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FLY CALIFORNIA

EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

1.1

Throughout California's history, our economic strength and development have been led by advances in transportation – first with the construction of railroads and later by investments in highways and airports.

In the mid-1990s, inspired by stunning successes in Japan and Europe, California began exploring how an economically viable high-speed train line linking major metropolitan areas could sustain the state's long-term mobility and economic growth.

California's burgeoning population and increasingly congested highways and airports demand new transportation solutions. Transportation consistently ranks near the top of the list of concerns expressed by the public. Yet, new airport capacity has proven elusive. Planners in San Diego and Orange counties, for example, have been unable to site new airports after more than a decade of effort. Highway construction has become limited by environmental constraints, development pressures and financing barriers. As a result, in addition to the intercity travel needs of the millions of visitors who come to our state each year, Californians are confronted with finding practical new options for accommodating the intercity travel needs of 45 to 50 million residents by the year 2020.

In 1996, the California High-Speed Rail Authority was created to build a high-speed train network connecting California's major metropolitan areas. By 2000, the Authority had developed investment-grade forecasts of ridership, revenue, cost and benefits of the system.

In 2004, the Authority and the Federal Railroad Administration (FRA) issued a Draft Program Environmental Impact Report/Environmental Impact Statement (EIR/EIS) (two volumes and 64 technical reports), received and reviewed over 2,000 public and government agency comments, and determined preferred corridors and stations for the majority of the line.

With initial planning completed, the Authority must next develop the structure and institutional organization to manage construction worth tens of billions of dollars, ensure maximum participation and risk-sharing from the private sector, and successfully adapt the existing high-speed train technology to California's needs.

The first section of this implementation plan summarizes the California high-speed project—its alignment, stations and technologies—as well as its financial and economic profile. The second section lays out the roadmap for the Authority's evolution, from a planning authority with a small staff to a construction management agency and, finally, to a comprehensive long-term manager of operations and assets.

Project Background

Created in 1996, the California High-Speed Rail Authority has pursued the vision for a high-speed train system connecting California's major metropolitan areas. The Authority has identified preferred corridor alignments and stations from the Central Valley through Los Angeles to San Diego as well as inside much of the Bay Area. Between the Central Valley and the Bay Area, further study is needed to select a preferred corridor alignment.

The recent program environmental review has found that the high-speed train system will have fewer impacts, create more economic stimulus and cost less than half as much as the alternative—building more lanes, bridges and ramps along highways; and terminals, gates and runways at airports. The Authority's studies show that the full system, serving 30 stations, will attract 42 to 68 million passengers per year in 2020, operate at a surplus and cost over $33 billion to build. High-speed trains will be capable of speeds of up to 220 mph and will be similar to those in service today in Europe and Asia. The system will be built mostly within or alongside existing transportation corridors and will be entirely grade-separated from parallel and crossing roads, providing the same extremely safe environment enjoyed in other countries, where not a single passenger fatality has occurred on new lines in 41 years of operation.

Trains will have multiple cars that can provide a variety of accommodations for travelers, such as a café car, business compartments, young family play areas or even a “Quiet Car”℠. Where demand is high, trains could seat up to 1,600 passengers. Seat restraints or belts will not be needed at any time and passengers will be free to move around the train safely and comfortably.

Most of the high-speed train tracks will be at ground level, needing a minimum path 50 feet wide—comparable to a new two-lane road with shoulders, but providing 20 times the transportation capacity.

In mountainous or hilly areas, or places where road crossings and freight railroad spur tracks are frequent, viaducts and tunnels may be used to grade-separate the high-speed train tracks. The high-speed train line will be fenced and equipped with intrusion detection linked to a state-of-the-art train control system.

Trains will draw electric power from overhead wires connected to the commercial power grid and, in braking, will regenerate electricity back to the grid, thereby conserving power and reducing costs. Train maintenance will be performed at several facilities throughout the state, whose locations will be determined in the project-level environmental work.

High-Speed Service and Station Area Development

Express high-speed trains will take one hour and fifteen minutes between San Diego and Los Angeles, and a little over two and one-half hours from San Francisco to Los Angeles. When time to get to, through, and from stations and airports is factored in, high-speed train travel will be as quick or quicker than air travel for most trips, and less time-consuming than all but the shortest intercity trips by car.

High-speed train fares will be set between the cost of driving and the fares for air travel and will vary depending on the service chosen, the demand for seats and time of booking. To meet passenger demand forecast by 2020, 86 weekday trains in each direction are expected to run in a mix of express and local trains.

Each of the 30 potential stations are expected to be significant hubs for transit- and pedestrian-oriented community development. All sites will be multi-modal transportation centers, serve a share of the projected 115,000 to 186,000 daily high-speed train passengers, and offer considerable opportunities for new shopping and business services.

