angeles will be \$81 (83 percent of anticipated airline ticket prices) in 2010 dollars, with up to nine trains per hour during the peak period.

For this Revised Plan, a planning schedule (Exhibit ES-4) was adopted that extended the date for completion of Phase 1 Blended from 2020 to 2028 to mitigate funding and other risks. Based on this schedule, costs have been inflated to assess the total costs in the year-of-expenditure.

**Exhibit ES-4. Construction schedule**

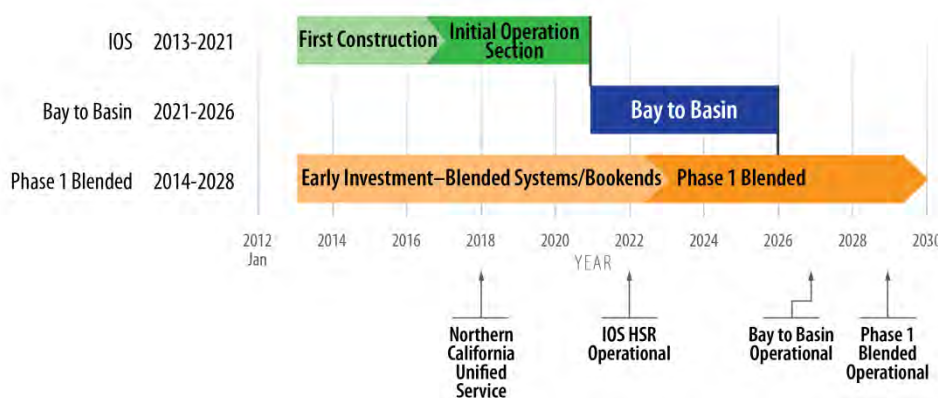


Exhibit ES-5 presents a planning case showing the impact of a 2028 schedule on year-of-expenditure cost.

**Exhibit ES-5. Planning case showing impact of planning schedule on year-of-expenditure cost**

Section	Incremental Capital Cost (billions 2011\$)	Cumulative Capital Cost (billions 2011\$)	Completion of Section	Incremental Year-of-Expenditure Capital Cost	Cumulative Year-of-Expenditure Capital Cost
IOS	26.9	26.9	2021	31.3	31.3
Bay to Basin	14.4	41.3	2026	19.9	51.2
Phase 1 Blended	12.1	53.4	2028	17.2	68.4

If required, a Full Build option for Phase 1 could be completed by 2033 at an incremental cost of \$23 billion in year-of-expenditure dollars, for a cumulative cost of \$91.4 billion.

**Ridership and revenue**

As is the case with any similar program, the forecasts of ridership and revenue continue to be the subject of extensive and intense review. Areas of focus include the model used to generate the forecasts, the assumptions and data used as inputs to the model, and the outcomes of the model. A number of steps have been taken to respond to comments and to continue to improve the reliability of the forecasts, and they are reflected in this Revised Plan. Those steps include the following:

- Inputs to the model have been updated and refined to use recent data reflect a broader range of scenarios.
- An independent panel of experts continues to review the model and its inputs.

- Post-model adjustments have been eliminated to reduce the potential for error, bias, or inconsistency.
- The model itself has been tested against actual conditions and external forecasts and demonstrated its reliability.
- Data and reports have been made available for public review.

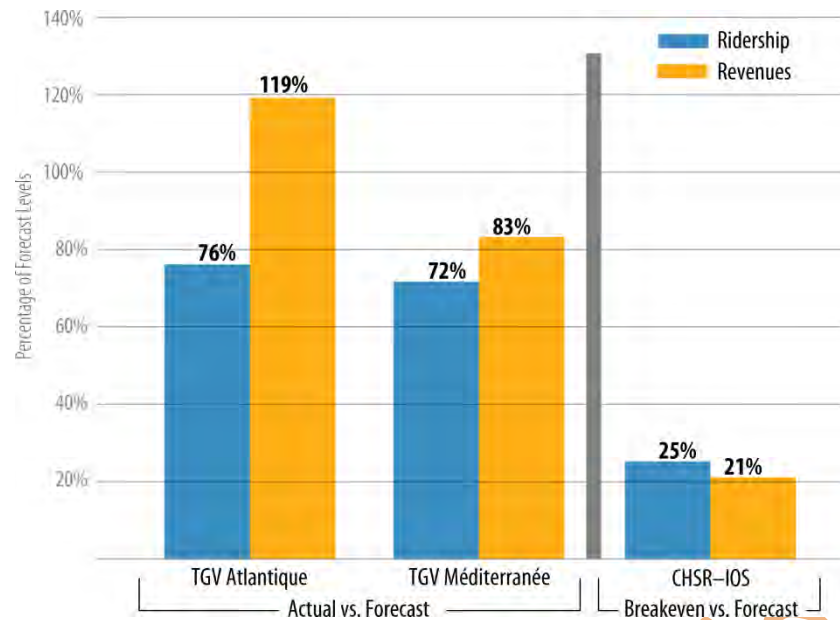
Details of these actions are provided in Chapter 5, Ridership and Revenue. An important step forward to demonstrate the viability of the model and the reliability of its outputs was the use of it to test actual conditions in the Northeast Corridor. This test demonstrated the sensitivity of the model to inputs and the reasonableness of the outcomes.

Another important aspect to consider is the performance of both domestic and international rail systems against their forecasts. Studies have been conducted on toll roads, high-speed rail systems, and quasi-high-speed rail systems. One of the most widely cited is a 2003 Cambridge University report titled *Megaprojects and Risk* by Flyvbjerg, et al. This report found that a common element in projects that failed to reach forecast results was an optimistic assumption of a particular event that would lead to higher ridership. For example, ridership forecasts for the French TGV system assumed significant spikes in motor fuel prices, which would cause more people to leave their cars and use high-speed rail. When the anticipated increase in prices did not occur, ridership did not materialize as projected.

This and other lessons were considered in developing the ridership and revenue modeling for the California high-speed rail program. Accordingly, there is no such reliance on singular and unsubstantiated factors such as an assumed spike in gasoline prices. Key inputs that are drivers of ridership, such as fuel prices, airline ticket prices, and population, are all conservative and based on external sources.

It is also important to understand what the performance of other HSR systems against forecasts might mean for the California system. In particular, international experience illustrates that disciplined management through a private-sector operator leads to stronger financial performance, even in the face of changing circumstances. For example, the French TGV Atlantique line initially was 24 percent below projected ridership, but exceeded revenue forecasts by 19 percent. Similarly, the TGV Mediterranee line ridership fell 28 percent below initial forecasts, but revenues were off by only 17 percent. As shown in Exhibit ES-6, the performance of California's system against forecasts would have to be approximately three times worse than the French examples to fall below the breakeven point at which the system will function without an operating subsidy.

**Exhibit ES-6. Percentage of forecast levels**



Three ridership scenarios were modeled in this Revised Plan: Low, Medium, and High. As described in Chapter 5, Ridership and Revenue, conservative assumptions for key factors, such as population and the cost of driving, were used 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 is a net positive cash flow from operations (revenues minus operating and maintenance costs) from the first year of operation under each phasing scenario (Exhibit ES-7). This is a consistent finding across operating segments, phases, and development scenarios once an IOS is achieved.

**Exhibit ES-7. Operating results for IOS, year 2025**

Ridership Scenario	Ridership (millions)	Revenue (millions)	Operating and Maintenance Cost (millions)	Net Cash Flow from Operations (millions)	Operating Subsidy?
High	10.5	\$1,096	\$556	\$540	No
Medium	8.1	\$844	\$499	\$345	No
Low	5.8	\$591	\$376	\$215	No

Projections demonstrate that high-speed rail in California will be viable, even at the very conservative low scenarios. Under all forecasted scenarios, each operating section of the California high-speed rail system is projected to operate without a subsidy. This is not only important in terms of achieving the Proposition 1A criteria, but it supports investment of private capital for construction.



### **Cost control**

Implementation of the program will be affected by a range of external factors over time. As such, this and future business plans should be seen as part of a dynamic process. One area where this will be especially pronounced is the continual process of managing the program to deliver benefits more cost-effectively.

The Authority will maintain and reinforce internal cost-control procedures and use external reviews to regularly evaluate options for reducing costs and accelerating improvements. Ongoing value engineering, collaborative planning, and focused use of procurement tools to incentive efficiencies are among the tools that will be used.

### **The role of the private sector**

The Authority's long-term business model is founded on a strong public-private partnership relying on the private sector to design, build, operate, and maintain a high-speed system that is funded by a combination of government investments and future revenues from riders that support the investments of capital from the private sector. Risk is transferred to the private sector immediately beginning with design and construction, and the transfer of risk increases as the system is developed and opened to incorporate operating performance and profit and loss.

The private sector will be brought on board through design-build contracts to finalize the design of the first segment of the IOS 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 7, Financial Analysis and Funding, this Revised Plan assumes capital investment when the IOS 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. Following up on recent questions posed by stakeholders, the Authority reevaluated private-sector interest in early 2012 by interviewing a number of the respondents who indicated interest in investing in the project and through one-on-one interviews with firms that responded to the Request for Qualifications for the first construction package. Responses from the Request for Expressions of Interest and recent discussions with interested companies confirmed the private sector's interest in the project and the conditions and timing required to attract the significant private-sector investment reflected in the Revised Plan.

Alternative financing and delivery processes, including early investment by the private sector, continue to be developed and adapted both domestically and in other countries. 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.

## Summary

This Revised Plan considers the comments on the Draft Plan and reflects those calls for change. It presents a **better** way to build the system incrementally and in partnership with regional/commuter rail systems. Implementation of the plan will deliver benefits to Californians **faster**. By leveraging existing systems, it will be significantly **cheaper** to deliver the high-speed rail program. The revisions go beyond these important improvements. By investing in electrification of the San Francisco Peninsula rail system and paving the way for more efficient operations around the state, HSR will help contribute to a **cleaner** transportation system. In addition, focusing early investments on the elimination of high-priority at-grade crossings and other improvements will help make California's growing passenger rail network **safer**.

## Contents of the Revised Plan

This Revised Plan addresses the requirements in Section 185033 of the Public Utilities Code and includes summaries of key changes in implementation strategy, ridership, and costs from the 2009 Business Plan. In addition to the major revisions discussed previously, throughout this Revised Plan there are modifications that respond to comments and address technical, editorial, and other issues. Supporting technical documents and appendices have been updated both to reflect and provide expanded explanation of these changes. Those documents will be posted on the Authority's website at [www.cahighspeedrail.ca.gov/business\\_plan\\_reports.aspx](http://www.cahighspeedrail.ca.gov/business_plan_reports.aspx).

As part of the Authority's commitment to transparency and accountability, a new supporting document, *Addressing Comments from Reviewing Entities*, summarizes the comments from the Legislative Analyst Office and the California High-Speed Peer Review Group on the Draft Plan and how the Revised Plan addresses those comments. The Draft Plan remains available as a reference document. Both of these and other supporting technical documents can be found at [www.cahighspeedrail.ca.gov/Business\\_Plan\\_reports.aspx](http://www.cahighspeedrail.ca.gov/Business_Plan_reports.aspx).

## 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 2012 Business Plan moves toward a much fuller integration with those systems toward realizing 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 segment is commenced.
- The Authority realizes that the current funding environment is challenging. However, there are sufficient funds to construct the foundation segment of HSR and secure important rights-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 the Authority actively working with the private sector to explore innovative, cost-effective ways to secure private participation for all elements of the program.

## End notes

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<sup>1</sup> *Climate Change Scoping Plan: A Framework for Change*. Prepared by the California Air Resources Board for the State of California Pursuant to AB 3, The California Global Warming Solutions Act of 2006. December 2008.

for board consideration

## 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.<sup>1</sup> According to the Texas Transportation Institute *2011 Annual Urban Mobility Report*, 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.<sup>2</sup> The report also estimated that congestion cost these six California metropolitan areas approximately \$6 billion in 2010 for time lost and fuel wasted. The statewide cost of time lost and fuel wasted in traffic congestion is estimated to be more than \$18.7 billion annually.<sup>3</sup>
- 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.
- The busiest short-haul air market in the country is between the Los Angeles and San Francisco metropolitan 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 Los Angeles-to-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.<sup>4</sup>
- 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.<sup>5</sup>



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



*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.*

This situation is not new and the need to deal with it progressively has been recognized by the Legislature and leaders in California for decades. In 1996, Governor Pete Wilson signed Senate Bill (SB) 1420 into law. In part, the statute says

*(a) California, over the past decades, has built an extensive network of freeways and airports to meet the state's growing transportation needs.*

*(b) These facilities are not adequate to meet the mobility needs of the current population.*

*(c) The population of the state and the travel demands of its citizens are expected to continue to grow at a rapid rate.*

*(d) The cost of expanding the current network of highways and airports fully to meet current and future transportation needs is prohibitive, and a total expansion strategy would be detrimental to air quality.*

*(e) Intercity rail service, when coordinated with urban transit and airports, is an efficient, practical, and less polluting transportation mode that can fill the gap between future demand and present capacity.*

*(f) Advances in rail technology have allowed intercity rail systems in Europe and Japan to attain speeds of up to 200 miles per hour and compete effectively with air travel for trips in the 200 to 500-mile range.*

*(g) Development of a high-speed rail system is a necessary and viable alternative to automobile and air travel in the state.*

## **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.

To put this additional demand in perspective, by 2050 California will *add* more people than now live in New York state.<sup>6</sup> 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.

### History of high-speed rail planning in California

California has evaluated the potential for high-speed rail in California for several decades. It first pursued the idea of a Southern California high-speed rail corridor working with Japanese partners in 1981. In the mid-1990s, planning began in earnest as it became clear that California's growing population was putting increasing strain on its highways, airports, and conventional passenger rail lines. At the federal level, as part of the High-Speed Rail Development Act of 1994, authored by then-Representative Lynn Schenk, California was identified as one of five corridors nationally for high-speed rail planning. In that same timeframe, the Legislature created the Intercity High-Speed Rail Commission and charged it with determining the feasibility of an HSR system in California. In 1996, the Commission issued a report that concluded that such a project was indeed feasible.

That same year, the California High-Speed Rail Authority (CHSRA) was created by the Legislature and tasked with preparing a plan and design for the construction of an HSR line to connect the state's major metropolitan areas. In 2002, following the release of the CHSRA's first business plan in 2000, SB 1865 was passed that authorized a \$9.95-billion bond issue to finance the system. Submission of that measure to the state's voters was delayed several years. In the interim, the CHSRA, together with its federal partner, the Federal Railroad Administration, issued a Draft Program-Level Environmental Impact Statement/Environmental Impact Report that

described the system and its potential impacts on a statewide scale. Through that process, the CHSRA received and reviewed more than 2,000 public and government agency comments on the draft document, which was used to determine the preferred corridors and station for the system.

In November 2008, the bond measure (Proposition 1A) was approved by the state's voters, making it the nation's first-ever voter-approved financing mechanism for high-speed rail. In 2009, \$8 billion in federal funds was made available for HSR nationwide as part of the American Recovery and Reinvestment Act (ARRA), which was passed to help stimulate the economy, create new jobs, and foster development of new rail manufacturing enterprises. This funding demonstrated a new and growing federal commitment to the development of high-speed rail in the United States as embodied in a plan issued by the U.S. Department of Transportation: "A Vision of High-Speed Rail in America."

California sought and successfully secured ARRA funds and other funds made available through federal appropriations and grants. As of the date of this Draft Revised 2012 Business Plan, California stands to receive \$3.5 billion in federal funds for planning and environmental work, as well as construction of the IOS-First Construction section in the Central Valley.

Through the passage of Assembly Bill (AB) 32, the Global Warming Solutions Act of 2006, and SB 375, the Sustainable Communities and Climate Protection Act of 2008, 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.

**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*

Even with implementation of AB 32 and SB 375, some 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, as is the ability to expand airport capacity in the state’s developed urban areas. 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, which would be more costly than HSR and would conflict with the land use and development goals of most communities. In its implementation plan for AB 32, the California Air Resources Board supports implementation of a high-speed rail system as “part of the statewide strategy to provide more mobility choice and reduce greenhouse gas emissions.”<sup>8</sup>

## 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, a national initiative to meet the infrastructure and economic development challenges of the United States in 2050, evaluated corridors where conditions exist to support strong passenger demand for high-speed rail services.<sup>9</sup> 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.

**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<sup>7</sup>*



- **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.

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.

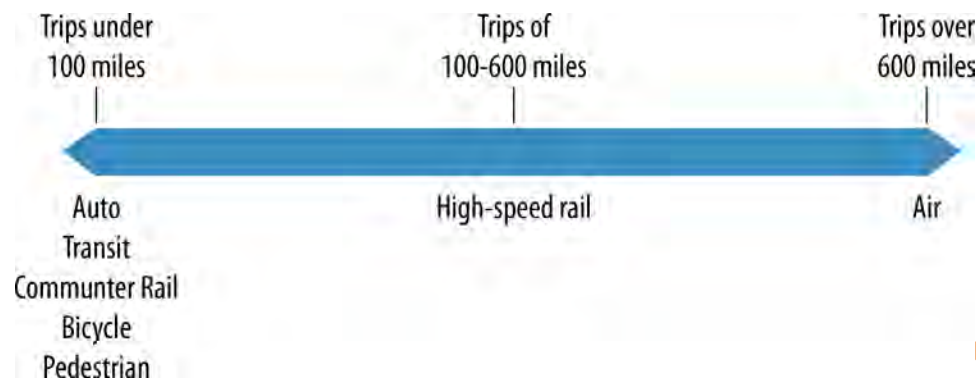
### High-speed rail fills a gap

Other countries’ experiences demonstrate that high-speed rail meets some specific transportation needs more effectively and efficiently than other modes. As shown in Exhibit 1-1, 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 rail 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.

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.

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<sup>10</sup>*

**Exhibit 1-1. Most efficient methods of travel based on trip length****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.<sup>17</sup>

**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. 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.

Starting construction on the HSR system now—during the current economic downturn—will create many new jobs, both in the construction industry and in other economic sectors, just as the infrastructure investments made during the 1930s did. As of February 2012, many of the counties along the HSR corridor are still designated as Economically Distressed Areas (EDAs). EDAs are counties where unemployment is 1 percent or more above the national average or the per capita income is less than 80 percent of the national average. Starting the system now—by beginning construction in the Central Valley and making early investments in other sections—will help jumpstart California’s economic recovery at a time when it needs it most.

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<sup>12</sup> in local and regional transportation investments.

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.

As the first state to develop and operate high-speed rail (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 HSR in the United States can be a catalyst for growth. The first state to develop HSR likely will be the state that becomes the country’s home to domestic research, engineering, production, assembly, and repair of HSR equipment.

**I would like to be part of the group that gets America to think big again.**

*Governor Jerry Brown, August 16, 2011<sup>13</sup>*

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. 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. In 2010, California’s Gross State Product was 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.



### **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 early-1900s. 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.

**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<sup>14</sup>*

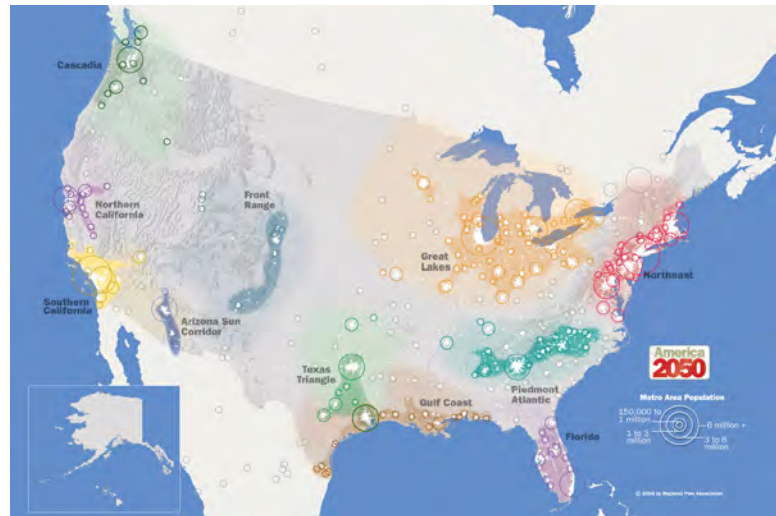
California’s future growth is seen by many as being part of “the era of the megaregion.” Megaregions (Exhibit 1-2) are areas with large or dense populations but, more importantly, they are regions where significant economic capacity, highly skilled talent, scientific achievement, and technological innovations 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).<sup>15</sup> 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.

### Advancing California's sustainability and livability objectives

Since its inception, the Authority set the goals of helping reduce statewide pollutant emissions and supporting sustainability policy objectives. Sustainability encompasses the concept of stewardship, continuous improvement, and accountability with a focus on meeting the needs of the present without compromising the ability to meet the needs of future generations. Environmental economists<sup>16</sup> generally cite three common sustainability goals: to achieve enhanced and balanced social, environmental, and economic outcomes.

**Exhibit 1-2. Megaregions of the United States**



#### 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.

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, the U.S. Department of Housing and Urban Development, the U.S. Department of Transportation Federal Transit Administration, and the U.S. Environmental Protection Agency. 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 shared 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<sup>17</sup>

These seven goals will help frame sustainability policy and 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, plus the fact that many HSR passengers will shift from driving cars, will help reduce California’s dependence on price-volatile foreign oil and also will help reduce pollution in the state. Similar to other systems around the U.S. and the world, the Authority is designing the system to take a net-zero approach to renewable energy: procuring and producing enough renewable energy to feed the California electricity grid equal to the amount it consumes for facilities and traction power.

An important way the Authority is working on its sustainability objectives is through proactive station area planning. With its federal partners, the Authority is providing planning grant funds to local municipalities to develop plans that will be context-sensitive and facilitate mode shift, livable urban design, and infill and sustainable development that supports the HSR system and benefits local economic development.

In addition, the Authority has 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.<sup>18</sup>

### 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 by 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 CO<sub>2</sub> 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.
- California would save 78 million acre-feet of water, equal to nearly two-thirds of the water in Lake Tahoe, by 2050. The average household would decrease its consumption by nearly 40 percent. The cumulative cost savings for the state's residents would be \$96 billion by 2050.

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—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 by 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 GHG 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.

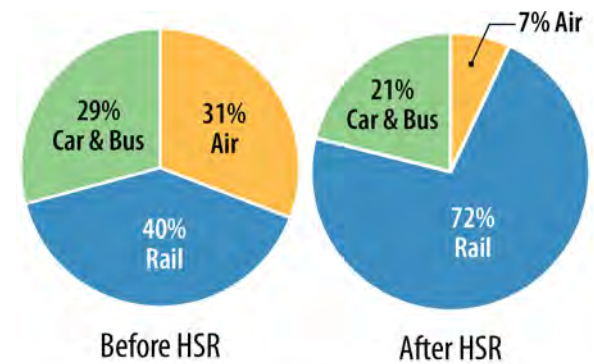
## How does California high-speed rail compare to international programs?

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 already have 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.

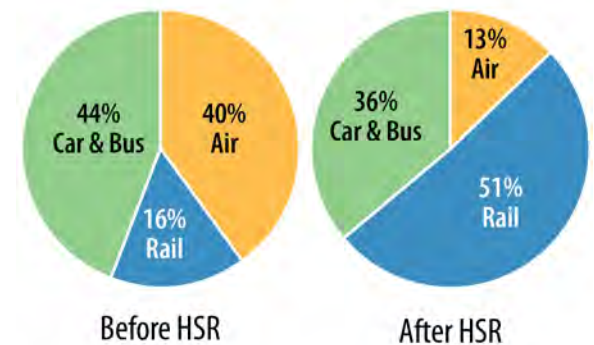
Some relevant findings shared among countries with HSR systems include the following:

- 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.<sup>19</sup> 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 Train à Grande Vitesse (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.
- 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 1-3, 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

**Exhibit 1-3. Mode of travel before and after high-speed rail operations in France and Spain**



**France’s Train à Grande Vitesse (TGV Sud-Est)**



**Spain’s Alta Velocidad Espanola (AVE Madrid-Seville)**



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. Between Madrid and Seville, rail modal share increased from 16 percent to 51 percent between 1991 and 1994.<sup>20</sup>

- In 1981, during the first year of operation, the French TGV system carried 1.26 million passengers. Three decades later, in 2010, the expanded TGV system carried 160 million passengers.<sup>21</sup> Rail gained more than 32 percent market share after HSR 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.<sup>22</sup> 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 integral 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 1-4).

## Exhibit 1-4. State's mayors support high-speed rail

*Life. Captured daily.*  
**The Sacramento Bee**  
 sacbee.com

Tuesday, June 2, 2011 | The Sacramento Bee | sacbee.com/ourregion

## 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.

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*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

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- <sup>1</sup> Source: The Road Information Program. 2004. *TRIP Analysis of Highway Statistics, 2004*, Federal Highway Administration (cited by Transportation California).
- <sup>2</sup> Source: Texas Transportation Institute. *2011 Urban Mobility Report* (cited by Transportation California).
- <sup>3</sup> Source: The Road Information Program. 2009. *TRIP Analysis of Highway Statistics, 2009*, Federal Highway Administration (cited by Transportation California).
- <sup>4</sup> 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.”
- <sup>5</sup> Source: Regional Plan Association. America 2050. 2011. *High-Speed Rail in America*. [www.america2050.org/pdf/HSR-in-America-Complete.pdf](http://www.america2050.org/pdf/HSR-in-America-Complete.pdf)
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- <sup>7</sup> 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.
- <sup>8</sup> Source: *Climate Change Scoping Plan: A Framework for change*. Prepared by the California Air Resources Board for the State of California Pursuant to AB 3, The California Global Warming Solutions Act of 2006. December 2008.
- <sup>9</sup> Source: Regional Plan Association. America 2050. 2011. *Where High-Speed Rail Works Best*. [www.america2050.org/pdf/Where-HSR-Works-Best.pdf](http://www.america2050.org/pdf/Where-HSR-Works-Best.pdf)
- <sup>10</sup> Source: Regional Plan Association. America 2050. 2011. *High-Speed Rail in America*. [www.america2050.org/pdf/HSR-in-America-Complete.pdf](http://www.america2050.org/pdf/HSR-in-America-Complete.pdf)
- <sup>11</sup> Source: SH&E, Inc. January 2010. *Regional Airport System Planning Analysis-2011 Update Final Report*.
- <sup>12</sup> Source: Self Help Counties Coalition. 2011. [www.selfhelpcounties.org](http://www.selfhelpcounties.org) and [www.facebook.com/pages/Self-Help-Counties-Coalition/103345919749642#!/pages/Self-Help-Counties-Coalition/103345919749642?sk=info](https://www.facebook.com/pages/Self-Help-Counties-Coalition/103345919749642#!/pages/Self-Help-Counties-Coalition/103345919749642?sk=info)
- <sup>13</sup> 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](http://www.fresnobee.com/2011/08/18/2503133/jerry-brown-backs-going-forward.html)
- <sup>14</sup> Source: American Society of Civil Engineers. 2011. “Failure to Act: The Economic Impact of Current Investment Trends in Surface Transportation Infrastructure.”
- <sup>15</sup> Source: U.S. Bureau of Economic Analysis. 2011. “GDP by State.” [www.bea.gov/iTable/iTable.cfm?reqid=70&step=1&isuri=1&acrdn=1](http://www.bea.gov/iTable/iTable.cfm?reqid=70&step=1&isuri=1&acrdn=1) (accessed August 3, 2011).
- <sup>16</sup> Source: United Kingdom Department of Transport. December 2006. *The Eddington Transport Study*.
- <sup>17</sup> 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.
- <sup>18</sup> 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](http://www.visioncalifornia.org/Vision%20California%20-%20Charting%20Our%20Future%20-%20Report%20-%20June%202011.pdf)
- <sup>19</sup> Source: February 2011 “Official stance of UIC, the worldwide railway association, on the profitability of the high speed rail system.” Position Paper.
- <sup>20</sup> Source: *International Railway Journal*. September 1, 1999. “Spanish to Build More High-Speed Lines.”
- <sup>21</sup> Source: Central Japan Railway Company (JR-Central). 2011. <http://english.jr-central.co.jp/company/company/achievement/transportation/index.html> (accessed July 22, 2011)
- <sup>22</sup> 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

### ***The Implementation Strategy: Blending, Phasing, Investing in Early Benefits***

The implementation strategy described in this chapter draws on successful international experience in building high-speed rail (HSR) systems and has been tailored to address the unique circumstances in California through collaboration with state, regional, local, and private transportation partners. It is a phased strategy with three key elements:

- **Blending** high speed with existing rail systems on shared infrastructure to accelerate and broaden benefits, improve efficiency, minimize community impacts, and reduce construction costs
- Making **early investments** in the “bookends,” or Bay Area and Los Angeles Basin regions, and north from the San Joaquin Valley, to upgrade existing services, increase regional connectivity, improve safety, build ridership, and lay the foundation for expansion of the high-speed rail system
- Delivering **early benefits** to Californians by using and leveraging investments as they are made

A system cornerstone will be its integration into the statewide transportation system. Proposition 1A recognized the 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, the HSR system will significantly enhance the passenger transportation network across the state, as shown in Exhibit 2-1. Existing intercity and regional/commuter systems will provide important feeder service to the HSR. Equally important, HSR also will 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 interconnected public transportation systems and can be expedited through early investments in the regional systems.

#### **What does “blended” mean?**

The Revised 2012 Business Plan (Revised Plan) refers to *blended systems* and *blended operations*, which are the integration of high-speed trains with existing intercity and regional/commuter rail systems via coordinated infrastructure (the system) and scheduling, ticketing, and other means (operations).



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

Exhibit 2-1. Early investments/statewide benefits



**Early Investments/Statewide Benefits**

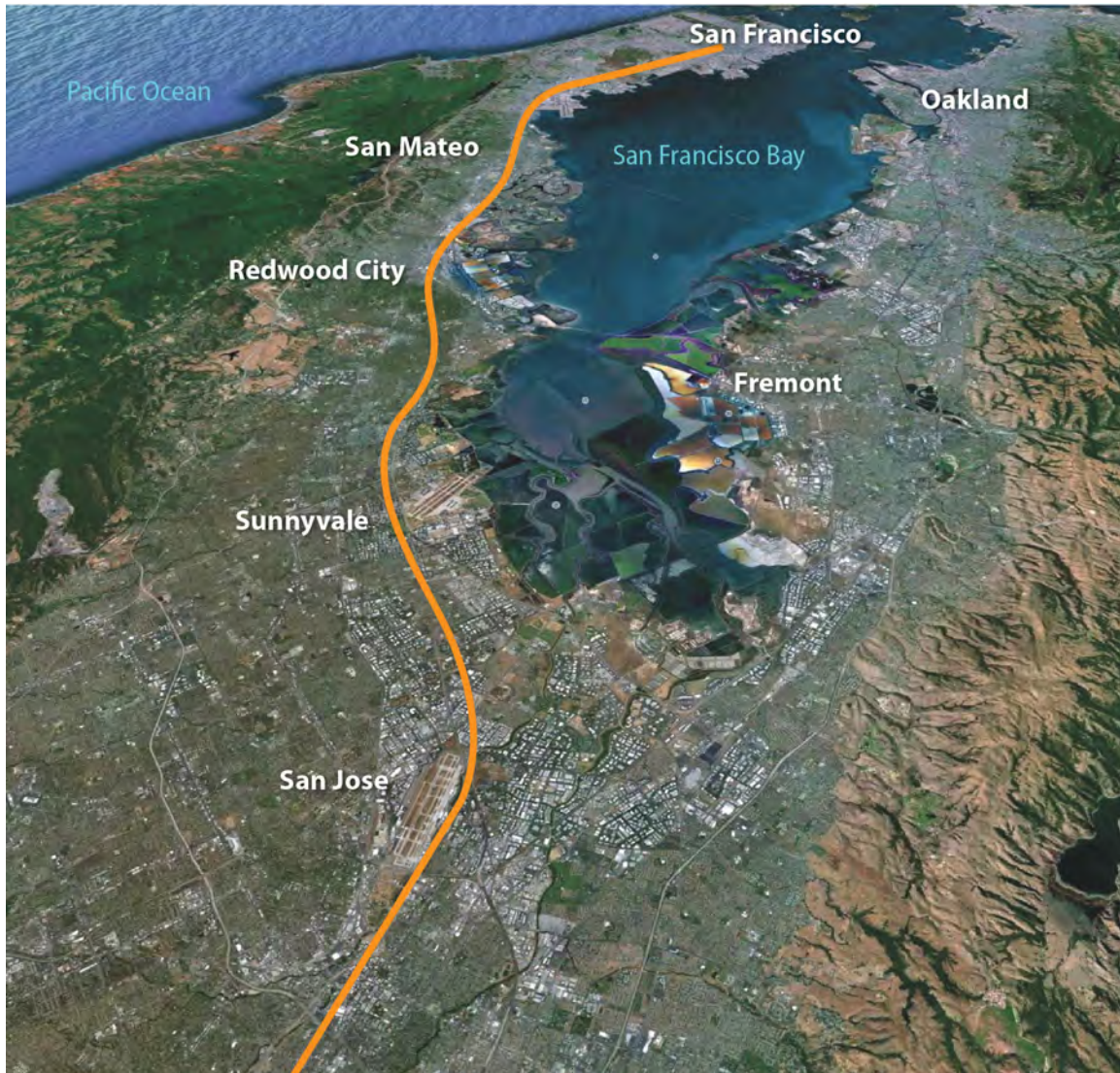
- ◆ Begin construction of IOS HSR infrastructure
- ◆ Start Northern California unified service
- ◆ Invest in the “bookends”
- ◆ Advance early priority:
  - Close rail gap to LA Basin

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

**Blended systems—infrastructure development**

California has rail systems that serve intercity, commuter, and regional trips throughout the state. A blended system would leverage these existing systems by tying them together with a HSR backbone through the Central Valley and connecting to the major metropolitan areas of Northern and Southern California. Integration of high-speed rail with these systems can serve two important functions. First, improvements to the intercity and regional/commuter rail systems will improve or facilitate connections and integration with the high-speed system. As such, they build rail ridership in corridors that will be served by high-speed rail. Second, in some cases, a blended approach means early construction of facilities that ultimately will be incorporated into the high-speed rail system, such as electrification of track that will be shared by high-speed and regional/commuter operations. Making improvements to these existing systems, such as eliminating at-grade crossings, electrification, advanced signal systems, and adding more passing tracks, will have independent utility that will benefit all of the state’s passengers prior to being connected to the high-speed system. Where possible, these improvements

should move ahead independently and as quickly as feasible to accelerate benefits to California travelers.



