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—111 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.

> One job-year is the equivalent of one person working a full-time job for one year. For example, a full-time job that lasts 20 years generates 20 job-years.

A statewide HSR system will create the following economic, social, and environmental benefits for California:

- Rail users will benefit from faster, more reliable, and safer options that connect the state's major metropolitan areas.
- All travelers will benefit from reduced highway and aviation congestion, and from external benefits such as reduced air emissions and less dependence on imported oil.
- Construction will create direct employment and earnings, and generate positive spin-off or indirect economic effects within the California economy.
- System operations and maintenance will create permanent jobs and associated indirect benefits.
- Businesses will have greater access to skilled labor and other markets, creating broad and permanent economic impacts and leading to regional economic transformations across existing and future economic sectors.
- Cities will experience significant local economic development benefits as higher development land use densities and businesses cluster around stations and corridors, following local development plans, as have European and Asian cities with high-speed rail.

In 2011 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.

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.[1]
- Nearly 50 percent of the additional traffic between Paris and Lyon in the first four years was newly generated, not merely a redistribution of the existing travel market.[2]
- Research from Europe suggests that the contribution to total European Union Gross Domestic Product (GDP) from high-speed rail investment may be 3 percent of GDP—significant impacts from one set of infrastructure investments.[3]

Major cities with large economies and global reach are the most beneficial to connect:

- The economic impacts of high-speed rail in Japan are concentrated in the larger metropolitan areas with international economies.[4]
- In Germany, smaller intermediate cities connected by high-speed rail to Frankfurt and Cologne experienced a 2.7-percent increase in GDP resulting from increased market accessibility to larger cities.[5]

European and Japanese high-speed rail projects have demonstrated that a station can be a catalyst for new development in the surrounding area:

- Spain's high-speed rail increased property values when improved access to other parts of the region was achieved and when intensified land uses were valued by the market.
- Zaragoza, which is roughly half-way between Madrid and Barcelona, created a new business district centered on its high-speed rail station.
- Lille has been able to generate urban development, in part because of its central location on the network. Lille sits at the intersection of high-speed rail lines connecting three major economic and political hubs: Paris, London, and Brussels.
- Evidence from Japan's Shinkansen system shows strong premiums in development and employment densities around stations compared to similar areas not served by high-speed rail.

Consistent with federal and state laws, the Authority is committed to minimizing localized negative impacts while working to capture the broad public benefits. Negative impacts will be identified and mitigated wherever possible as part of the project's planning and design. As noted in Chapter 3, Capital Costs, 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.[6] The five cities with the highest unemployment rate nationwide are *all* located in the Central Valley.[7] 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).[8] 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[9]. 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	$43,245	$20,259	$22,986	12.89%	2.13
Bay to Basin	$62,738	$27,854	$34,884	13.49%	2.25
Phase 1 Blended[1]	$70,190	$33,261	$36,929	12.91%	2.11

[1]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 2.11, while the IOS and Bay to Basin have benefit-cost ratios of 2.13 and 2.25, 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 111 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
Benefits			
Benefits for HSR users	$26,270	$37,792	$42,432
Benefits from reduced driving	$16,337	$23,423	$26,017
Benefits from reduced flying	$637	$1,523	$1,741
Total benefits	$43,245	$62,738	$70,190
Costs			
Construction costs	$17,496	$23,769	$28,841
Operating and maintenance costs	$2,670	$3,906	$4,244
Periodic rehabilitation costs	$106	$196	$207
Salvage value	($14)	($18)	($31)
Total costs, net of salvage value[1]	$20,259	$27,854	$33,261
Net present value	**$22,986**	**$34,884**	**$36,929**
Benefit-cost ratio	**2.13**	**2.25**	**2.11**
Economic rate of return	**12.89%**	**13.49%**	**12.91%**