Organizational Structure

Experience from recent successful large rail projects shows that design and construction staffing needs are highly dynamic, with large numbers of expert, specialized staff needed for relatively short periods of time. Even government-owned railroads have made extensive use of private sector consulting engineers and construction contractors supervised by a core staff of experts to manage contracts and ensure fulfillment of public goals.

Increasingly, governments have looked to the private sector for operation, maintenance and financing of high-speed train lines. While some projects have sought to assign the full responsibility for implementation and operation to private sector consortia, this is not possible in California, because the high-speed train project is several times more geographically extended, and financially several times more costly than the private sector's ability to obtain bonding to ensure completion of the project.

Consequently, the Authority has determined that the best approach for the California high-speed train is an institutional structure that relies upon an experienced core public sector staff to manage specialist contractors in civil and structural engineering, architecture, train systems, construction management, operations and maintenance, travel forecasting and marketing.

The Authority staff also will need strong capabilities in environmental permitting, transportation and procurement law, contract management and finance to provide oversight and maintain its fiduciary responsibilities.

Contracting for Design, Construction and Operation

The Authority will divide the project into a variety of contracts of different lengths, content and dollar amounts to achieve the best combination of cost, schedule, technical expertise and equitable distribution of work within California.

The Authority will generally use a "design/build" approach in awarding infrastructure contracts, integrating the final design and construction into single contracts.

For the various high-speed trains and their power, signaling, track and communications systems, the Authority believes a single contract for design, installation/supply and maintenance is the best guarantor of success and cost-effectiveness. The Authority will seek bids on these terms and—if warranted by the ridership and revenue studies underway and the potential suppliers' perception of the revenue risks—may also seek to include operations in those bids.

Choosing the California High-Speed Train Technology

The Authority intends to adapt to U.S. requirements the electrically powered high-speed train technology that has been proven extremely safe and effective in revenue service in Europe and Asia. This will minimize the risks of unproven technology, lower costs, ensure a faster delivery of rolling stock, and assure the use of the safest transportation technology operating today.

Several train and systems manufacturing consortia are expected to aggressively compete for the chance to equip California's high-speed train line and to develop the nation's first high-speed train system that meets U.S. requirements. This offers California the valuable opportunity to obtain a competitively priced system.

The Authority and any potential high-speed train supplier will have to obtain approval of operating equipment, infrastructure and operating practices from the FRA. As an early priority, the Authority will assemble an industry group to cooperatively study with the FRA whatever changes may be needed to European or Asian designs. Based on these results, the Authority will competitively bid the high-speed train systems, select a winning bidder and then formally apply to the FRA for specific approval.

The Authority believes it will obtain approval based on the demonstrated safety of high-speed trains on mostly dedicated, grade-separated lines with appropriate train control systems, inspection and maintenance regimes, and affordable design changes.

Construction and Financing of the Line

In deciding which parts of the line would start construction and operation first, the Authority will consider the following factors:

- availability of capital
- ridership
- ability to operate without state subsidy
- train maintenance
- geographical distribution of construction and service
- scarcity-related cost increases

A full financing plan will be developed after completion of the ongoing ridership and revenue forecast update. Currently, the most likely funding sources are through public/state-issued bonds and federal matching funds.

Sample Schedule Overview

It will take from eight to 11 years, depending on the complexity of the segment, to develop and begin operation of an initial segment of the California high-speed train, assuming that the Authority chooses a specific supplier of high-speed train technology as an early action.

Next Steps

With adequate funding, the Authority can move forward on the following next steps:

- Complete selection of preferred alignments and stations
- Start project-level environmental impact review on high-priority segments
- Prepare financial plan
- Develop Authority staffing resources plan and scope-of-work for a program management team
- Select the program management team
- Pre-qualify train system suppliers and undertake joint industry/FRA studies
- Work with local governments and transportation agencies on right-of-way preservation.

San Francisco
SFO
Oakland
Oakland Airport
Redwood City/
Palo Alto
San Jose
Union City
Fremont
Stockton

Modesto
Sacramento
Merced
Fresno
Bakersfield
Palmdale
Sylmar
Burbank
Los Angeles
Norwalk


Anaheim
Irvine
East San Gabriel Valley
Ontario Airport
Riverside
Temecula
Escondido
University City
San Diego
Sacramento
Stockton
Oakland
San Francisco
Oakland Airport
SFO Airport
Union City
Modesto
Redwood City/ Palo Alto
San Jose
Merced
Fresno
Bakersfield
Palmdale Airport
Sylmar
Burbank
Los Angeles
Industry
Ontario Airport
Riverside
Norwalk
Anaheim
Irvine
Murrieta
Escondido
University City
San Diego

THE PROJECT

CALIFORNIA HIGH-SPEED TRAIN PROJECT

2.1 Introduction

Through California's history, economic strength and development have been led by advances in transportation—first with the construction of railroads and later by investments in highways and airports. In the mid-1990s, inspired by stunning successes in Japan and Europe, California began exploring how a high-speed train line linking the major metropolitan areas could cost-effectively sustain the state's long-term mobility and economic growth.