*Immediate benefits will be realized with improvements in the San Jose to San Francisco corridor system.*

### **Blended operations—services**

The blended system will allow rail operators to take advantage of new and improved infrastructure to enhance existing service, delivering benefits sooner. Blended operations will evolve over time, as new infrastructure is developed and will include the following components:

- Operating existing services over new high-speed rail infrastructure before high-speed revenue service is initiated
- Coordinating conventional rail services and connecting high-speed rail after high-speed rail service begins
- Emphasizing interoperability of high-speed and conventional rail on shared infrastructure

During each phase, the goal is to maximize and accelerate the benefits of investments in the most cost-effective manner and provide enhanced service to rail passengers across the state.



Visualization of Caltrain and high-speed trains sharing tracks on the existing four-track section at Brisbane

## 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 (Capitol Corridor, San Joaquin, and Surfliner) 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 intercity 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 (mph), and it averages just over 50 mph.<sup>1</sup> In spite of these limitations, the San Joaquin line is Amtrak's fifth busiest, with more than 1 million riders annually. This north-south 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/commuter rail systems that will tie into that HSR connection

This Revised 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 (the Capitol Corridor, the San Joaquin, and the Pacific Surfliner lines) and \$760 million is allocated to local and regional/commuter rail systems. Proposition 1A gave approval authority over project selection to the California Transportation Commission (CTC).<sup>2</sup>

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**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*

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The \$760 million for regional/commuter 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 those linkages are efficient and effective. The 10 agencies are as follows:

- Altamont Commuter Express (ACE)
- Los Angeles County Metropolitan Transportation Authority (LACMTA)
- 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 Transit System (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.”<sup>3</sup> A program of projects was identified and adopted by the CTC in May 2010. However, to date,

of the \$760 million, only \$45.5 appropriated, 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. As part of the implementation strategy of early investment, the CTC has begun to work collaboratively with regional transportation agencies to reach agreement on a package of investments that will provide near-term local benefits and address previous concerns that resulted in vetoes. Success will allow regional agencies to put their shares of these funds to use for important projects—creating jobs, transportation improvements, and economic activity as the system progresses, as well as increasing the overall rail-system capacity to support high-speed rail.

A goal of this collaboration is to identify and move forward with a program of “early investments” in the regional/commuter 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 systems, they will provide the basis for enhanced blended operations. Some of the property or rail corridors involved in this network are owned by private parties or share operations by freight and passenger services, meaning that cooperative approaches will need to be further developed among public and private parties.

This Revised 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 connects 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 is working with state, regional, and local agencies and private parties to establish formal processes to achieve the following:

- Ensure that the initial high-speed rail capital investment in the Initial Operating Section (IOS) is immediately used by regional/commuter rail services to provide benefits to the public
- 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 among public and private rail operators, including freight
- Develop a cooperative and complementary agenda for jointly pursuing federal support
- Ensure that plans for improvements adequately assess and address the needs of both passenger and freight operations and take into account their respective needs, rights, and operating issues

## Regional early investment strategies

The Authority is working closely with Caltrans, regional/commuter rail agencies, and private rail operators to better define how high speed, conventional passenger, and freight rail can be integrated and leveraged effectively. Consistent with the long-term vision for high-speed rail, these cooperative efforts focus on the following:

- **Passengers**—Making improvements that benefit rail riders and make rail a better option for travelers now and in the future
- **Early benefits**—Optimizing new investments and other opportunities to accelerate improvements in passenger and freight operations
- **Improved coordination**—Working to reduce costs, avoid redundancies, and leverage resources

Early investment strategies for Southern California, the San Francisco Bay Area, and the Northern San Joaquin Valley are being led by regional agencies and have the common goal of accelerating investments in rail infrastructure and services in their regions, while also preparing for the eventual arrival of high-speed rail service in the future. The Authority is in the process of executing a series of Memoranda of Understanding (MOU) with each these three regions to formalize the process for the early investments. Below is a brief summary of the regional strategies currently under development.

### ***Southern California***

Early investments in Southern California in projects such as double tracking, crossing improvements, and grade separations, will accelerate benefits to the region in preparation for high-speed trains. Connections in Los Angeles County and the San Fernando Valley via Metrolink and Amtrak (Surfliner and other intercity rail routes) will allow passengers to continue their trip to destinations both east into the Inland Empire and south toward San Diego. Station enhancements to facilitate and improve these passenger connections also could be implemented, improving the overall passenger experience.

The LACMTA has been working on a strategic analysis of the Metrolink Antelope Valley commuter rail line that connects Los Angeles' Union Station with Palmdale. This work has progressed with the goal of providing additional capacity and faster travel times over this corridor and is the important first step in ensuring sufficient Metrolink commuter service to meet the needs of the HSR system as it reaches Palmdale as part of the IOS. LACMTA will be advancing analysis of this line for additional operations that would provide shorter run times as well as additional capacity for the line. In addition to this analysis, LACMTA is studying a possible Metrolink station located at Bob Hope (Burbank) Airport on this

line. Coupled with a high-speed train station at this location, this station will provide additional connectivity options for the HSR system and Metrolink.

The Southern California Transportation Authorities have approved a MOU that would address early investment procedures with a goal of having projects in place by 2020 and are identifying specific projects. The following agencies are parties to the MOU and will be working with the Authority to implement a program of improvements:

- Southern California Association of Governments (SCAG)
- Southern California Regional Rail Authority (Metrolink)
- Los Angeles County Metropolitan Transportation Authority (LACMTA)
- San Diego Association of Governments (SANDAG)
- Riverside County Transportation Commission (RCTC)
- San Bernardino Association of Governments (SANBAG)
- California High-Speed Rail Authority (CHSRA/Authority)

### ***The Bay Area***

As the transportation planning, coordinating, and financing agency for the nine-county San Francisco Bay Area, the Metropolitan Transportation Commission (MTC) is taking the lead in defining early investments for the region. MTC is collaborating with Caltrain and the City of San Francisco on developing a phased investment strategy that will allow for Caltrain service between San Jose and San Francisco to develop into a HSR-ready railroad capable of allowing HSR passengers to travel from Los Angeles to San Francisco with a one-seat ride (see the discussion on Phase 1 Blended Operations later in this chapter). As with Southern California, Caltrain's objective is that this early investment in the Caltrain corridor be completed before 2020, and the agency continues to move forward with a collaborative planning process to better define specific improvements in the corridor that would best meet the traveling public's needs while also being sensitive to community concerns about potential impacts.

Over the next several months, Caltrain, in consultation with the Authority, will work with communities on the San Francisco Peninsula to further define the blended system, focusing on the following three efforts:

- Defining a planning process for developing a vision/project for the corridor. While the early investments will focus on implementing an advanced signal system, electrification of the corridor and necessary infrastructure upgrades, Caltrain will continue to work with its cities and communities to define additional infrastructure improvements needed to support blended Caltrain/high-speed rail operations and to bring high-speed rail to Downtown San Jose and San Francisco
- Conducting additional service plan/operational analysis to supplement the blended operations capacity analysis
- Conducting a grade-crossing and traffic analysis to identify needed crossing upgrades to support blended operations

### **Northern San Joaquin Valley**

The California Department of Transportation (Caltrans) is working with the San Joaquin Regional Rail Commission (SJRRRC) and others to identify early investments for connecting regional rail service to the first segment of the IOS using the San Joaquin intercity service and Altamont Commuter Express (ACE) service. Service improvements are being planned in the Northern San Joaquin Valley and the East Bay Area to improve and enhance existing commuter and intercity services to create much needed mobility in the Central Valley and improve access to metropolitan areas. Together the SJRRRC, the Caltrans Division of Rail, the Capitol Corridor Joint Powers Authority, and Sacramento Regional Transit have developed a Northern California Unified Service Concept, as shown on Exhibit 2-1. Unified Service would use the first IOS segment in the interim period until the initiation of full high-speed service. This concept would include speeds on the first IOS segment of 125 mph (compared to a maximum of 79 mph and an average of 50 mph on the existing line) and improved sections of existing rail up to 90 mph to significantly speed up rail travel from Bakersfield to Sacramento, Oakland, and San Jose. Once high-speed rail becomes operational, the improved network becomes a critical feeder service to the high-speed rail system.

The Unified Services group is finalizing an MOU, to which the Authority will be a party, that includes a list of early investments such as grade-crossing improvements, grade separations, double-tracking, curve realignments, and positive train control that will improve existing rail operating speeds and safety and allow for substantial increases in frequency by the 2018 operations on the first IOS section. This partnership will immediately benefit the traveling public while preparing the region for eventual HSR service.

### **Phased implementation**

As discussed elsewhere in this Revised Plan, the 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. Chapter 4, Business Model, addresses the role of the private sector in delivering the high-speed program over time and outlines strategies for effectively engaging the private sector.

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 regional systems that connect with HSR, resulting in the conventional and high-speed systems complementing each other.

The goals of Proposition 1A were used to develop the phasing strategy for the statewide HSR system and were guided by the following key principles:

- Divide the statewide high-speed rail *program* into a series of smaller, discrete *projects* that can 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 early 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 for 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

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**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 the 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 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 Authority applied these principles, taking into account key factors discussed in subsequent chapters such as cost, funding scenarios, and ridership and revenue projections, to develop an implementation strategy with the following key steps:

- **Step 1—Early Investments, Statewide Benefits.** The first construction of dedicated high-speed infrastructure for the IOS begins in the Central Valley. As with all of the steps, this initial section is being developed to deliver early benefits by leveraging other systems—enabling them to operate on the new high-speed tracks, which can be done without impacts on design or the integrity of the new infrastructure. Improved passenger rail service would begin upon completion of the first IOS segment by connecting the San Joaquins, ACE, Sacramento Regional Transit, the Capitol Corridor (and potentially Caltrain). Through a new, strategic approach, there is also the opportunity for new or improved one-seat rides between Bakersfield and Sacramento, Oakland, San Jose, and San Francisco. This expanded Northern California Unified Service could begin operation as early as 2018,

with the potential to provide transportation and economic benefits well before fully operational high-speed rail service is initiated.

As part of this first step, complementary investments and improvements will be made to both accelerate benefits and distribute them more widely across the state. These investments will be made using the \$950 million in Proposition 1A connectivity funding, available Proposition 1A high-speed rail funds, future federal funds, and other sources, and will include the following:

- Investment in the bookends: In Northern California, the long-awaited electrification of the Caltrain corridor will begin under a collaborative program between Bay Area agencies and the Authority. In addition, consistent with the Southern California MOU, investments will be made in key rail corridors in the southern part of the state, such as upgrading the Metrolink corridor from Los Angeles to Palmdale.
  - The Northern California Unified Service described above will be initiated.
  - As the next step in the IOS, work to close the rail gap between Bakersfield and Palmdale through the Tehachapi Mountains will begin. Environmental clearance is possible in early 2014, and plans are being developed to move quickly to implement the improvements to close this critical gap and create the first statewide rail link between the Bay Area and the Los Angeles Basin.
- **Step 2—Initial High-Speed Rail Operations.** Introduction of the state’s (and the nation’s) first fully operational high-speed rail service will begin. This service can be operated by a private entity without subsidy, will have the potential to attract private investment to expand the system from Bay to Basin, and can be completed within a decade. The service will be blended with regional/local systems. The IOS is achieved through expansion of the first construction segment into an electrified operating high-speed rail line from Merced to Palmdale and the San Fernando Valley, accessing the populous Los Angeles Basin. Following on the work discussed above, the next priority in implementing the IOS will be closing the rail gap between Northern and Southern California by crossing the Tehachapi Mountains with new, dedicated high-speed rail infrastructure. Prior to completion of the IOS to the San Fernando Valley, this link will tie the north to the south at Palmdale, where Metrolink commuter rail service can then provide service and connections throughout Southern California.

Currently, the IOS is defined as extending from Merced to the San Fernando Valley, and high-speed revenue service would only start once the full IOS is built and operable. Should ridership and revenue forecasts and financial projections demonstrate that revenue service compliant with Proposition 1A could begin earlier, with a shorter IOS, appropriate reviews would occur to consider and implement earlier service, if appropriate.

- **Step 3—The Bay to Basin System.** The dedicated high-speed rail infrastructure of the IOS will be expanded north and west to San Jose, providing HSR service between the state’s major population centers in the north and south and providing the platform for the transition to statewide blended operations. At this stage, passengers will be able to take a one-seat ride between greater Los Angeles (San Fernando Station) and the San Francisco Transbay Transit Center using blended infrastructure in the north between San Francisco and San Jose (Caltrain corridor), using dedicated

high-speed rail infrastructure between San Jose and the San Fernando Station, and, in the south, connecting via Metrolink between the San Fernando Valley Station and Los Angeles' Union Station and on to other points throughout Southern California.

- **Step 4—The Phase 1 System.** For the blended approach, the dedicated high-speed rail infrastructure of the Bay-to-Basin system will be extended from the San Fernando Valley to Los Angeles Union Station, linking to a significantly upgraded passenger rail corridor developed to maximize service between Los Angeles and Anaheim while also addressing community concerns about new infrastructure impacts in a congested urban corridor that includes a number of established communities that abut the existing right-of-way. Under a Full Build scenario, dedicated high-speed rail infrastructure would be extended from San Jose to San Francisco's Transbay Transit Center and from Los Angeles to Anaheim.
- **Step 5—The Phase 2 System.** Phase 2 will extend the high-speed rail 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. Phase 2 areas will see improvements in rail service well in advance of the expansion of the high-speed rail system through the combination of early investments and blended operations, as described in this Revised Plan.

### ***Step 1: Early investments, statewide benefits***

Assuming approval of a state appropriations request to use Proposition 1A bond proceeds to match federal funds, HSR construction can begin within a year. This first construction segment will cover up to 130 miles of new high-speed rail alignment from just north of Bakersfield to north of Fresno. Because this segment has a set budget tied to the award of federal funds to date, the actual length will depend on what alignment is selected through the pending environmental process and on prices received with the procurement of design-build contracts beginning 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 IOS will bring much needed employment to the Central Valley—approximately 100,000 job-years of employment will be created during the construction period.<sup>4</sup>

The ARRA funding comes with three important requirements:

- First, because the legislative intent was to stimulate the economy, the ARRA funding sunsets on September 30, 2017, and therefore must be fully expended by that date.
- Second, any project funded with ARRA funds must have "operational independence."
- Third, funding is limited to "rail passenger transportation except commuter rail passenger transportation."<sup>5</sup>

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 IOS—First Construction section. These federal funds require state matching funds. These are to come from California Proposition 1A bond proceeds.





*Placing a priority on “Closing the Gap” through the Tehachapi Mountains brings high-speed rail service to the Los Angeles Basin within the decade.*

The Authority submitted funding applications for four 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 first IOS segment using ARRA funds can be completed by 2017; operational independence can be achieved by allowing intercity rail service to use the line; and this section will be the first high-speed, intercity section in the state.

In addition to meeting the federal funding criteria, beginning construction in the Central Valley is an important first step for the HSR 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 construction 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 first IOS segment 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 significant 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 compared to construction in dense urban areas. 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. It also will enable small and disadvantaged businesses to begin developing valuable experience that will help position them to be involved in future extensions to the system.

The segment will become operational by allowing Caltrans to operate expanded San Joaquin service between Bakersfield and Merced on the first IOS section. To achieve this, track connections would be built to connect to the BNSF Railway line at the northern and southern ends of the first constructed segment. Relatively minor investments would be made in rail systems (signaling, positive train control) and other investments to augment the base infrastructure so that the San Joaquin service can operate on it. Combined with improvements described earlier, this would allow trains to travel at speeds up to 125 mph or more in the Central Valley, which would 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 at least 45 minutes and likely well over one hour.

Planning for early interim service on the IOS segment is already underway, with the goal of commencing Amtrak operations as soon as possible after construction is complete in 2017. The Authority is already collaborating with its transportation partners to identify and address the technical and policy issues that would be associated with developing early service. Through this process, agreements will be worked out on a range of issues, including how and where the service would operate, how it would be integrated with other systems, and how to transition to revenue HSR service as the IOS is completed.

## Step 2: Initial high-speed rail operations

This stage marks the introduction of world-class high-speed rail to the United States. 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 7, Financial Analysis and Funding, under the three different revenue and operating and maintenance cost scenarios analyzed, there is positive net cash flow from the first year of operation of the IOS.

Completion of the IOS is a pivotal step in the development of the statewide system, providing a high-speed rail link between the Los Angeles Basin and the fastest-growing part of California, the Central Valley. With a population approaching 7 million, the Central Valley is larger than 38 states and comprises close to 20 percent of California's population. Over the last 10 years, the Central Valley has been the fastest growing region in the state, with its population increasing by 17 percent, compared to 10 percent statewide. The counties in the region have been some of the fastest growing counties in the state over the last decade.

This growth is predicted to continue. Moody's Analytics, which develops population and other forecasts, predicts that by 2040, the Central Valley will approach 10 million residents while most of its counties will continue to grow faster than the rest of the state. The cities of Fresno and Bakersfield today have populations of 500,000 and 350,000, or roughly 60 percent and 45 percent of the population of San Francisco respectively. In fact, only Los Angeles, San Diego, San Jose, and San Francisco are larger than Fresno.

As detailed in Chapter 5, Ridership and Revenue, the IOS 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, the IOS is a viable, profitable high-speed rail 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.

A decision about which direction to expand following the first construction segment—either north to San Jose or south to the Los Angeles Basin, is based on a number of factors, including the following:

- Ridership and revenue generation
- Capital and operating costs

**Operating the San Joaquin trains over this new route at higher speeds on an interim basis while other segments of your proposed system are developed to allow for full high-speed train service would benefit the public and our riders by greatly improving travel times, reliability, and passenger comfort... we will work closely with your agency and the Caltrans Division of Rail to address any details that will need to be discussed.**

*Letter from Amtrak to High Speed Rail Authority, October 2010*

- Funding availability
- Public and stakeholder input
- Environmental approvals
- Level and type of potential private-sector investment
- Connectivity with regional rail systems
- Complementary investments/statewide system benefits
- Policy considerations

Based on these factors, this Revised Plan assumes that the next step in constructing dedicated high-speed rail infrastructure will be to complete the southern link to the Los Angeles Basin after the first IOS section is construction to close the rail gap between Northern and Southern California. Should this extension be prevented for a significant time as a result of environmental or other delays, the Authority could proceed with extending the system north to San Jose. This route, the “IOS-North,” was described in detail in the Draft 2012 Business Plan (Draft Plan), which was completed in November 2011 and is available at [www.cahighspeedrail.ca.gov/Business\\_Plan\\_reports.aspx](http://www.cahighspeedrail.ca.gov/Business_Plan_reports.aspx).

The 300-mile IOS, shown on Exhibit 2-2, will extend from Merced south through Bakersfield and Palmdale to the San Fernando Valley. Importantly, it will close the existing gap in passenger rail service between Northern and Southern California with new dedicated high-speed rail infrastructure. Through a connection to the San Joaquin service at Merced, it will allow passengers from the Sacramento region to travel on high-speed rail to greater Los Angeles with a single transfer, cutting travel time from what is



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

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.

Within the IOS, the first priority is to close the rail gap between Bakersfield and Palmdale. Approximately \$4 billion in Proposition 1A funds are identified for this priority, and obtaining the necessary matching funding will be the top financial priority for the Authority. Elimination of this gap will create an unprecedented connection between the state’s intercity rail service and the Metrolink commuter system.

Implementation of the IOS makes blended operations in the Los Angeles Basin possible, improving travel between the Basin, the Central Valley, and other parts of the state. 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.

### **High-speed rail and freight operations**

While the United States lags behind other nations in the development of high-speed passenger rail, America's freight rail system is the envy of the world. The freight rail infrastructure is an interconnected network of privately owned track and signaling systems, which provides for the safe and efficient movement of goods. Aspirations for improved inter-city passenger rail have depended, in all but a few cases, on access to privately owned railways and the integration of such service with private freight operations. To ensure the safety of these combined operations, federal regulations limit the speeds of passenger trains on mixed routes.

Freight railroads have accommodated passenger rail service to a high degree, but the construction of a dedicated high-speed rail system in California will provide an important additional benefit in ultimately transferring key passenger operations off existing rail lines, thus increasing the capacity and efficiency of freight operations and enhancing safety.

Over the long term, the vitality of freight operations is itself critical to California's economy, particularly in providing efficient connections to and from California's ports. The ports, an indispensable element of California's economy, face growing competition from port operations in other states. High-speed rail can contribute to improved goods movement by freeing not only highways but also freight rail lines of some passenger traffic.

It is important to note that high-speed, electrified train service is the only effective means to close this Bakersfield-to-Palmdale passenger rail gap. Today, there is a single freight line, owned and operated by the Union Pacific Railroad that provides a vital freight connection between the Los Angeles Basin (and the Ports of Los Angeles/Long Beach) with the Central Valley. Since diesel-powered locomotives are limited to no more than approximately 2-percent grades to ascend the mountains, the routing is circuitous and speeds are modest. These limitations have no great effect overall on freight movement through that corridor but would be unacceptable for passenger service. Electrified trains can efficiently ascend greater gradients and maintain higher speeds climbing and descending the Tehachapi Mountains. Thus, the only effective means to bring intercity passenger rail service across the mountains that separate Los Angeles from the Central Valley is with an electrified high-speed rail line, which will be the IOS.

## Exhibit 2-2. Initial Operating Section



- IOS—High Speed Rail**
- ◆ Extend HSR to Merced and San Fernando Valley
  - ◆ Start HSR service
  - ◆ Start blended service
    - Northern California unified service
    - Metrolink corridor
  - ◆ Continue investment in “bookends”

The IOS will connect with transit options allowing passengers to reach a wide range of regional destinations.

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 (LACMTA, 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 “thruway” bus services that will allow passengers to continue their trip to destinations throughout the region.



*Completion of the IOS will cut travel time from the Sacramento region to Los Angeles' Union Station by three hours.*

### **Step 3: The Bay to Basin system**

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 systems and eventually blended operations in both metropolitan regions (Exhibit 2-3). Bay to Basin will achieve the following:

- 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 BART extension to San Jose will enhance access to Oakland and the East Bay area. At Merced, the HSR will provide an interchange with the Northern California Unified Service to all of the major metropolitan areas. 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 the San Joaquins and ACE 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.

Exhibit 2-3. 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 4: The Phase 1 system**

Completion of the Bay-to-Basin system moves closer to a Phase 1 connection between San Francisco and Los Angeles/Anaheim. This 520-mile route would be completed through a coordinated “blended operation” that uses the infrastructure investments made to create upgraded “high-speed rail ready” commuter rail corridors and systems. These investments will allow high-speed trains to make a complete journey from San Francisco to Los Angeles and Anaheim by operating on the upgraded corridors between San Jose and San Francisco in the north and between Los Angeles and Anaheim in the south.



*Artist's rendering of the Transbay Transit Center, the northern terminus for California High Speed Rail*

#### **The coordinated blended operation**

Similar to systems in Europe, it is anticipated that connecting service to the IOS, 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 Los Angeles, offering passengers a “one-seat-ride” from end to end. In the Bay Area, the high-speed rail trains will use upgraded existing Caltrain infrastructure between San Jose and San Francisco. 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 mph. However, such improvements likely can be accomplished while staying substantially within the existing rights-of-way, resulting in substantially reduced impacts to communities along the corridor. On the San Francisco to San Jose section, Caltrain is taking a leadership role to define the rail corridor based on the needs and desires of the project’s stakeholders.

Based on the Caltrain planning process and the Southern California Passenger Rail Planning Coalition’s efforts in the Los Angeles region, 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 rail 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.

#### **Blended operations from San Jose to San Francisco**

The proposed blended system for the San Francisco Peninsula is primarily a two-track system that will be shared by Caltrain, high-speed rail service, and current rail tenants. Initial investigations show that blended operations as currently envisioned for the corridor are cost-effective solutions on both a capital and operating basis.

The key improvements needed to support the blended system are Caltrain's advanced signal system, electrification, and infrastructure upgrades, and are intended to be made as part of the early investment strategy. Planning and implementation of this electrification will be coordinated between the Authority and Caltrain to ensure full integration with the statewide system. Additional improvements necessary for blended operations are currently being identified by Caltrain through a planning process with local stakeholders.

Sharing the existing commuter rail facilities will significantly reduce community impacts and result in substantial cost savings as compared to the dedicated, four-track system analyzed in the first-tier, Bay Area to Central Valley Program Environmental Impact Report (EIR). A blended system will require further environmental analysis in the form of a project-level EIR prior to implementation. 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 one or more additional, future second-tier environmental reviews.

The revised *Bay Area to Central Valley Program EIR* was certified on September 2, 2010, well before the San Jose to San Francisco blended approach was proposed. In response to the proposal for a blended system, the Authority's Board of Directors suspended further substantive work on the San Francisco–San Jose project-level EIR in order to understand and consider the blended approach and determine what should be studied in the project-level EIR. Litigation challenging the Revised Program EIR also has proceeded, resulting in a court ruling requiring the Authority to rescind its September 2, 2010, routing decision and conduct additional analysis per the California Environmental Quality Act prior to making a new first-tier decision regarding the route into the Bay Area. The Authority has proceeded with corrections to the Program EIR and will consider making a new program-level route decision in the near future. While a new Program EIR decision has not yet been made, several alternatives into the Bay Area would use the Caltrain corridor and could benefit from the blended approach. With adoption of this Revised Plan, including the blended approach on the San Francisco Peninsula, and as allowed by law, the "project" to be studied in the Project EIR for a San Francisco to San Jose second-tier project will be the blended system.

High-speed trains on the Caltrain corridor will serve the following stations:

- The Transbay Transit Center: (BART, (MUNI, Caltrain, Alameda-Contra Costa Transit District (AC Transit), and Golden Gate Transit) and to Caltrain's 4th and King Station if necessary

- Millbrae (Caltrain, San Mateo County Transit District–SamTrans, and BART, providing a connection to San Francisco International Airport)
- A potential mid-peninsula station (at Redwood City) (Caltrain, SamTrans, and VTA)

### Blended operations to Los Angeles and Anaheim

The ultimate HSR operation into the Southern California region, envisioned by Phase 1 Blended and shown in Exhibit 2-4, 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, provision of a one-seat ride to Anaheim would require implementation of the Phase 1 Full Build improvements there. However, as outlined in the description of the IOS earlier in this chapter, the connection made through the IOS 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 also will have connections to Amtrak's Surfliner and the Metrolink commuter rail service. Station enhancements to facilitate and improve these passenger connections also could be implemented, improving the passenger experience with faster, easier ticketing and baggage-handling processes.

The Southern California Passenger Rail Planning Coalition is a staff level working group that has been formed with the goals of increasing cooperation, enhancing rail service in the south, developing cost-effective solutions to infrastructure problems, and preparing for the HSR system's entrance into Southern California. The coalition 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. Participating staff of the major rail transportation providers in Southern California, along with the rail corridor owners and major transportation planning agencies, include the following:

- Amtrak
- BNSF Railway
- Caltrans Division of Rail
- LACMTA
- North County Transit District (San Diego County)
- Orange County Transportation Authority (OCTA)
- Riverside County Transportation Commission (RCTC)
- San Diego Association of Governments (SANDAG)
- Southern California Regional Rail Authority (Metrolink)
- Union Pacific (UP) Railroad
- California High-Speed Rail Authority (CHSRA/Authority)

Exhibit 2-4. Phase 1 Blended Operation—San Francisco to Los Angeles/Anaheim

**Phase 1 Blended**

- ◆ Extend HSR to Los Angeles
- ◆ Deliver one-seat HSR service, San Francisco Transbay Terminal to Los Angeles Union Station
- ◆ Continue blended service
  - Northern California unified service
  - Metrolink corridor, Los Angeles to Anaheim

This “one-seat ride” allows a passenger to ride high-speed rail all the way from San Francisco to Los Angeles.

**Step 5: The Phase 2 system**

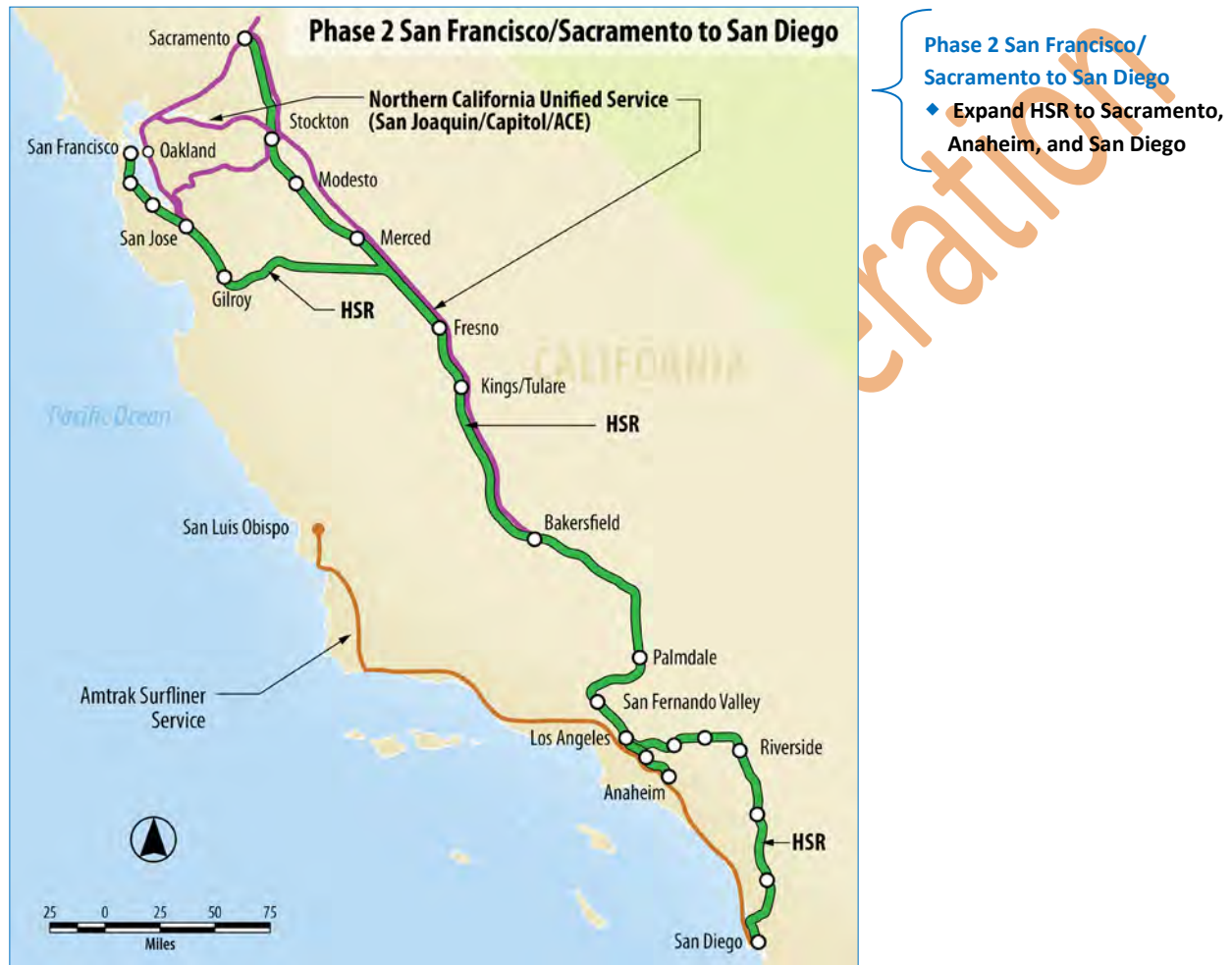
This step will add a northern and southern extension, resulting in an 800-mile system. The northern extension will extend from Merced to Sacramento, allowing direct high-speed rail service from San Francisco and Los Angeles to Sacramento. As shown in Exhibit 2-5, the train also will serve Stockton and Modesto.

