BENEFIT-COST ANALYSIS

Prepared

by

CAMBRIDGE SYSTEMATICS

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TABLE OF CONTENTS

I.

BENEFIT COST ANALYSIS: BENEFITS TO HIGH-SPEED TRAIN PASSENGERS AND THE TRAVELING PUBLIC

OVERVIEW

The high-speed train system will be a statewide transportation project on the scale of the freeways and the state water projects. It will transform the way in which people travel between cities in California, offering travelers the choice of driving, flying, or using high-speed trains. The high-speed train system will benefit the State in a number of ways. Many of the benefits are quantifiable and can be estimated based on detailed ridership and revenue forecasts. For projects such as the high-speed train system that require public investment, if these benefits are greater than the total costs, then the project is said to be economically justified.

In the private sector, a project is said to be commercially feasible only if commercial revenue exceeds costs paid directly by the project developer. For projects requiring public investment, a more appropriate evaluation tool is benefit-cost analysis, which compares the total benefits to the total costs of a project. Benefit-cost analysis includes all benefits and costs accruing to the public at large as well as the project developer. If the total benefits exceed the total costs, the project is said to be economically justified or economically feasible.

This analysis includes only those benefits and costs which are quantifiable, monetizable, not duplicative and not transferred from one group of society to another. More specifically, the benefits include:

- Intercity passenger revenue;
- Benefits to both intercity and urban high-speed train passengers (net of fares paid);
- Reduction of airside delay for air passengers;
- Reduction in aircraft operating costs;
- Reduction of highway delay for both intercity and urban auto trips; and
- Reduction of accident and air pollution costs from intercity and urban auto trips.

Costs include all the construction, operation and maintenance costs for the high-speed train system.

Through the year 2050, California will accrue over $150 billion in directly measured benefits from a high-speed train system—nearly triple the total costs using the preferred high-speed train alignment *(Table 1).* Not only high-speed train passengers will benefit from the system. In fact, over one-third of the benefits will be enjoyed by air and auto travelers in the form of reduced delays, reduced air pollution, and reduced auto accidents and fatalities. The benefits will extend to interstate and even international travelers at California's major airports.

The computation of the benefits directly utilizes the latest ridership and revenue forecasts for the high-speed train service, and the procedures are consistent with guidance provided by the Environmental Protection Agency (*Guidelines for Preparing Economic Analyses*) and the Federal Highway Administration (*Economic Analysis Primer*). Conservative, reasonable assumptions were used throughout, and not all potential benefits were included. For example, the analysis did not include the potential reduction in airport ground access congestion, reduced highway maintenance and capital costs, or monetary benefits of reduced greenhouse gas emissions.

The estimated streams of benefits and costs occurring each year between 2011 and 2050 were discounted to their present value and summarized to calculate the benefit cost ratio seen in *Table 2 and Figure 1.* Benefits would begin with the opening to riders of an initial phase of the high-speed train system on January 1, 2020, and continue through 2050, allowing 31 years of economic returns for the high-speed train project.

TABLE 1 SUMMARY OF BENEFIT-COST ANALYSIS RESULTS (THROUGH 2050)

Total Benefits	$150.5 (billions of 2008 dollars)
Total Costs	$53.1 (billions of 2008 dollars)
Net Present Value	$97.4 (billions of 2008 dollars)
Benefit/Cost Ratio	2.84

NOTE: Excludes benefits from induced employment growth and business efficiency savings, greenhouse gas and energy savings, development around stations, and potential freight revenues, and avoided costs for highway maintenance and capital investment.

The discount rate is a means of calculating a value now of benefits that occur in the future. The discount rate recognizes the time value of money. A four percent real discount rate was used in the calculations. However, the high-speed train project would be economically feasible even under the higher discount rates used by some public agencies and economists. The *Internal Rate of Return* (IRR) is an evaluation measure that is independent of any chosen discount rate. The IRR is the real discount rate at which the net present value of a project is equal to zero, and can be thought of as the discount rate threshold at which the project is no longer economically feasible. The real IRR for the high-speed train project is 8.8 percent, indicating that the project remains economically feasible even at real discount rates well above four percent.

The following sections present additional detail on the calculation of each category of benefits.