In 1996, the California High-Speed Rail Authority (Authority) was created to implement a high-speed train system connecting California's major metropolitan areas. By 2000, the Authority had developed investment-grade forecasts of ridership, revenue and cost, and quantified the benefits of the high-speed line embodied in a business plan. Shortly after the issuance of the business plan, the Authority initiated the required federal and state programmatic environmental reviews in partnership with the U.S. Department of Transportation's Federal Railroad Administration (FRA). In 2004, the Authority and the FRA issued a Draft Program Environmental Impact Report/Environmental Impact Statement (EIR/EIS) (two volumes and 64 technical reports), received and reviewed over 2,000 public and government agency comments, and determined preferred corridors and stations for the majority of the line.

The Authority, having accomplished this initial planning work with a small staff directing numerous consultant teams, must now develop the structure and organization to manage construction work worth tens of billions of dollars, ensure maximum participation and risk-sharing from the private sector, and successfully adapt existing high-speed train technology to California's needs.

The first section of this implementation plan summarizes the California high-speed train project—its alignment, stations and technologies—as well as its financial and economic profile. The second section lays out the roadmap for the Authority's evolution, from planning authority with a small staff, to construction management agency and, finally, to a comprehensive long-term manager of operations and assets.

2.2 Building on Worldwide Experience

California's high-speed trains will use state-of-the-art electrified trains capable of speeds of up to 220 mph in revenue service similar to those in service today in Europe and Asia. The line will consist of new infrastructure, often in or alongside existing transportation corridors, but mostly existing railroads. The entire high-speed train system will be grade-separated from parallel and crossing roads providing a very reliable and extremely safe travel environment.

Proven high-speed train technology was chosen because it meets the requirements of the enabling legislation for the California High-Speed Rail Authority to operate at sustained speeds of 200 mph (320 km/h) or greater and because there is

Figure 2.1
German ICE on Hallerbachtal bridge next to highway between Köln and Frankfurt

Figure 2.2
TGV Mediterranean line crosses A7 toll plaza near Avignon

extensive operational history for this technology and there are competitive manufacturers. Additionally, high-speed trains like these have the potential to share tracks at reduced speeds with other conventional trains.

High-speed trains have steadily expanded their market share and geographical coverage in Europe and Asia.

Beginning in 1964 with the Tokyo–Osaka bullet train (Shinkansen), Japan showed that high-speed trains could provide major transportation capacity, deliver significant operating profits, and reduce the need for new airports and highways. Today's 1,350 miles of high-speed line continues to be expanded to serve most major cities and the additional demand for travel that comes with increasing income and population. Today, the Shinkansen carries over 300 million passengers a year.

In 41 years of high-speed train operation in Japan, there has not been a single passenger fatality, largely due to the separation of the rail line from roads and the myriad of safety features and operating procedures incorporated into the service.

In Europe, the first high-speed train began operating in 1976 on a short section of a new line between Rome and Florence that was completed in 1992. In 1981, the first TGVs were operating on portions of a new line between Paris and Lyon, eventually cutting the train trip time in half and freeing up airline and airport capacity for flights from overseas and the rest of Europe. In 1987, Germany launched its first high-speed train and began operations of InterCity Express (ICE) service.

With the addition of new lines in Italy, France and Germany, and the construction of high-speed lines in Spain, England, Belgium and the Netherlands, over 2,550 miles of high-speed lines have been completed in Europe. European high-speed trains currently carry roughly 250 million passengers a year and have not had a passenger fatality on new grade-separated high-speed lines.

In 2002, Korea opened a high-speed line from Seoul to Pusan, which is now carrying around 100,000 passengers per day. Taiwan has begun operational tests on a new 225-mile-long high-speed line from Taipei to Kaohsiung, and expects to carry around 186,000 passengers per day within a decade.

Top commercial speeds on dedicated high-speed lines continue to increase in response to market demand, technological advancement and operational profitability. These trains have run daily at top speeds of 187 mph (300 km/h) for over 15 years, and the newest lines are being built to accommodate 218 mph (350 km/h). East Japan Railways is testing prototype trains capable of in-service speeds of 224 mph (360 km/h).

Recorded test speeds routinely exceed commercial speeds, providing significant confidence in the capability of these train systems to operate commercially at these higher speeds. Currently, the TGV holds the train speed record at 323 mph (515 km/h), and the ICE and various Shinkansen trains have reached 255 mph and 277 mph, respectively.