Proposition 1A focuses investments on the Phase 1 system. The Revised Plan, with its emphasis on blending and early investments, provides a basis for improvements that will accelerate benefits to Phase 2 areas, provide the foundation for Phase 2 HSR service, and could help attract additional investment. 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, San Joaquin intercity rail service, and the local transit provider San Joaquin RTD
- In Modesto, connections to the San Joaquin Corridor and Modesto Area Express (MAX) transit service

**Exhibit 2-5. Phase 2—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 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 to plan for 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 would be new dedicated infrastructure, would 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 San Joaquin Regional Rail Commission, the Authority is looking to share high-speed rail infrastructure and tracks with the future Super ACE service to allow regional service to areas around such cities as Elk Grove, Galt, Lodi, Manteca, and Turlock. This blended service 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 end in Downtown San Diego. The Authority has executed various memoranda of understanding 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 (LACMTA)
- San Diego County Regional Airport Authority (SDCRAA)
- Caltrans Districts 7, 8, and 11

The Los Angeles-to-San Diego extension will extend east through the Inland Empire to the Riverside/San Bernardino areas 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, LACMTA)
- West Covina (Foothill Transit, LACMTA)
- Pomona (Foothill Transit, Metrolink)



*Artist's rendering of Sacramento Station*

- Ontario Airport (Foothill Transit, Metrolink, Omnitrans)
- San Bernardino (Metrolink, Omnitrans)
- Corona/March ARB (RTA)
- Murrieta (RTA)
- Escondido (NCTD)
- San Diego International Airport (MTS, NCTD)

## **Environmental schedule**

The key environmental milestone dates are summarized in Exhibit 2-6. The schedule for environmental clearance is predicated on the desire to achieve environmental clearance of all sections within five years to permit early right-of-way acquisition and provide opportunities for early implementation of projects along the HSR corridor. The schedule may be revised to reflect funding availability and refined implementation strategies. The Merced–Fresno and Fresno–Bakersfield environmental documents are the most advanced. Draft Environmental Impact Statements/Environmental Impact Reports (EIR/EISs) were published for both the Merced–Fresno and Fresno–Bakersfield sections in August 2011, and the public comment period closed on these documents on October 13, 2011. Preparation of the Merced–Fresno Final EIR/EIS is underway and is scheduled for release in April 2012, with certification by the Authority anticipated in May 2012 and issuance of a Record of Decision by the Federal Railroad Administration in June 2012. The Fresno-to-Bakersfield section is being updated for recirculation as a Revised Draft EIR/EIS in June 2012 based on a request from the U.S. Environmental Protection Agency and the U.S. Army Corps of Engineers to analyze a new alignment west of Hanford. The Final EIR/EIS is scheduled for certification in December 2012 with the issuance of the Record of Decision anticipated in January 2013. The start of construction is expected to in early 2013 with the issuance of a Notice to Proceed for

the first construction segment. Completion of construction on these two segments is expected in mid-2017.

**Exhibit 2-6. Projected milestones for completing the environmental review process/potential construction completion**

High-speed Rail Section	Release Draft EIR/EIS	Adopt Final EIR/EIS	Receive Record of Decision	Complete Construction
Merced–Fresno (ARRA)	August 2011	June 2012	June 2012	2021
Fresno–Bakersfield (ARRA)	May 2012	November 2012	December 2012	2017
San Francisco–San Jose	February 2014	October 2014	December 2014	2028
San Jose–Merced	February 2013	October 2013	December 2013	2026
Bakersfield–Palmdale	May 2013	December 2013	February 2014	2021
Palmdale–Los Angeles	February 2013	September 2013	October 2013	2028
Los Angeles–Anaheim	February 2014	September 2014	December 2014	TBD
Merced–Sacramento (Phase 2)	TBD	TBD	TBD	TBD
Los Angeles–San Diego (Phase 2)	TBD	TBD	TBD	TBD

Note: Construction completion schedule is based on the business planning schedule described below.

### 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](http://www.cahighspeedrail.ca.gov/environmental_review.aspx)

## Business planning schedule

### Introduction

California's HSR 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 Revised 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 section identifies the assumed project development schedule, which serves as the basis for the financial analysis conducted for this Revised 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 of Directors or other decision-makers, nor does it represent recommendations of Authority staff.

**Project schedule**

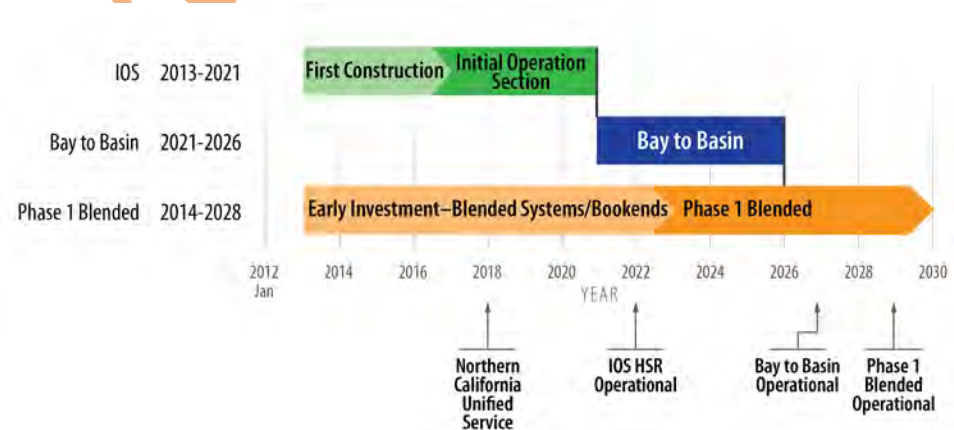
If substantially all of the project budget were available to allow multiple major contracts to begin simultaneously, and if there were no significant environmental document delays, the Phase 1 system from San Francisco to Los Angeles/Anaheim could be completed in approximately 12 years (by 2024). This represents a *financially unconstrained* schedule. However, this unconstrained schedule presents an unrealistic view of the likely project development schedule.

A more realistic phased implementation schedule shows how the system could be implemented over time and results in a fully operational segment (the IOS) by 2021; the Bay to Basin in 2026; and Phase 1 Blended by 2028. Early investments would begin along with the first IOS segment and be made over the course of the Phase 1 Blended time frame.

This project-development schedule was used as a basis to inflate capital costs, revenues, and operating and maintenance costs to a year of expenditure. After 2015, a standard inflation rate of 3 percent is used throughout this Revised Plan. In the near term, inflation is based on actual rates, as detailed in Chapter 7, Financial Analysis and Funding.

The schedule for completing the various development sections is shown in Exhibit 2-7. The schedule identifies a construction timeline for each section, as well as the year in which operations could commence by section. This schedule is also illustrated in other chapters.

**Exhibit 2-7. Schedule by section**



The financial plan assumes that self-sufficient operating sections that do not require operating subsidies would be opened for passenger service beginning in 2022 after construction of the IOS is complete. 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 for service in 2027. The Phase 1 Blended system is estimated to be opened in 2029. As previously discussed, incremental blended system improvements between San Francisco and San Jose and between San Fernando and Anaheim will be made during every phase of HSR construction.

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

## **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. California's current 50,000 miles of 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 2-8 illustrates the phased implementation and progress in building Interstate 5 through the Central Valley.

Exhibit 2-8. 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 2-9 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 2-9. 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	

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](http://www.cahighspeedrail.ca.gov/business_plan_reports.aspx)

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 2-9 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).

France initiated the first TGV service between Paris and Lyon in 1981 (Exhibit 2-10). This corridor was selected because of capacity constraints on the conventional rail lines. Service began after construction of the initial two-thirds of the system; the remaining portion was completed 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 required 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 2-10. France's high-speed rail system and four decades of expansion**

*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 its high-speed rail network using upgraded existing inter-city rail infrastructure. As ridership grew and funding became available, dedicated high-speed rail corridors were developed.

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 2-11). 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 approaches to the capital, Seoul.

Exhibit 2-11. Japan's high-speed rail system and six decades of expansion



### ***Phased approach and private capital***

As discussed elsewhere in this Revised Plan, a 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 would require guarantees contrary to plans. This Revised Plan assumes—based on similar experience throughout the world and information from private infrastructure development interests—that upon completion of the IOS, 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.

**Town of Atherton CEQA litigation and the high-speed train connection to the Bay Area**

The California High-Speed Rail Authority has studied the connection for the high-speed train (HST) between the San Francisco Bay Area and the Central Valley for many years. Its environmental compliance process and its decisions have also been the subject of litigation challenges under the California Environmental Quality Act (CEQA) for many years. The Authority originally certified the Bay Area to Central Valley HST Final Program Environmental Impact Report (EIR) in 2008 for its compliance with CEQA and selected the Pacheco Pass Network Alternative for further analysis in second-tier environmental documents. These decisions were challenged in litigation (Atherton 1, Sacramento Superior Court Case No. 34-2008-8000022), which resulted in a final judgment requiring the Authority to correct certain aspects of the Program EIR and one CEQA finding.

The Authority circulated a Revised Draft Program EIR to comply with the Atherton 1 court ruling, received public comment, and issued a Final Program EIR in August 2010. The Program EIR was then certified in September 2010, and the Authority again selected the Pacheco Pass Network Alternative for further analysis in second-tier environmental documents. Further lawsuits ensued, including a renewed challenge to the Authority's CEQA compliance in the Atherton 1 case, as well as a new case (Atherton 2, Sacramento Superior Court No. 34-2010-8000679). On November 10, 2011, after release of the Draft 2012 Business Plan, rulings in the two cases were issued that upheld the Program EIR in many respects, but also required further analysis on certain noise, vibration, and traffic issues related to the Monterey Highway and the San Francisco Peninsula, as well as construction impacts.

The Authority released a Partially Revised Draft Program EIR on January 6, 2012, to address the Atherton rulings. The 45-day public comment closed on February 21, 2012. The Authority was served with final court papers on February 13, 2012. The Authority Board is expected to consider an agenda item to rescind its prior 2010 decisions, including its selection of the Pacheco Pass Network Alternative at a publicly noticed board meeting in spring 2012. After issuance of a Partially Revised Final Program EIR, the Authority will consider the entire record before it, including all historic work on the Program EIR and all public input received, in deciding whether to certify the Partially Revised Program EIR for compliance with CEQA. The Authority will also make a new decision on the network alternative for connecting the Bay Area with the Central Valley.

This Business Plan depicts a statewide high-speed train system utilizing the Pacheco Pass to reach the San Francisco Bay Area, consistent with the staff recommendation in the Partially Revised Draft Program EIR. Adoption of the Business Plan by the Authority Board does not, however, constitute an approval of the Pacheco Pass Network Alternative as described in the Partially Revised Draft Program. Nor does approval of the Business Plan commit the Authority to the Pacheco Pass or limits its discretion at the conclusion of the Program EIR process.

## End notes

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<sup>1</sup> Source: California Department of Transportation. March 2108. *San Joaquin Corridor Strategic Plan*. <http://149.136.20.80/rail/dor/assets/File/SJCSPExecutiveSummary-032508.pdf>.

<sup>2</sup> 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](http://www.catc.ca.gov/programs/HSR/HSR_Formulashare_Attachment_I_121709.pdf)

<sup>3</sup> Source: California Transportation Commission. February 24, 2010. *High-Speed Passenger Train Bond Program Guidelines*.

<sup>4</sup> The estimates of jobs in this Revised 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.

<sup>5</sup> Source: *Federal Register*. April 2010. "High Speed Intercity Passenger Rail (HSIPR) Program" (notice by the [Federal Railroad Administration](#))



## Chapter 3

### ***Capital Costs***

#### **Introduction**

Adoption of the blended approach as the preferred implementation strategy is a fundamental shift in the Revised 2012 Business Plan (Revised Plan). Making this shift results in significant changes to previous proposals and capital cost estimates. It translates into projected costs well below the estimates included in the Draft 2012 Business Plan (Draft Plan), completed in November 2011. The reductions are the result of two key changes tied to the blended approach:

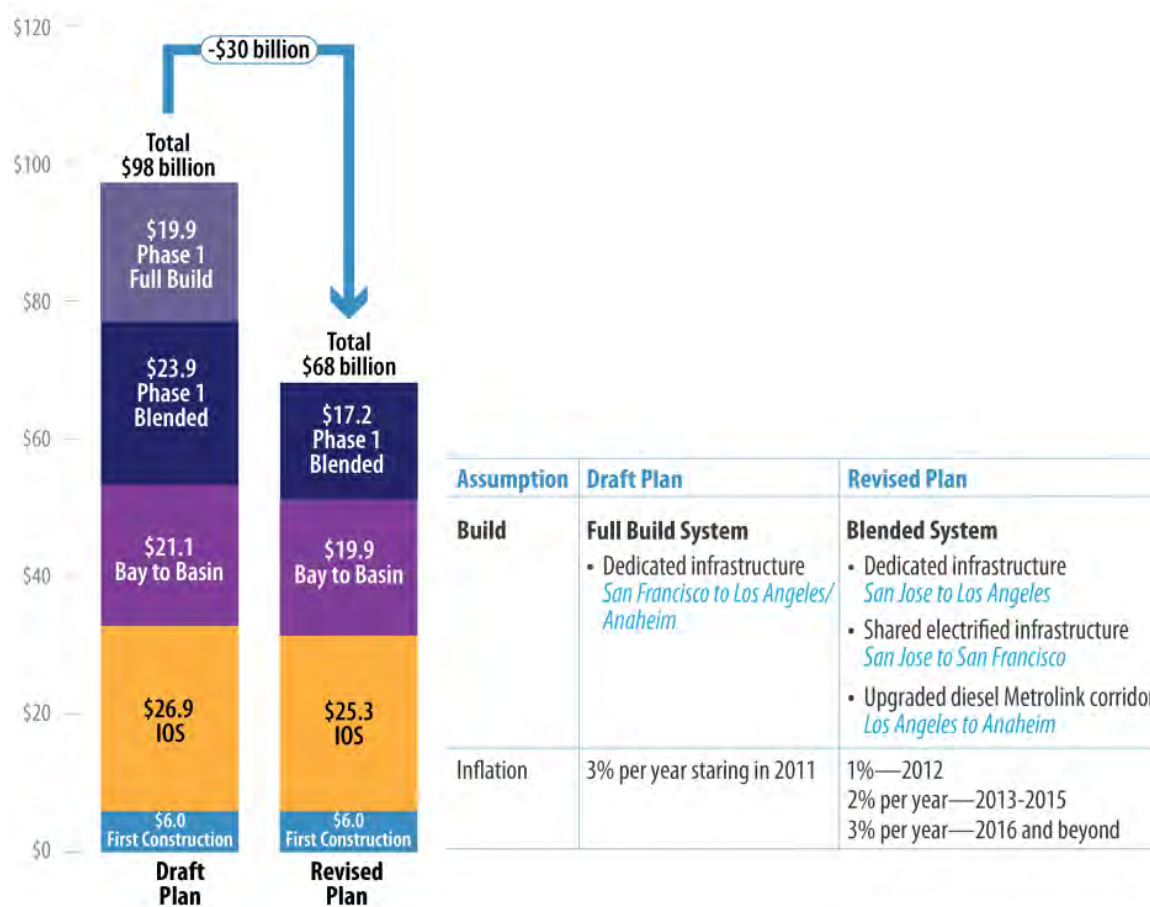
- The Phase 1 Blended option eliminates the need for costly and intrusive new HSR infrastructure in urban areas, reducing the cost of delivering the HSR system called for in Proposition 1A by nearly \$30 billion (year-of-expenditure dollars [YOES]) from the previous Phase 1 Full Build proposal. Completion of the Phase 1 Blended system, as described in Chapter 2, is estimated at \$68.4 billion in inflated, YOES dollars, compared to the previous Phase 1 Full Build estimate of \$98.1 billion.
- Acceleration of the delivery of improvements in urban areas through early investments and the adjustment of early inflation estimates to align with projections.

Exhibit 3-1 compares the construction cost (YOES) of the Phase 1 Blended system to the Phase 1 Full Build system and shows how these two key changes yield \$30 billion in cost reductions.

This chapter presents updated capital cost estimates for constructing the Phase 1 high-speed rail (HSR) system connecting San Francisco and Merced with Los Angeles and Anaheim through a phased and blended implementation approach. This chapter also describes the Authority's approach to developing these cost estimates and outlines comparisons to international systems and other projects in the United States.

Additional information on the capital cost estimates in this Revised 2012 Business Plan (Revised Plan) is available in *Cost Changes from 2009 Report to 2012 Business Plan Capital Cost Estimates*, which can be accessed at [www.cahighspeedrail.ca.gov/business\\_plan\\_reports.aspx](http://www.cahighspeedrail.ca.gov/business_plan_reports.aspx).

Exhibit 3-1. Phase 1 construction cost comparison—Draft and Revised Business Plan (YOE\$)



### Presentation of capital costs

The capital costs for the high-speed rail system are presented in this chapter in two ways:

- **Constant dollars**—Estimates are initially provided in 2011 dollars to serve as a baseline for conversion to YOE dollars and for comparison with other projects.
- **Year-of-expenditure dollars**—Estimates are then converted into year-of-expenditure dollars by using the baseline 2011 costs and projecting them into the future, using the schedule and implementation approach described in Chapter 2, The Implementation Strategy: Blending, Phasing, Investing in Early Benefits.

A range of costs is associated with each phase of the program because until final environmental approval of all preferred alignments, stations, and maintenance facilities is received, a number of key decisions will remain unresolved. When those decisions are finalized, the final costs also will be determined. For example, for the Central Valley alone, more than 20 alignment options have yet to be finalized, and each option has different costs. To show the range of potential costs, the low cost estimate includes the cumulative lowest cost options, and the high cost estimate includes the cumulative highest cost options, both including environmental mitigation.

This chapter provides the costs for the different steps in the implementation plan (as outlined in Chapter 2, The Implementation Strategy: Blending, Phasing, Investing in Early Benefits) broken out by Federal Railroad Administration (FRA) cost category in 2011 dollars. A contingency of between 10 and 25 percent is included in each cost category to protect against material cost increases, use of different components or parts, and minor quantity changes, depending on the category. A separate and additional “Unallocated Contingency” value of 5 percent also is included as a general reserve to address unanticipated changes. The costs for each step represent a project total at that step and include the cost for constructing prior sections. For example, the Bay-to-Basin estimate includes the cost of the IOS.

## Approach and methodology

The following important programmatic considerations directly affect the cost estimates:

- **Program size**—The CHSRP is one of the largest infrastructure programs undertaken in the United States. This program includes installing potentially up to 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 approximately 190 grade separations. A significant portion of the project—approximately 190 miles—may be constructed on elevated structures or in tunnels.
- **Shared benefits and costs**—Consistent with the emphasis on blended systems, many of the improvements included in the cost estimate will benefit other California rail and transit operators as well as the communities through which the system will be constructed. Investments will be made in tracks and systems in joint-use corridors. 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. Through the development of cooperative memoranda of understanding and other means, the Authority and its transportation partners are working to develop collaborative funding and cost-sharing strategies. Many costs for these joint-benefit improvements are included in full within the program budget. For example, in the Caltrain corridor between the San Francisco and San Jose corridor, Caltrain and HSR will share the electrified tracks requiring joint investments to enhance the corridor to accommodate additional commuter and HSR service in this heavily traveled corridor. Similarly, investments will be made to upgrade the Southern California Regional Rail Authority (Metrolink) corridors to achieve the blended service and operations described in Chapter 2, The Implementation Strategy: Blending, Phasing, Investing in Early Benefits.

## 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. Proceeding with the procurement of a design-build contractor at this stage follows standard industry practice for balancing the need for sufficient specificity of preliminary design and the flexibility for innovation in final design and construction. The type and level of cost estimation undertaken by the Authority is in accordance with guidelines from the Association for the Advancement of Cost Engineering (AACE-International) and under those AACE guidelines, are appropriate for bid/tender<sup>1</sup>. A comprehensive report prepared for the U.S. Department of Transportation, the *Design-Build Effectiveness Study*<sup>2</sup> evaluated lessons learned from a variety of design-build projects, including rail, and recommended specific steps for agencies to maximize the benefits of the design-build approach. A key recommendation was that,
 

*Preliminary designs that are incorporated in the RFP [request for proposal] should be no more than 30 percent complete, dropping to lower levels as the size and complexity of the project increases and the contracting agency gains greater experience with this project delivery approach and the use of performance-based specifications.*
- Final Engineering (100 percent) provides the documentation to build the final product.

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 now has 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. Thus, at this stage of the project, local conditions, stakeholder requirements, and engineering demands are well understood. Barring major changes in scope or requirements, the level of contingency at this stage—a total of 10 to 25 percent of each construction category—should be sufficient to address reasonably foreseeable increases arising from the normal design process.



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

The HSR program will be constructed through design-build contracts. Under a traditional design-bid-build project development approach, there is a separate process for completing project design, which is then provided to the construction contractor. Under a typical design-build approach, the public entity provides about 15 percent of the design to the contractor, and a single contractor both completes the design and constructs to those specifications. There are many advantages to this approach, but one of the primary ones is avoiding conflicts between the design and the practical realities that come up during construction. Since a single contractor manages both aspects of project development, costs and risks to the public agency are reduced and the contractor guarantees that the completed project will meet performance criteria established by the public agency.

## 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:

- **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 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, embankments, and retaining walls and 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.

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.

### Capital costs in 2011 dollars

The 2009 cost estimates were based on programmatic conceptual design. As noted previously, the cost estimates in this Revised Plan are based on a higher level of preliminary design, which also have been shaped by the changes resulting from the environmental and community review processes. The increased costs in the current estimates are tied to several key factors. Eighty to eighty-five percent of this increase is for additional viaducts, tunnels, embankments, and retaining walls and trenches

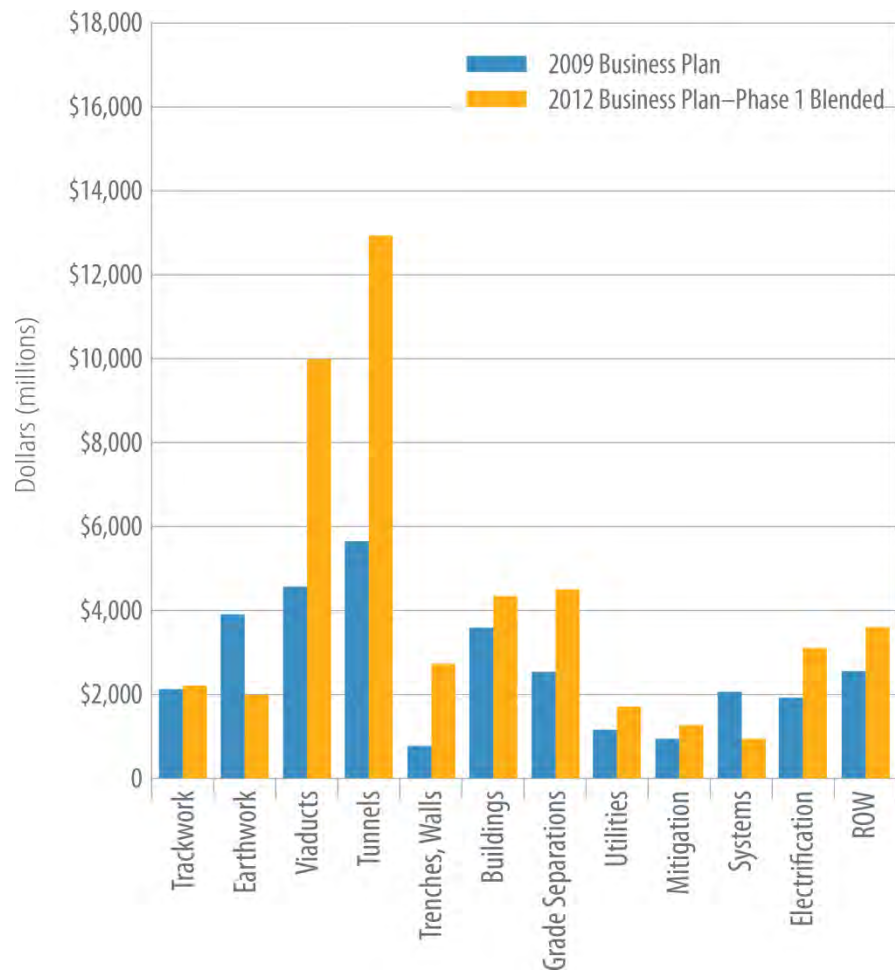
directly attributable to changes in scope and alignment based on stakeholder input, environmental necessity, and improved knowledge of site conditions; the remaining 15 to 20 percent is attributable to increases in composite unit prices (Exhibit 3-2).

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



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

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, floodplains, 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 reduced community impacts and disruption. Approximately 30 to 36 percent of the Phase 1 Blended 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 113 and 140 miles, and tunnels increased from 32 miles to between 44 and 48 miles (with the ranges based on different alternatives still under consideration). 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 because of domestic and international demand, particularly from China.

In summary, the Phase 1 Blended 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.

### Initial Operating Section

The IOS 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 first segment of the IOS between Merced and Bakersfield and extending the tracks to the San Fernando Valley, the IOS includes passenger stations, maintenance and support facilities, traction electrification systems, and train control and communication systems for the entire system, as well as the necessary high-speed trains required for service. Exhibit 3-3 presents construction costs for the IOS broken out by FRA cost category in 2011 dollars.

**Exhibit 3-3. Cost to construct IOS—Central Valley to San Fernando Valley (base year fiscal year 2011 dollars)**

FRA Standard Cost Categories	Low-cost Option (millions)	High-cost Option (millions)
10—Track structures and track	\$14,319	\$17,275
<i>Civil (10.04–10.06, 10.08, 10.18)</i>	\$1,470	\$1,712
<i>Structures (10.01–10.03, 10.07)</i>	\$11,719	\$14,298
<i>Track (10.09, 10.10, 10.14)</i>	\$1,132	\$1,267
20—Stations, terminals, intermodal	\$618	\$618
30—Support facilities: yards, shops, administrative buildings	\$433	\$433
40—Sitework, right-of-way, land, existing improvements	\$4,667	\$5,341
<i>Purchase or lease of real estate (40.07)</i>	\$1,461	\$1,523
50—Communications and signaling	\$518	\$559
60—Electric traction	\$1,699	\$1,830
70—Vehicles	\$871	\$871
80—Professional services (applies to categories 10–60)	\$2,805	\$3,309
90—Unallocated contingency	\$935	\$1,103
100—Finance charges	\$0	\$0
<b>Total</b>	<b>\$26,865</b>	<b>\$31,339</b>

Subtotals for information only



**Bay to Basin**

The Bay-to-Basin 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. This system will allow for blended systems with Caltrain and HSR in San Jose, and with Metrolink and HSR in the San Fernando Valley. Bay to Basin 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 3-4 presents construction costs for Bay to Basin broken out by FRA cost category in 2011 dollars.

**Exhibit 3-4. Cost to construct—Bay to Basin (base year fiscal year 2011 dollars) (includes cost of IOS)**

FRA Standard Cost Categories	Low-cost Option (millions)	High-cost Option (millions)
10—Track structures and track	\$21,286	\$26,716
<i>Civil (10.04–10.06, 10.08, 10.18)</i>	\$2,320	\$4,353
<i>Structures (10.01–10.03, 10.07)</i>	\$17,350	\$20,569
<i>Track (10.09, 10.10, 10.14)</i>	\$1,618	\$1,795
20—Stations, terminals, intermodal	\$1,135	\$1,137
30—Support facilities: yards, shops, administrative buildings	\$471	\$468
40—Sitework, right-of-way, land, existing improvements	\$7,922	\$8,795
<i>Purchase or lease of real estate (40.07)</i>	\$1,914	\$2,043
50—Communications and signaling	\$692	\$749
60—Electric traction	\$2,250	\$2,434
70—Vehicles	\$1,835	\$1,835
80—Professional services (applies to categories 10–60)	\$4,296	\$5,161
90—Unallocated contingency	\$1,426	\$1,713
100—Finance charges	\$0	\$0
<b>Total</b>	<b>\$41,313</b>	<b>\$49,008</b>

Subtotals for information only

### **San Francisco to Los Angeles/Anaheim—Phase 1**

Implementation of Phase 1 service connecting the San Francisco Transbay Transit Center in the north with the Anaheim Regional Transportation Intermodal Center in the south can occur in increments building off the Bay-to-Basin-operating section described above. The Phase 1 Blended system involves constructing an HSR extension to Los Angeles' Union Station, which will provide dedicated high-speed rail infrastructure between Los Angeles and San Jose, and upgraded blended operations in the Caltrain Corridor and in the Metrolink corridor between Los Angeles and Anaheim. Exhibit 3-5 presents construction costs for Phase 1 Blended broken out by FRA cost category in 2011 dollars.

**Exhibit 3-5. Cost to construct—Phase 1 Blended (base year fiscal year 2011 dollars) (includes cost of IOS and Bay to Basin)**

FRA Standard Cost Categories	Low-cost Option (millions)	High-cost Option (millions)
10—Track structures and track	\$23,595	\$29,815
<i>Civil (10.04–10.06, 10.08, 10.18)</i>	\$3,069	\$5,347
<i>Structures (10.01–10.03, 10.07)</i>	\$18,705	\$22,422
<i>Track (10.09, 10.10, 10.14)</i>	\$1,821	\$2,046
20—Stations, terminals, intermodal	\$3,208	\$3,210
30—Support facilities: yards, shops, administrative buildings	\$764	\$761
40—Sitework, right-of-way, land, existing improvements	\$11,938	\$13,059
<i>Purchase or lease of real estate (40.07)</i>	\$3,607	\$3,915
50—Communications and signaling	\$861	\$916
60—Electric traction	\$2,822	\$3,001
70—Vehicles	\$3,211	\$3,211
80—Professional services (applies to categories 10–60)	\$5,256	\$6,236
90—Unallocated contingency	\$1,788	\$2,117
100—Finance charges	\$0	\$0
<b>Total</b>	<b>\$53,443</b>	<b>\$62,326</b>

Subtotals for information only  
Figures may not sum due to rounding.

### **Capital costs in year-of-expenditure dollars**

The previous section showed the costs by phase in 2011 dollars. This section converts the 2011 estimates to their year-of-expenditure estimates using the planning schedule in Chapter 2, The Implementation Strategy: Blending, Phasing, Investing in Early Benefits, and assumptions regarding inflation. In this Revised Plan, costs are escalated by applying an inflation rate for each year beyond the baseline. Inflation for 2012 is assumed to be 1 percent; 2013 through 2015 is 2 percent per year; and 3 percent per year is used for 2016 forward. These rates have been estimated based on multiple sources, including the California inflation forecast data provided by the California Department of Finance,

Engineering News Record Construction Cost Index historical and forecast indexes, and medium/long-term federal inflation targets.

The planning schedule (Exhibit 3-6) was used to develop year-of-expenditure estimates.

**Exhibit 3-6. Construction schedule**

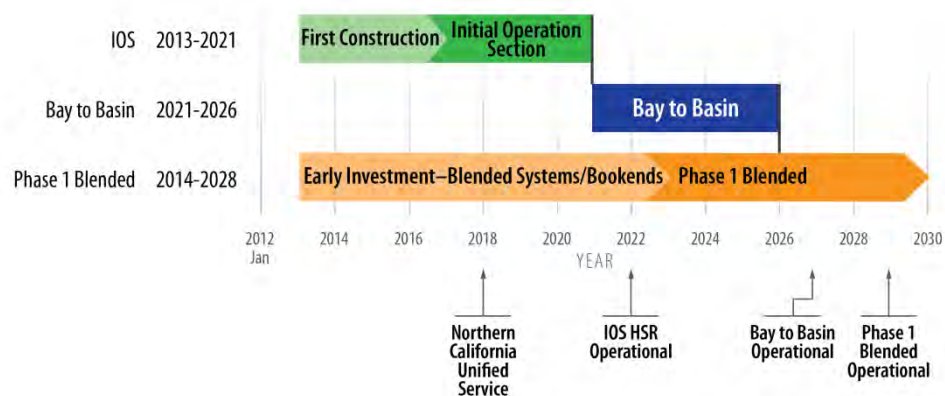


Exhibit 3-7 and Exhibit 3-8 show cost estimates in 2011 and year-of-expenditure dollars for the low-cost options and the high-cost options previously shown in Exhibit 3-3, Exhibit 3-4, and Exhibit 3-5.

**Exhibit 3-7. Year-of-expenditure cost for the low-cost options**

Section	Incremental Capital Cost (billions 2011\$)	Cumulative Capital Cost (billions 2011\$)	Completion of Section	Incremental Year-of-Expenditure Capital Cost	Cumulative Year-of-Expenditure Capital Cost
IOS	26.9	26.9	2021	31.3	31.3
Bay to Basin	14.4	41.3	2026	19.9	51.2
Phase 1 Blended	12.1	53.4	2028	17.2	68.4

**Exhibit 3-8. Year-of-expenditure cost for the high-cost options**

Section	Incremental Capital Cost (billions 2011\$)	Cumulative Capital Cost (billions 2011\$)	Completion of Section	Incremental Year-of-Expenditure Capital Cost	Cumulative Year-of-Expenditure Capital Cost
IOS	31.3	31.3	2021	36.6	36.6
Bay to Basin	17.7	49.0	2026	24.3	60.9
Phase 1 Blended	13.3	62.3	2028	18.8	79.7

For purposes of financial analysis, the low-cost options are illustrated in the primary tables and the impact of higher costs is shown in the alternative funding scenarios in Chapter 7, Financial Analysis and Funding.



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

If a decision is made in the future to construct the Phase 1 Full Build system, this would involve constructing fully dedicated high-speed rail infrastructure between San Jose and San Francisco and between Los Angeles and Anaheim. The projected schedule for completing the Full Build system is 2033, and the total cost is \$67.4 billion in 2011 dollars, which would be \$91.4 billion in year-of-expenditure dollars. An alternative approach to construction of a Full Build Option on the San Francisco Peninsula was developed and reported in the Draft 2012 Business Plan. It is not under consideration.

## 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 only can provide an order of magnitude indication of the current estimate's reasonableness for the CHSRP as every project has its own 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?* This 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.<sup>3</sup>*

The international cost range can be compared to the costs of the CHSRP implementation steps as described in this Revised Plan. For comparison purposes, the real estate and professional fees have been subtracted from the CHSRP costs, but the costs are shown in 2011 dollars. The construction cost for the IOS will be \$75 million to \$88 million per mile. For the Bay-to-Basin section, the construction cost will range from \$86 million to \$102 million per mile. For the Phase 1 Blended system, the construction cost will be \$86 million to \$100 million per mile. These costs fall within the international HSR cost range.<sup>4</sup>

### **Amtrak Next Generation (Washington–NYC–Boston)**

In September 2010, Amtrak announced its ambitious Next Generation HSR Program for the 460-mile Northeast Corridor (Exhibit 3-9). The program will reduce trip times to less than three hours and 30 minutes for a Washington-to-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.<sup>5</sup>

In contrast, the current capital cost estimate for Phase 1 Blended of the CHSRP (\$53.4 in 2011\$) equates to about \$103 million per mile (including real estate and professional fees). The capital cost for the Bay-to-Basin section (\$41.3 to \$49.0 billion) equates to \$100 to \$119 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 lies in more densely populated urban areas requiring costly tunnels, elevated structures, and expensive property acquisitions. When compared to the cost of California's system, it is comparable to the per-mile costs of the segments that travel through California's dense urban areas.

