CALIFORNIA
High-Speed Rail Authority

2023 BENEFIT-COST ANALYSIS

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May 11, 2023

Agenda

Methodology

A tool to comprehensively assess the overall impact of a project on society

Benefits

Review of the working assumptions about how the project will benefit our communities

Costs

Overview of the expected investments and costs related to the project

Results

The net impact of connecting the San Francisco Bay Area, the Central Valley and Southern California with High-Speed Rail

Conclusions

The full social and economic impact of the project is significant

Executive Summary

Phase 1 high-speed rail system benefits are substantial and significantly exceed costs

The California High-Speed Rail Authority (the Authority) has produced a Benefit-Cost Analysis (BCA) that estimates the societal benefits and costs of the Phase I high-speed rail system from San Francisco to Los Angeles/Anaheim through 30 years of operations. This differs from the Economic Impact Analysis (EIA) Report presentation to the Board in March 2023, which considered the effects of project expenditures on the local economy during construction in terms of jobs, labor income, and economic output.

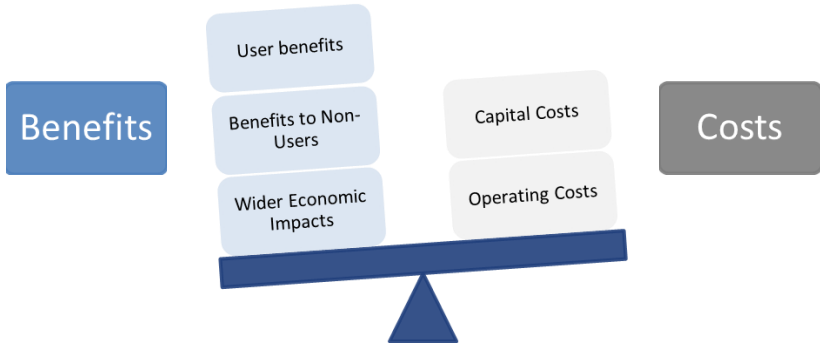
The inputs used in this analysis are consistent with the ridership and cost assumptions in the 2023 Project Update Report. The methodology used follows guidance from the US Department of Transportation (DOT) and Federal Railroad Administration (FRA) for use in federal grant applications. Information from this BCA was submitted with the Authority's recent grant applications.

Methodology

Benefit-Cost Analysis Explained

Benefit-Cost Analysis assesses a project's social, economic and environmental impact

A Benefit-Cost Analysis (BCA) is a systematic process for identifying, quantifying and comparing expected societal benefits and total costs of a project.



Benefit and cost estimates reflect real resource use

Transfers such as fare revenues or indirect taxes are not included since they do not change real resources (items that go from one pocket to another).

BCA differs from an Economic Impact Analysis (EIA)

An EIA views the investment as a stimulus to the local economy of project expenditures during construction. A BCA considers project benefits and costs from construction through operations.

BCA is different than a financial analysis

A BCA considers all societal costs and benefits, including environmental externalities (pollution, emissions, noise) and wider economic impacts.

Benefit-Cost Ratio (BCR) is a key metric in federal grant applications

BCR is calculated by dividing the total project benefits by the total project costs. A project is considered cost-effective when the BCR is equal to or greater than 1.0. This means that the project Net Present Value (NPV), which benefits minus costs, is positive.

Methodology

Department of Transportation (DOT) & Federal Railroad Administration (FRA) Standards

Who did the work

KPMG conducted the study

The Authority utilized the Financial Advisor Contract with KPMG to perform the specialty economic modeling work for this BCA.

Methodology

FRA standards used

Certain parameters of the analysis were defined by the FRA to ensure consistency of analysis among grant applicants.

For example, the operation life of the project is limited to 30 year for analysis and future benefits and costs are discounted at 7 percent per year.

Result formats

Benefits and costs are quantified three ways

- Year of Benefit (YOB) and Year of Expenditures (YOE), which are the nominal values in each year.
- 2021 base year dollars.
- Discounted dollars with a 7% annual discount rate.

Methodology

Conversion of Nominal Dollars to Base Year Dollars and Discounted Dollars

2021 is used as the base year in accordance with DOT & FRA Guidance

The chart below illustrates the impact of conversion of nominal benefits and costs to base year dollars and to discounted dollars. Using a common dollar year adjusts for the effects of inflation, while discounting reflects the principle that benefits and costs that occur sooner in time are more highly valued than those that occur in the future.