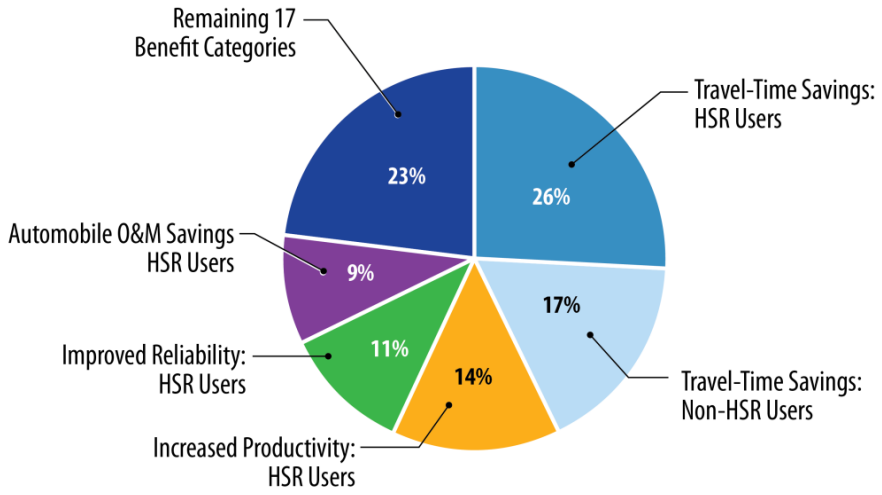
[1]Salvage value is the discounted value of the remaining useful life of the system at the end of the analysis period. For example, tracks that were laid in 2020 and have a 100-year useful life would have 40 years or 40 percent of their useful life remaining at the end of the analysis period in 2080.

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 $36.9 billion in net discounted benefits to society with an economic rate of return of 12.9 percent and have a benefit-cost ratio of 2.11. Meanwhile, if the Phase 1 Full Build system is required to be built, it will generate $38.4 billion in net discounted benefits with an economic rate of return of 12.6 percent and a benefit-cost ratio of 2.02.

The benefit-cost analysis generates 22 benefit categories:

- Four of those benefit categories accrue directly to system users, accounting for 51 percent of all the benefits.
- The other 18 benefit categories accrue to all California citizens, and these account for 49 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 nearly 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 26 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.[10] 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 438 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.[11] 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 11 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 9 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).[12] 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.[13] 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.

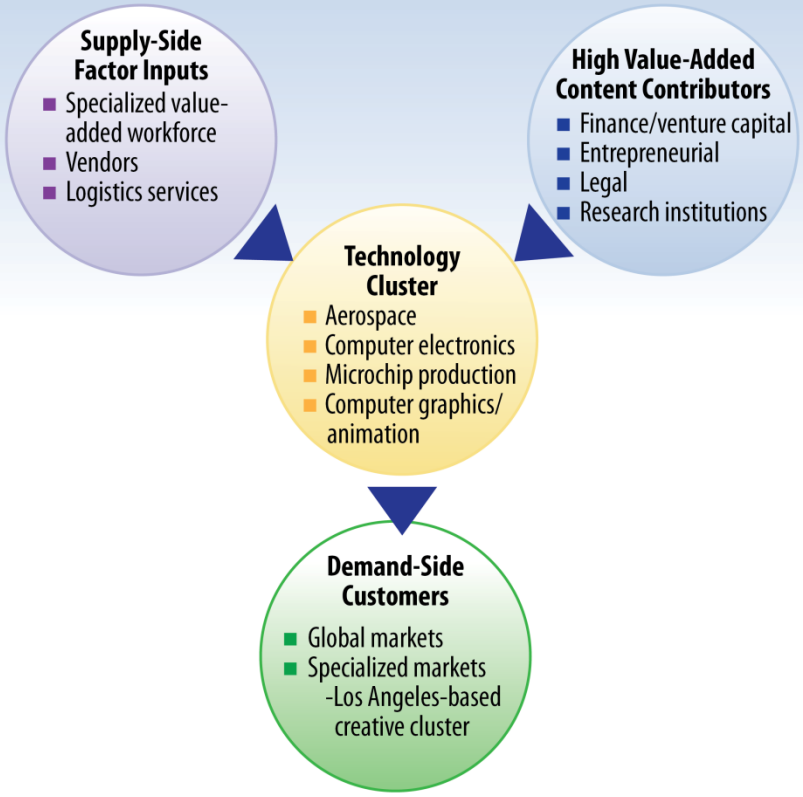
High-speed rail service will improve market access; companies that operate locally or regionally will be able to expand their operations statewide. The increased market size will subsequently increase competition among businesses, lowering production costs and improving market efficiency. Research indicates 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.[14] 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[15] 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 Mediteranée line. Local station area development, which can include higher property values, more and denser development, and higher employment densities, relies on existing land uses, availability of connecting transit and transportation services, and local planning policies. Most important, strong background market demand, including not

just passenger demand but also strong development forces within the larger surrounding region, must already be present for increased station development to occur.

Experience with other international high-speed rail systems shows that major hubs and intermediate stations 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.

The high-speed rail station in Malaga, Spain, a city of about 550,000, has become a major retail destination, spurring further development around it.