### **Comparing the cost to other California transportation investments**

California will continue to grow and will continue to need to invest in new infrastructure. With the addition of the equivalent of the population of the State of New York, the level of investment will be in the tens and hundreds of billions if California is to maintain its economic competitiveness and the quality of life that people of the state enjoy.

Several recent reports have identified transportation needs for the state that indicate the level of investment needed in California in the coming decades:

- In October 2011, the California Transportation Commission issued its 2011 *Statewide Needs Assessment Report* that identified \$182 billion in capital expansion needs in the state by 2020 (without including high-speed rail). This report can be accessed at [www.catc.ca.gov/reports/2012%20Reports/Trans\\_Needs\\_Assessment\\_corrected\\_01172012.pdf](http://www.catc.ca.gov/reports/2012%20Reports/Trans_Needs_Assessment_corrected_01172012.pdf)

**Exhibit 3-9. Amtrak Next Generation**



- The independent, non-partisan *Think Long Committee for California*—which includes such distinguished members as George P. Schultz, Condoleezza Rice, former chair of the Council of Economic Advisors Laura Tyson, and Google Chief Executive Officer (CEO) Eric Schmidt—has cited the state’s transportation investment needs at \$550 billion over the next *decade*. This report can be accessed at [http://berggruen.org/files/thinklong/2011/blueprint\\_appendix\\_3\\_jobs\\_infrastructure.pdf](http://berggruen.org/files/thinklong/2011/blueprint_appendix_3_jobs_infrastructure.pdf)
- The American Society of Civil Engineers estimated that California needs to invest \$365 billion in infrastructure *above* existing funding levels over the next 10 years. This report can be found at <http://www.ascecareportcard.org/>

These numbers provide context for the tremendous needs and investments required to ensure that California’s transportation system can accommodate future growth and keep its economy growing.

In preparing this Revised Plan, the Authority did not conduct its own needs assessment for transportation investments. However, a comparison of costs of equivalent capacity provided through different modes of transportation has been prepared. It does not suggest or imply that the equivalent capacity in highways or aviation would be needed and built in the same timeframe; it is a comparison of the costs of doing so. The basis for using a capacity-based comparison lies in the origins of the high-speed rail program. It is different than other infrastructure programs in that the Legislature specifically established the need for the investment and defined it in statute, which was then approved by the voters as Proposition 1A:

*Cal.S. & H. code § 2704.04. Legislative intent regarding construction of a high-speed train system; use of proceeds of bonds*

*(a) It is the intent of the Legislature by enacting this chapter and of the people of California by approving the bond measure pursuant to this chapter to initiate the construction of a high-speed train system that connects the San Francisco Transbay Terminal to Los Angeles Union Station and Anaheim, and links the state’s major population centers, including Sacramento, the San Francisco Bay Area, the Central Valley, Los Angeles, the Inland Empire, Orange County, and San Diego consistent with the authority’s certified environmental impact reports of November 2005 and July 9, 2008.*

Construction of the HSR system will provide the state with a given level of capacity for moving people. The actual levels of ridership will vary, much in the way that the capacity of a lane of highway is defined, but the actual usage varies over time. With the need for and the parameters of the system having been established by the Legislature and affirmed by voters, the analysis in this Revised Plan is intended to provide decision-makers with additional context for considering the capital costs of the high speed program, along with an understanding of the cost of providing that same capacity through other modes, and the scale of environmental and social challenges that would be faced in attempting to do so.

For validation, the Authority requested that the California Department of Transportation (Caltrans) calculate the costs of equivalent highway capacity based on guidance from the Authority on the level and location of added capacity. Determination of the appropriate methodology, including assumptions of vehicle occupancy, lane capacity, number of lanes added, and per-mile costs of new lanes, was made

by Caltrans. Among other changes, the Caltrans methodology assumes lower vehicle occupancy rates, lower lane volumes, lower cost-per-mile prices based on recent projects, and that lanes would be added in pairs, not individually, as was assumed in the Draft Plan, resulting in an increase in lane miles required. As noted previously, this is not a needs analysis, so Caltrans' estimates do not infer plans to add this specific level of capacity.

The analysis shows that providing equivalent new highway capacity (using the Caltrans methodology) and aviation capacity as that provided by the San Francisco-to-Los Angeles/Anaheim HSR system would cost approximately twice as much as the HSR investment. Building equivalent capacity to Phase 1 Blended through road and airport expansions would cost an estimated \$124 billion (\$2011) which is equivalent to \$158 billion in YOE dollars. Providing the same capacity as the HSR system would require the following: 4,300 new lane-miles of highway, 115 additional gates at California airports, and 4 new airport runways.<sup>6</sup>

In addition, Caltrans estimates that the cost of operating and maintaining the additional highway infrastructure would be \$132.8 billion over the next 50 years. Such funding would have to be included in the state budget. Operations and maintenance for high-speed rail will be paid by the operator and funded through system revenues.

Although investment in a balanced, multi-modal transportation clearly is a more cost-effective means of addressing congestion and mobility, this analysis does not calculate or imply a direct correlation between investment in one mode of transportation and avoidance of investment in another. However, such analyses have been made in other cases. For example, Metrolink service in the Los Angeles region has been found to remove the equivalent of one lane of traffic off of Interstate 5 and other highways.<sup>7</sup> Based on Caltrans' estimate of \$30 to \$50 million per lane-mile for the construction of urban interstate highways, adding a lane for each direction of the full 45-mile length of I-5 in Orange County would cost from \$2.7 to \$4.5 billion.

## End notes

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<sup>1</sup> Source: *Professional Practice Guide to Construction Cost Estimating, Third Edition*. Association for the Advancement of Cost Engineering.

<sup>2</sup> *Design Build Effectiveness Study, As Required by TEA-21 Section 1307(f)*. Final report prepared for USDOT–Federal Highway Administration. January 2006. ([www.fhwa.dot.gov/reports/designbuild/designbuild5.htm](http://www.fhwa.dot.gov/reports/designbuild/designbuild5.htm))

<sup>3</sup> Source: Amos, P., D. Bullock, J. Sondhi. July 2010. *High-Speed Rail: The Fast Track to Economic Development?* The World Bank. [www.worldbank.org/research/2010/07/12582340/high-speed-rail-fast-track-economic-development](http://www.worldbank.org/research/2010/07/12582340/high-speed-rail-fast-track-economic-development)

<sup>4</sup> Source: *Engineering News Record* (ENR). December 27, 2010. “The 2010 4th Quarterly Cost Report.” <http://enr.construction.com/magazine/2010/1227.asp>

<sup>5</sup> Source: Amtrak. September 2010. “A Vision for High-Speed Rail in the Northeast Corridor.” [www.Amtrak.com](http://www.Amtrak.com)

<sup>6</sup> Source: Parsons Brinckerhoff. October 2011. *Technical Memorandum: Cost of Alternative Modes to High-Speed Rail*, October 2011.

<sup>7</sup> *Cost/Benefit Assessment of Metro’s Funding for Metrolink*, prepared for Los Angeles County Metropolitan Transportation Authority (Metro), Final Report, October 4, 2007.



## Chapter 4

### ***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 Revised 2012 Business Plan (Revised 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 including the various ways the private sector will be involved in the project.

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 (IOS) 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 almost all recent high-speed rail projects in the world.
- The partnership between the public and private sectors 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. Most of the employment created will be in California to

support construction of the system and long-term operations and maintenance activities. A 30-percent goal has been established for contracting with small and disadvantaged businesses.

- 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/private partnership—design-build-finance and maintain in contract for tolled tunnel
- **2009 Netherlands:** Amsterdam to Belgian Border—public/private partnership-infrastructure
- **2007 Taiwan:** Taipei to Tsoying—public/private partnership—infrastructure and operations

Systems in France, Spain, and The Netherlands attracted private investment once ridership was established or by using availability-based public-private partnership structures where the government retained portions of the revenue risk. Both Taiwan and HS1 had private capital investment prior to commencing revenue operations, and early results did not support the anticipated private-sector returns. As discussed in this section, the experience of other international high-speed rail projects was an important input to the business model and anticipated timing of private-sector investment.

### Business model principles

The business model for delivery of HSR was designed around the following 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. The system's development strategy incorporates blended usage of existing commuter rail networks in urban areas and the business model includes working arrangements and agreements with other state agencies, regional transportation authorities, existing

commuter rail systems, and other transit systems. It is anticipated that regional authorities will lead the development of improvements in existing commuter corridors.

- **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.
- **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 (RFEI) 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. Following up on recent questions posed by stakeholders, the Authority reevaluated private-sector interest in early 2012 by interviewing a number of the respondents that indicated interest in investing in the project and through one-on-one interviews with firms that responded to the Request for Qualifications for the first construction package. Responses from the RFEI and recent discussions with interested companies confirmed the private sector’s interest in the project and the conditions and timing required to attract significant private-sector investment.

## 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.

A key consideration in the private-sector’s role is at what point the state should anticipate that private-sector parties will have the capability and interest to invest capital in the project based on potential cash flows and without additional state guarantees. Based on stakeholder questions related to the timing of private-sector investment, the Authority contacted a range of investors and firms that had responded to the RFEI to confirm investment timing and interest. The magnitude of construction, risks related to completion, and the unknowns surrounding actual levels of revenue were identified by investors as reasons why significant early investment in construction of the system should not be anticipated from the private sector. There was agreement that, absent state guarantees, there would be little private capital available to invest into the project until after completion of the IOS and a positive cash flow is

demonstrated. There was also agreement that once these conditions were met, substantial private-sector investment interest could be expected consistent with other systems in the world.

Given these precedents, the Authority's long-term business model is founded on a strong public-private partnership relying on the private sector to design, build, operate, and maintain a high-speed rail system that is funded by a combination of government investments and future revenues that support the investments of capital from the private sector. Elements of cost, schedule, and delivery risk are transferred to the private sector immediately beginning with design and construction, and the transfer of risk increases as the system is developed and opened to incorporate operating performance and profit and loss. The Authority will continue to assess private capital markets, as market conditions, financing tools, and expectations change over time.

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.

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.

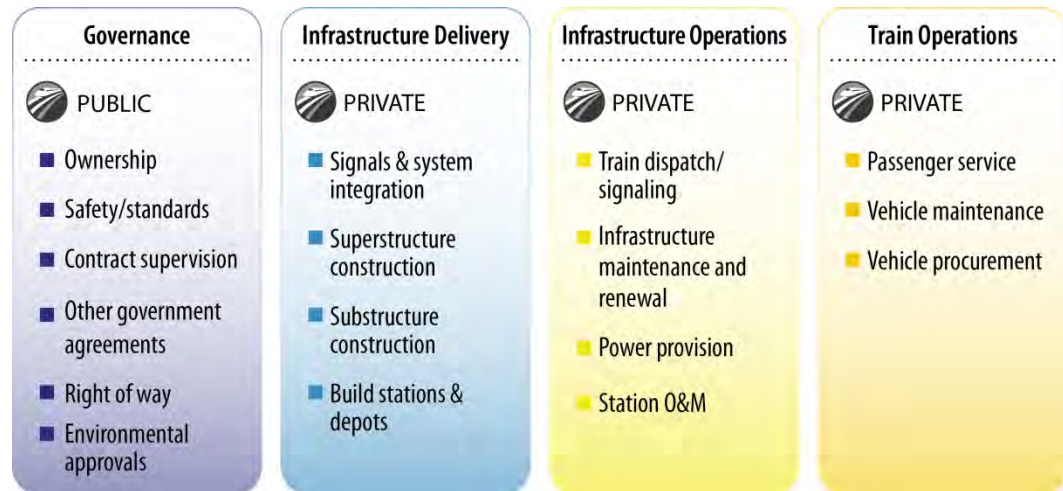
The U.K. transferred development, finance, and maintenance responsibility for HS1 to the private sector in 1996. The U.K. government took back control of the operating system in 2009 due to insolvency. Subsequently, the government successfully sold an operating concession for HS1 to the private sector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

## Public and private sector roles

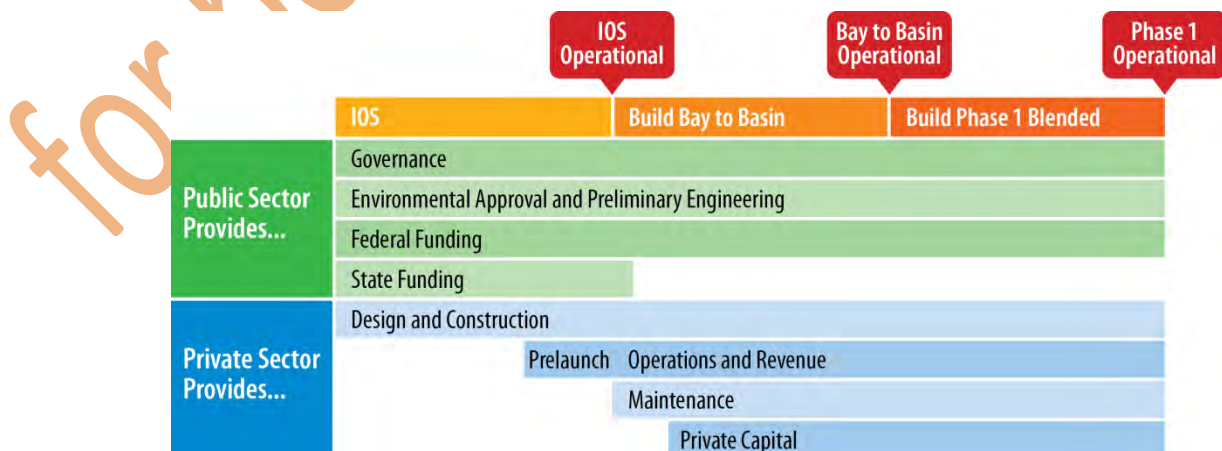
High-speed rail systems include four principal roles that are organized in different combinations around the world (Exhibit 4-1). These four roles form the foundation of the California high-speed rail business model.

**Exhibit 4-1. High-speed rail organizational model**



As stated earlier, the Authority will rely on the private sector for infrastructure delivery (e.g., construction, systems etc.), infrastructure operations, and train operations. The business structures under which these services will be provided will be implemented over time as the project moves from its early stages (construction of the IOS) to more advanced stages (rail operations and system maintenance). The underlying financial model will also be implemented over time as development risks are reduced and public funds can be augmented with private capital. Exhibit 4-2 illustrates the roles of the public and private sector as the program is implemented.

**Exhibit 4-2. Public and private sector roles for program development**



The state 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. Regional authorities will continue to be responsible for commuter rail systems used by high-speed operators. A series of agreements are required to align the various public participants in a manner that allows efficient development and operation by the private sector.

As described further in Chapter 7, Financial Analysis and Funding, construction of the IOS will be government funded through federal funds, state 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.

The major delivery elements of the system will be performed by the private sector under contracts and/or concession agreements 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.

As described in Chapter 2, The Implementation Strategy: Blending, Phasing, Investing in Early Benefits, the IOS will be developed before the Authority initiates high-speed passenger service. In the initial years

A concession agreement is a mutually beneficial arrangement between a government entity and a private-sector company, or joint venture. The private entity enters into an agreement with the government for the right to perform a variety of services which can include designing, constructing, operating, maintaining, and/or financing a specific piece of public infrastructure for a given number of years.

of construction, the private sector will be retained under design-build contracts to build portions of the IOS with elements of cost overrun and other risks transferred to the private sector. As portions of the track are completed, they will be made available to existing passenger rail carriers for use under operating agreements that include fees for track usage and maintenance.

As the IOS is moving toward completion, the Authority will procure infrastructure operations and maintenance and a high-speed train operator to launch and operate the high-speed rail service. The role of the operator pre-launch will include activities to create a strong sense of anticipation and demand for the high-speed rail service. These initial operating contracts will be structured to support the Authority's plan for granting a long-term operating concession after the IOS is in operation and

early ridership is proven. The long-term operating concession will include up-front concession payments to the state and be timed to create a competitive environment that captures good value for the state.

### ***Governance and management capacity***

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 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 Authority's organizational development is a key requirement of the business model and one of the risks identified in Chapter 8, Risk Identification and Mitigation.

The Authority is actively seeking to hire additional resources with experience with high-speed rail systems and to transfer state staff with key development experience. 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 rail 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.

## Public-sector partners

In addition to the Authority's role in providing program governance, a wide range of other public-sector entities also has a role in the program's development, such as the following:

- **Other California state agencies, including the California Department of Transportation, the Department of Finance, the 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. The Authority will work closely with Caltrans, which manages existing intercity rail routes that will connect with HSR.
- **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 rail service. Based on asset ownership structures, joint-operating agreements for high-speed rail 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.
- **Regional commuter rail systems**—The high-speed rail system will be integrated with existing commuter rail systems in urban areas (see Chapter 2, The Implementation Strategy: Blending, Phasing, Investing in Early Benefits). 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 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 memoranda of understanding, operating agreements, and grant funding agreements. These processes and agreements are not further described in this Revised 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



## Private-sector expertise

The Authority has used the planning services of the international organizations described above in developing and reviewing design elements, costs, and other portions of the system. It is recognized that early involvement of potential operators could help identify options that could improve service and revenue potential. The Authority has developed an agreement with the International Union of Railways, the international organization of high-speed rail developers and operators, to provide assistance in the form of peer review. This will allow structured international review and input without a specific focus on one type of system or technology until such technical decisions are made in conjunction with competitive procurements by the state. Given the potential conflicts of relying on one potential operator for advice during early planning, the Authority does not believe that the role of operating advisor should be exclusive to a single operating company at this early point in the project. However, the Authority does recognize the importance of the operator being appointed well in advance of the launch of high-speed operations to assist in both technical decisions and in building market awareness and demand prior to operations as described later in this section.

## Small and disadvantaged business goals

A key element of the Authority's strategy is local job creation, which encourages the support of small and disadvantaged businesses. The Authority understands the importance of diversity and its benefits to the California economy. To further this initiative, the Authority signed an assurance to comply with best practices of the U.S. Department of Transportation Disadvantaged Business Enterprise (DBE) Program and the Civil Rights Act, as well as establishing a Small and Disadvantaged Business Program. Additionally, in November 2011, the Authority created and subsequently adopted a policy to diversify the types of firms involved in developing the high-speed rail system. The policy aims to provide work to small and disadvantaged businesses in the amount of at least 30 percent of the total price for a given contract. Qualified firms in any combination and at any tier level who are certified as Small Businesses (SB) inclusive of DBEs, Disabled Veteran Business Enterprises (DVBES), and Microbusinesses (MBs) will be encouraged to participate.

## Planned approach by phase

### *Initial Operating Section*

The IOS will be developed as follows:

- Construction and electrification, control systems, and other infrastructure will be implemented by the private sector under fixed-cost contracts that transfer design-build completion risk to an appropriate extent. The scale of the IOS is too large for a single competitive construction contract and will therefore encompass multiple design-build and other contract packages.
- The management and maintenance of systems and other infrastructure to support high-speed operations will be retained under one or more long-term infrastructure maintenance and management contract(s). The Authority will seek to use availability-based contracts that will be paid for from track access fees paid by operators (as described below).

- A private-sector train operator will be selected to initiate early passenger service on a contract basis. The operator will have input on the optimal service specification, marketing, the vehicles, and final station designs and will be selected two to three years prior to completion of the IOS. This contract will be structured to allow the Authority to move operations to a concession structure once early ridership has been proven and significant private-sector interest is available to allow the state to capture strong up-front value. Under the planned concession approach, the operator will pay an up-front concession fee for the rights to operate the service and collect revenues. Consistent with other international high-speed rail systems, the operator will also pay track access fees for use of the infrastructure. For planning purposes, costs for the rolling stock are included in capital cost estimates, although lease-based financing and service contracts are common structures in other high-speed rail systems and will be considered when equipment decisions are made.

The first construction segments for the IOS will be procured under design-build contracts and potentially several small advance works design-bid-build contracts. 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.

Early use of the IOS as described in Chapter 2, The Implementation Strategy: Blending, Phasing, Investing in Early Benefits, will be based on contracts that include usage fees and maintenance payments to cover costs. Maintenance services will be provided under contract and aligned with usage and fees collected.

Based on discussions with private-sector investors described earlier in this chapter, construction of the IOS will require state and federal funding until the section is completed. Once operations commence, the IOS will not require a state subsidy as operating costs are covered by operating revenues, as further described in Chapter 7, Financial Analysis and Funding. A well-established train operator market exists in Europe and includes SNCF, Deutsche Bahn, Virgin Rail, and others. The growing international passenger train market provides a strong base of experienced operators to drive competition and value for the state.

### ***Future phases—Bay to Basin/Phase 1 Blended***

As with the IOS, the Bay-to-Basin phase consists of the development of additional track and systems through a mountain range. The Bay to Basin addresses three travel markets: the San Francisco Bay Area to the Los Angeles Basin; the San Francisco Bay Area to the Central Valley; and the Los Angeles Basin to the Central Valley. As a result, it has much stronger ridership than the IOS, as discussed in Chapter 5, Ridership and Revenue.

### **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 7, Financial Analysis and Funding, revenues begin to support funding of capital costs (in addition to covering operating 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.

As further described in Chapter 7, Financial Analysis and Funding, significant private-sector financial interest is expected upon completion of the IOS, and proving early ridership and project revenues are expected to assist in funding portions of the construction of the Bay to Basin, Phase 1, and Phase 2.

### Train and equipment operations

As the system is extended, additional or extended concession agreements will be required for equipment operations and maintenance, as well as for train operations. With each extension, the value of the system to the state will be enhanced. Each new or extended concession will provide an additional opportunity for the state to negotiate increased concession-based payments that can be applied to capital needs or other purposes. 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 the 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.

## 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 procurement plan. As the project progresses over time, procurement flexibility will be retained within the business model. Planned approaches for each phase are as follows:

- **Initial Operating Section**—This is the first section for high-speed rail operations. Construction will use design-build approaches, and infrastructure management and maintenance will be performed under contract. Operations will be provided under a concession agreement.
- **Bay to Basin/ Phase 1 Blended**—The system development will be mature enough to support greater private-sector participation in operations and maintenance and various forms of private finance. The Bay to Basin and future sections will follow a course similar to the IOS, although the additional flexibility of revenues to support project-based financing allows other public-private partnership structures to also be considered as procurement options.
- The completion of the system through Phase 2 will leverage similar approaches.



## Chapter 5

### ***Ridership and Revenue***

#### **Introduction**

As is the case with many transportation programs, the forecasts of ridership and revenue for the California high-speed rail (HSR) system continue to be the subject of extensive review. Areas of focus and scrutiny include the model used to generate the forecasts, the assumptions and data used as inputs to the model, and the results of the modeling. In preparing the forecasts for the Revised 2012 Business Plan (Revised Plan), a number of steps have been taken to respond to questions and comments and to continue to improve the reliability of the forecasts. Those steps are presented in this chapter and include the following:

- Further findings and recommendations of the independent Ridership Peer Review Panel based on the August–December 2011 review period have been included.
- Inputs to the model have been updated and refined to use recent data and to reflect a broader range of scenarios, including recent gasoline price forecasts from the Energy Information Administration (EIA).
- A wider range of ridership and revenue forecasts have been introduced to better incorporate possible outcomes presented in three ridership/revenue scenarios developed for the Business Plan—High, Medium, and Low.
- Post-model adjustments have been eliminated to reduce the potential for error, bias, or inconsistency.
- The model has been tested against actual conditions and external forecasts and demonstrated its reliability.

An important step forward in demonstrating the viability of the model and the reliability of its outputs was to use it to test actual circumstances in the Northeast Corridor. To do that, the Authority developed a California HSR scenario that has service levels comparable to those offered by Acela service between Washington D.C. and Boston. The model forecasts 2.7 million annual interregional riders on California HSR with Acela-like service in 2008, which is 79 percent of the ridership on the Acela in 2008. A comparison of mega-region population shows that the California HSR corridor had 76 percent Northeast Corridor population in 2000. The outcome therefore could be explained by the difference in population between the corridors.

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**The Peer Review Panel reviewed the inputs used in these different runs and endorses the ... reports as providing a good perspective on the reasons for the difference in the expected CHSR ridership compared to the Acela-NEC ridership. The panel endorses this report as an excellent indication that the ridership estimates ... in support of the 2012 Business Plan are reasonable, possibly even conservative.**

*Frank S. Koppelman, Chair Ridership and Revenue Peer Review Panel, January 17, 2012*

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Another important aspect that has been considered is the actual performance of high-speed rail and other systems against their forecasts. A 2003 Cambridge University report identified some common elements in projects that failed to reach forecast results, such as an optimistic assumption of a particular event that would lead to higher ridership. To mitigate the risks related to optimistic bias and variations in the system environment, a wider range was defined for the Business Plan scenarios that were developed for the Revised Plan.

These and other lessons were considered in developing the ridership and revenue modeling for the California HSR program. Accordingly, there is no such reliance on singular and unsubstantiated factors such as an assumed spike in gasoline prices. Key inputs that are drivers of ridership, such as fuel prices, airline ticket prices, and population, are all conservative and based on external sources.

Additional information on the ridership estimates in this Revised Plan is available in the Technical Memoranda *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 accessed at [www.cahighspeedrail.ca.gov/business\\_plan\\_reports.aspx](http://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 Peer Review Panel (Panel) directly reports to the Authority's Board of Directors and its members are under no contractual relationship with other Authority consultants involved in ridership in order to guarantee their free judgment and independence. 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 Revised 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. These improvements will provide greater levels of detail but will not impact the overall results presented in this Revised Plan.

The California High Speed Rail Authority established a Peer Review Panel for travel demand forecasting in January 2011. It was broadly charged with providing a detailed and independent appraisal of the ridership and revenue forecasting process used by the Authority and to guide its evolution. Since then the Panel has critically reviewed scores of documents and working papers, forecasting results, and their interpretations. Careful attention has been paid to issues identified by the Panel during its first meeting. The Panel's principal findings have been documented in three reports issued since their formation. As documented in its second and third reports, the panel found that the modeling system is satisfactory for the system wide and IOS ridership forecasts, the most recent of these being the development of forecasts supporting the evolving 2012 Business Plan. Some data and methodological issues have been identified for enhancement; many of these have already been addressed by the contractor. There is no evidence that the remaining issues pose significant risks to the forecasts or plans developed using them.

*Ridership Peer Review Panel—April–December 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 it 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
- Is suitable for use in preparing environmental documents and current business planning

In the August–December 2011 review period, the Panel focused on the use of the model in forecasting by examining some of the key inputs and assumptions and assessing the sensitivity of the model to changes in them. This examination was made within the context of the forecasts used to support the

Draft 2012 Business Plan (Draft Plan) and the Revised Plan. The Panel has also carefully considered the criticisms published by others and researched those aspects of the model more closely.

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 price of gasoline and fuel efficiency assumptions have been revisited, including a very low U.S. government gasoline price forecast in the range of the Business Plan scenarios.
- 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<sup>1</sup> to reflect capacity constraints in shared corridors.
- Socioeconomic data were updated with post-recession state forecasts using well established financial sources such as Woods & Poole and Moody's analytics.
- 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"

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"



Through its extensive analysis, the Panel concluded that the model is appropriate for business planning purposes and 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 model 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 prepared using the updated assumptions. As described below, and consistent with statutory requirements associated with the Business Plan, High, Medium, and Low forecasts were prepared. The Business Plan High and Low forecasts resulted from model runs with optimistic and conservative entry parameters, respectively. These forecasts thus represent reasonable High and Low Scenarios. The Business Plan Medium forecast was derived from the average of these two model runs, rather than a separate run of the model with more moderate assumptions. Consistent with the implementation plan described in Chapter 2, The Implementation Strategy: Blending, Phasing, Investing in Early Benefits, forecasts were prepared for each of the implementation steps up through Step 4, the completion of the Phase 1 Blended 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. For each implementation step, a ramp-up assumption was developed to reflect the time it would take to reach full market potential.

### Scenarios and specific assumptions

A 2003 Cambridge University report<sup>2</sup> revealed that ridership forecasts frequently exceed actual observed demand. In almost all cases, the gap between actual and forecasted demand was due to the inability to predict variations in the following model parameters:

- Overall passenger market (i.e., the population and socioeconomic data)
- Response from competitive modes on price (e.g., budget airlines)
- Changes in gasoline price and subsequent cost of driving
- General level of service (e.g., frequency, accessibility, connectivity, comfort, and reliability)

To mitigate the risks related to market estimation issues and optimism bias, it is best practice to develop a set of scenarios (High, Medium, and Low) that provide a range of assumptions derived from key input variables. In addition, a significant step has been taken for the Revised Plan to reduce the potential for error, bias, and inconsistency. Adjustments that previously had been made post-model run (population adjustment, service plans, contingencies, etc.) have been included in the ridership and revenue model or are now part of the input range.

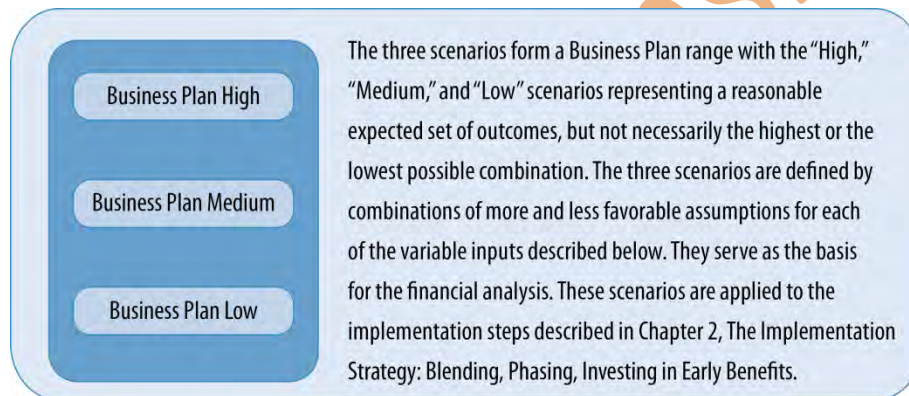
The High range of the forecast presents an optimistic but realistic prediction of the model entry parameters, while the low range depicts a very conservative but realistic view of how input parameters could evolve in the forecasting horizon.

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:

- Socioeconomic data
- 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 5-1 were created to develop a reasonable range of forecasts under a range of inputs and assumptions. As described below, the modeling work conducted for this Revised Plan takes a deliberately conservative approach. This was done to minimize the risk of inflated results for use in the financial plan.

#### Exhibit 5-1. Ridership and revenue scenarios



#### **Key inputs**

##### **Socioeconomic projections**

The recession of 2007–2009 dampened expectations regarding future socioeconomic growth. State and local agencies are currently developing updated 2035 forecasts that will reflect the downturn in the economy, but those forecasts are not yet available.

The forecasting work developed for this Revised Plan is based on socioeconomic projections that reflect the best readily available information from independent sources. Population and household growth and employment growth are the two factors used in the model to reflect future socioeconomic variations. Two forecasts were developed—one representing higher potential ridership conditions based on stronger socioeconomic growth and one representing lower ridership conditions based on more conservative socioeconomic growth. The basis for these forecasts is as follows:

- Business Plan High—Based on 2030 Woods & Poole Forecasts
- Business Plan Low—Based on 2030 Moody’s Analytics Forecast
- Business Plan Medium—Scenario lies midway between the Low and the High

Exhibit 5-2 presents the growth predicted by both sources for household and employment in 2030.

**Exhibit 5-2. Summary of socioeconomic projections for Business Plan Scenarios**

2030 Forecasts	Households Forecasts (in millions)	Employment Forecasts (in millions)
Pre-recession Forecast	16.9	22.6
Woods & Poole	16.8	21.3
Moody’s Analytics	15.5	17.3

### 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 fully test input assumptions, the Business Plan High Scenario uses the *pre*-recession mix of trips, which is characterized as “favorable” to high-speed rail. 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, and fuel efficiency

The cost of driving is significantly influenced by the price of gasoline, 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.

The U.S. Energy Information Administration (EIA) provides updated motor gasoline forecasts out to year 2035 for three different scenarios in its 2011 Annual Energy Outlook. The spread between the Low and High forecast for 2030 is considerable—from \$2.34 for the Low Scenario to \$5.49 for the High Scenario in 2011 dollars—which is a spread of over three dollars. This spread is greater than those developed by other sources, such as the California Energy Commission which forecasts a range of about \$3.23 to \$5.00 in 2011 dollars. Historically, California retail gasoline prices have been 12 percent higher than the U.S. average as noted by the EIA.

In response to earlier comments and suggestions to include a very conservative price of gasoline in the range of the ridership and revenue forecasts, a projection of California gasoline prices was developed by taking the EIA 2030 High and Low forecasts and increasing them by 12 percent to reflect California's historically higher prices. Exhibit 5-3 shows the prices expressed in 2011 dollars.

#### Exhibit 5-3. Forecast 2030 gasoline price in California (2011 dollars)

Description	Low	Reference	High
Gasoline Price Forecast	\$2.60	\$4.23	\$6.11

Source: EIA Forecast for 2030 and Analysis of California Prices

The EIA also provides projections on fuel economy (miles per gallon (mpg)) for light-duty vehicles (LDV) through year 2035 for a Reference case plus two other cases based on faster growth variations of the Corporate Average Fuel Economy (CAFE) Standards. These last two forecasts assume a faster achievement of the CAFE Standards and are referred to as CAFE +3 percent and CAFE +6 percent. (CAFE Standards are regulations intended to improve the average fuel economy of cars and light trucks (trucks, vans and sport utility vehicles) sold in the United States.