Year of Benefit or Cost	Nominal or YOE / YOB Amount	Converted to 2021$ Base Year	2021$ Base Year Discounted at 7%
2021	$1,000,000	$1,000,000	$1,000,000
2030	$1,000,000	$766,417	$416,880
2040	$1,000,000	$570,286	$157,689
2050	$1,000,000	$424,346	$59,647
2060	$1,000,000	$315,754	$22,562

Project Benefits

Total Benefits by Category

Total Phase 1 project benefits sum to about $850 billion

In the table below, the nominal or "Year of Benefit" values are used to show the benefits of the Phase I high-speed rail system through 30 years of operation. Total benefits net of operating and maintenance costs is **$848 billion** in undiscounted YOB$.

Benefit Category	Value (YOB$, Billions)
High-Speed Rail User Benefits	$278.7
Safety and Environmental Benefits	$175.4
Wider Economic Benefits to Workers and Firms	$213.0
At-Grade Rail Crossing Removals	$67.7
Residual Value	$177.1
Freight and Passenger Rail Efficiency Gains	$18.4
Operations & Maintenance and Repair & Rehabilitation (disbenefit)	-$82.1
Total	**$848.3**

**Assumes 3.0% annual inflation from 2031 to 2060.*

Project Benefits

High-Speed Rail User Benefits

Future riders of high-speed rail and users of related facilities will collectively enjoy the following benefits that total **$279 billion** in YOB dollars:

- **Travel and Transfer Time Savings**: 1 billion total hours of time savings for riders resulting in **$141 billion** in total benefits
- **Reliability Relative to Other Modes**: HSR arrives on time more than other modes, resulting in **$59 billion** in total benefits
- **Stations and Train Amenities**: Improvements relative to current trains and stations for all users of those facilities result in **$51 billion** in total benefits
- **Induced Ridership:** These benefits accrue to those that would not have traveled but for fast, safe and convenient high-speed rail, resulting in **$27 billion** in total benefits

Project Benefits

Safety and Environmental Benefits (Part 1 of 2)

Transportation systems users – both HSR riders and highway users – will see the following safety benefits that total **$175 billion** in YOB dollars:

- **Automobile Cost Savings**: Due to a 96-billion-mile total reduction in vehicle miles traveled (VMT), automobile costs of operation and maintenance will have savings that result in **$98 billion** in total benefits
- **Highway Traffic Crash Reduction**: Due to reduced VMT, 1,346 fatal crashes, 23,985 injury crashes, and 41,001 property damage crashes will be avoided, resulting in **$56 billion** in total benefits
- **Auto and Air Emission Reduction**: Due to reduced VMT, reduced congestion, and reduced flights, harmful emissions will be reduced resulting in **$8.0 billion** in total benefits

Project Benefits

Safety and Environmental Benefits (Part 2 of 2)

Transportation systems users – both HSR riders and highway users – will see the following safety benefits that total **$175 billion** in YOB dollars:

- **Reduced Congestion:** Due to reduced VMT, congestion will be reduced resulting in **$12.5 billion** in total benefits
- **Airport Delay Savings:** Due to reduced air passengers, airport delay will be reduced, resulting in **$1.2 billion** in total benefits
- **Noise and Pavement Costs**: Due to reduced VMT, other automobile harms will be reduced resulting in **$0.2 billion** in total benefits

Project Benefits

Wider Economic Benefits to Workers and Firms

High-speed rail systems produce greater economic efficiency and productivity for workers and firms by bringing workers, firms and collaborators together. Studies show wage growth and firm profit (measured here through commercial real estate values) grow quicker where high-speed rail exists than where it does not. Wider Economic Benefits total **$213 billion** in YOB dollars:

- **Worker Wage Uplift**: Due improved collaboration opportunity with other workers and firms, workers will be more productive and see wage gains that result in **$197 billion** in total benefits
- **Firm Productivity Uplift**: Due improved access to workers and improved collaboration opportunities with other firms, commercial real estate near high-speed rail stations will appreciate faster resulting in **$16 billion** in total benefits

Project Benefits

Infrastructure Improvements, Residual Value, Operating Costs

High-speed rail will eliminate numerous at-grade rail crossings, provide efficiency improvements to freight rail, and will have a significant residual value after 30 years of operations resulting to net benefits that total **$181 billion** in YOB dollars:

- **Elimination of Current At-Grade Rail Crossings**: New grade separated crossing reduce delays for ambulance and fire service, and avoid fatal and injury crashes at crossings resulting in **$68 billion** in total benefits
- **Freight and Passenger Rail Efficiency Gains**: Shift of passenger rail on dedicated tracks reduces demand on freight tracks resulting in **$18 billion** in total benefits
- **Residual Value**: While the FRA guidance limits benefits from operations to 30 year, some high-speed rail assets have 100-year design life if properly maintained, resulting in **$177 billion** in total benefits
- **O&M and R&R Cost:** These costs are counted as negative benefits (disbenefits) of **$82 billion** in total

Project Costs

Phase 1 Total Costs by Region

In nominal or Year of Expenditure dollars, the 2023 Project Update Report estimates the full cost of constructing the Phase I system at $106.2 billion, with a range of $88.5 billion to $127.9 billion. The table below from the PUR summarizes the Phase 1 cost by region.