Figure 2.3
Shinkansen on elevated track travels through Tokyo

DEVELOPMENT OF HIGH-SPEED TRAIN RIDERSHIP IN JAPAN AND EUROPE

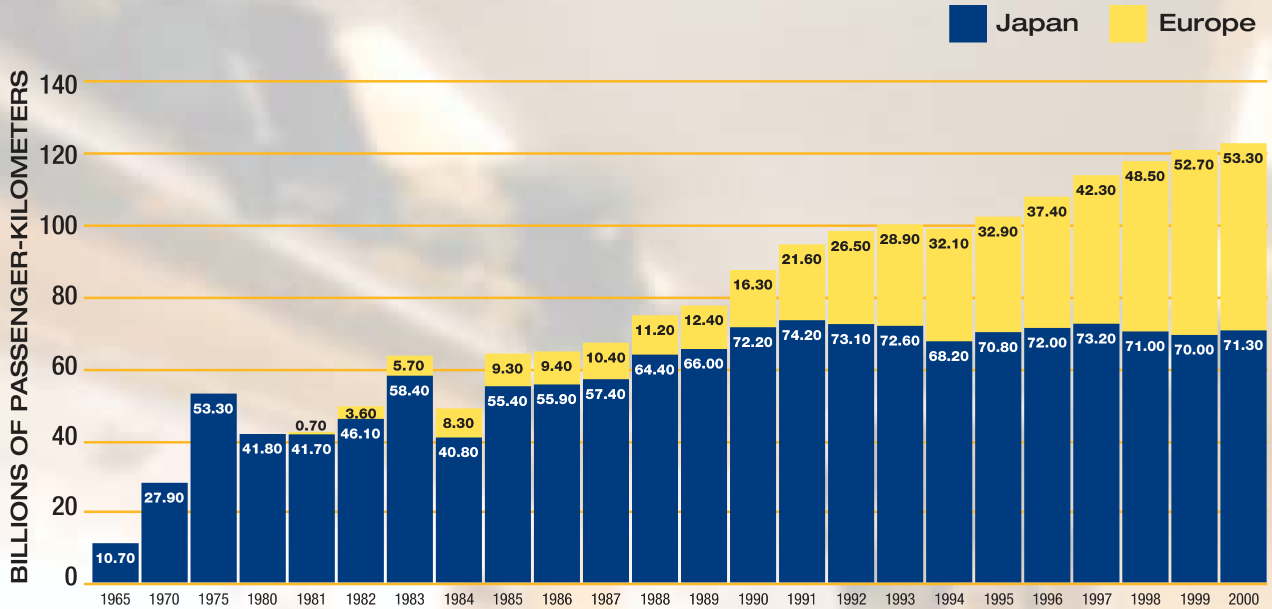


Figure 2.4
Source: UIC, International Union of Railways

2.3

Train Types and Amenities

In developing California's system, the Authority intends to take full advantage of the many years of research and development and practical application of high-speed train service by utilizing train systems that have been proven in everyday regular revenue service over extended periods of time.

Operating "trainsets" will have multiple cars and will be up to 1,300 feet long, depending on the type of train and the market demand. At peak travel times, trains can be lengthened, or trainsets can be connected, to operate as a single train, providing seating for up to 1,600 passengers. Seats will have more space than a conventional airline seat and seat restraints or belts will not be needed at any time. Passengers will be able to comfortably and safely stroll to a café car to purchase snacks and beverages. The precise configuration of seating and accommodation will depend on market demand. With multiple cars, each trainset can provide different types of accommodation for different passenger markets. The same train can have business compartments for conferencing en route, theater- or airline-style seating, young family play areas, or even "Quiet Cars" SM where cell phones and loud computer programs are not allowed. Tables, power jacks, reliable cell phone connections, wireless Internet service and video or audio entertainment can also be provided, depending on market demand.

Figures 2.5 and 2.6
High-speed train interiors – seating, Shinkansen (top), TGV café car (bottom)

2.4
The High-Speed Line and Physical Structures

The majority of the California high-speed train system will be at-grade alongside existing railroads, roads and highways. The minimum path required for the two-track rail line is about 50 feet wide, or about the space required for a new two-lane highway with shoulders and a small median. However, this two-track high-speed train line has 20 times the capacity of such a road, allowing up to 20 trains per hour in each direction.

Smooth transitions and grades of less than three percent will assure a comfortable and safe ride at high speeds. Mountainous and hilly areas often will require viaducts and tunnels, as seen in Figures 2.7 and 2.8. Also, in areas with many consecutive at-grade road crossings or freight railroad sidings, viaducts and tunnels may be used to separate the high-speed line, rather than building numerous bridges over the line.

California's high-speed trains will mirror the outstanding safety record of overseas systems. Tracks will be fully grade-separated from road traffic with bridges or underpasses. The high-speed line will be fenced and equipped with intrusion alarms linked to train controls that can detect persons, animals or debris on the tracks. And high-speed train control systems will provide in-cab signaling and automatically stop trains if necessary.

The electric trains will draw power from overhead wires connected to the commercial power grid. Trains will be regularly inspected at terminal stations and train maintenance will be performed at several new facilities throughout the state, whose locations will be determined during the project-level environmental work.