Exhibit 5-4 shows the fuel economy projections for the Reference, CAFE3, and CAFE6 cases, as well as an average between CAFE3 and CAFE6 for the entire fleet of vehicles (not just new vehicles.)

#### Exhibit 5-4. Projections of fuel economy of light-duty vehicles

	Light-Duty Stock <sup>1</sup> (mpg)			
	Reference	3% LDV fuel economy growth	6% LDV fuel economy growth	Average of 3% and 6% Fuel Economy Growth
2015	22.1	22.1	22.1	22.1
2025	25.7	28.6	30.2	29.4
<b>2030</b>	<b>27.0</b>	<b>31.8</b>	<b>35.3</b>	<b>33.6</b>
2035	27.9	34.0	39.4	36.7

Source: Annual Energy Outlook 2011, Transportation Sector Key Indicators and Delivered Energy Consumption

<sup>1</sup>Combined "on-the-road" estimate for all cars and light trucks

The 2030 auto operating cost estimates for the High, Medium, and Low Business Plan Scenarios incorporate the fuel component described above and a non-fuel component representing normal wear and tear associated with the operation of a car (tires, maintenance, etc). The non-gasoline operating costs are likely to be less volatile than fuel prices, so it is reasonable to keep this as a constant amount, modified only by inflation over time. Exhibit 5-5 presents the range of auto operating costs used to develop the High, Medium, and Low Scenarios for this Revised Plan, including both fuel and non-fuel components. The Low Scenario includes the very conservative EIA gasoline price forecast of \$2.60 in 2030.

**Exhibit 5-5. 2030 auto operating cost assumptions for Revised Plan (2011 dollars)**

Business Plan Scenario	Low	Medium	High
Motor gasoline	\$2.60	\$4.23	\$6.11
Fuel efficiency (mpg)	27.0	30.3	33.6
Gas operating cost (\$/mile)	\$0.10	\$0.14	\$0.18
Non-gasoline operating cost (\$/mile)	\$0.10	\$0.10	\$0.10
<b>2030 auto operating cost (\$/mile)</b>	<b>\$0.20</b>	<b>\$0.24</b>	<b>\$0.28</b>

Based on these assumptions, the Revised Plan Scenarios include a wide range of auto operating costs—from \$0.20 to \$0.28 per mile in 2030. The incorporation of this broader range in the ridership and revenue forecasts responds to comments and questions received regarding the forecasts developed for the Draft Plan and is intended to ensure that they are more reliable and conservative. The midpoint is slightly below the current statewide average for gasoline in California.

### Airfares

The potential range of airfares used to develop the ridership forecasts was 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:

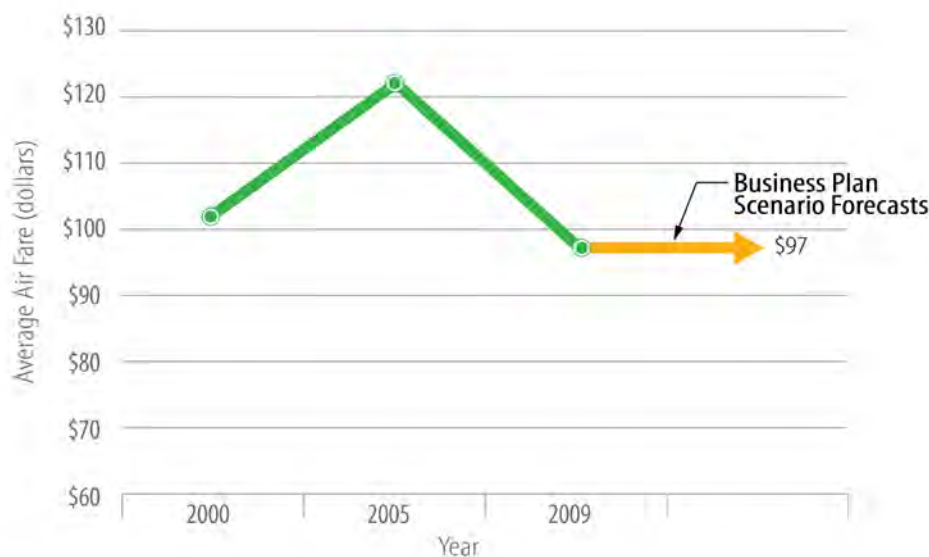
- With low-cost air carriers (Southwest, Virgin America, and JetBlue) heavily present in all airport pairs, airfares are unlikely to decrease significantly.
- Capacity constraints on the region's airports and continued growth in long-distance demand will shift many airlines' priority to trans-continental 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 5-6 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.<sup>3</sup> Sensitivity analyses were undertaken using the high and the low airfare variations. Aviation System Consulting determined a low fare scenario with a 9 percent reduction in real fares from the 2009 level, and a high fare scenario of 16 percent over the 2009 level. It was determined that using the range of scenarios presented in the referenced aviation report resulted in an upward bias. That is, it drove the Medium Scenario to be on the optimistic side. To be conservative, it was therefore decided that all three Business Plan Scenarios assume that airfares stay constant at 2009 levels. This has the effect of making air more competitive with high-speed rail and thereby constraining projected HSR ridership levels.

**Exhibit 5-6. Average airfare: Los Angeles Basin to San Francisco Bay Area (2011\$)**



*For purposes of evaluating the three Business Plan Scenarios (High, Medium, and Low), airfares are assumed to remain constant at 2009 levels. The 2009 airfare was inflated to 2011 prices for consistency in the year price shown in the Business Plan.*

### **Summary of Business Plan Scenarios**

All three Business Plan Scenarios assumed that airfare between Los Angeles and San Francisco will be \$97 (one way in 2011\$). Gasoline prices and fuel efficiency have been integrated in the range. Two separate sets of socioeconomic data—one more favorable to HSR and one less favorable to HSR—are used as part of the High and the Low Scenarios. In sum, the variable inputs used for the Business Plan Scenarios are summarized as follows:

- **Business Plan Low Scenario**—Assumes a very conservative driving cost equivalent to \$2.60 gasoline price per gallon, \$0.10 non-gasoline operating cost per mile, and a 27 mpg fuel efficiency in 2030. Socioeconomic forecasts from Moody's Analytics generating lower ridership conditions and less favorable trip-making patterns derived from the June 2011 trip survey.
- **Business Plan High Scenario**—Assumes a high driving cost equivalent to \$6.11 price per gallon of gasoline, \$0.10 non-gasoline operating cost per mile, and a 33.6 mpg fuel efficiency in 2030 derived

from the EIA forecast. Socioeconomic forecasts from Woods & Poole generating higher ridership conditions and favorable trip-making patterns derived from the initial trip survey.

- **Business Plan Medium Scenario**—Derived from the average of the High and Low Scenarios rather than a separate run of the model using intermediate assumptions.

## 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.<sup>4</sup> 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. A comparison of international HSR system fares would not provide a sound basis to set the California HSR system pricing, as too many structural factors inherent in the HSR system make a “like-for-like” comparison very complex. The appropriate fare level will need to consider direct competition from air and road travel, as well as system service costs (see chapter 6, Operating and Maintenance Costs). The ridership forecast assumes a HSR average fare at 83 percent of 2009 airfare levels between Los Angeles and San Francisco, which reflects the maturity of the California air market in terms of passenger capacity and the number of airlines and budget airlines. A comparison of HSR fare levels in Spain, France, Germany, and Japan relative to airfares indicates that this assumption is reasonable and most likely to accurately project market behavior. The primary objective associated with the assumed fare structure is to maximize passenger revenues and the net cash-flow from operations.

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<sup>5</sup>

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 fare.

Exhibit 5-7 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 Phase 1 Blended include the cost of rail or dedicated feeder service to reach the HSR system at the most convenient station.

**Exhibit 5-7. Example of 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 the Phase 1 Blended service, up to six trains per peak hour are assumed to operate between Los Angeles and San Jose. Four trains continue to San Francisco.

This schedule allows one train per hour to operate as an “express/non-stop” 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 segment and the Bay to Basin, the schedules are less frequent because of lower expected travel demand.

For the Phase 1 Full Build service, if constructed, one additional train in the peak would run between Los Angeles and San Francisco. On the south end, three of the seven trains would continue past Los Angeles to Anaheim.

### ***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), as shown in Exhibit 5-8. In developing its ramp-up assumption for the ridership forecast, the Authority learned from international experience (see additional discussion below). For the California HSR 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

### **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 has been used to develop the forecasts for the Business Plan. 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. In developing this Revised Plan, an even more conservative gasoline price forecast from the EIA has been incorporated to provide a wider range of results and to develop a Low Business Plan Scenario that allows for greater uncertainty in future conditions. 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. 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 Phase 1 Blended. 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.

**Exhibit 5-8. Examples of ridership growth (ramp-up) in European HSR systems**



Another perspective can be gained by considering the ridership levels of existing public transportation systems in California. Exhibit 5-9 shows 2010 ridership levels for various transit systems throughout the state in areas that will be served by the statewide HSR 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.

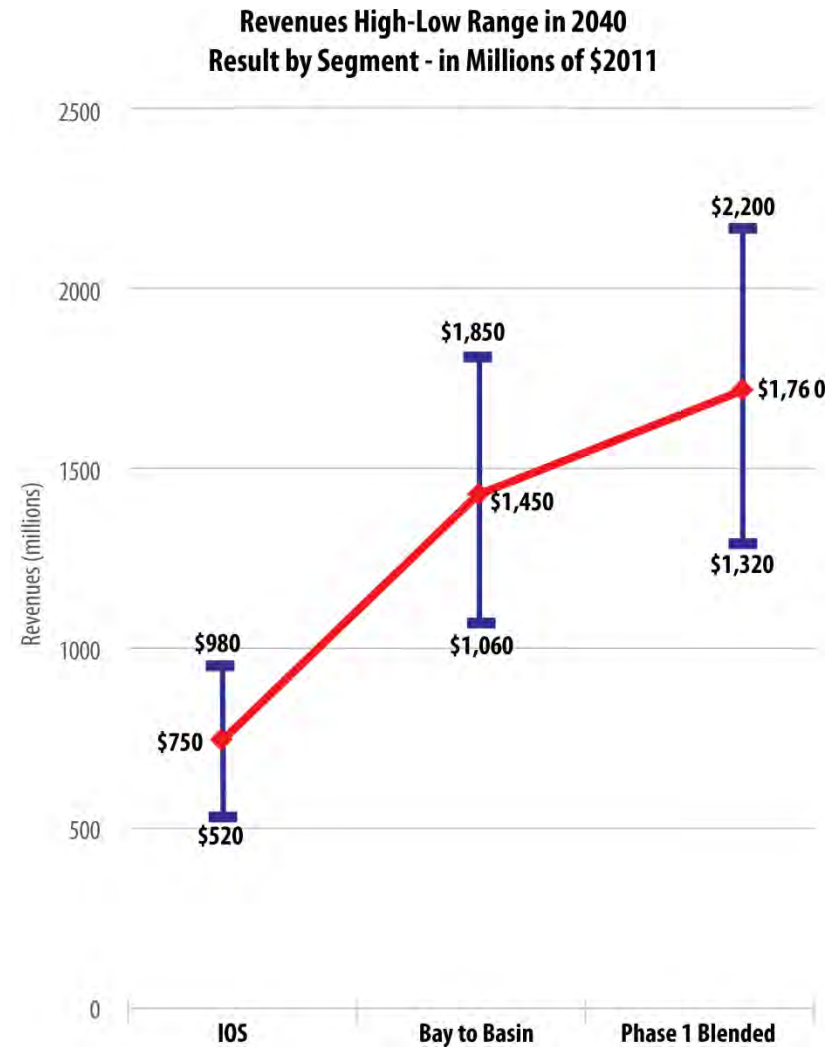
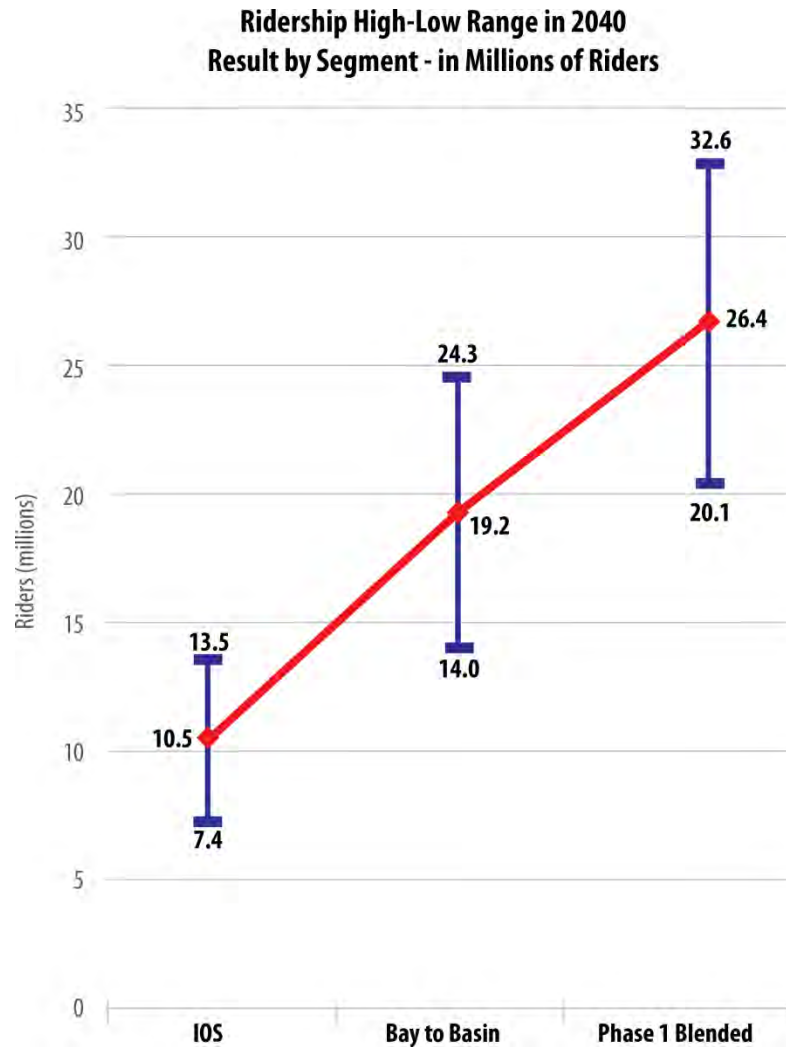
**Exhibit 5-9. California transit systems 2010 ridership (in millions of riders)**

Transit Agency	2010 Ridership
Los Angeles County Metropolitan Transportation Authority (LA Metro)	453.8
San Francisco Municipal Railway (Muni)	209.5
San Francisco Bay Area Rapid Transit District (BART)	108.3
San Diego Metropolitan Transit System	79.0
Orange County Transportation Authority	53.8
Santa Clara Valley Transportation Authority	42.1
Santa Monica Big Blue Bus	20.2
Sacramento Regional Transit District	14.4
San Mateo County Transit District	13.7
Fresno Area Express	13.3
Peninsula Joint Powers Authority Board (Caltrain)	12.2
North Coast Transit District, San Diego	11.1
Southern California Regional Railroad Authority (Metrolink)	10.5
Golden Gate Bridge, Highway and Transit District	8.6
Golden Empire Transit District	7.0
Visalia City Coach	1.5

Source: Public Transportation Ridership Report, Fourth Quarter 2010. American Public Transportation Association. [www.apta.com/resources/statistics/Documents/Ridership/2010\\_q4\\_ridership\\_APTA.pdf](http://www.apta.com/resources/statistics/Documents/Ridership/2010_q4_ridership_APTA.pdf)

Exhibit 5-10 shows the annual Low and High ridership and revenue forecasts for each of the implementation phases starting with the Initial Operating Section (IOS), advancing to the Bay to Basin system, and finally to the Phase 1 Blended system between San Francisco and Los Angeles/Anaheim. The results are shown for year 2040 and the revenues are shown in 2011 dollars.

Exhibit 5-10. Ranges of ridership and revenue across all Business Plan Scenarios and phases



**Why are the Business Plan ridership forecasts different than the ridership forecasts in the Draft Environmental Impact Report/Draft Environmental Impact Statements (EIR/EIS)?**

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. For the purpose of the cash-flow analysis presented in Chapter 7, Financial Analysis and Funding, the ridership and the revenue projections are presented from IOS through Phase 1 Blended. The High, Medium, and Low ridership and revenue scenarios are illustrated. The segments are placed into operation as shown on the schedule in Exhibit 5-11.

Revenue projections are presented in 2011 dollars and in Year-of-Expenditure (YOE) dollars to show the effect of growth and the impact of inflation. HSR ticket prices are assumed constant and are only increasing with inflation over time.

Exhibit 5-12 shows the projected ridership for the High, Medium, and Low Ridership Scenarios in millions from IOS through Phase 1 Blended.

**Exhibit 5-11. Schedule by section**



**Exhibit 5-12. Ridership, IOS through Phase 1 Blended (in millions)**

Ridership	2025	2030	2035	2040	2045	2050	2055	2060
High	10.5	26.8	31.8	32.6	33.4	34.3	35.1	36.0
Medium	8.1	21.4	25.7	26.4	27.0	27.7	28.4	29.1
Low	5.8	16.1	19.6	20.1	20.6	21.2	21.7	22.2

All revenues were provided in 2011 dollars. Inflation for 2012 is assumed to be 1 percent, 2013 through 2015 is 2 percent per year, and 3 percent per year is used for 2016 forward. These rates have been estimated based on multiple sources, including the California inflation forecast data provided by California Department of Finance, ENR Construction Cost Index historical and forecast indexes, and medium/long-term federal inflation targets.

In addition to revenue from ridership, rail and transit systems around the world generate additional revenue from ancillary services and uses of assets. For the California HSR, such revenues will relate to stations, advertising, and use of right-of-way for services such as cell phone towers. Much of the station revenue will be controlled by cities and local governments. However, several categories of revenue will be available to help fund HSR operations and capital needs. These include retail, naming rights, renewable energy, cell towers, and advertising.

Other international high-speed services collect actual ancillary revenues ranging from 1 percent to 37 percent with an average of 13 percent of revenues. Based on review of the potential revenues in California, the Planning Case includes 1 percent of revenues from ancillary sources.

Exhibit 5-13 shows the projected revenues for the High, Medium, and Low Scenarios in 2011 dollars from IOS through Phase 1 Blended.

**Exhibit 5-13. Revenues, IOS through Phase 1 Blended (2011 dollars in millions)**

Ridership	2025	2030	2035	2040	2045	2050	2055	2060
High	\$761	\$1,808	\$2,147	\$2,202	\$2,257	\$2,314	\$2,373	\$2,432
Medium	\$586	\$1,432	\$1,717	\$1,761	\$1,805	\$1,851	\$1,897	\$1,945
Low	\$410	\$1,057	\$1,287	\$1,320	\$1,353	\$1,387	\$1,422	\$1,458

The Medium Scenario, which is used as the planning case in Chapter 7, Financial Analysis and Funding, generates approximately 25 percent less projected revenue than the High Scenario, with a similar incremental difference to the Low Scenario. Consistent with the results in other countries that experienced significant ridership growth at the commencement of operations, a four-year ramp-up period is assumed into the projections.

Under the IOS Medium Ridership Scenario, the projected revenues are \$586 million (2011\$) in 2025, which is the fourth year after completion of the IOS to the San Fernando Valley. Revenues rise to \$1.4 billion (2011\$) in 2030, the fourth year after completion of Bay to Basin. This represents a 145 percent increase in revenue as a result of the increased ridership once Bay to Basin is completed. Revenues rise to \$1.7 billion (2011\$) in 2035, seven years after completion of Phase 1 Blended and the 14th year of operations.

Exhibit 5-14 provides the projected revenues for the High, Medium, and Low Ridership Scenarios in YOE dollars from IOS through Phase 1 Blended.

**Exhibit 5-14. Revenues, IOS through Phase1 Blended (YOE dollars in millions)**

Ridership	2025	2030	2035	2040	2045	2050	2055	2060
High	\$1,096	\$3,019	\$4,157	\$4,941	\$5,872	\$6,979	\$8,295	\$9,859
Medium	\$844	\$2,392	\$3,324	\$3,951	\$4,696	\$5,581	\$6,634	\$7,885
Low	\$591	\$1,765	\$2,492	\$2,961	\$3,520	\$4,183	\$4,972	\$5,910

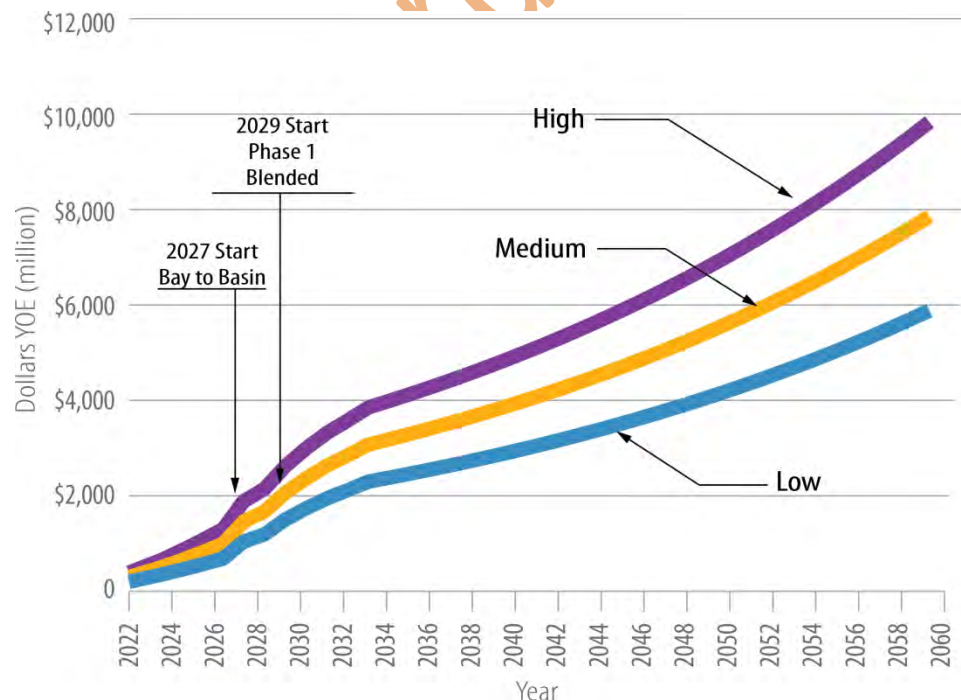
Under the IOS Medium Ridership Scenario, the projected revenues are \$844 million in 2025, which is the fourth year after completion of the IOS to the San Fernando Valley. Revenues rise to \$2.4 billion in 2030, the fourth year after completion of Bay to Basin, and to \$3.3 billion in 2035, seven years after the completion of Phase 1 Blended and the 14th year of operations.

If Phase 1 Full Build was constructed, the projections would show an increase in ridership of 7.7 million riders in the Medium Scenario in 2040, representing a 29 percent increase over Phase 1 Blended.

The projected revenues for Phase 1 Full Build would reach just over \$2 billion (\$2011) in the Medium Scenario or an equivalent of \$4.7 billion in year of expenditure. This represents an increase of only 18 percent over Phase 1 Blended, thus demonstrating the early benefits achieved with Phase 1 Blended.

Exhibit 5-15 illustrates projected revenue growth from IOS through Phase 1 Blended for all three scenarios—Low, Medium and High.

**Exhibit 5-15. Revenue growth, IOS through Phase1 Blended (YOE dollars in millions)**



## 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 Phase 1 Blended 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. 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 the 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 5-16 compares the Draft EIR/EIS ridership forecasts in 2035 with the Business Plan Phase 1 Full Build 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 5-16. Business Plan and Draft EIR/EIS ridership forecast comparison (year 2035)

Ridership Forecast Purpose and Type	Phase 1 Full Build <sup>1</sup>	Full System <sup>1</sup>
EIR/EIS Low forecast (HSR ticket price = <b>83%</b> of airfare levels)	40.2	69.3
Business Plan Medium Ridership Scenario (HSR ticket price = <b>83%</b> of airfare levels)	33.0	50.0
EIR/EIS High forecast (HSR ticket price = <b>50%</b> of airfare levels)	57.0	98.2
Business Plan Medium Ridership Scenario <sup>2</sup> (HSR ticket price = <b>50%</b> of airfare levels)	50.0	75.0

Source: Table 2-14 in Merced to Fresno Section Draft EIR/EIS; Table 2-16 in Fresno to Bakersfield Section Draft EIR/EIS; and Exhibit 5-10 in the 2012 Business Plan.

<sup>1</sup> 2012 Business Plan 2040 forecasts have been reduced by 0.5% per year to create 2035 forecasts for comparison purposes.

<sup>2</sup> Preliminary estimate of Business Plan Medium Ridership Scenario assuming 50% of airfare—provided for illustrative purposes only.



Exhibit 5-16 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 Phase 1 Full Build is 33 million riders annually, and the correlating Draft EIR/EIS forecast for Phase 1 Full Build 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 Phase 1 Full Build 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 the numbers presented for the Business Plan are based on Phase 1 Full Build ridership (33 million riders annually assuming 83 percent of airfare). A comparison of the most closely correlating forecasts for Phase 1 Full Build and Full System, using consistent assumptions about HSR ticket prices, shows that the EIR/EIS forecasts are somewhat higher than those for the Business Plan, but the difference is reasonable in light of the distinct purposes for which the forecasts have been developed.

#### **Comparison of CHSR ridership with Acela Express in the Northeast Corridor (NEC)**

To address the recurring issue of comparing the CHSR ridership forecast to the denser and more transit-friendly Acela Express service in the Northeast Corridor (NEC), the Authority analyzed the difference in the train services in both corridors. Acela is much slower, and much less frequent and fares are far more expensive than the proposed CHSR service. In addition, the California forecast is 20 years in the future, so a comparison to today's Acela ridership is inappropriate. To create a better comparison, the Authority developed and modeled a CHSR scenario that has service levels comparable to those offered by Acela service in the NEC between Washington, D.C. and Boston. The model forecasts 2.7 million annual interregional riders on CHSR with Acela-like service in 2008, which is 79 percent of the ridership on the Acela in 2008 and 10 percent of the forecast 2030 CHSR ridership under the Phase 1 operating plan forecast. The primary cause of the difference is the greater population in the Northeast Corridor. The CHSR Ridership and Revenue Panel reviewed the analysis and the results and endorsed the findings in support of the 2012 Revised Business Plan.

## Comparisons with international systems

Existing HSR corridors in other countries 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 full market potential.

Exhibit 5-8 earlier in this chapter 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 5-17 compares the ridership *forecast* for the Phase 1 Blended system (San Francisco/Merced to Los Angeles) 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 exhibit 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 high-speed rail corridors. The total *statewide* population is projected to be higher—more than 44 million—which is the basis for the ridership forecast. 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 5-17. Population and ridership comparison of existing and forecast ridership

HSR Systems	Distance (miles)	Corridor Population (millions)	Riders (millions)
Madrid–Seville (Spain) High Speed Rail	295	7.3 <sup>1</sup>	10.0 <sup>1</sup>
Paris–Marseilles (France) High Speed Rail	490	15.0 <sup>2</sup>	31.0 <sup>2</sup>
California High Speed Rail Phase 1 Blended	520	26.9 <sup>3</sup>	20.1–32.6 <sup>3</sup>

<sup>1</sup> 2009

<sup>2</sup> 2008

<sup>3</sup> 2040 forecasts

## End Notes

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<sup>1</sup> Sources:

“California High-Speed Train Project Operations and Maintenance Peer Review,” TUC Rail, November 16, 2010 (Belgium)

“Operational and Maintenance Peer Review—Introductory Material,” Ferrovie dello Stato Group (Italy)

“Review on Operations and Maintenance Report of California High-Speed Train,” East Japan Railway Company (JR East), November 30, 2010 (Japan)

“California High-Speed Train Project Operations and Maintenance Peer Review,” Republic of Korea Ministry of Land, Transport, and Maritime Affairs, December 7, 2010

“California High-Speed Rail Project Peer Review Report of Operation and Maintenance,” The Third Railway Survey and Design Institute Group Corporation, November 2010 (People’s Republic of China)

“California High-Speed Train Project Operation and Maintenance Peer Review,” MEDDTL, January 13, 2011 (France)

“California High-Speed Train Project Peer Review of Current Planning on Operations and Maintenance Comments by Renfe Operadora,” Renfe, February 2011 (Spain)

<sup>2</sup> Source: “Megaprojects and Risks: An Anatomy of Ambition,” Bent Flyvbjerg, Cambridge University Press, 2003.

<sup>3</sup> Source: *California High-Speed Rail 2012 Business Plan Ridership and Revenue Forecasting*.

<sup>4</sup> Source: *California High-Speed Rail 2012 Business Plan Ridership and Revenue Forecasting*.

<sup>5</sup> European and Asian HSR operators use the same “yield management” techniques to manage the price of seats as U.S. 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 Los Angeles-San Diego services.



## Chapter 6

# 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.

In developing this Revised Plan, the Authority has refined its operations planning and cost estimating process consistent with the greater emphasis on the phased implementation approach discussed in Chapter 2, The Implementation Strategy: Blending, Phasing, Investing in Early Benefits. Specifically, cost estimates have been updated to show the O&M costs associated with the Phase 1 Blended system.

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 implementation of the system from the initiation of HSR service on the Initial Operating Section (IOS), to Bay to Basin, and through Phase 1 Blended. 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 Revised 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](http://www.cahighspeedrail.ca.gov/business_plan_reports.aspx).

### 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 5, Ridership and Revenue. The operating plan provides the number and frequency of trains required to serve the projected riders, as well as the



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

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 2009 data generated by the International Union of Railways;<sup>1</sup> separate HSR analyses for Spain<sup>2</sup> and Brazil;<sup>3</sup> a review of O&M costs by the Japan Railway Construction, Transport, and Technology Agency;<sup>4</sup> and a comparison with Amtrak's Next-Gen published HSR operating costs.

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.

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**JR 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*

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Exhibit 6-1 summarizes the major operating and maintenance categories on which the international operators were 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 2011 dollars. The 2011 cost estimate was escalated to produce annual O&M cost projections in year-of-expenditure (YOE) dollars for use in the funding and financial analyses developed for the Revised Plan. Inflation for 2012 is assumed to be 1 percent, 2013 through 2015 is 2 percent per year, and 3 percent per year is used for 2016 forward. These rates have been estimated based on multiple sources, including the California inflation forecast data provided by California Department of Finance, ENR Construction Cost Index historical and forecast indexes, and medium/long-term federal inflation targets.

**Exhibit 6-1. 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 6-2 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 a review of energy costs, labor rates, station requirements, and insurance costs in the U.S.

As noted, the costs shown in Exhibit 6-2 were developed in 2009 and, in order to compare them to costs for the international systems consulted in 2010, as shown in Exhibit 6-3, they are still shown in 2009 dollars.

As noted, the maintenance unit cost estimates were primarily based on international HSR data and applied to California's planned HSR operations. Exhibit 6-3 compares the California unit values for infrastructure and equipment maintenance to published costs for overseas systems. As highlighted below, this Revised 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 6-2. 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. Costs include necessary indemnities
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 6-3. Comparison of California HSR maintenance costs with international HSR costs (2009\$)**

Cost Type	Unit	France <sup>1</sup>	Spain	JR Central	UIC Europe	Halcrow/Sinergia	CAHSR 2009
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

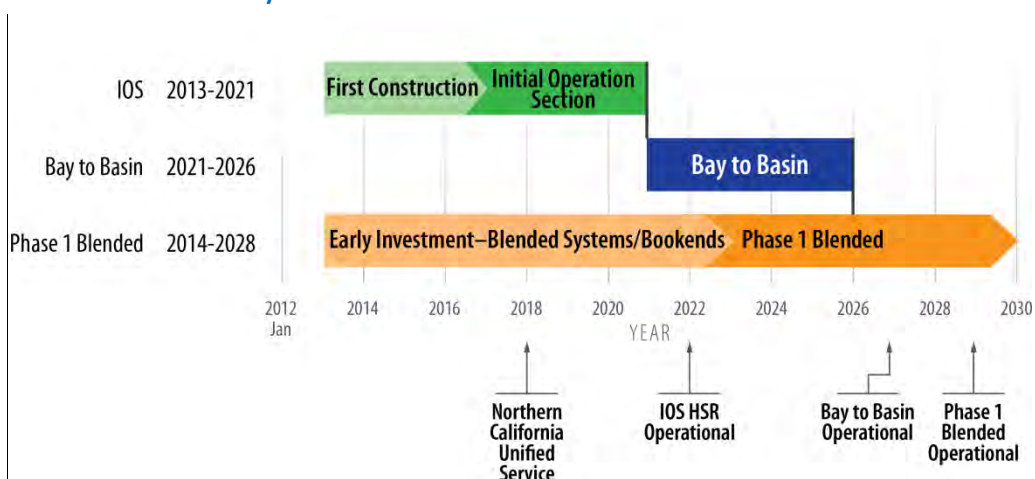
<sup>1</sup> Infrastructure maintenance figure represents an average cost per route mile.



**Scenarios**

This section illustrates the projected operating and maintenance costs of the system, assuming the phased implementation schedule discussed in Chapter 2, The Implementation Strategy: Blending, Phasing, Investing in Early Benefits, and shown in Exhibit 6-4.

**Exhibit 6-4. Schedule by section**



For this analysis, the Revised Plan’s High, Medium, and Low Ridership Scenarios described in Chapter 5, Ridership and Revenue, were used to develop High, Medium, and Low Operating and Maintenance Cost Scenarios.

Operating and maintenance cost projections are shown in 2011 dollars to allow the reader to see the effect of real growth without the impact of inflation. These cost projections were then escalated to show year-of-expenditure costs that were used to calculate the impact of O&M costs on financial performance as presented in Chapter 7, Financial Analysis and Funding.