INTERCITY PASSENGER REVENUE

In a publicly financed project, passenger revenue reduces the costs that must be funded from other sources. However, in a benefit cost analysis, passenger revenues are counted as a benefit. The present value of the intercity passenger revenue totals over $33.7 billion, about 22 percent of the total benefit between through 2050 (see *Figure 2).*

BENEFITS TO HIGH-SPEED TRAIN PASSENGERS

Most intercity high-speed train passengers will value the benefits from traveling on these high-speed, comfortable, and safe trains more than the fares they paid to ride the system. This value, measured as the difference between the fares paid by passengers and the amount they would be willing to pay, is also known as consumer surplus.

The consumer surplus for intercity high-speed train passengers has a present value of $55.2 billion, or about $78 per intercity passenger in the year 2030. Notably, the consumer surplus is about 60 percent larger than passenger fare revenue. This result reflects a fare policy assumed by the Authority that maximizes public benefits while maintaining a healthy operating surplus.

In urban areas, travelers who use high-speed trains will save time and money over the previously available travel options. The present value of this benefit to urban high-speed train travelers has a present value of $1.5 billion.

HIGHWAY CONGESTION REDUCTION BENEFITS

Congestion-reduction benefits for intercity auto travelers have a present value of $27.1 billion, while the additional congestion reduction benefits for urban auto travelers have a present value of $15.4 billion. These estimates of congestion reduction reflect the travel time savings for remaining auto travelers across California due to the diversion of 100,000 vehicle trips per day to high-speed trains.

These estimates reflect planned highway system expansions through year 2030, and were derived using methods consistent with the travel demand models maintained by regional planning agencies. The estimates also reflect a very conservative assumption that highway congestion will grow at only 1.5 percent per year after year 2030, which is only slightly above projected statewide population growth and well below highway congestion growth rates in California's urban areas over the past 10 years.

HIGHWAY POLLUTION AND ACCIDENT REDUCTION BENEFITS

By making fewer intercity automobile trips each day, Californians will also benefit from reduced highway accidents and air pollution. These highway-related benefits have a present value of over $13.8 billion. This estimate undoubtedly understates the true pollution reduction benefit, since it only includes reduction in primary pollutants (hydrocarbons, particulate matter, carbon monoxide) from automobile travel. Quantifying the benefits of greenhouse gas reduction from reduced auto travel and other energy usage would greatly increase the overall environmental benefit; however, greenhouse gas analysis methods are still being developed.

BENEFITS TO INTERCITY AIR PASSENGERS

Californians who continue to travel by air will also benefit from the high-speed train system. Over the next 20 years, at least three airports in California, including San Diego's Lindberg Field, Los Angeles International, and San Francisco International, are predicting "unacceptable" delays. By diverting some passengers to high-speed trains, the system will reduce the otherwise expected delays in major airports. These reductions in delay will, in turn, reduce aircraft operating costs. At California's nine largest airports, the present value of these benefits is estimated at over $3.7 billion.

There is considerable uncertainty with respect to airport expansion in California because of noise pollution and other environmental concerns. Nonetheless, the delay calculations assumed the planned capacity improvements and expansions listed in the airports' planning documents. Other conservative assumptions included a cap on total average airside delays of 15 minutes per aircraft, and an assumed shift of air passengers from congested airports to nearby airports with remaining capacity (i.e., passengers would shift from LAX to Burbank and from SFO to Oakland). The estimated benefits to air passengers do not include savings from potential reduced ground access congestion at these airports.

TABLE 2 RESULTS OF BENEFIT-COST ANALYSIS
(Present Value in 2008 Dollars, Discounted at Four Percent Through 2050)

	Millions of 2008 Dollars
BENEFITS	
Passenger Revenue	$33,718
Benefits to High-Speed Train Passengers	
Intercity Travelers	$55,210
Urban Area Travelers	$1,542
Benefits to Highway Travelers	
Congestion Reduction for Intercity Travelers	$27,081
Congestion Reduction for Urban Area Travelers	$15,385
Accident and Pollution Reduction	$13,822
Benefits to Air Travelers	
Delay Reduction for Airline Passengers	$1,969
Delay Reduction for Airline Operations	$1,750
Total Benefits	$150,478
COSTS	
Capital	$33,993
Operating and Maintenance	$19,065
Total Costs	$53,058
Total (Net Present Value)	**$97,420**
Benefit-Cost Ratio	**2.84**
Internal Rate of Return	**8.8%**