Figure 2.7 (far left)
TGV on viaduct, near Sens, France

Figure 2.8 (left)
Tungsiao tunnel portal and high-speed track, Taiwan

2.5
Travel Times and Fares

The California high-speed train will be very competitive with air travel times for many intercity travelers and will be faster than all but the shortest intercity trips by car. Figure 2.9 displays the door-to-door time for several major markets; while less time is spent on a plane than on the high-speed train, extra time required to pass through airport security and for access/egress to and from airports makes rail faster overall for many trips, including the downtown-to-downtown trips shown.

The high-speed train will not only save its passengers time but also will benefit those who choose to use the airlines and roads—by reducing the additional peak demand and congestion that is expected to grow by 2020.

Fares will be set to maximize the transportation and environmental benefits of the investment while still providing a positive cash flow to cover operations. This level lies between the cost of driving and the fares for air travel. As in systems around the world, fares would vary depending on how much in advance tickets were bought and the class of service, such as coach or business. To meet 2020 forecast passenger demand, 86 trains are projected to run in each direction on weekdays in a mix of express and local trains that maximize service to a variety of markets.

AVERAGE ESTIMATED TRAVEL TIME BY MODE IN 2020 WITH HIGH-SPEED TRAIN

	AUTO	AIR		HIGH-SPEED TRAIN Express Times	
CITY PAIRS	TOTAL Door to Door	On the plane	TOTAL Door to Door	On the train	TOTAL Door to Door
Los Angeles to San Francisco	7h 36m	1h 20m	3h 26m	2h 35m	3h 30m
Fresno to Los Angeles	4h 18m	1h 05m	3h 00m	1h 22m	2h 33m
San Diego to Los Angeles	2h 41m	0h 48m	2h 46m	1h 13m	2h 16m
Burbank to San Jose	6h 32m	1h 00m	3h 08m	1h 59m	3h 02m
Sacramento to San Jose	2h 33m	no service		0h 50m	1h 53m

Figure 2.9

h=hours m=minutes

YEAR 2020 POTENTIAL TRAIN STOPPING PATTERNS (total per day each direction)

Type of train service	Number of trains per day
Express	20
Semi-Express	21
Suburban-Express	20
Local	21
Regional	4

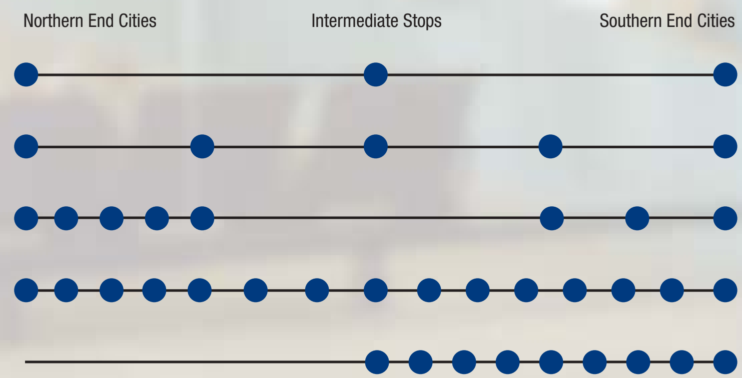


Figure 2.10

2.6 High-Speed Train Stations

Stations providing travelers with access to high-speed trains can be strong focal points for transit-oriented community development. Approximately 30 potential stations have been identified based on their ridership potential, cost to construct, opportunity to connect with other modes of transportation, and distribution of population and major destinations along the routes. Existing transportation hubs will be served, such as Union Station in Los Angeles, Santa Fe Depot in San Diego, Diridon Station in San Jose, Transbay Terminal in San Francisco and Anaheim (ARTIC) Station.

The high-speed train facilities at each station will consist of tracks, controlled access platforms, full access for disabled passengers and ticketing/waiting/passenger service areas. Many stations along the route will have platform tracks off the main high-speed line to allow express trains to pass unimpeded. Stations are expected to have 1,300-foot-long platforms allowing level boarding of the train.

Figure 2.11 High-speed train station in France built for the TGV Mediterranean in Avignon

Figure 2.12 Multi-level Kyoto station combines travel and commerce

Figure 2.13 New TGV station and development at Perpignan

In urban centers where trains would routinely end their runs, larger and more complex track and platform arrangements are planned. Such stations also will provide sufficient passenger traffic to create new opportunities for shopping, business meetings, and provide offices and other development not primarily dependent on the automobile for mobility. Kyoto's Shinkansen station is shown in Figure 2.12 on the previous page as an example of how this could occur.

Preferred station sites will all be multi-modal transportation hubs with links to local and regional transit, airports and highways. It is assumed that parking at the stations would be provided at market rates (no free parking). Each station site would support higher density, mixed-use, pedestrian-oriented development around the station. As the project proceeds to more detailed study, local governments will have to plan and zone for transit-oriented development around high-speed train station locations and to finance (e.g., through value capture or other financing techniques) and maintain the public spaces needed to support the pedestrian traffic generated by hub stations.