**O&M projections—IOS**

Exhibit 6-5 provides the projected operating and maintenance costs for the High, Medium, and Low Ridership Scenarios in 2011 dollars through Phase 1 Blended.

**Exhibit 6-5. O&M costs, IOS through Phase 1 Blended (2011 dollars in millions)**

Ridership	2025	2030	2035	2040	2045	2050	2055	2060
High	\$386	\$728	\$873	\$913	\$946	\$982	\$954	\$927
Medium	\$346	\$644	\$744	\$797	\$824	\$826	\$786	\$799
Low	\$261	\$533	\$627	\$672	\$724	\$727	\$690	\$674

Operations and maintenance forecasts were escalated using 2011 price levels. Exhibit 6-6 shows operating and maintenance costs in YOE dollars through Phase 1 Blended.

**Exhibit 6-6. O&M costs, IOS through Phase 1 Blended (YOE dollars in millions)**

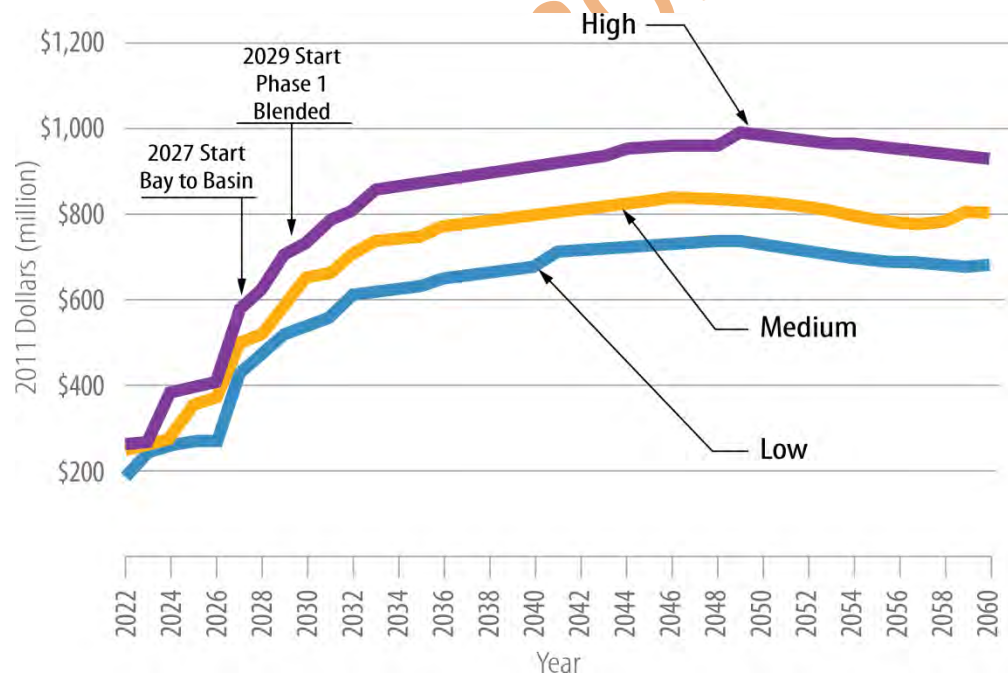
Ridership	2025	2030	2035	2040	2045	2050	2055	2060
High	\$556	\$1,216	\$1,691	\$2,048	\$2,462	\$2,961	\$3,336	\$3,758
Medium	\$499	\$1,075	\$1,440	\$1,789	\$2,143	\$2,492	\$2,749	\$3,240
Low	\$376	\$889	\$1,215	\$1,509	\$1,884	\$2,194	\$2,412	\$2,731

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.

As each section becomes operational, the O&M costs for that section are phased in according to the ramp-up periods. For example, when the Bay-to-Basin system 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 6-7 compares the O&M costs shown above and how those costs would change for the High, Medium, and Low Ridership Scenarios.

**Exhibit 6-7 . O&M cost ranges, IOS through Phase 1 Blended (2011 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 6-8 shows the track structures and system components and their respective design lives based on design standards.

**Exhibit 6-8. 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, for the Bay-to-Basin section in 2027, and for Phase 1 Blended in 2020. 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 6-9 shows the timing that was assumed for trainset replacement for those trains placed into service for the IOS. Exhibit 6-10 shows the trainset replacement timeline for those additional trains placed into service for the Bay-to-Basin section. Trainsets to operate Phase 1 and the Phase 2 extensions will be replaced under similar assumptions.

**Exhibit 6-9. Trainset replacement assumptions—IOS**

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 6-10. 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

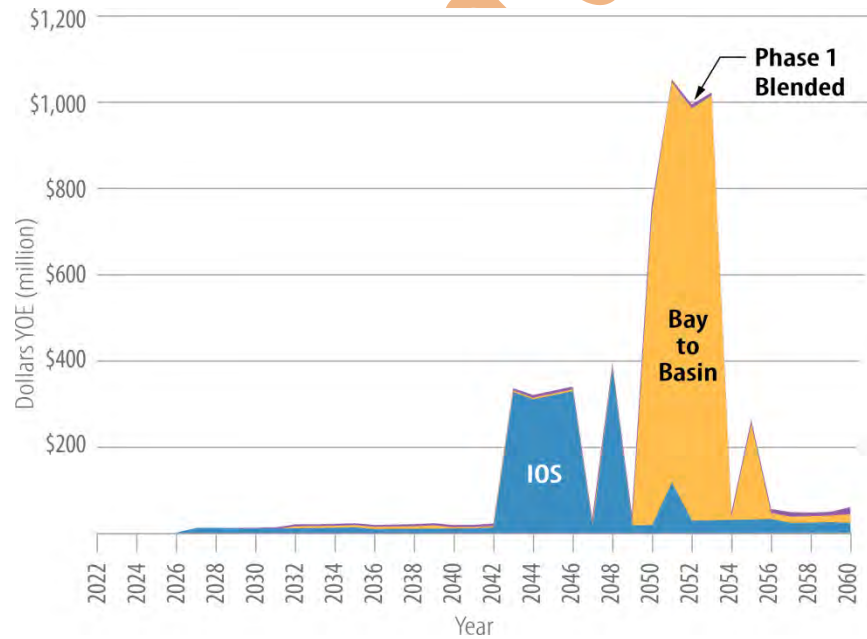
**Exhibit 6-11. Trainset replacement assumptions IOS through Phase 1 Blended (2011 dollars in millions)**

Segment	Opening	2022–2025	2026–2030	2031–2035	2036–2040	2041–2045	2046–2050	2051–2055	2056–2060
IOS	2022	—	—	—	—	\$364	\$246	\$32	—
Bay to Basin	2027	—	—	—	—	—	\$239	\$954	—
Phase 1 Blended	2029	—	—	—	—	—	—	—	—
Total		—	—	—	—	\$364	\$485	\$986	—

**Capital renewal 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 Blended is illustrated in Exhibit 6-12.

**Exhibit 6-12. Annual capital renewal profile through Phase 1 Blended**



## End notes

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<sup>1</sup> Source: Union International des Chemins-de-Fer. 2010. *High-Speed Rail—Fast Track to Sustainability*. Paris, France. [www.uic.org/IMG/pdf/20101124\\_uic\\_brochure\\_high\\_speed.pdf](http://www.uic.org/IMG/pdf/20101124_uic_brochure_high_speed.pdf)

<sup>2</sup> 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 4<sup>th</sup> Annual Conference on Railroad Industry Structure, Competition and Investment, Universidad Carlos III de Madrid (cited in Halcrow/Sinergia, 2009).

<sup>3</sup> Source: Halcrow/Sinergia Consortium. June 2009. “Brazil TAV Project—Volume 4, Rail Operations and Technology, Part 1: Rail Operations.” [www.tavbrasil.gov.br/documentacao/ingles/vol-4-operations&technology/operations/vol\\_4\\_pt\\_1\\_operations\\_final\\_report.pdf](http://www.tavbrasil.gov.br/documentacao/ingles/vol-4-operations&technology/operations/vol_4_pt_1_operations_final_report.pdf)

<sup>4</sup> 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 7

### ***Financial Analysis and Funding***

#### **Introduction**

This chapter presents the financial analysis and funding strategy for the California High-Speed Rail program. The initial part of this chapter focuses on operational viability and the ability of the various sections of the system to be operated without a subsidy. Included in this section is a detailed description of the project's breakeven point. This section is followed by a discussion of projected cash flows and capital funding plans for the various sections of the system including private-sector investment.

The planning case presented in the initial sections of this chapter is based on the development of the Phase 1 Blended system starting with the IOS, the Medium Ridership Scenario, and the year-of-expenditure (YOE) revenues and costs presented in earlier chapters. The final section of this chapter illustrates a set of alternative scenarios to demonstrate the impact of various types of changes to key planning assumptions. The analysis in this chapter is presented in terms of cash flow, which is consistent with the State's need to evaluate questions relating to operating subsidies and potential financing opportunities for investors.

This chapter includes several key findings. The analysis of potential operating sections shows that the system can be operationally self-sustaining and would not require operating subsidies. As illustrated in this chapter, the system is projected to generate a positive net cash flow from operations. The breakeven analysis illustrates that ridership projections could be below the low projection and the project could still reach breakeven on an operating cash flow basis.

Cash-flow projections illustrate that the project does not have an internal rate of return sufficient to finance the total capital required for construction, which supports the need for up-front government investment. Absent cost of capital and financing, the cash flows illustrate a cash on cash payback of 45 years (i.e., if the system were built and operated by one entity that paid for all costs and collected all revenue, the amount spent would equal the amount collected in 45 years). This illustrates that the project is not financeable early, but that capital costs are eventually recouped without regard to financing. The process for this analysis was confirmed by external review by the Bay Area Council Economic Institute.

Full funding for the IOS is identified. The first construction segment of the IOS will be funded with a mix of Proposition 1A funds and federal funds totaling \$6 billion. The remaining portions of the IOS will be funded using state bonds, federal support, and local funds, and cap and trade funds are available as needed, upon appropriation, as a backstop against federal and local support to complete the IOS. The Bay to Basin system is expected to be funded using a mix of federal, local, and other funds, as well as private-sector capital. Phase 1 Blended is expected to be funded in a similar manner.

The remainder of this chapter discusses the following:

- Operational viability
- Project breakeven
- Project cash flows
- Capital funding
- Private-sector investment
- Alternative funding scenarios

## Operational viability

This section discusses the amount of projected revenues, operating and maintenance expenses, and net cash flow from operations that are estimated for the system over time. For purposes of this Revised 2012 Business Plan (Revised Plan), net cash flow from operations is defined as project revenues less operating and maintenance expenses.

Revenue and operating and maintenance cost scenarios are described in Chapter 5, Ridership and Revenue, and Chapter 6, Operating and Maintenance Costs. Exhibit 7-1, Exhibit 7-2, and Exhibit 7-3 illustrate the first 12 years of projected revenue and operating and maintenance (O&M) costs in YOE or inflated dollars. The first 12 years encompass the opening and ramp-up of the system beginning with the IOS, projected to open in 2022; Bay to Basin, open in 2027; and Phase 1 Blended, open in 2029. Projections are shown for the High, Medium, and Low Ridership Scenarios, respectively. As described in Chapter 5, revenue projections include ancillary revenue which constitutes 1 percent of revenue. Exhibit 7-4 shows the growth in net cash flow from operations through 2060. Full cash flow projections through 2060 for each scenario are provided in the attachments to this Revised Plan.

**Exhibit 7-1. Net cash flow from operations (YOE dollars in millions)—High Scenario**

	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Revenue	\$486	\$675	\$878	\$1,096	\$1,329	\$1,915	\$2,174	\$2,649	\$3,019	\$3,345	\$3,605	\$3,879	\$4,016
Less: O&M costs	\$(334)	\$(354)	\$(527)	\$(556)	\$(591)	\$(875)	\$(976)	\$(1,133)	\$(1,216)	\$(1,334)	\$(1,419)	\$(1,564)	\$(1,624)
<b>Net cash flow from operations</b>	<b>\$151</b>	<b>\$321</b>	<b>\$351</b>	<b>\$540</b>	<b>\$738</b>	<b>\$1,040</b>	<b>\$1,198</b>	<b>\$1,516</b>	<b>\$1,804</b>	<b>\$2,010</b>	<b>\$2,186</b>	<b>\$2,316</b>	<b>\$2,391</b>



**Exhibit 7-2. Net cash flow from operations (YOE dollars in millions)—Medium (Planning Case) Scenario**

	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Revenue	\$380	\$524	\$678	\$844	\$1,020	\$1,492	\$1,698	\$2,089	\$2,392	\$2,659	\$2,875	\$3,102	\$3,211
Less: O&M costs	\$(321)	\$(345)	\$(382)	\$(499)	\$(547)	\$(755)	\$(814)	\$(945)	\$(1,075)	\$(1,133)	\$(1,252)	\$(1,328)	\$(1,381)
<b>Net cash flow from operations</b>	<b>\$59</b>	<b>\$179</b>	<b>\$296</b>	<b>\$345</b>	<b>\$473</b>	<b>\$737</b>	<b>\$884</b>	<b>\$1,144</b>	<b>\$1,316</b>	<b>\$1,526</b>	<b>\$1,623</b>	<b>\$1,775</b>	<b>\$1,830</b>

**Exhibit 7-3. Net cash flow from operations (YOE dollars in millions)—Low Scenario**

	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Revenue	\$274	\$373	\$478	\$591	\$711	\$1,069	\$1,222	\$1,530	\$1,765	\$1,973	\$2,144	\$2,325	\$2,407
Less: O&M costs	\$(239)	\$(322)	\$(354)	\$(376)	\$(386)	\$(646)	\$(734)	\$(830)	\$(889)	\$(951)	\$(1,072)	\$(1,116)	\$(1,163)
<b>Net cash flow from operations</b>	<b>\$35</b>	<b>\$51</b>	<b>\$124</b>	<b>\$215</b>	<b>\$325</b>	<b>\$423</b>	<b>\$487</b>	<b>\$700</b>	<b>\$875</b>	<b>\$1,022</b>	<b>\$1,073</b>	<b>\$1,210</b>	<b>\$1,244</b>

The projections illustrate that under all three revenue and operating and maintenance cost scenarios, the project generates positive net cash flow from operations beginning with the initial year of

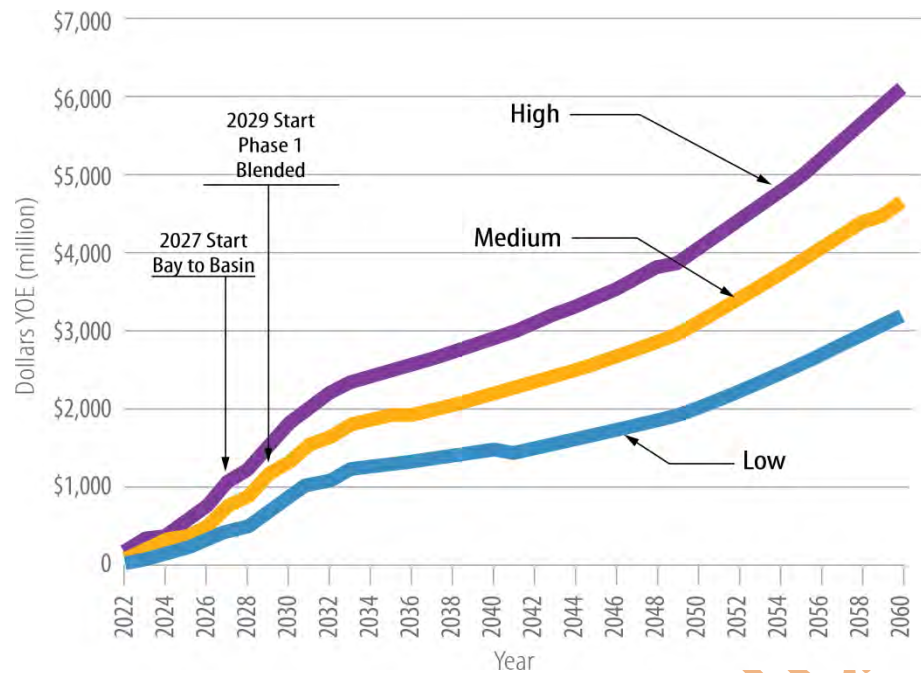
Projections illustrate that the three revenue and operating and maintenance cost scenarios generate positive net cash flow operations.

operations. In 2026, the net cash flow from operations for the Medium and Low Ridership Scenarios are lower than the High Ridership Scenario by 36 percent and 56 percent, respectively. Each operating segment of the project is subjected to a five-year ramp-up period.

Based on the Medium Scenario, net cash flow from operations in year 2022 is projected to be \$59 million. Net operating cash flow from operations rises to \$1.8 billion after full ramp up of the Phase 1 Blended operations in 2034.

Exhibit 7-4 illustrates the net cash flow from operations for each ridership scenario from 2022 to 2060 in YOE dollars assuming the Phase 1 Blended development approach. Exhibit 7-4 demonstrates growth in net cash flow from operations in all ridership scenarios from the commencement of operations in 2022 to the analysis period end in 2060.

**Exhibit 7-4. Net cash flow from operations—Phase 1 Blended (YOE dollars in millions)**



**Breakeven analysis**

Exhibit 7-5 presents the results of the breakeven analysis that was performed using the revenues for the High, Medium, and Low Ridership Scenarios. The analysis identifies the revenue necessary to equal the minimum operating and maintenance costs needed to run the system. The results are presented for 2022, which is the first year of IOS operations and the year most sensitive to changes in ridership. The results also are presented for 2026, which is 5 years into the operations period and after the IOS ramp-up period.

Exhibit 7-5 shows that projected ridership for the High Ridership Scenario in the first year of operations (2022) could fall 55 percent and still cover operating and maintenance costs. As the project progresses through operations, the percentage increases. In 2026, the breakeven percentage is 81 percent below the high ridership projection. The number of riders needed to breakeven when the IOS opens in 2022 is 2.35 million or 45 percent of the high projection. The number of riders needed to breakeven when the Phase 1 Blended is opened in 2029 is 6.1 million or 23 percent of the high projection.

**Exhibit 7-5. Revenue breakeven analysis**

Ridership Scenario	IOS Startup in 2022		IOS in 2026		Phase 1 Blended Startup in 2029	
	2022 Revenue (YOE dollars in millions)	Percent of 2022 High Ridership Revenue	2026 Revenue (YOE dollars in millions)	Percent of 2026 High Ridership Revenue	2029 Revenue (YOE dollars in millions)	Percent of 2029 High Ridership Revenue
High	\$486	100%	\$1,329	100%	\$2,649	100%
Medium	\$380	78%	\$1,020	77%	\$2,089	79%
Low	\$274	56%	\$711	54%	\$1,530	58%
Breakeven	\$218	45%	\$247	19%	\$601	23%

As illustrated in Exhibit 7-6, projections indicate that no operating subsidy will be required under High, Medium, or Low Ridership Scenarios. This is consistent with the results of other high-speed rail projects across the world.

**Exhibit 7-6. 2022 net cash flow from operations summary (YOE dollars)**

Year 2022	Revenue	Operating Cost	Net Cash Flow from Operations	Operating Subsidy?
High	\$486	(\$334)	\$151	No
Medium	\$380	(\$321)	\$59	No
Low	\$274	(\$239)	\$35	No

**Project cash flow analysis**

This section provides a project cash flow analysis through 2060. The net project cash flow calculation begins with the net cash flow from operations (revenue less operations and maintenance costs) discussed above. Depreciation is a non-cash item and is excluded from this calculation. To account for capital replacement needs, the projected annual expenditures for repairing and replacing capital assets over time, including trains, equipment, and rail infrastructure, are then deducted to arrive at net operating cash flow after capital replacement costs. This represents the net cash flow available to be used for capital purposes and is before consideration of any debt service or investment returns.

The net cash flows are used to calculate an internal rate of return and capital payback period for the project before any consideration of financing or any particular source of funding. This analysis does not differentiate between funds that must be repaid (e.g., a Transportation Infrastructure Finance and Innovation Act of 1998 loan) and funds that do not (e.g., an American Recovery and Reinvestment Act of 2009 (ARRA) grant). This analysis provides an understanding of how total revenues, operating and maintenance costs, capital replacement, and construction costs interact together without regard to sources.

As illustrated in Exhibit 7-7 net cash flow from operations and after payment of capital replacement costs through 2060 exceeds \$83 billion. The project requires capital of \$68.4 billion until 2029 when Phase 1 Blended is complete.

The net project cash flows have been analyzed over the entire analysis period (2013 to 2060) to calculate the project internal rate of return (IRR). The estimated IRR for the project is 0.78 percent, which is low because capital costs must be paid up front while revenues come in over an extended period into the future. This total project return is insufficient to attract capital to pay for the entire project.

While the IRR is low, the project does pay back its capital over time. The payback period for the total capital invested is 36 years from IOS operations commencement and 45 years from start of construction. It is estimated that net cash collected will equal total cash expended for capital in 2057.

for board consideration

Exhibit 7-7. Net project cash flow through Phase 1 Blended (YOE dollars in millions) Medium Case

	Total Cash Flow through 2060	2013	2014	2015	2016	2017	2018	2019	2020	2021
Revenue	\$160,585	—	—	—	—	—	—	—	—	—
Less: O&M	(\$70,643)	—	—	—	—	—	—	—	—	—
<b>Net cash flow from operations</b>	<b>\$89,942</b>	—	—	—	—	—	—	—	—	—
Capital replacement costs	\$(6,609)	—	—	—	—	—	—	—	—	—
<b>Net operating cash flow after capital replacement</b>	<b>\$83,333</b>	—	—	—	—	—	—	—	—	—
Capital cost	\$(68,365)	\$(1,334)	\$(1,289)	\$(4,101)	\$(4,224)	\$(4,351)	\$(4,741)	\$(4,884)	\$(5,030)	\$(5,385)
<b>Net project cash flow</b>	<b>\$14,968</b>	<b>\$(1,334)</b>	<b>\$(1,289)</b>	<b>\$(4,101)</b>	<b>\$(4,224)</b>	<b>\$(4,351)</b>	<b>\$(4,741)</b>	<b>\$(4,884)</b>	<b>\$(5,030)</b>	<b>\$(5,385)</b>
<b>Cumulative net project cash flow</b>		<b>\$(1,334)</b>	<b>\$(2,623)</b>	<b>\$(6,724)</b>	<b>\$(10,948)</b>	<b>\$(15,299)</b>	<b>\$(20,040)</b>	<b>\$(24,924)</b>	<b>\$(29,954)</b>	<b>\$(35,339)</b>
<b>Project IRR</b>	<b>0.78%</b>									

for board consideration

Exhibit 7-7. Net project cash flow through Phase 1 Blended (YOE dollars in millions) Medium Case (continued)

	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Revenue	\$380	\$524	\$678	\$844	\$1,020	\$1,492	\$1,698	\$2,089	\$2,392	\$2,659
O&M	\$(321)	\$(345)	\$(382)	\$(499)	\$(547)	\$(755)	\$(814)	\$(945)	\$(1,075)	\$(1,133)
<b>Net cash flow from operations</b>	<b>\$59</b>	<b>\$179</b>	<b>\$296</b>	<b>\$345</b>	<b>\$473</b>	<b>\$737</b>	<b>\$884</b>	<b>\$1,144</b>	<b>\$1,316</b>	<b>\$1,526</b>
Capital replacement costs	\$0	\$(1)	\$(4)	\$(4)	\$(4)	\$(14)	\$(15)	\$(16)	\$(17)	\$(17)
<b>Net operating cash flow after capital replacement</b>	<b>\$59</b>	<b>\$178</b>	<b>\$292</b>	<b>\$341</b>	<b>\$469</b>	<b>\$723</b>	<b>\$869</b>	<b>\$1,128</b>	<b>\$1,300</b>	<b>\$1,509</b>
Capital cost	\$(4,805)	\$(6,315)	\$(6,505)	\$(6,700)	\$(3,685)	\$(2,471)	\$(2,545)	—	—	—
<b>Net project cash flow</b>	<b>\$(4,746)</b>	<b>\$(6,137)</b>	<b>\$(6,212)</b>	<b>\$(6,359)</b>	<b>\$(3,216)</b>	<b>\$(1,749)</b>	<b>\$(1,676)</b>	<b>\$1,128</b>	<b>\$1,300</b>	<b>\$1,509</b>
<b>Cumulative net project cash flow</b>	<b>\$(40,085)</b>	<b>\$(46,222)</b>	<b>\$(52,435)</b>	<b>\$(58,793)</b>	<b>\$(62,010)</b>	<b>\$(63,758)</b>	<b>\$(65,435)</b>	<b>\$(64,307)</b>	<b>\$(63,007)</b>	<b>\$(61,498)</b>

Exhibit 7-7. Net project cash flow through Phase 1 Blended (YOE dollars in millions) Medium Case (continued)

	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
Revenue	\$2,875	\$3,102	\$3,211	\$3,324	\$3,441	\$3,562	\$3,687	\$3,817	\$3,951	\$4,090
O&M	\$(1,252)	\$(1,328)	\$(1,381)	\$(1,440)	\$(1,531)	\$(1,594)	\$(1,656)	\$(1,721)	\$(1,789)	\$(1,860)
<b>Net cash flow from operations</b>	<b>\$1,623</b>	<b>\$1,775</b>	<b>\$1,830</b>	<b>\$1,885</b>	<b>\$1,910</b>	<b>\$1,968</b>	<b>\$2,031</b>	<b>\$2,096</b>	<b>\$2,162</b>	<b>\$2,230</b>
Capital replacement costs	\$(24)	\$(24)	\$(25)	\$(27)	\$(23)	\$(24)	\$(24)	\$(27)	\$(22)	\$(23)
<b>Net operating cash flow after capital replacement</b>	<b>\$1,598</b>	<b>\$1,750</b>	<b>\$1,805</b>	<b>\$1,858</b>	<b>\$1,887</b>	<b>\$1,944</b>	<b>\$2,007</b>	<b>\$2,069</b>	<b>\$2,139</b>	<b>\$2,207</b>
Capital cost	—	—	—	—	—	—	—	—	—	—
<b>Net project cash flow</b>	<b>\$1,598</b>	<b>\$1,750</b>	<b>\$1,805</b>	<b>\$1,858</b>	<b>\$1,887</b>	<b>\$1,944</b>	<b>\$2,007</b>	<b>\$2,069</b>	<b>\$2,139</b>	<b>\$2,207</b>
<b>Cumulative net project cash flow</b>	<b>\$(59,900)</b>	<b>\$(58,149)</b>	<b>\$(56,345)</b>	<b>\$(54,487)</b>	<b>\$(52,599)</b>	<b>\$(50,655)</b>	<b>\$(48,648)</b>	<b>\$(46,579)</b>	<b>\$(44,440)</b>	<b>\$(42,234)</b>

Exhibit 7-7. Net project cash flow through Phase 1 Blended (YOE dollars in millions) Medium Case (continued)

	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051
Revenue	\$4,234	\$4,382	\$4,537	\$4,696	\$4,861	\$5,032	\$5,209	\$5,392	\$5,581	\$5,778
O&M	\$(1,931)	\$(2,001)	\$(2,073)	\$(2,143)	\$(2,229)	\$(2,302)	\$(2,371)	\$(2,435)	\$(2,492)	\$(2,546)
<b>Net cash flow from operations</b>	<b>\$2,303</b>	<b>\$2,382</b>	<b>\$2,463</b>	<b>\$2,553</b>	<b>\$2,632</b>	<b>\$2,730</b>	<b>\$2,838</b>	<b>\$2,957</b>	<b>\$3,089</b>	<b>\$3,232</b>
Capital replacement costs	\$(26)	\$(341)	\$(325)	\$(335)	\$(345)	\$(32)	\$(399)	\$(34)	\$(753)	\$(1,059)
<b>Net operating cash flow after capital replacement</b>	<b>\$2,277</b>	<b>\$2,041</b>	<b>\$2,138</b>	<b>\$2,218</b>	<b>\$2,287</b>	<b>\$2,699</b>	<b>\$2,439</b>	<b>\$2,923</b>	<b>\$2,336</b>	<b>\$2,173</b>
Capital cost	—	—	—	—	—	—	—	—	—	—
<b>Net project cash flow</b>	<b>\$2,277</b>	<b>\$2,041</b>	<b>\$2,138</b>	<b>\$2,218</b>	<b>\$2,287</b>	<b>\$2,699</b>	<b>\$2,439</b>	<b>\$2,923</b>	<b>\$2,336</b>	<b>\$2,173</b>
<b>Cumulative net project cash flow</b>	<b>\$(39,956)</b>	<b>\$(37,916)</b>	<b>\$(35,777)</b>	<b>\$(33,560)</b>	<b>\$(31,273)</b>	<b>\$(28,574)</b>	<b>\$(26,135)</b>	<b>\$(23,212)</b>	<b>\$(20,876)</b>	<b>\$(18,704)</b>



Exhibit 7-7. Net project cash flow through Phase 1 Blended (YOE dollars in millions) Medium Case (continued)

	2052	2053	2054	2055	2056	2057	2058	2059	2060
Revenue	\$5,981	\$6,191	\$6,408	\$6,634	\$6,867	\$7,108	\$7,358	\$7,617	\$7,885
O&M	\$(2,597)	\$(2,646)	\$(2,700)	\$(2,749)	\$(2,811)	\$(2,871)	\$(2,981)	\$(3,157)	\$(3,240)
<b>Net cash flow from operations</b>	<b>\$3,384</b>	<b>\$3,545</b>	<b>\$3,708</b>	<b>\$3,884</b>	<b>\$4,056</b>	<b>\$4,237</b>	<b>\$4,377</b>	<b>\$4,459</b>	<b>\$4,645</b>
Capital replacement costs	\$(1,001)	\$(1,029)	\$(48)	\$(267)	\$(60)	\$(53)	\$(52)	\$(53)	\$(64)
<b>Net operating cash flow after capital replacement</b>	<b>\$2,383</b>	<b>\$2,517</b>	<b>\$3,661</b>	<b>\$3,618</b>	<b>\$3,996</b>	<b>\$4,185</b>	<b>\$4,326</b>	<b>\$4,406</b>	<b>\$4,580</b>
Capital cost	—	—	—	—	—	—	—	—	—
<b>Net project cash flow</b>	<b>\$2,383</b>	<b>\$2,517</b>	<b>\$3,661</b>	<b>\$3,618</b>	<b>\$3,996</b>	<b>\$4,185</b>	<b>\$4,326</b>	<b>\$4,406</b>	<b>\$4,580</b>
<b>Cumulative net project cash flow</b>	<b>\$(16,320)</b>	<b>\$(13,804)</b>	<b>\$(10,143)</b>	<b>\$(6,525)</b>	<b>\$(2,529)</b>	<b>\$1,655</b>	<b>\$5,981</b>	<b>\$10,387</b>	<b>\$14,968</b>

The analysis above is instructive for evaluating why the project cannot be totally self-financing. As grants and other government funding sources that do not require repayment from the project are contributed to the project, the payback period shortens and the IRR increases. The analysis of the relative contribution of public-sector funding and private-sector financing is provided in the next section.

The approach and results of the net project cash flow analysis were independently reviewed and verified by the Bay Area Council Economic Institute, which confirmed that the cash flows were accurately calculated and that the analysis approach is consistent with that used in the financial industry to calculate project payback period and internal rates of return.

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**“We found the cash flow projection to be accurately calculated using a traditional cash flow analysis framework used by the financial industry to determine payback periods and internal rates of return.”**

*Bay Area Council Economic Institute, March 20, 2011*

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## Funding

The previous sections of this chapter evaluated the operational viability, breakeven, and project cash flows for the project. These sections illustrated that the project can generate a positive net cash flow from operations but that it requires government funding for construction. This section of the chapter discusses the availability, timing, and magnitude of the various sources of capital funding for each section of the project.

### ***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. As described below, government funding for the IOS is fully identified, and once the IOS begins operating high-speed service, private sources of capital will be available to augment public funding sources to complete the Bay to Basin and Phase 1 Blended. Known and potential funding sources for each phase are described below.

A total of \$6 billion in funding has been identified for the first segment of construction for the IOS, including \$3.3 billion in federal funds and \$2.7 billion in Proposition 1A bond proceeds. Funding for the remaining segments of the IOS is identified and will come from additional Proposition 1A bond funds, federal support, and local funds. Cap and trade funds are available as needed, upon appropriation, as a backstop against federal and local support to complete the IOS. Project cash flows illustrate that the project can support over \$10 billion in private capital through Bay to Basin and additional amounts for the Phase 1 Blended alignment. In addition to these state and private sources, a significant contribution of funds is needed from the federal government. While supported by the Obama Administration, there is substantial discussion underway within the federal government related to both overall transportation

funding and high-speed rail funding. Currently, there is no consensus on funding high-speed rail projects. Existing and potential options for new federal programs are presented in Exhibit 7-8.