Areas of evaluation

As part of the station-area analysis for this 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:

- 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, Lemore, and even Corcoran.
- **Bakersfield**—Current plans call for the station to be located at the site of the existing Amtrak station on Truxtun Avenue. The plans point out the potential for concentrating business development in the area but stop short of identifying specific sites for development. Plans that are now somewhat aged suggest redevelopment areas that total more than 1 million square feet of development, which would probably occur over a long horizon.
- **Palmdale**—As with Gilroy, two alternative station locations are being considered. TOD plans exist for the Metrolink Station about 2.5 miles away, but they do not encompass HSR plans.
- **San Fernando Valley**—The station location has not been finalized. Current plans call for a station in the San Fernando Valley or near Burbank Bob Hope Airport. The Bob Hope Airport is currently creating development plans for available land next to the airport that may include HSR. Research indicates that HSR stations can leverage locations serving airports to increase both ridership and development potential.
- **Los Angeles Union Station**—Catellus, a private development LLC and former owner of LA Union Station, sold the 38 acres and development rights totaling close to 6 million square feet of TOD to the Los Angeles County Metropolitan Transportation Authority in 2011 for approximately $75 million. Currently three buildings totaling 728,000 square feet of office development and a small amount of multifamily residential development are located on the site. HSR service in this market could drive further demand for development, but the relative (to San Francisco) lack of highly utilized local transit services in Los Angeles and the generally less dense development pattern may cause redevelopment in the station area to be spread over a longer period of time.
- **Gateway Cities**—The station location has not been finalized. Options include the Norwalk/Santa Fe Springs or Fullerton Metrolink station sites. While at least some small-scale industrial redevelopment opportunities exist, the magnitude of large-scale redevelopment potential in certain Gateway Cities communities may be very limited.
- **Anaheim**—The Anaheim Station (ARTIC intermodal station) is planned as part of the 20-plus million square feet Platinum Triangle redevelopment project, which currently has 15 projects at or past the design stage totaling more than 8,000 new residential units, 600,000 square feet of commercial space, and 130 hotel rooms. The 17 acre portion of the Platinum Triangle in the ARTIC zone is expected to be office-oriented with some retail and residential space, specifically allowing for 520 residential units, 2.2 million square feet of office space, and 360,000 square feet of retail. Overall, the Platinum Triangle redevelopment program has momentum and is expected to continue regardless of HSR access. One major attribute that the Anaheim station and HSR ridership will benefit from is the concentration of recreational destinations within close proximity to the station, including Disneyland, Angeles Stadium, and the Honda Center.

End notes

[1] *Source:* Nash, C. December 2009. "When to Invest in High-speed Rail Links and Networks?" Institute for Transport Studies, University of Leeds. Paper given at the International Transport Forum Symposium on Transport Economics, Madrid, November 2009.

[2] *Source:* Bonnafous, A. 1987. "The Regional Impact of the TGV." *Transportation,* Volume 14, Number 2, 127-137.

[3] *Source:* Preston, J., A. Larbie, and G. Wall. 2006. "The Impact of High Speed Trains on Socio-Economic Activity: The Case of Ashford (Kent)." Paper for the 4th Annual Conference on Railroad Industry Structure, Competition and Investment. Universidad Carlos III de Madrid.

[4] *Source:* Albalate, D. and G. Bel. 2010. "High-Speed Rail: Lessons for Policy Makers from Experiences Abroad" (working paper). GiM-IREA Universitat de Barcelona.

[5] *Source:* Ahlfeldt, G. M. and A. Feddersen. September 2010. "From Periphery to Core: Economic Adjustments to High-speed Rail" (working paper). The London School of Economics and Political Science and University of Hamburg.

[6] www.centralcalifornia.org/RegionalData.aspx

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[8] American Public Transportation Association. *Economic Impact of Transportation Investment*. 2009. (www.apta.com/resources/reportsandpublications/Documents/economic_impact_of_public_transportation_investment.pdf) Page 31.

[9] 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) Page 9.

[10] *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).

[11] *Source:* Administrator of Railway Infrastructures (ADIF). 2009. *Memoria Económica y de Actividad 2009* (2009 Financial Report). www.adif.es/en_US/conoceradif/memoria.shtml (accessed September 7, 2011).

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

[13] The term job-years represents the equivalent number of one-year-long, full-time jobs that will be created.

[14] *Source:* U.S. Conference of Mayors. 2010. *The Economic Impacts of High-Speed Rail on Cities and Their Metropolitan Areas.*

[15] *Source:* American Public Transportation Association (APTA). February 2011. *The Case for Business Investment in High-Speed and Intercity Passenger Rail.*