The precise location, configuration and number of stations is not known at this time, but would be decided during subsequent project-level environmental review.

2.7 Environmental and Economic Benefits

Spurred by population and economic growth in the next 35 years, intercity travel and long-distance commuting in California is forecast to nearly double from current levels. Comprehensive studies comparing the environmental impacts of high-speed trains and alternative highway/airport expansion alone (conducted from 2000 to 2004 in compliance with California and federal requirements) concluded that high-speed trains would:

- create less impact on the natural and built environment
  - less potential impact on wetlands and water resources, biology and farmlands
  - less noise impact and even reductions in areas where the high-speed train project grade-separates existing roads over adjacent rail lines
- cost less than half as much to build over 30 years than other transportation options and will not require operating subsidy
- create more jobs and economic activity and reduce the cost of travel in the state
- encourage more compact transit-oriented development, saving 67,000 acres from urban/suburban development, including 24,000 acres of farmland
- avoid 10,000 auto accidents yearly with their attendant deaths, injuries and property damage compared to expanding only highways
- save up to five million barrels of oil per year and reduce pollutant emissions, even with future improvements in auto fuel efficiency.

Furthermore, economic studies show that the high-speed trains would bring economic benefits worth twice the cost of construction and would directly result in creating 450,000 new permanent jobs in California.

IMPLEMENTATION

PROJECT IMPLEMENTATION TASKS AND SCHEDULES

3.1 Institutional Structure

The Authority's legislative mandate to develop a high-speed train system includes broad powers to enter into contracts for any of the stages and activities of planning, design, construction, operation and maintenance. To date, the Authority has used this power to conduct its planning work with a small staff directing numerous consultant teams under contract.

Now, the Authority needs to transition into an agency capable of handling much larger workloads and ensuring that the public interest is met during all phases of the project. The agency staff needs to have a broad range of expertise, provide continuity and institutional stability, and be able to adequately oversee private sector contractors. At the same time, the Authority wants to keep the permanent agency staff small enough to be flexible, innovative and efficient during the various phases of the project.

The Authority examined several recent successful large high-speed train and related infrastructure projects, both overseas and in the U.S., to identify the institutional structure that would best meet its objectives. Organizational alternatives ranged from established government-owned railroads to small new government agencies that issue large, long-term franchise contracts to major private sector conglomerates.

Each of the projects investigated had very dynamic staffing needs. Large numbers of specialized engineering and construction personnel were needed over a relatively short design and construction period, and even during this phase, the necessary specialties changed. Subsequent long-term operations typically required yet a different group of specialized personnel. All of these projects used contractors to some extent to meet these changing personnel needs.

The specialized expertise needed to oversee implementation and operation of a high-speed train system does not currently exist in California state government, although the related expertise of state agencies could be tapped for some functions. Personnel needs would vary during implementation (e.g., to support the construction effort, several hundred staff would be needed for limited terms varying from two to 10 years). Current state personnel hiring processes are cumbersome and time-consuming and do not provide recruitment incentives to attract the specialized expertise needed to manage construction and launch of the proposed system. While rail operations and maintenance functions will be ongoing, the capability to carry these functions out is more readily available in the private sector. Competitive private sector bidding is increasingly used by California's public transit agencies and for high-speed train operations in Europe and Asia.

The Authority has determined that the best approach for the California high-speed train is a hybrid institutional structure which relies upon an expert core public sector staff using competitive contracting to the greatest extent possible. Private sector contractors would best provide the majority of personnel needed to implement the high-speed train system. This structure would allow for competitive bidding and targeted recruitment to meet the ebbs and flows of expertise and labor needed to implement and operate the proposed system. A key private sector contract would provide for project management support.

Initially, the project management contractor/s, under the direction of Authority staff, would assist in the development of design criteria, preliminary designs, bid documents, project timeline and controls, and system integration. When projects enter the design and construction stage, the project management contractor/s would provide oversight and coordination of the work being done by other contractors. The project management contractor/s would need to be brought on early in the implementation period through multi-year contracts requiring continued close coordination with and oversight by the Authority staff. Other private sector agreements would include numerous contracts for civil works design and construction, train systems design, procurement and installation as well as operations, maintenance and supply contracts.

The Authority would need to be able to manage a number of separate activities for different parts of the system simultaneously—planning, environmental review and permitting; design, real estate acquisition, negotiations with existing railroads and public entities; construction and testing; and finally, operation, maintenance and supply.