#### Exhibit 7-8. Funding sources

Funding Source	Description
American Recovery and Reinvestment Act and U.S. Department of Transportation Annual Appropriations (Federal)	In February 2009, President Obama signed the American Recovery and Reinvestment Act of 2009 (Recovery Act or ARRA). Using the Passenger Rail Investment and Improvement Act of 2008 as a framework, Congress has provided total program funding of \$10.1 billion for new high-speed and intercity passenger rail grants. California's high-speed rail program has received an allocation of \$3.5 billion, or 34 percent of these federal funding sources. In addition, based on the Passenger Rail Investment and Improvement Act framework, Congress allocated High-Speed Intercity Passenger Rail (HSIPR) funding through FY 09 and FY 10 appropriations.
Dedicated Passenger Rail Trust Fund (Federal)	The President's Fiscal Year 2013 budget request for the U.S. Department of Transportation outlined the Administration's six-year proposal, which includes the establishment of a Transportation Trust Fund with a new subaccount for passenger rail. The plan designated \$35 billion for building new corridors or substantially improving existing corridors, at an average level of nearly \$6 billion per year.
Federal Transportation Financing Programs	The federal government has several low-cost debt programs (borrowing tools) that may be accessed by the private sector (and in some instances, the public sector) to help reduce financing costs of the program. These programs include the Transportation Infrastructure Finance and Innovation Act of 1998, the Railroad Rehabilitation and Improvement Financing Program, and Private Activity Bonds.
Proposition 1A, 2008 (State)	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) 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. This Revised Plan assumes that \$8.2 billion is available for construction after environmental, planning, and support costs for the program are applied.
Cap-and-Trade Program Funds	Assembly Bill 32 (Statutes, 2006, Chapter 488) mandates a reduction of statewide greenhouse gas emissions to 1990 levels by 2020. In accordance with that law, California will implement a market-based cap-and-trade program. Funds from the program can be used to further the purposes of AB 32, including for development and construction of the high-speed rail system.
Locally Generated and Other Revenues	Locally generated revenues can include funds from the use of transit-oriented development, in partnership with local jurisdictions. The Authority and its local municipal partners also plan to target private revenues from passenger stations and other sources of revenue derived from growth and economic activity supported by the project.

### Initial Operating Section

The IOS will be completed over nine years and in segments.

The first segment is fully funded from the following sources (subject to satisfaction of various conditions associated with each):

- 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

The amount of each of these funding sources allocated to the development costs of the first segment (including planning and construction costs) is shown in Exhibit 7-9.

**Exhibit 7-9. IOS-First Construction funding sources (YOE dollars in millions)**

	Total	2013	2014	2015	2016	2017
<b>Sources</b>						
Federal grants secured	\$3,316	\$738	\$621	\$633	\$652	\$672
State Bonds (Proposition 1A)	\$2,684	\$597	\$503	\$513	\$528	\$544
<b>Total Sources</b>	<b>\$6,000</b>	<b>\$1,334</b>	<b>\$1,123</b>	<b>\$1,146</b>	<b>\$1,180</b>	<b>\$1,216</b>
<b>Uses</b>						
Capital expenditure	\$6,000	\$1,334	\$1,123	\$1,146	\$1,180	\$1,216
<b>Total Uses</b>	<b>\$6,000</b>	<b>\$1,334</b>	<b>\$1,123</b>	<b>\$1,146</b>	<b>\$1,180</b>	<b>\$1,216</b>

Numbers are subject to rounding  
2013 represents the first full year of construction

Once the IOS is under construction and early works have begun on blended improvements in both Northern and Southern California (the bookends), the Authority will begin to build the remaining sections of the IOS with initial attention on closing the rail gap between Bakersfield and Palmdale. As presented in Chapter 4, Business Model, the development of the IOS will need to be funded through government sources because private-sector capital for construction of the IOS is not available given the restrictions of Proposition 1A related to state revenue guarantees.

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. Cap and trade funds are available as needed, upon appropriation, as a backstop against federal and local support. As described below, once the IOS has been completed and operational, the opportunity for private investment is greatly increased, and the expected percentage of funds that could be used to match federal dollars increases substantially.

The funding plan assumes that a total of \$8.2 billion in state Proposition 1A bond funds is available for construction after environmental, planning, and administrative costs are applied. Of that amount, \$2.7 billion will be used for the first segment and \$1.1 billion is set aside for blended improvements, leaving a total of \$4.4 billion to contribute to funding the remainder of the IOS. Under the Authority's Revised Plan, these funds will be used to match with federal funding to close the rail gap from

Bakersfield to Palmdale and complete the IOS. 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 Exhibit 7-8). Cap and trade funds are available as needed, upon appropriation, as a backstop against federal and local support.

Potential funding sources to complete construction of the IOS in aggregate without regard to individual projects are shown in Exhibit 7-10.

**Exhibit 7-10. Sources and uses for completing the IOS (YOE dollars in millions)**

	Total	2015	2016	2017	2018	2019	2020	2021
<b>Sources</b>								
Federal support	\$20,265	\$2,214	\$2,281	\$2,349	\$3,629	\$3,738	\$3,850	\$2,203
State Bonds (Proposition 1A)	\$4,416	\$554	\$570	\$587	\$907	\$935	\$657	\$206
Other funds	\$650	—	—	—	—	—	\$305	\$345
<b>Total Sources</b>	<b>\$25,331</b>	<b>\$2,768</b>	<b>\$2,851</b>	<b>\$2,936</b>	<b>\$4,537</b>	<b>\$4,673</b>	<b>\$4,813</b>	<b>\$2,754</b>
<b>Uses</b>								
Capital expenditure	\$25,331	\$2,768	\$2,851	\$2,936	\$4,537	\$4,673	\$4,813	\$2,754
<b>Total Uses</b>	<b>\$25,331</b>	<b>\$2,768</b>	<b>\$2,851</b>	<b>\$2,936</b>	<b>\$4,537</b>	<b>\$4,673</b>	<b>\$4,813</b>	<b>\$2,754</b>

Numbers are subject to rounding

### **Bay to Basin**

The development of the Bay to Basin phase will be undertaken concurrent with operation of the IOS. The IOS is expected to be generating revenue and a net cash flow from operations. In Chapter 4, Business Model, the Authority set out the strategy to leverage the value of future revenue from both the IOS and the Bay-to-Basin sections through a concession arrangement that is described in the next section. The Authority has contacted a range of investors and firms that responded to the Request for Expressions of Interest to confirm investment timing and interest. There was agreement that, absent state guarantees, there would be little private capital available to invest into the project until after completion of the IOS and a positive cash flow is demonstrated. There also was agreement that once these conditions were met, substantial private-sector investment interest could be expected consistent with other systems in the world.

Under a scenario in which 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 cash flow from operations in each year. This is, in effect, a “pay as you go” basis. The financial analysis for the funding of the Bay-to-Basin assumes the same 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 \$3.7 billion in local or other funds will be needed to match federal funds to complete construction of the Bay to Basin. This illustrates the need to structure a transaction to monetize the net

operating cash flow after operations of the IOS as part of the completion of the Bay to Basin. This is shown on an annual basis in Exhibit 7-11.

**Exhibit 7-11. Sources and uses for completing Bay to Basin—Without private-sector capital (YOE dollars in millions)**

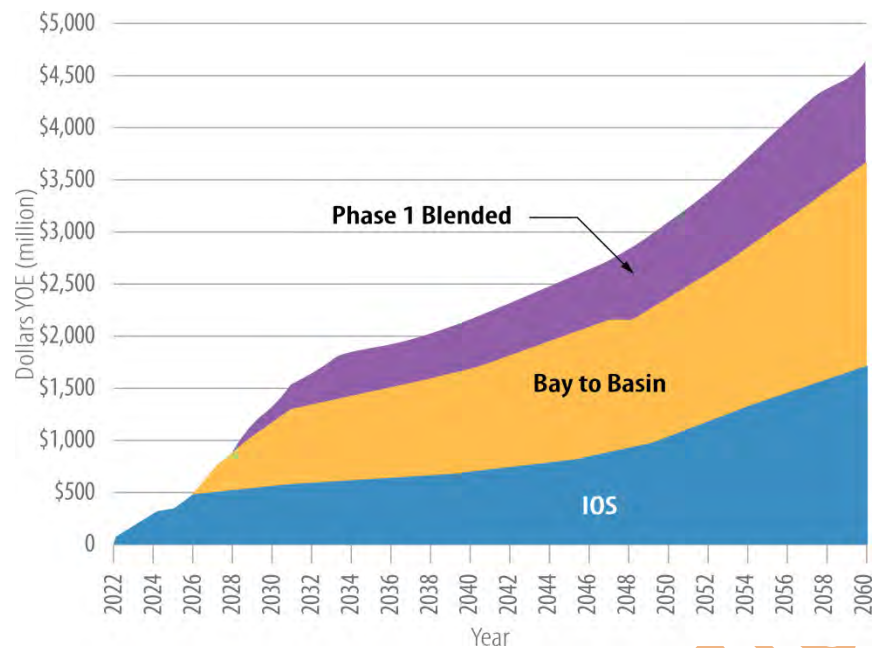
	Total	2021	2022	2023	2024	2025	2026
<b>Sources</b>							
Net operating cash flow after operations	\$1,351	—	\$59	\$179	\$296	\$345	\$473
Federal support	\$14,823	\$1,479	\$3,153	\$3,153	\$3,161	\$3,224	\$654
Other funds	\$3,706	\$370	\$788	\$788	\$790	\$806	\$163
<b>Total Sources</b>	<b>\$19,881</b>	<b>\$1,849</b>	<b>\$4,000</b>	<b>\$4,121</b>	<b>\$4,247</b>	<b>\$4,374</b>	<b>\$1,290</b>
<b>Uses</b>							
Capital expenditure	\$19,869	\$1,849	\$4,000	\$4,120	\$4,243	\$4,371	\$1,286
Capital replacement	\$12	—	—	\$1	\$4	\$4	\$4
<b>Total Uses</b>	<b>\$19,881</b>	<b>\$1,849</b>	<b>\$4,000</b>	<b>\$4,121</b>	<b>\$4,247</b>	<b>\$4,374</b>	<b>\$1,290</b>

Numbers are subject to rounding

### Private-sector capital

As the system develops over time it will generate implicit value through the generation of positive net operating cash flow. Exhibit 7-12 illustrates the growth in net operating cash flow for the Planning Case Scenario for all sections beginning at the commencement of operations in 2022.

**Exhibit 7-12. Planning case net operating cash flow by section (YOE dollars in millions)**



A critical decision will be when those future net cash flows could offer the greatest value to the state. The private sector will value the net operating cash flows after capital replacement to derive an up-front valuation of future cash flows. The private-sector valuation is expected to be greatest once the system is operational. Therefore, this Revised Plan assumes private investment occurs soon after the IOS is operational. The IOS is projected to have a material value to a potential private-sector investor as a stand-alone service.

If the IOS is demonstrating strong ridership and revenues, as forecast, along with overall strong asset operational performance, the private sector also is expected to have interest in valuing the future benefit of the Bay-to-Basin network prior to its completion. The cash flow scenario in Exhibit 7-13 is based on the Authority awarding a concession to a private-sector developer and investor that provides 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 for the potential contribution from the private sector based on a range of discount rates for such a transaction.

The analysis has been based on the discounting of the net operating cash flow after capital replacement at three illustrative discount rates:

8 percent, 11 percent, and 14 percent. It is more likely that the private sector would apply a higher discount rate to any net revenue from future sections yet to be completed, as opposed to proven cash flows from existing

**Exhibit 7-13. Discounted cash flows for Planning Case—IOS through Bay to Basin (YOE dollars in millions)**

PV date	Discount Rate		
	8%	11%	14%
End 2023	\$14,828	\$10,132	\$7,396

operational sections, which would support application of a lower discount rate.

Given the magnitude of the estimated value of future cash flows, the Authority will seek to place a concession that is timed to provide private capital to support construction to complete the final part of the Bay-to-Basin section. This approach would allow the private-sector investment to reduce the total government funding required to complete the Bay-to-Basin section.

Taking into account the estimated amount of private-sector investment that could be generated from a concession, a revised amount of federal and state funding was calculated. Using the Planning Case revenue projections, discounted net operating cash flows after capital replacement costs were calculated based on the discount rates described above to arrive at a present value. This present value serves as a proxy for the estimated proceeds the Authority could anticipate receiving from a private sector investor in a full concession transaction. The analysis was based on the assumption that private investment occurs close to the end of 2023, 3 years prior to completion of the Bay-to-Basin section.

For the purpose of illustrating the impact of an investment of private capital, an 11 percent discount rate was selected to discount future net operating cash flows from operations after capital replacement costs. The analysis estimates that \$10.1 billion of proceeds would be made available to the Authority, which could be used to offset state and federal funding contributions for completion of the Bay to Basin. This analysis is presented in Exhibit 7-14.

**Exhibit 7-14. Sources and uses for Bay to Basin with private-sector capital (YOE dollars in millions)**

	Total	2021	2022	2023	2024	2025	2026
<b>Sources</b>							
Net cash flow from operations	\$238	—	\$59	\$179	—	—	—
Private capital	\$10,132	—	—	\$221	\$4,247	\$4,374	\$1,290
Federal support	\$8,353	\$1,479	\$3,153	\$3,721	—	—	—
Other funds	\$1,158	\$370	\$788	—	—	—	—
<b>Total Sources</b>	<b>\$19,881</b>	<b>\$1,849</b>	<b>\$4,000</b>	<b>\$4,121</b>	<b>\$4,247</b>	<b>\$4,374</b>	<b>\$1,290</b>
<b>Uses</b>							
Capital expenditure	\$19,869	\$1,849	\$4,000	\$4,120	\$4,243	\$4,371	\$1,286
Capital replacement	\$12	—	—	\$1	\$4	\$4	\$4
<b>Total Uses</b>	<b>\$19,881</b>	<b>\$1,849</b>	<b>\$4,000</b>	<b>\$4,121</b>	<b>\$4,247</b>	<b>\$4,374</b>	<b>\$1,290</b>

Numbers are subject to rounding

The total reduction in federal and other funding of approximately \$6.5 billion and \$2.5 billion, respectively, resulting from the private-sector investment are offset by \$1.4 billion in reduced cash flow used for the “pay-as-you-go” funding described earlier. These figures would vary depending on the actual value invested by the private sector.

The timing for award of a concession contract will be determined based on early ridership results and projected capital return requirements and concession values. As revenues are discounted to arrive at an upfront concession value, a delay will increase the future value amount if net cash flow projections are



held constant. In the scenario above, a transaction occurring 1 year later in late 2024 would provide an additional \$800 million in concession value to the state; however, the delay also would affect the construction schedule.

Exhibit 7-15 illustrates a complete funding plan for the IOS through Bay to Basin from 2013 until 2026. This is based on leveraging private capital during the completion of Bay to Basin as described above.

Total capital costs for completing Bay to Basin are \$51.2 billion in YOE dollars. The funding plan in Exhibit 7-16 summarizes the relative levels of funding required or available from various sources, including federal support, state bonds, and other funds (local and private development). Cap and trade funds are available as needed, upon appropriation, as a backstop against federal and local support to complete the IOS.

Exhibit 7-16 assumes a private-sector concession provides \$10.1 billion. The key to reducing total government funding is the private-sector concession assumption that occurs in 2023. While \$10.1 billion represents a significant value in 2023 terms, in 2011 terms it is the equivalent of \$7.3 billion.

The commercial arrangements underlying this transaction would be developed as the procurement strategy develops. In today's dollars, \$7.3 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 HS2 line using government funds and will sell the asset upon completion. A recent study suggests the value of the sale could be approximately \$9 billion.

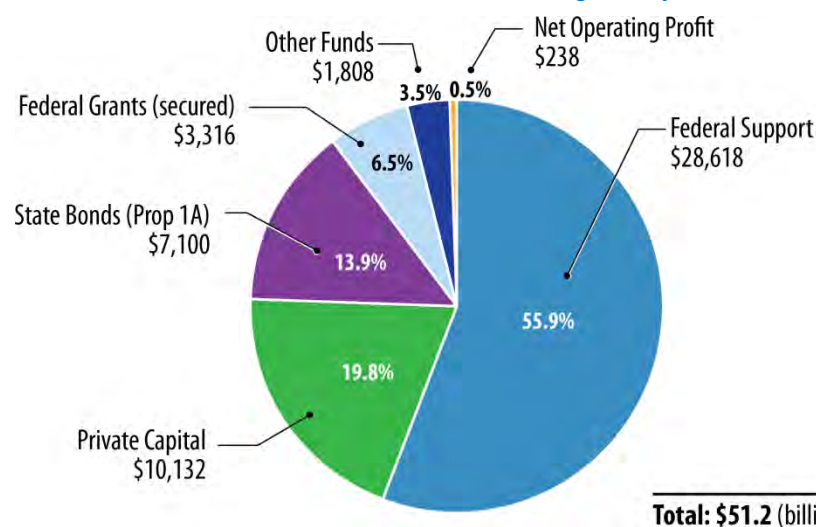
This Revised Plan recognizes that the amount to be financed is very large in current private-sector investment terms and the transaction would likely need to encompass low-cost federal debt programs and be staged to allow for market capacity and competition.

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, as discussed in greater detail in Chapter 4, Business Model.

Exhibit 7-15. Total sources and uses for IOS to Bay to Basin assuming private-sector investment in 2023 (2013 to 2026) (YOE dollars in millions)

	Total	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
<b>Sources</b>															
Net cash flow from operations	\$238	—	—	—	—	—	—	—	—	—	\$59	\$179	—	—	—
Private capital	\$10,132	—	—	—	—	—	—	—	—	—	—	\$221	\$4,247	\$4,374	\$1,290
Federal grants secured	\$3,316	\$738	\$621	\$633	\$652	\$672	—	—	—	—	—	—	—	—	—
Federal support	\$28,618	—	\$0	\$2,214	\$2,281	\$2,349	\$3,629	\$3,738	\$3,850	\$3,683	\$3,153	\$3,721	—	—	—
State Bonds (Proposition 1 A)	\$7,100	\$597	\$503	\$1,066	\$1,098	\$1,131	\$907	\$935	\$657	\$206	—	—	—	—	—
Other funds	\$1,808	—	—	—	—	—	—	—	\$305	\$715	\$788	—	—	—	—
<b>Total Sources</b>	<b>\$51,212</b>	<b>\$1,334</b>	<b>\$1,123</b>	<b>\$3,914</b>	<b>\$4,031</b>	<b>\$4,152</b>	<b>\$4,537</b>	<b>\$4,673</b>	<b>\$4,813</b>	<b>\$4,603</b>	<b>\$4,000</b>	<b>\$4,121</b>	<b>\$4,247</b>	<b>\$4,374</b>	<b>\$1,290</b>
<b>Uses</b>															
Capital expenditures															
IOS-First Construction	\$6,000	\$1,334	\$1,123	\$1,146	\$1,180	\$1,216	—	—	—	—	—	—	—	—	—
IOS	\$25,331	—	—	\$2,768	\$2,851	\$2,936	\$4,537	\$4,673	\$4,813	\$2,754	—	—	—	—	—
Bay to Basin	\$19,869	—	—	—	—	—	—	—	—	\$1,849	\$4,000	\$4,120	\$4,243	\$4,371	\$1,286
Capital replacement	\$12	—	—	—	—	—	—	—	—	—	—	\$1	\$4	\$4	\$4
<b>Total Uses</b>	<b>\$51,212</b>	<b>\$1,334</b>	<b>\$1,123</b>	<b>\$3,914</b>	<b>\$4,031</b>	<b>\$4,152</b>	<b>\$4,537</b>	<b>\$4,673</b>	<b>\$4,813</b>	<b>\$4,603</b>	<b>\$4,000</b>	<b>\$4,121</b>	<b>\$4,247</b>	<b>\$4,374</b>	<b>\$1,290</b>

Numbers are subject to rounding  
2013 represents the first full year of construction

**Exhibit 7-16. Relative amounts of sources of funding for Bay to Basin**

### Phase 1 Blended

The Phase 1 Blended section is estimated to cost an additional \$17.2 billion in YOE dollars over Bay to Basin. The blended system construction period extends from 2014 to 2028. Much of the development of the improvements in the Los Angeles Basin and San Francisco Bay Area will be managed and contracted by local agencies with authority over these corridors. In many cases, the Authority will be a planning and funding partner working with local agencies to acquire federal funds and coordinate the use of bond funds. Early improvements will be funded by the \$950 million in bond funds dedicated to local connectivity projects and an additional \$2.2 billion described in recent Memoranda of Understanding between the Authority and local agencies (excluding capital costs for Caltrain rolling stock). For planning purposes, funding of the \$2.2 billion is assumed to include \$1.1 billion in state Proposition 1A funds, \$600 million in new federal funds which are not committed, and \$500 million in other funds. This amount would fund early projects beginning in 2014 and extending to 2022. The completion of Phase 1 Blended is assumed in 2028 and its full development would require further government and other funding.

The incremental revenues from Phase 1 Blended create an additional source of private capital. When discounted using the 8 percent to 14 percent range discussed earlier, the incremental Phase 1 Blended net cash flows generate between \$2.1 billion and \$4.5 billion at the time of the Bay-to-Basin monetization, which is assumed to occur in 2027. Comparing these ranges to the incremental cost to complete Phase 1 Blended, the future value represents between 12 and 26 percent of the incremental Phase 1 Blended cost in YOE dollars.

**Exhibit 7-17. Sources and uses—Phase 1 Blended with private-sector capital (YOE dollars in millions)**

	Total	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
<b>Sources</b>																
Private capital	\$2,986	—	—	—	—	—	—	—	—	—	—	—	—	—	\$441	\$2,545
Federal support	\$9,956	\$50	\$56	\$58	\$60	\$61	\$63	\$65	\$235	\$337	\$1,756	\$1,809	\$1,863	\$1,919	\$1,624	—
State bonds (Proposition 1A)	\$1,100	\$66	\$75	\$77	\$80	\$82	\$84	\$87	\$313	\$236	—	—	—	—	—	—
Other funds	\$3,123	\$50	\$56	\$58	\$60	\$61	\$63	\$65	\$235	\$232	\$439	\$452	\$466	\$480	\$406	—
<b>Total sources</b>	<b>\$17,166</b>	<b>\$165</b>	<b>\$187</b>	<b>\$193</b>	<b>\$199</b>	<b>\$205</b>	<b>\$211</b>	<b>\$217</b>	<b>\$782</b>	<b>\$805</b>	<b>\$2,196</b>	<b>\$2,261</b>	<b>\$2,329</b>	<b>\$2,399</b>	<b>\$2,471</b>	<b>\$2,545</b>
<b>Uses</b>																
Phase 1 Blended capital expenditure	\$17,166	\$165	\$187	\$193	\$199	\$205	\$211	\$217	\$782	\$805	\$2,196	\$2,261	\$2,329	\$2,399	\$2,471	\$2,545
<b>Total uses</b>	<b>\$17,166</b>	<b>\$165</b>	<b>\$187</b>	<b>\$193</b>	<b>\$199</b>	<b>\$205</b>	<b>\$211</b>	<b>\$217</b>	<b>\$782</b>	<b>\$805</b>	<b>\$2,196</b>	<b>\$2,261</b>	<b>\$2,329</b>	<b>\$2,399</b>	<b>\$2,471</b>	<b>\$2,545</b>

Numbers are subject to rounding

for board consideration

Therefore, even if the net cash flows from IOS and Bay to Basin are awarded as a concession, it would be feasible for additional Phase 1 Blended cash flows to provide a potential funding source for developing Phase 1 Blended as described above for Bay to Basin. From a commercial perspective, the monetization of Phase 1 Blended 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.

Having considered the future value of Phase 1 Blended, a portion of the development costs will have to be publicly funded. This funding requirement will be many years into the future and will be dependent on new federal or other government programs. It is not possible to provide specific details on future funding programs.

### **Alternative funding scenarios**

This Revised Plan presents a Planning Case based on the best information and assumptions available to the Authority at this time. However, a range of events and actions can impact the project schedule, cost, and funding requirements. This section identifies the following three alternative scenarios to illustrate the impact on funding requirements if key portions of the plan change over time:

- Extending the construction schedule by 5 years
- Reducing revenue forecasts to low ridership
- Increasing construction costs

#### ***Extending the construction schedule by five years***

The project schedule is closely linked to the availability of funding. The current planning schedule illustrates a build out from 2013 to 2028, or 15 years for the blended service.

Exhibit 7-18 illustrates the effect of extending the schedule and shows the change in financial requirements if the project were extended to a 20-year construction timeframe. This is based on the Planning Case ridership and the 11 percent discount factor. Similar increases, primarily due to inflation, would occur if the project schedule extended longer than 20 years.

The Planning Case illustrated in Exhibit 7-18 represents the Medium Ridership Scenario discussed earlier in this chapter. Increasing the construction schedule by 5 years would increase costs approximately 1.7 percent. As revenues are extended into the future, it would also reduce the amount of revenue generated by the project (see last column) over the analysis period and the amount and timing of private-sector investment. This is estimated to reduce the private-sector investment amount by nearly \$700 million that, in turn, requires a commensurate increase from federal and other public sources of funds.

**Exhibit 7-18. Extending the construction schedule (YOE dollars in millions)**

	Planning Case	Extended Schedule Scenario
<b>Sources</b>		
Net cash flow from operations	\$238	\$238
Federal support	\$41,890	\$41,454
State bonds (Proposition 1A)	\$8,200	\$8,200
Other funds (state, local, private)	\$4,931	\$7,211
Private capital	\$13,118	\$12,411
<b>Total Sources</b>	<b>\$68,377</b>	<b>\$69,514</b>
<b>Uses</b>		
Phase 1 Blended capital cost <sup>1</sup>	\$68,377	\$69,514
<b>Total Uses</b>	<b>\$68,377</b>	<b>\$69,514</b>

Numbers are subject to rounding

<sup>1</sup>Capital costs include capital replacement costs

**Reducing revenues**

Ridership and revenue levels drive cash flow from operations and the cash flow available to support capital purposes. The Planning Case illustrated earlier in this chapter is based on the Medium Ridership Scenario. Exhibit 7-19 illustrates the impact to the project if the low ridership and revenue projections are achieved. This is based on the Planning Case ridership and the 11 percent discount factor.

**Exhibit 7-19. Reducing ridership and revenues (YOE dollars in millions)**

	Planning Case	Low Revenue Scenario
<b>Sources</b>		
Net cash flow from operations	\$238	\$86
Federal support	\$41,890	\$45,897
State bonds (Proposition 1A)	\$8,200	\$8,200
Other funds (state, local, private)	\$4,931	\$5,834
Private capital	\$13,118	\$8,360
<b>Total Sources</b>	<b>\$68,377</b>	<b>\$68,377</b>
<b>Uses</b>		
Phase 1 Blended capital cost <sup>1</sup>	\$68,377	\$68,377
<b>Total Uses</b>	<b>\$68,377</b>	<b>\$68,377</b>

Numbers are subject to rounding

<sup>1</sup>Capital costs include capital replacement costs

As illustrated in Exhibit 7-19, assuming the Low Ridership Scenario reduces the amount of revenue generated by the project (see last column) over the analysis period. This is estimated to reduce private-sector investment amount and net cash flow from operations by \$4.8 billion that, in turn, requires a commensurate increase from federal and other public sources of funds.

### **Increasing construction costs**

Construction costs impact the amount of funding required. Exhibit 7-20 shows how an increase in construction costs impacts various funding sources. This scenario assumes that the costs for the system are equal to the high cost of building the Phase 1 Blended system.

**Exhibit 7-20. Total sources and uses of funds—increased construction costs**  
(YOE dollars in millions)

	Planning Case	Increased Construction Costs Scenario
<b>Sources</b>		
Net cash flow from operations	\$238	\$238
Federal support	\$41,890	\$50,648
State bonds (Proposition 1A)	\$8,200	\$8,200
Other funds (state, local, private)	\$4,931	\$7,548
Private capital	\$13,118	\$13,118
<b>Total Sources</b>	<b>\$68,377</b>	<b>\$79,752</b>
<b>Uses</b>		
Phase 1 Blended capital cost <sup>1</sup>	\$68,377	\$79,752
<b>Total Uses</b>	<b>\$68,377</b>	<b>\$79,752</b>

Numbers are subject to rounding

As illustrated in Exhibit 7-20, increasing the construction costs for the project by \$11.4 billion (see last column) requires a similar increase in government funding estimated at \$8.8 billion from federal sources and \$2.6 billion in other funds.

Each alternative funding scenario, extended construction schedule, lower revenues, and higher construction costs, results in a need for additional public funds. Should additional public funds not be available, the project phasing, scoping, or schedule would be negatively affected.

### **Summary**

The financial analysis has used the cost and revenue estimates for the system to examine the overall economics and funding requirement of the program. The results demonstrate the following:

- The key initial operating segment from the Central Valley to the Los Angeles Basin is fully funded, will not require an operating subsidy, will generate positive cash flow to attract future investment, and will close the state's rail gap with the country's first dedicated high-speed rail system.

- The system is forecast to produce positive net cash flow from operations after capital replacement immediately following commencement of operations, even under a Low Revenue Scenario. Breakeven revenues are estimated at \$218 million in 2022, which is 55 percent below the first year high estimate and 20 percent below the low estimate.
- Private-sector development and operation of the system is expected from the outset of construction and operations. Private-sector capital 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. Private-sector investment could exceed \$10 billion in year-of-expenditure terms.

for board consideration



## Chapter 8

### *Risk Identification and Mitigation*

#### Introduction

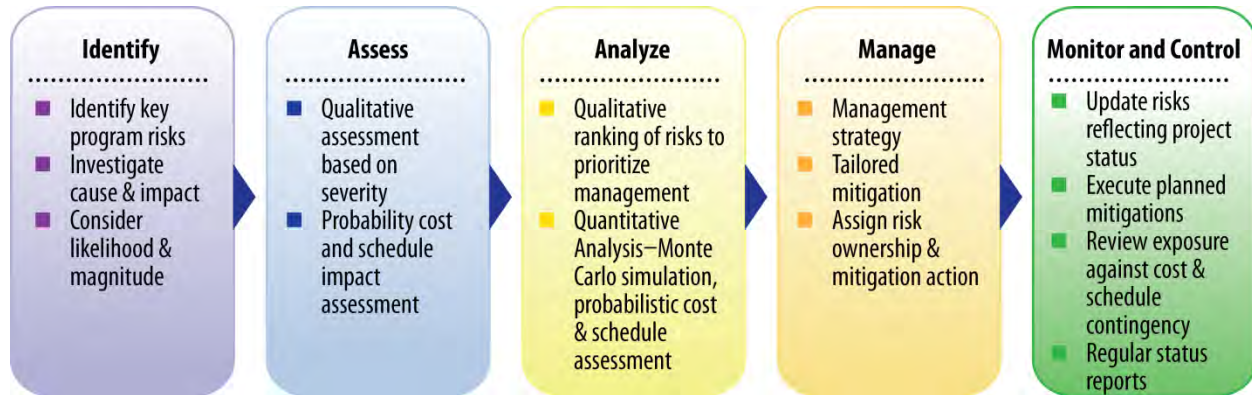
Undertaking a program as large as the California high-speed rail (HSR) system involves risk from both the program and project-level perspectives. It is critical to identify, manage, and mitigate risks at each stage of the HSR system's life cycle.

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 general 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 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 processes to manage and monitor risk throughout the HSR system's life cycle. A key step in tailoring risk management processes is occurring as part of the risk management plan process for delivery of the first construction segment of the Initial Operating Section (ICS).

The Authority's risk management process involves five key steps, as illustrated in Exhibit 8-1. This chapter discusses outputs from the "Identify" and "Manage" activities described in Exhibit 8-1.

**Exhibit 8-1. Authority's risk management process**



## Key risks

The Authority has taken a number 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 world markets.

Design on the first construction segment of the IOS has progressed in excess of 15 percent in certain segments, and many cost and schedule updates and changes have been incorporated to reflect more detailed design, environmental mitigation measures, and refined contingencies; however, the design and environmental process for the project is not complete. The federal Record of Decision (ROD) for the Merced-to-Fresno section of the first construction segment of the IOS is expected to be received in June 2012; however, the Fresno-to-Bakersfield section has been delayed following the public comment process and a supplementary alignment has been added. Although considered unlikely, the design for

the first IOS construction segment (and the project as a whole) could change and, therefore, capital costs could further change.

The schedule is tied directly to the availability of funding. While this has been discussed with a range of stakeholders, the actual schedule will be different, as discussed in Chapter 3, Capital Costs. In the event that funds are provided over longer periods of time, capital costs likely will rise as a result of inflation.

In relation to the four design-build construction projects that comprise the IOS first construction segment, certain federal funds require that this portion of the project be completed in 2017, which requires a specific plan and risk mitigation strategy for the project.

### 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 or keep funding

### Mitigation and management approach

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:

- **Adopting the Phase 1 Blended systems strategy as the preferred implementation strategy.** This strategy allows the system to use existing assets in urban areas, thereby significantly reducing costs, development risk, and time frames.
- **Developing and implementing the HSR using a phased approach, beginning with the 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, The Implementation Strategy: Blending, Phasing, Investing in Early Benefits.
- **Including significant contingencies, inflation estimates, and schedule extension in the financial plan.** The Phase 1 Blended construction cost in 2011 dollars includes a contingency of between 15 and 25 percent to protect against material cost increases, use of different components or parts, and minor changes in quantities, depending on the cost category. A six-year schedule extension is factored into the plan to account for funding delays. These assumptions individually and collectively are mitigations for the risk that the financial plan costs are materially understated.
- **Procuring the IOS under design-build contracts that transfer significant cost and schedule risk to the design-build contractor.** The Authority has included a number of terms and conditions in the first construction package of the IOS (and would include similar provisions in future contracts) that are designed to help ensure schedule and cost certainty. These proposed contract provisions include

limiting the situations in which change orders, increase to costs, and time extensions are allowed. In addition, the design-build contract stipulates that liquidated damages are payable to the Authority in the event the design-build contractor cannot deliver the first construction package by a certain date.

- **Advancing the procurement for the initial construction segments of the IOS to take advantage of favorable construction pricing, maintaining project schedule, and resolving issues before implementing system-wide operations.** Additionally, once construction is completed and systems and electrification installed for the IOS, it 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.
- **Adopting an aggressive cost-management strategy for the entire system that leverages private-sector delivery models that transfer risk of cost increases and schedule delay where appropriate.** These models include design-build, concession structures for train operations; an infrastructure operating and maintenance (O&M) concession for infrastructure operations and maintenance; or broader public-private partnership 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 discussion of public-private partnership delivery models, see Chapter 4, Business Model.
- **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 of the Fresno-to-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-to-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.
- **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.
- **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 6, Operating and

Maintenance Costs, discusses this in more detail. The O&M cost projections are undergoing review by the International Union of Railways, an international organization representing high-speed rail operators around the world, to further validate the assumptions underlying the O&M cost projections.