Scope Element	Low	Base	High
	Phase I Program		
Merced to Bakersfield	29,833	31,497	32,976
Northern California	21,180	27,865	35,514
Southern California	31,908	40,650	52,807
Program Wide	5,624	6,151	6,636
Total:	**88,545**	**106,163**	**127,933**

(YOE$ in millions)

* Includes Project Development and Bookend Investments already budgeted for these regions.

Benefit-Cost Analysis (BCA) Results

Adjustments and Comparison

To compare benefits to costs, future benefits and costs are converted to a base dollar year values (2021$) and a discount rate is applied to value the shorter term project benefits and costs more than the longer term project benefits and costs.

While economists may differ on the appropriate discount rate to use, the DOT & FRA directs a 7 percent rate to be used so all applications can be compared on a like basis.

Benefit-Cost Analysis (BCA) Results

Benefits with Adjusted Values

In the table below, the monetized value of the Phase I benefits are shown four ways: (1) Nominal (Year of Benefit or "YOB") dollars, no discount (2) 2021 dollars, no discount (3) 2021 dollars at a 4% discount rate and (4) 2021 dollars at a 7% discount rate

Benefit Category	Value (YOB$, Billions), No Discount	Value (2021$, Billions), No Discount	Value (2021$, Billions), 4% Discount Rate	Value (2021$, Billions), 7% Discount Rate
High-Speed Rail User Benefits	$278.7	$125.4	$47.5	$25.0
Safety and Environmental Benefits	$175.4	$79.2	$30.3	$16.6
Wider Economic Benefits for Workers and Firms	$213.0	$100.8	$41.6	$23.5
At-Grade Rail Crossing Removals	$67.7	$31.1	$12.2	$6.7
Residual Value	$177.1	$55.9	$12.1	$4.0
Freight and Passenger Rail Efficiency Gains	$18.4	$8.5	$3.3	$1.8
Operations & Maintenance and Repair & Rehabilitation (disbenefit)	-$82.1	-$36.7	-$13.7	-$7.1
Total	**$848.3**	**$364.2**	**$133.5**	**$70.6**

Benefit-Cost Analysis (BCA) Results

Costs with Adjusted Values

In the table below, the monetized value of the Phase I costs are shown four ways: (1) Nominal (Year of Benefit or "YOB") dollars, no discount (2) 2021 dollars, no discount (3) 2021 dollars at a 4% discount rate and (4) 2021 dollars at a 7% discount rate.

Cost Category	Value (YOE$, Billions), No Discount	Value (2021$, Billions), No Discount	Value (2021$, Billions), 4% Discount Rate	Value (2021$, Billions), 7% Discount Rate
Capital Costs	$106.2	$83.0	$67.1	$57.9
Capital Costs (Net of Indirect Taxes)	**$98.4**	**$76.9**	**$62.2**	**$53.7**

* The capital costs are also shown net of indirect taxes, as indirect taxes are considered a transfer payment and excluded from the benefit-cost calculations.

Benefit-Cost Analysis (BCA) Results

Benefits Compared with Costs

In the table below, benefits are compared to costs with each valuing methodology.

Category	Value (YOE$, Billions), No Discount	Value (2021$, Billions), No Discount	Value (2021$, Billions), 4% Discount Rate	Value (2021$, Billions), 7% Discount Rate
Total Benefits	$848.3	$364.2	$133.5	$70.6
Total Capital Costs (1)	$106.2	$76.9	$62.2	$53.7
Net Benefits	**$742.1**	**$287.3**	**$71.3**	**$16.9**

(1) Capital Costs net of indirect taxes for all but YOE$

DOT & FRA Summary Statistics (2021$, Discounted at 7%)

- $70.6B in Net Benefits
- $53.7B in Net Costs
- **$16.9B in Net Present Value (NPV)** [Net Benefits minus Net Costs]
- **1.32 Benefit-Cost Ratio (BCR)** [Net Benefits divided by Net Costs]

Conclusions

- The Phase I High-Speed Rail System is transforming California and our nation's transportation infrastructure.
- The project benefits far exceed the costs of building it and offers increased access to opportunity to disadvantaged areas.
- The societal benefits generated by the project are estimated to be $70.6 billion in discounted 2021 dollars over the lifetime of the system. The total capital costs *net of indirect taxes* are calculated to be $53.7 billion in discounted 2021 dollars. The difference in the discounted benefits and costs equals a net present value of $16.9 billion in discounted 2021 dollars, resulting in a benefit-cost ratio (BCR) of 1.32.
- Over half of the project's investment occurs in designated disadvantaged communities where improving access to jobs and opportunities is a priority for the State.

Questions