HIGH-SPEED RAIL AUTHORITY ORGANIZATIONAL STRUCTURE

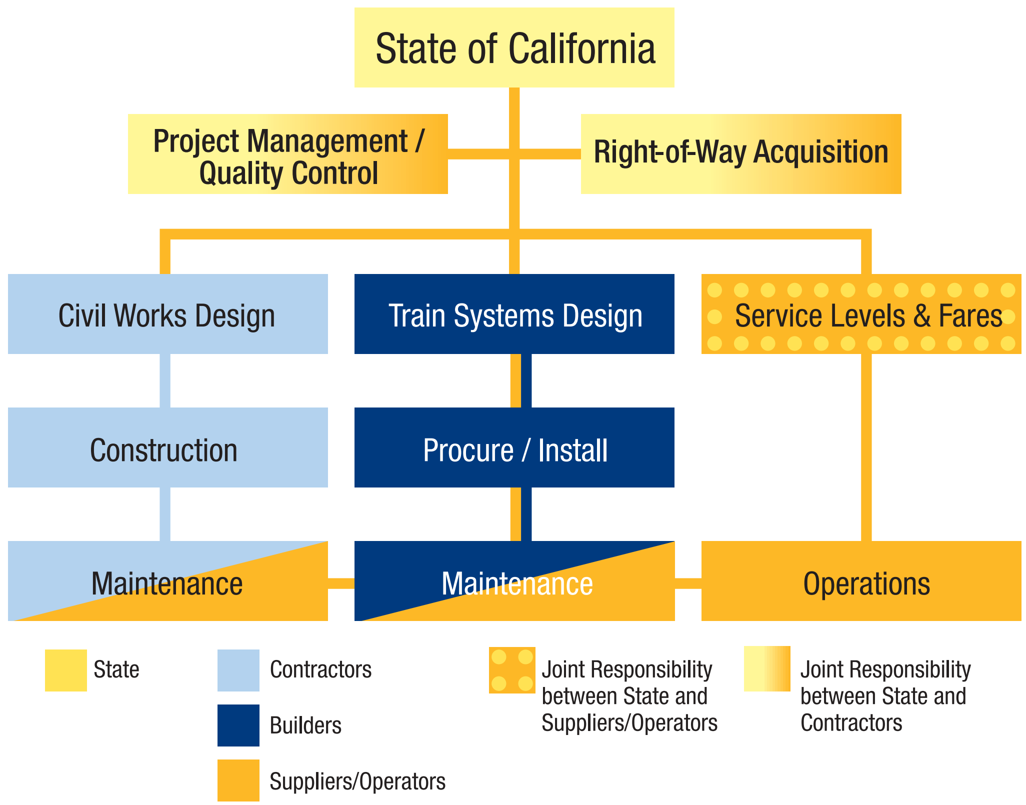


Figure 3.1

3.2
Organizing Design, Construction and Operation Contracts

The Authority's enabling legislation gives it the ability to enter into contracts with private or public entities for the design, construction and operation of high-speed trains and allows for contracts to be separated into individual tasks or segments, including design/build or design/build/operate contracts.

At over $33 billion for the complete high-speed train project, a single contract for the planning, design, construction, operation and maintenance of the entire system is neither practical nor desirable. The project is simply too large to consider such an approach. Numerous private sector contracts in varying sizes and dollar amounts will be required to complete system implementation. Breaking the project tasks into multiple contracts, where possible, would promote competition within the construction and supply industry.

With a modest public sector staff supported by private sector consultants and the Authority's broad contracting capabilities, the Authority can choose the best procurement strategy for each contract package, whether design/build, design/bid/build, design/build/operate, design/build/operate/maintain or other hybrid.

Design/Build (D-B)

This approach integrates the design and construction functions into one contract. D-B will generally be the most appropriate approach for the large civil works construction contracts. Detailed design and construction will be based on the preliminary designs prepared by the Authority and its consultants and the performance criteria.

The D-B method brings many benefits:

- it provides a single point of responsibility for final design and construction
- it typically reduces the time for project completion
- project costs are usually reduced due to lower design costs (as compared to the DBB method)
- the latest in construction methods are integrated early into the design
- it allows for "fast-track" construction (the ability to begin construction while the design of the project element continues)
- and D-B can effectively harness competition among contractors and suppliers.

Design/Bid/Build (DBB)

The DBB method is the conventional method for building public works projects in the U.S. Preliminary designs are prepared by either the project management contractor/s or other contractor/s. Based on the preliminary design and the performance criteria, the Authority would contract for the development of final designs and bid documents. The completed final designs would be put out to bid for construction.

The DBB method would allow the Authority greater control because the designer is exclusively serving the Authority's interests, and it increases the involvement of smaller, local and minority-owned contractors; however, it requires more oversight, coordination and administration from the Authority. The DBB method is not easily fast-tracked due to the need to conduct two procurement processes, and it requires extensive coordination between the design and construction contractors.