FIGURE 1 QUANTIFIED BENEFITS VERSUS COST (THROUGH 2050)

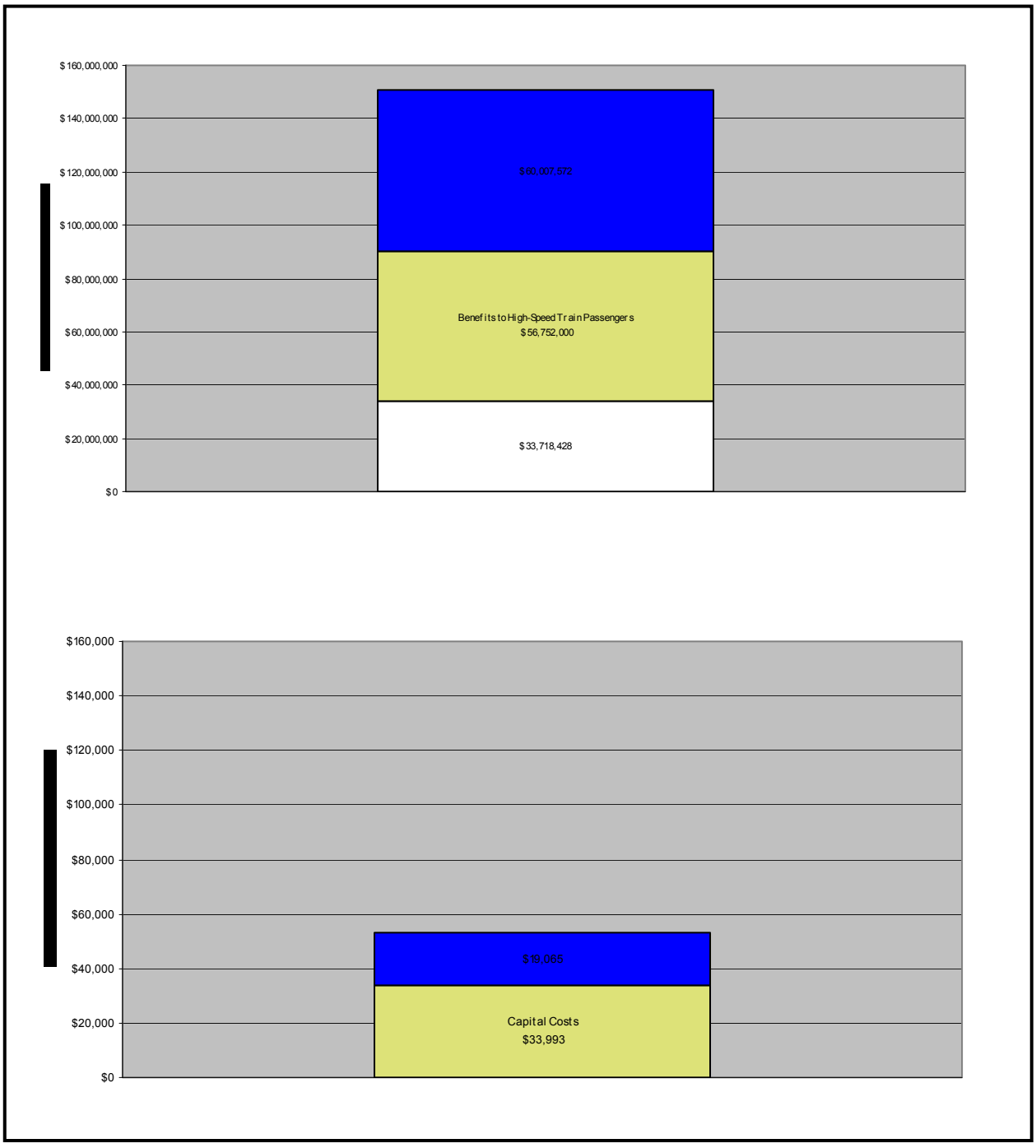
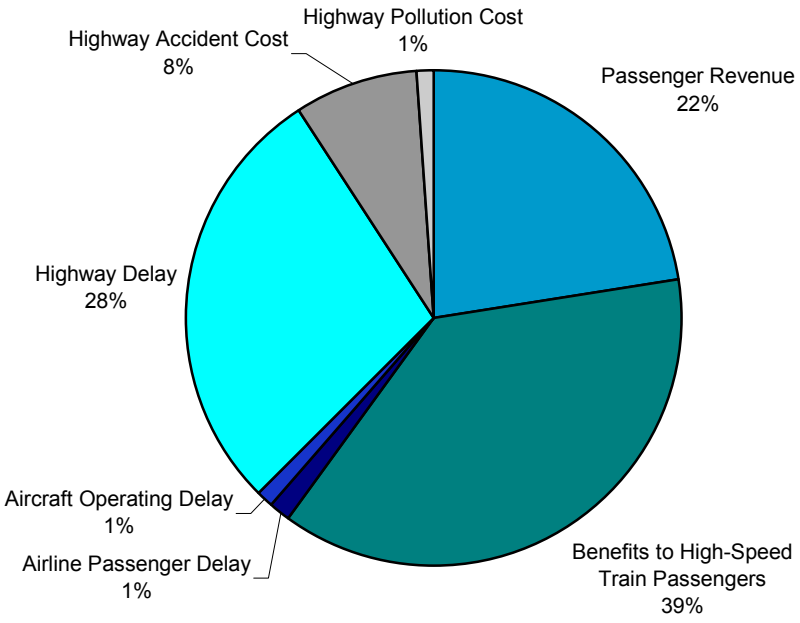