- **Continuing to incorporate value engineering to reduce overall program cost without compromising quality or safety as engineering proceeds to the 30 percent design level.** For example, the first design-build contract for the IOS has incorporated Alternative Technical Concept and Value Engineering processes that incentivize the design-build contractor to find innovative solutions that will help lower the overall cost of construction without compromising quality.
- **Developing a schedule for the entire program based—and highly dependent—on funding availability.** If all of the funding required to complete the program were available, the blended system could be built as early as 2023. The Authority has structured the construction packages relating to the first construction segment of the IOS so that construction may be completed with available funds. In particular, the scope of the two final construction packages (#4 and #5) of the segment will be adjusted up or down to accommodate the remaining funds and/or procurement savings in the project budget. For the purposes of financial planning, a schedule was developed to illustrate program completion that results in a completion date of 2028. This additional time in the financial plan schedule would mitigate most schedule-oriented risks.

### ***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 rail programs. In-depth high-speed rail industry expertise and experience is critical within state service.

The Authority has increased staffing and capacity, and expanded its organizational structure. The Authority is working with the California Department of Transportation (Caltrans) and other state agencies to identify both permanent transfers and temporary secondments to fill needed positions. This focus on increased staffing 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 with 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 using consultants 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:

- Delay in critical management decision making
- 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's Board of Directors has made this a priority and is working with staff to address key issues. 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:

- **Soliciting candidates to fill open positions to lead major work streams**, including a new chief executive officer and chief deputy director, as well as 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.
- **Engaging the PMT and other consultants to provide supplemental expertise** in areas necessary to develop and implement the IOS. An integrated organizational structure has been developed to support that effort.

In addition to the measures described above, the Authority is pursuing the use of business and commercial structures to transfer risks associated with certain administrative and management functions during the construction and operation phases. For a more detailed discussion of these structures see Chapter 4, 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.

Currently the Environmental Impact Report/Environmental Impact Statement (EIR/EIS) for the Merced-to-Fresno section of the IOS is progressing and a ROD is expected to be received in June 2012. The EIR/EIS for the Fresno-to-Bakersfield section of the IOS has been delayed following the public comment process and a supplementary alignment has been added. As a result, a revised EIR/supplementary EIS will be certified in November 2012 and a ROD is expected in December 2012.

In addition, there are many other permits and governmental approvals that must be secured before beginning construction.

### Potential impact

The impact to the program could be wide ranging and include the following:

- Loss of public funding (ARRA) and an increase to the 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:

- **Increasing the Authority's internal staffing and soliciting individuals** given the complicated nature and magnitude of agencies involved in the approval processes. The risk of delay in or inability to obtain approvals is linked to the internal management of these processes.
- **Developing a planning schedule to evaluate funding needs that extends Phase 1 Blended completion five years from 2023 to 2028.** 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 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. The Authority will continue to coordinate with FRA staff on regulatory requirements, particularly the environmental

requirements for the first construction segment of the IOS, including implementing a schedule with deadlines and an accountability matrix that assigns ownership of each approval process. In addition, the Authority will continue 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 ensuring that the right-of-way acquisition and environmental approval processes are legally compliant and aligned to project delivery schedules.** 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. In addition, the Authority continues to coordinate with the Public Works Board to refine the ROW acquisition process with the objective of shortening the duration of time necessary to acquire ROW.
- **Pursuing a variety of methods in which to transfer risk related to approvals.** Apart from securing the ROD for both the Merced-to-Fresno and Fresno-to-Bakersfield sections of the IOS, the Authority is transferring the responsibility (and risk) associated with securing other permits and governmental approvals to the design-build contractors for the first design-build construction package of the IOS. For example, under the design-build contract, the design-build contractor is not entitled to receive any increase in costs or time extensions for the delay or inability to receive any permits or governmental approvals (apart from the RODs).

### ***Demand/ridership and revenues***

#### **Description**

The financial viability of the program is dependent on public funding for early construction and then on 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 the private sector has been willing to accept this risk 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 taken a number of steps toward mitigating this risk. A number of these activities were undertaken at the direction of the Authority's Board in the past six months. 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 conditions and population growth. A range of inputs for gas prices and fuel efficiency was modeled based on independent industry guidance. The range of possible outcomes was compared to operating costs and to the system's breakeven point. All projections analyzed, which encompass a wide range of inputs, result in a positive cash flow. The testing of possible ridership scenarios illustrates that the system can be expected to generate positive operating results and not require operating subsidies even if ridership comes in well below initial estimates. This is consistent with other high-speed rail operations internationally.
- **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 5, Ridership and Revenue, for more information.
- **Analyzing the project's operating performance from a breakeven standpoint.** As illustrated in Chapter 7, Financial Analysis and Funding, the system's breakeven point is well below the lowest projection of ridership. This includes a Low Scenario projection that incorporates gasoline prices at \$2.60 per gallon, which is much lower than current and any recent historical prices.
- **Testing the operation of the model overall using an actual system and comparing with known results.** The HSR model was tested using the attributes of the Acela system running in the North-eastern United States. As discussed in Chapter 5, Ridership and Revenue, the attributes for the functioning system were input into the California model and the model results generated a projection that was within 79 percent of the actual results of the functioning system.
- **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 4, 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 public funding impacts 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:

- **Securing backup funding for the full IOS.** The Authority has been working with state stakeholders, including the California Department of Finance, to develop backup funding support for the full IOS should federal funding support fall short of the amount needed to complete the IOS. Cap-and-Trade funds are available, as needed, upon appropriation, as a backstop against federal and local support to complete the IOS. This is a major milestone in the mitigation efforts to decrease the risk related to funding the IOS.
- **Developing the system in functional phases and placing completed sections into immediate service.** The phased implementation of the system mitigates 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 phase that generates economic benefits. For example, the completion of the first IOS construction segment will be used by Amtrak San Joaquin service and potentially other operators. Similarly, when the gap between Bakersfield and Palmdale is closed, it will be available for immediate use by others. Once the full IOS is commissioned there will be fully operational high-speed rail service that is forecast to generate a strong level of net operational cash flow 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. For more information, see Chapter 2, The Implementation Strategy: Blending, Phasing, Investing in Early Benefits.
- **Focusing on maintaining stakeholder support for the program.** This involves, among other things, 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.

- **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 9, Economic Analysis, for an in-depth discussion of the economic benefits of the program.
- **Maintaining effective communication.** The Authority is actively communicating with state agencies and policy leaders for the appropriations requests as part of the fiscal year 2012-13 budget process. The Authority will submit an Expenditure Funding Plan as required under Proposition 1A following issuance of this Revised 2012 Business Plan (Revised Plan) in April 2012.

The Authority continues to work closely with legislators, the FRA, the Federal Transit Administration, the private sector, and other stakeholders to maintain funding support for the program. For example, the Authority provides quarterly updates to the FRA on the administration of all grant funding committed to the project. The Authority will continue to evaluate future sources of federal funding, as identified in Chapter 7, Financial Analysis and Funding, in conjunction with federal project partners and funders.

The Authority also is continuing to meet with private-sector entities to discuss the ability of private financing mechanisms to complement or supplement public-sector funding. For more information, see Chapter 4, Business Model.

- **Establishing a cash management strategy.** The Authority is meeting with the California Department of Finance, the State Treasurer's Office, and the State Controller's Office, as needed, to refine the cash management process associated with the timely receipt of bond proceeds for project expenditures and the appropriate handling of federal reimbursement payments.

## **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.
- **Considering the use of delivery models that leverage private finance to help deliver elements of the program.** The Authority has had extensive discussions with potential private financiers who may be interested in investing in the HSR system through the Requests for Expressions of Interest process. The feedback has been incorporated into the business model. For detailed information, see Chapter 4, Business Model.
- **Monitoring private-sector investor interest.** The analysis presented in Chapter 7, Financial Analysis and Funding, 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 also will 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 throughout the program.
- **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 organizations. For more information, see Chapter 7, Financial Analysis and Funding.
- **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.
- **Working to align state stakeholders.** This will help reduce the perceived risk associated with financing as lenders carefully review the public sector's commitment to a program. Key to this confidence is continuity of support to advance the HSR system. This also will help reduce the

perceived risk associated with private financing as lenders and financiers carefully evaluate public-sector partners prior to making investments.

- **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 4, Business Model.

### **Right-of-way**

#### **Description**

Acquiring right-of-way (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:

- **Engaging qualified ROW firms with significant experience.** These firms are well versed 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 have a demonstrated success in delivering property rights for large-scale, design-build transportation projects.
- **Developing a ROW acquisition plan for the first design-build contract for the IOS that sets forth the parcels that must be acquired and the timeline for acquisition.** Sharing this ROW acquisition plan with other appropriate state agencies also will facilitate timely receipt of funding and completion of the relevant government review and approval processes. The ROW acquisition plan will be released for review by all design-build contractors who have been prequalified to submit a proposal to enter into the first design-build contract. The design-build contractors must design and construct the work within the right-of-way limits set forth in the ROW acquisition plan. In addition, each design-build contractor must agree to the ROW acquisition plan before submitting its proposal and certify that it is able to construct within the ROW acquisition plan.

- **Structuring the first design-build contract for the IOS such that multiple notices to proceed can be issued as the ROW is acquired.** This will mitigate delay to one portion of the work as a result of delay in ROW acquisition for a distinctly separate portion of the work.
- Continuing communications with the Union Pacific Railroad (UPRR), the Burlington Northern Santa Fe Railway (BNSF), and other stakeholders that may hold shared ROW required for the HSR alignment.
- Commissioning a peer review of 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 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 UPRR and BNSF. Other entities also will have an interface with the program, including Caltrain, Amtrak, Caltrans, and other local transportation and transit agencies. This includes 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.** While the Authority is responsible for securing agreements with the utilities, the Authority intends to transfer much of the risk related to maintaining the agreements to the design-build contractors responsible for constructing the IOS. For example, the first design-build contract for the IOS mandates that the contractor will be responsible for fulfilling the Authority's obligations under the agreements with continued participation by the Authority.
- **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.
- **Developing Memoranda of Understanding and future operating agreements with transit agencies, Caltrain, and Amtrak about optimizing future operations, including coordination on schedules, ticketing, station operations, and parking.** Memoranda of Understanding for both Southern California and the San Francisco Bay Area have been drafted and are in the process of approval.

- **Enhancing stakeholder outreach and communication.** To maintain stakeholder support, the Authority has employed a multi-pronged initiative of outreach and communication to all stakeholder groups throughout California, and specifically in the Central Valley. This strategy involves regular communication with local elected officials and local government staff to keep them apprised of new information relating to the Project, building trust and confidence in the Authority. Business organizations, such as chambers of commerce and economic development groups, have been contacted to establish relationships. Additionally, through the environmental processes (workshops, open houses, meetings, etc.) the Authority has attempted to reach out to the broader community to communicate the goals and benefits of the project.

## Risk mitigation and allocation strategies

The previous section identified key 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 and allocation 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.
- **Risks are "owned"**—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.
- **Communication and reviews are regular**—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 aligning technical and operational risk transfer with commercial and financial risk transfer to realize 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 4, 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 4, Business Model, for more detail on contracting strategies being considered.

For example, the Authority is using a design-build contracting method for the first construction segments of the IOS. The first design-build contract for the IOS has been developed and the procurement is underway. This contract transfers a significant amount of risk to the design-build contractor. This approach to risk transfer via a design-build contract also will be used by the Authority for the remaining construction packages for the IOS to achieve cost and schedule certainty.

### **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
- Rationalizing allocation of resources
- Informing 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 within their region. Regional managers are also responsible for motivating response planning, supporting quantitative risk assessment, preparing for quantitative risk analysis, and incorporating into their work plans the resources and time required to execute specified mitigations.

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 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.

The risk owner (regional consultant, PMT, or Authority team members) develops and updates the assigned risk response strategy, as necessary; monitors the assigned risk; informs the regional manager, regional risk manager, and regional consultant risk manager of any changes to its status; and executes the 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 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 funding agencies and, as such, is subject to those agencies' rigorous risk programs and oversight.

### ***Risk assessment workshops***

Risk assessment 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, by the Authority, its staff, and consultants, are held quarterly. For regions within the first construction segments of the IOS, workshops are held monthly. For other regions, formal reviews are held quarterly.

In addition to formal risk management workshops and risk review sessions with key personnel, monthly meetings are held 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 reviews individual risks with team members, monitors progress on mitigation actions, and updates 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 (risk analysis)***

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 input into the total project costs.

## Summary

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 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 already has commenced with the detailed technical risk register for the first construction of the IOS.

The risk analysis will be used as a key foundation in the development of commercial agreements with the private sector for design and construction of the first IOS segment as well as future sections of the IOS.

The program's development plan has been structured to help mitigate the following key risks:

- **Enhancing the value of early investments**—The Authority has adopted the blended operations strategy to allow other operators to use the first IOS segment and portions of the IOS before commencement of HSR service. This approach increases the value of early investments, provides earlier benefits to California, and allows the system to be built up over time and “walk before it begins to run.”
- **Schedule and approval**—The program has been analyzed assuming a schedule delay due to funding availability. A five-year delay is included in the Business Plan that should mitigate many of the schedule and approval risks.
- **Project cost**—The Phase 1 Blended system strategy has been adopted, which allows HSR to reduce the amount of dedicated track to be built, reduces costs, and accelerates benefits. 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, design-build -finance-operate-maintain, 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 a positive operating cash flow.
- **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 other categories.
- **Funding**—The amount and timing of funding for the program remains a risk. Major accomplishments have been made to mitigate this risk for the IOS. Notably, the Authority has secured a backup funding commitment from the state for funding the full IOS should the estimated amount of federal funding not materialize. In addition, the blended approach provides for fully functioning segments after each phase of the program. 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.

for board consideration



## Chapter 9

### *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 (HSR) 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 HSR system makes the costs high. However, the program benefits are even greater—as detailed in this chapter—88 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 first segment of the IOS, to long-term efficiencies that will transform California's economy to make it more competitive. This chapter provides these analyses.

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.

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.

In 2011 and 2012, the Authority undertook a comprehensive and well-vetted economic impact and benefit-cost analysis on the high-speed rail system. The analysis completed for the Draft 2012 Business Plan (Draft Plan) has been updated for this Revised 2012 Business Plan (Revised Plan) to include a benefit-cost analysis on the Phase 1 Blended system.



*Strong benefit-cost ratios demonstrate that the net benefits to society greatly outweigh the cost of building and maintaining the 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 Revised 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](http://www.cahighspeedrail.ca.gov/business_plan/reports.aspx).

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 5, Ridership and Revenue; and Chapter 6, 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.<sup>1</sup>
- 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.<sup>2</sup>
- 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.<sup>3</sup>

**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 metropolitan areas with international economies.<sup>4</sup>
- 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.<sup>5</sup>

**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, over 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.

## **Gross domestic product, fiscal, and other impacts of the first segment of the IOS**

Construction of the first IOS segment will bring many benefits to the Central Valley. The \$6 billion investment will provide a major boost to the region's economy. Thousands of Californians will earn paychecks as a result of construction of the project, and their spending will flow through the region's economy to many other industries. This "multiplier effect" will significantly benefit many small and large businesses in the region that may never be directly involved with the actual construction of the system. This will represent the biggest financial investment by the federal and state governments in the Central Valley in decades.

The Central Valley has suffered significantly during the Great Recession. The current unemployment rate in the region still stands at over 15 percent, which is nearly four percentage points higher than the state as whole and nearly double the rate nationwide.<sup>6</sup> The five cities with the highest unemployment rate nationwide are *all* located in the Central Valley.<sup>7</sup> Meanwhile, per-capita income in the region is less than \$29,000, compared to more than \$42,000 statewide. Every county in the region has been designated an Economically Distressed Area by the federal government.

California's investment in the construction of the first IOS segment will have significant stimulative *economic* impacts. For the \$2.7 billion that the state will provide, the federal government is contributing another \$3.3 billion. However, the actual impact on the California economy will be even larger than the \$6 billion that will be invested in it. According to the American Public Transportation Association (APTA), every billion dollars of infrastructure investment has a \$1.5 billion impact on the Gross Domestic Product (GDP)<sup>8</sup>. Applying that to the cost of the first segment of the IOS, net of real estate, yields a total of \$8.3 billion in increased GDP over the five years of construction. Similarly, Moody's Analytics found that every dollar invested in infrastructure yields a GDP impact of \$1.59<sup>9</sup>. At that rate, the GDP impact would be closer to \$8.8 billion. Thus for its \$2.7 billion investment to start the construction of the IOS, the state stands to gain \$8.3 to \$8.8 billion in GDP—or over three times the amount that it is investing.

APTA also estimates the *fiscal* impacts of infrastructure spending. APTA found that for each \$1 billion invested, federal, state, and local governments would earn back approximately \$350 million in taxes. Thus the first construction of the IOS would yield more than \$1.9 billion in new tax revenues. APTA estimates that for spending on the construction and operation of infrastructure, 32.6 percent of the tax impact would be state and local taxes and 67.4 percent would be federal. Based on that split, the state and local jurisdictions would receive \$629 million in tax revenues from construction of the first IOS construction segment.

In summary, if California makes a \$2.7 billion investment, the state's economy would see a net economic impact of \$8.3 to \$8.8 billion—a 3:1 return on its initial investment—and state and local governments would earn more than \$600 million back in tax revenue, or nearly 25 percent of how much the state will spend.

The first segment of the IOS also offers many benefits beyond the jobs and spending that it will create during construction. With blended service, travel time on the San Joaquins will be reduced by 45 minutes. Stronger connections with other rail services, such as the Altamont Commuter Express, also will increase efficiency and spur further ridership growth on those lines. Better connections and faster travel times will attract riders to these systems by offering them not just improved service but more destination options.

When combined with other policies, the first segment of the IOS can start to transform *land use* in Central Valley cities. The reduced travel time between the Bay Area and the Central Valley can help spur more compact development around stations in cities along the line. Unlike highways that have many access points and thus induce sprawl, rail access is concentrated at stations located in downtowns. The increased travel produced by faster, more reliable trips, will make the areas around stations more attractive to a variety of businesses and over time will induce more development.

The early benefits experienced during interim operations will lay the groundwork for further development as future segments are constructed and become operational. The more compact development patterns that will evolve over time will preserve valuable agricultural land by shifting development toward already urbanized locations. Alternatively, if the mobility needs of the state were to be met with more highways, the sprawl that they would induce would consume many more acres of valuable agricultural land.

## 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.

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

### 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 1 means that the societal benefits outweigh societal costs.

indirect economic benefits were included in the analysis, the program's benefit-cost ratio, while robust, would be much greater.

For the benefit-cost analysis, the Authority only included benefits accruing directly from the system itself. However, with blended operations and shared improvements, there would be many additional benefits to other systems from these upgrades. This is especially impactful in the BCA for the Phase 1 Blended system whose benefits to Caltrain, Metrolink, and other connecting services would be substantial but are not included in the analysis. Meanwhile, the costs of those improvements *are* included.

### **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 Initial Operating Section (IOS), Bay to Basin, Phase 1 Blended, and the Phase 1 Full Build systems. Exhibit 9-1 and the following sections summarize 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 9-1. Benefit-cost analysis results summary**

System	Discounted Total Benefits (2011\$ in millions)	Discounted Total Costs (2011\$ in millions)	Net Present Value (2011\$ in millions)	Economic Rate of Return	Benefit-Cost Ratio
IOS	\$40,832	\$19,483	\$21,349	13.71%	2.10
Bay to Basin	\$59,805	\$27,727	\$32,078	14.25%	2.16
Phase 1 Blended <sup>1</sup>	\$67,038	\$35,687	\$31,351	13.43%	1.88

<sup>1</sup>The BCA includes the full costs of the Phase 1 Blended improvements but only those benefits accruing from the HSR system. Many additional benefits from the blended improvements would accrue through Caltrain, Metrolink, and other interlined systems but are not included in the BCA.

The benefit components of the benefit-cost analysis are all driven by the ridership forecasts presented in Chapter 5, 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 Medium Ridership Scenario was used. This is explained in Chapter 5, 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 6, 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 investments are in place and a 7-percent real discount rate. Both of these assumptions are consistent with guidance from the U.S. Department of Transportation.

## Results

The Phase 1 Blended system has a benefit-cost ratio of 1.88, while the IOS and Bay to Basin have benefit-cost ratios of 2.10 and 2.16, respectively. Additionally, many benefits from the Phase 1 Blended improvements would accrue through Caltrain, Metrolink, and the other connecting systems, none of which are included in the BCA. These are strong benefit-cost ratios, showing that the net benefits to society greatly outweigh the cost of building and maintaining the system. As the BCA shows, the investment in the Phase 1 Blended system yields a return on investment—in terms of benefits—that exceed the costs by 88 percent.

The BCA uses the capital and O&M costs from Chapter 3, Capital Costs, and Chapter 6, Operating and Maintenance Costs, respectively, and discounts those costs and all of the benefits using a 7-percent real discount rate based on the implementation schedule in Chapter 3, Capital Costs. The real discount rate accounts for the opportunity cost of making this investment versus other investments. Note: the capital costs in Exhibit 9-1 and in Exhibit 9-2 appear lower than in Chapter 3, Capital Costs, because of discounting. The benefits are discounted by the same rate as the costs, but because they extend further out, the discounting has 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.

**Exhibit 9-2. Benefit-cost analysis results (2011\$)**

Category	IOS	Bay to Basin	Phase 1 Blended
<b>Benefits</b>			
Benefits for HSR users	\$27,180	\$38,903	\$43,692
Benefits from reduced driving	\$12,009	\$17,053	\$18,961
Benefits from reduced flying	\$1,643	\$3,849	\$4,385
Total benefits	\$40,832	\$59,805	\$67,038
<b>Costs</b>			
Construction costs	\$16,654	\$22,770	\$27,391
Operating and maintenance costs	\$2,670	\$4,735	\$8,046
Periodic rehabilitation costs	\$169	\$241	\$292
Salvage value	(\$10)	(\$19)	(\$42)
Total costs, net of salvage value <sup>10</sup>	\$19,483	\$27,727	\$35,687
<b>Net present value</b>	<b>\$21,349</b>	<b>\$32,078</b>	<b>\$31,351</b>
<b>Benefit-cost ratio</b>	<b>2.10</b>	<b>2.16</b>	<b>1.88</b>
<b>Economic rate of return</b>	<b>13.71%</b>	<b>14.25%</b>	<b>13.43%</b>

Source: California High-Speed Rail Benefit-Cost Analysis (BCA)—March 2012

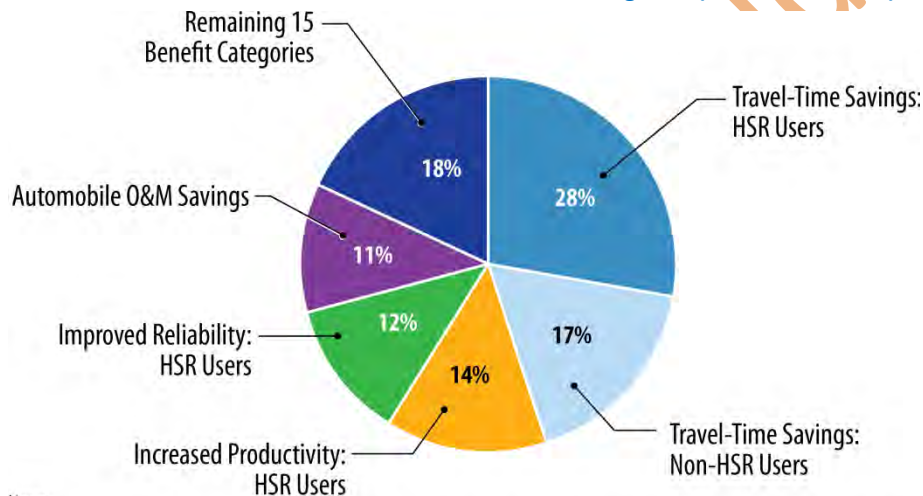
Net present value and the economic rate of return also reflect similar life-cycle analysis of costs and benefits. Net present value is the total dollar value of discounted benefits minus discounted costs; the economic rate of return represents the project's (real) rate of return and provides a means to compare the returns of this project against other competing public investments. The Phase 1 Blended system will

generate \$31.4 billion in net discounted benefits to society with an economic rate of return of 13.4 percent and have a benefit-cost ratio of 1.88. Meanwhile, if the Phase 1 Full Build system is required to be built, it will generate \$30.6 billion in net discounted benefits with an economic rate of return of 13.0 percent and a benefit-cost ratio of 1.72.

The benefit-cost analysis generates 20 benefit categories:

- Four of those benefit categories accrue directly to system users, accounting for 65 percent of all the benefits.
- The other 16 benefit categories accrue to all California citizens, and these account for 35 percent of the benefits (Exhibit 9-3).
- 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 more than 80 percent of the benefits.

**Exhibit 9-3. Percent breakdown of the main benefit categories (Phase 1 Blended)**



Note: Almost half of the benefits from California HSR 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.

***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 79 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 28 percent of the benefits.

***Provide 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 nationwide are in California.<sup>11</sup> Delays and poor highway travel reliability cost the California economy billions of dollars a year. High-speed rail with the blended system will take thousands of cars off the roadways, which will reduce state vehicle miles traveled by more than 338 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, the blended HSR system will save Californians 6.4 billion hours. The reduced vehicle 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 17 percent of 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 14 percent of all system benefits.

***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.<sup>12</sup> The operating plans presented in Chapter 6, 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 12 percent of the system 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 11 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).

**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.

### **Employment related to construction of HSR**

Building the HSR system will employ thousands of California's construction workers and generate jobs directly and indirectly for other workers.

#### ***Approach and inputs***

In 2010, the Authority compared job creation estimates from several sources, including the 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 (in 2010\$), 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 Revised Plan, the Authority re-evaluated the previous analysis, consulted with new outside sources, and concluded that the 20,000 job-years of employment/\$1 billion number is still a reasonable and accurate estimate of the job creation impact. Similarly, in its 2009 Annual Report to the Legislature, the California Transportation Commission stated that, "As every \$1 billion of construction projects generates 18,000 jobs in California, The Commission believes that these transportation infrastructure projects should be the highest priority for bonds funding, putting Californians back to work building a better transportation system and a stronger economy." 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 (about 11 percent statewide and close to 15 percent in the Central Valley).<sup>13</sup> Starting in the Central Valley in 2013, construction of the IOS-First Construction will create 100,000 job-years of employment over the next five years.<sup>14</sup> 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.

Construction of the high-speed rail will employ thousands of Californians and provide economic benefits.

Building the Phase 1 Blended system will generate an additional 900,000 job-years of employment (on top of the first segment of the IOS) during construction (Exhibit 9-4). If the Phase 1 Full Build system were required to be built, it would generate a total of 1.25 million job-years of employment during construction. 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.

**Exhibit 9-4. Construction job-years and multipliers by step, spread over the implementation schedule**

Step	Total Employment (job-years)
First IOS construction segment	100,000
IOS	510,000
Bay to Basin	780,000
Phase 1 Blended	990,000

**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 employment 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 discussed in Chapter 6, Operating and Maintenance Costs; U.S. and California labor practices and requirements; and international high-speed rail experience. Staffing was estimated for Phase 1 Blended, Phase 1 Full Build, Bay to Basin, and the Initial Operating Section (IOS) based on the Medium Ridership Scenario (see Chapter 5, Ridership and Revenue) for the following four employment categories:

- **Passenger services and administration/management**—Manage passenger services at 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 Phase 1 Blended system will directly employ approximately 2,900 people, as shown in Exhibit 9-5. 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 effects across the state's entire economy. If the Phase 1 Full Build system was required to be built, it would directly employ 3,500 people.

**Exhibit 9-5. Permanent O&M jobs by implementation phase**

Step	Estimated Staffing Level (Year 2040)
IOS	1,300
Bay to Basin	2,300
Phase 1 Blended	2,900

### **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

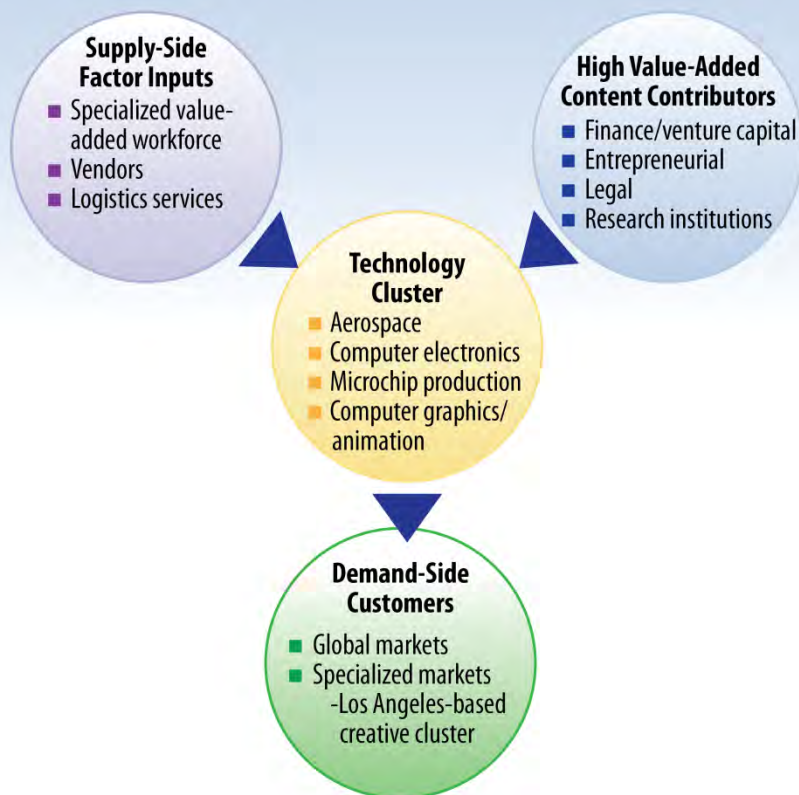
businesses, lowering production costs and improving market efficiency. Research indicates that high value-added sectors benefit from the increased access and proximity brought about by HSR. Economists have identified business clusters within high value-added sectors that comprise combinations of businesses 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.<sup>15</sup> That study did not provide a complete estimation of job creation for the entire California HSR corridor, but if it is 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 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<sup>16</sup> 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 long-term/permanent 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 Méditerranée 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 experience 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 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 extending to three major economic and political hubs—Paris, London, and Brussels. In planning for HSR, Lille used publicly owned land to develop 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.

### **Areas of evaluation**

As part of the station-area analysis for this Revised Plan, individual stations were evaluated across an array of relevant criteria that are likely to influence station-area development potential. These include the following:



*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.*

- 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 new development
- Advanced station area and/or downtown planning, which reflects public and private-sector interest and determination to develop

### ***Key findings***

Based on international experience, it is possible to conclude that high-speed rail leads 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 major metropolitan areas. Although they will likely attract less total development than 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.



**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, Lemoore, 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 foot 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.

## End notes

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<sup>1</sup> 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.

<sup>2</sup> Source: Bonnafous, A. 1987. "The Regional Impact of the TGV." *Transportation*, Volume 14, Number 2, 127-137.

<sup>3</sup> 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.

<sup>4</sup> Source: Albalate, D. and G. Bel. 2010. "High-Speed Rail: Lessons for Policy Makers from Experiences Abroad" (working paper). GIM-IREA Universitat de Barcelona.

<sup>5</sup> 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.

<sup>6</sup> [www.centralcalifornia.org/RegionalData.aspx](http://www.centralcalifornia.org/RegionalData.aspx)

<sup>7</sup> [www.usnews.com/news/articles/2012/01/20/the-10-worst-cities-for-finding-a-job](http://www.usnews.com/news/articles/2012/01/20/the-10-worst-cities-for-finding-a-job)

<sup>8</sup> American Public Transportation Association. *Economic Impact of Transportation Investment*. 2009. ([www.apta.com/resources/reportsandpublications/Documents/economic\\_impact\\_of\\_public\\_transportation\\_investment.pdf](http://www.apta.com/resources/reportsandpublications/Documents/economic_impact_of_public_transportation_investment.pdf)) Page 31.

<sup>9</sup> Zandi, Mark. *The Economic Impact of the American Recovery and Reinvestment Act*. Moody's Analytics, 2009. ([www.economy.com/mark-zandi/documents/Economic\\_Stimulus\\_House\\_Plan\\_012109.pdf](http://www.economy.com/mark-zandi/documents/Economic_Stimulus_House_Plan_012109.pdf)) Page 9.

<sup>10</sup> 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.

<sup>11</sup> 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).

<sup>12</sup> Source: Administrator of Railway Infrastructures (ADIF). 2009. *Memoria Económica y de Actividad 2009* (2009 Financial Report). [www.adif.es/en\\_US/conoceradif/memoria.shtml](http://www.adif.es/en_US/conoceradif/memoria.shtml) (accessed September 7, 2011).

<sup>13</sup> Source: U.S. Bureau of Labor Statistics. 2012. "Unemployment Rates for States." [www.bls.gov/web/laus/laumstrk.htm](http://www.bls.gov/web/laus/laumstrk.htm) (accessed March 14, 2011).

<sup>14</sup> The term job-years represents the equivalent number of one-year-long, full-time jobs that will be created.

<sup>15</sup> Source: U.S. Conference of Mayors. 2010. *The Economic Impacts of High-Speed Rail on Cities and Their Metropolitan Areas*.

<sup>16</sup> Source: American Public Transportation Association (APTA). February 2011. *The Case for Business Investment in High-Speed and Intercity Passenger Rail*.