FIGURE 2 BREAKDOWN OF PRESENT VALUE OF HIGH-SPEED TRAIN BENEFITS



II.

BENEFITS NOT INCLUDED IN THE BENEFIT COST ANALYSIS

This section discusses some of the additional benefits associated with the high-speed train system. Although these benefits were not quantified for this analysis, the discussion is intended to add a different perspective on the benefits provided by high-speed trains.

STATION-AREA DEVELOPMENT

High-speed train is a mode of transportation that can enhance and strengthen urban centers. In combination with appropriate local land use policies, such as the *Station Area Development Guidelines* outlined in the San Francisco Bay Area to Central Valley Program EIR/EIS, the increased accessibility afforded by the high-speed train service could encourage more intensive development and may lead to higher property values around stations. Although the financial plan does not assume that any of this revenue is available to help construct the system, local authorities may realize some of this gain in value through various value capture techniques such as benefit assessment districts or tax increment financing.

CONSTRUCTION IMPACTS

The short-term impacts of constructing the system should not be ignored. While construction of the system will require a large capital investment, this investment translates into jobs and industrial output in California. System construction expenditures will produce the following types of effects

- Direct Economic Effects—activity generated at firms directly receiving the construction spending;
- Indirect Economic Effects—activity generated by the successive rounds of off-site purchases from suppliers of materials and services; and
- Induced Economic Effects—activity generated as a consequence of additional worker income being re-spent on consumer purchases.

The direct, indirect, and induced economic impacts will occur in four basic forms:

- Industry output—the dollar value of industry's total production;
- Job-years—the number of jobs supported in each industry;
- Personal income—all individual income generated as a result of increased industry output; and
- Taxes—all taxes generated as a result of added industry output.

Construction of the high-speed train system is estimated to generate the equivalent of almost 168,000 job-years of employment. Some portion of the labor and construction spending may, of course, occur outside of the state, but the bulk of the effect is expected to occur in California. Furthermore, the system will generate thousands of permanent jobs through the ongoing operations of high-speed trains.

FREIGHT REVENUE

The high-speed infrastructure offers great flexibility and potential in the type of services it can support. In addition to passenger traffic, the high-speed infrastructure could also be used to transport high-value/time-sensitive goods within the state. Preliminary analyses have shown that two types of freight service are possible. One type of service would involve transport of small packages and parcels on the passenger trains. The other type of service would involve running dedicated medium-weight, high-speed freight trains on the infrastructure during night hours. Although the ultimate specifications of any freight service are yet to be determined, the prospects for carrying freight on high-speed trains are very good. Any freight revenue would be a benefit not only in that it enhances the operating margins of the system but also in that the infrastructure would be used more intensively. In addition, there is value in having another option for carrying high-value/time-sensitive goods throughout the state.

INDUCED ECONOMIC GROWTH

A growth inducement analysis conducted for the Bay Area to Central Valley Program EIR and Tier 1 EIS showed that the travel and accessibility benefits generated by the high-speed train would lead to an additional 320,000 jobs and 500,000 tax-paying residents by year 2030. This economic growth is projected to occur across California, with a particular concentration in the San Joaquin Valley. A high-speed train system would create this growth by improving accessibility to labor and customer markets, thereby, improving the competitiveness of the state's industries and the overall economy. Businesses that locate in close proximity to a high-speed train station can operate more efficiently than businesses that locate elsewhere.

Experience from overseas suggests that a high-speed train system would create a competitive advantage for high-wage employment sectors that are frequently in high demand in many communities. A high-speed train system exhibits a tendency to attract a higher proportion of high-paying jobs in the services; government; and finance, insurance, and real estate (FIRE) sectors. The strongest employment sectors for high-speed train tend to be the most compatible for location in higher-density settings, such as near potential high-speed train sites.

High-speed train station areas will establish a relatively stronger market for commercial and office development than other transportation improvement options. Research conducted for the Statewide Program EIR/EIS found that industries needing large numbers of highly skilled and specialized employees are most attracted to rail station area development, and that a noticeable densification pattern is likely to emerge in the vicinity of many high-speed train stations under regular real estate market forces. In fact, the considerably stronger draw of a high-speed train station, when compared to a conventional intercity rail station or freeway interchanges provides a potent tool for encouraging more compact development patterns.

Importantly, the additional population growth in the San Joaquin Valley is driven by internal job growth related to initiation of high-speed train service, rather than population shifts from the Bay Area and Southern California with commensurate long distance commuting. Results suggest a stronger propensity for redistribution of population within the San Joaquin Valley, with the Valley's existing long-distance commuters relocating to lower cost and better positioned (for high-speed train service) housing in areas such as Merced and Stanislaus Counties.

OTHER BENEFITS

In addition to those benefits described above, the high-speed train system will bring other opportunities and benefits to the state that cannot be quantified. First and foremost, the high-speed infrastructure represents a major transportation capacity improvement that can be tapped by future generations in ways as-yet unimagined. The economic vitality and stability of California has depended historically on the ability to move people, goods, and information freely and efficiently between population centers, agricultural markets, and ports of entry. This improvement to the statewide infrastructure will support commuter as well as intercity passenger traffic and high-speed freight service. High-speed trains will complement and connect to airports and highways, providing a substantially greater degree of mobility for those who travel in California.

Second, the high-speed train system will promote stability through diversity in California's transportation network. High-speed trains will provide a third option for intercity travel, giving Californians the choice of using airplanes, autos, or high-speed trains. The high-speed train system can reduce California's dependence on fossil fuels for intercity travel since it will use electric power traction, and as such high-speed trains can be a key element in helping California meet the AB 32 greenhouse gas reduction goals. In the face of a natural disaster, high-speed trains would offer insurance against major disruptions to intercity travel, much as the BART system provided mobility after the 1989 Loma Prieta earthquake. For the Central Valley, a high-speed train system would eliminate much of the uncertainty and unreliability of both air and highway travel resulting from ground fog and other climatic conditions present at certain times.

Third, the high-speed train system can act as a catalyst to strengthen urban centers, promote more compact development around stations, and even increase local property values. The high-speed train system will provide a means to directly access urban centers, bypassing the congested roadways leading from airports and intercity highway corridors. It will also improve service to central city employment centers, and to residents and groups with low auto availability (whether by choice or necessity). In concert with suitable local land use and economic development policies, high-speed trains can strengthen existing city centers by maintaining and improving accessibility.

Lastly, high-speed trains would enhance the quality of California as a place to live and do business. The advanced technology involved in constructing and operating the system—everything from the latest in signaling, communications, and controls systems to the most advanced structural engineering techniques—is consistent with California's leadership in high technology. Implementation of the high-speed train system would show that the state is committed to making the infrastructure investments necessary to sustain economic growth and improve the quality of life of its citizens.