Design/Build/Operate (DBO), Design/Build/Maintain (DBM), or Design/Build/Operate/Maintain (DBOM)

These methods initially are similar to the design/build option but continue over time with added functions of operations or operations with maintenance. While the Authority has found it impractical and undesirable to enter into a single franchise contract for the implementation of the entire high-speed train system, there is the possibility of entering into a single contract for the systems (signaling, communications, track and electrification) and train technology for the entire project. This option may provide the best opportunity for private sector financing, risk sharing and clear accountability for the performance of trains and systems.

Although the Authority will utilize all contracting mechanisms, the Authority believes that the design/build procurement strategy will likely be preferred for the major, high-value construction contracts, especially those in which final design and construction problems are relatively well understood at the end of preliminary design.

The Authority believes that the best procurement strategy for the train technology and systems will include design, construction/supply/installation and maintenance in a single contract because it best supports the integration of high-speed train systems and offers the possibility of leveraging public/private partnership opportunities. In some projects, operations of the train service has also been included with provision of train systems and, in others, maintenance and operations have been kept separate. The Authority may consider a train systems package that includes maintenance and operations as well; this decision will depend on the outcome of the final ridership and revenue analyses now underway and on the potential suppliers' perception of the revenue risks.

Further discussions with technology providers and others as well as additional analysis will be needed to determine if a DBOM for the systems and train technology is financially feasible and preferable to a DBM. If a single DBOM or DBM is not pursued, another approach would be to break major system and operating elements into separate contracts: 1) track; 2) electrification; 3) signaling/communications and train technology; 4) operations; and 5) maintenance.

In any of these approaches, a single operator would be responsible for providing a variety of services (local, regional, express, premium, etc.). The Authority believes that a single high-speed train operator would better ensure integration of services, accountability, reduced risk, effective coordination and communication, and would simplify Authority oversight.

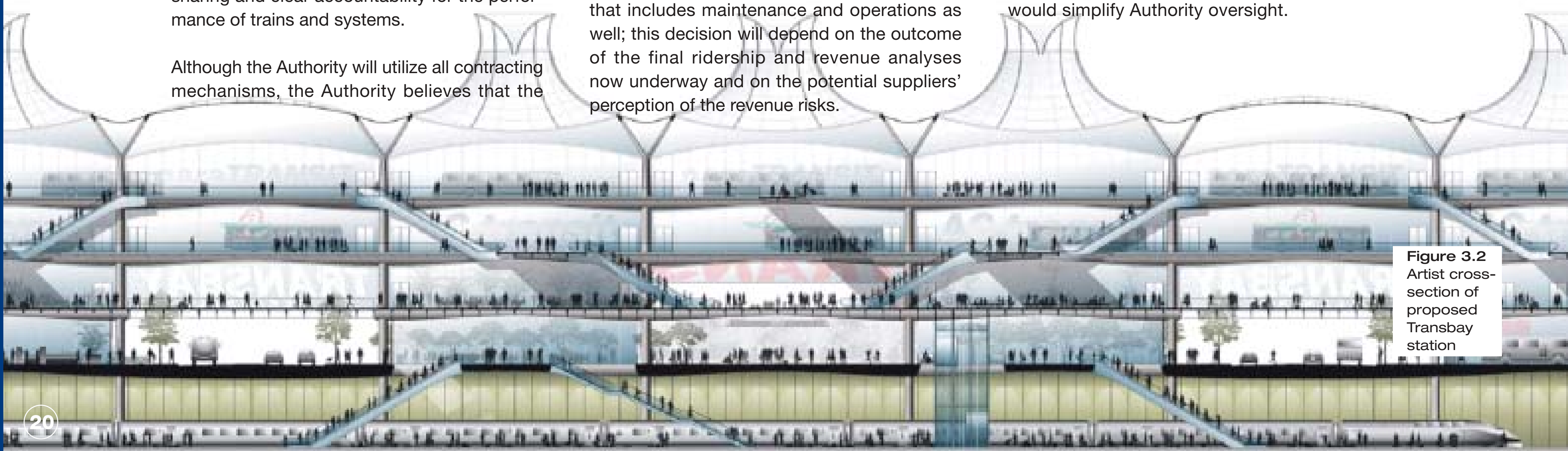


Figure 3.2 Artist cross-section of proposed Transbay station

3.3
Technology Selection

In developing California's high-speed train, the Authority intends to build on technology developed over more than 40 years of increasingly sophisticated and extensive high-speed train service around the world. Having existing suppliers adapt off-the-shelf equipment to an assortment of U.S. requirements will minimize the risks of unproven technology, lower the cost of design and testing, ensure a faster delivery of trainsets, and place more of the risk on the supplier.

However, one issue will require the Authority to work closely with the FRA on potential changes to or waivers from FRA regulations in order to operate the safest, most reliable high-speed train service possible. Extremely successful European and Asian technology differs significantly in one major respect from the current U.S. regulatory requirements governing passenger and freight trains. The FRA currently requires all existing U.S. passenger trains to be at least twice as strong in certain aspects than the lightweight equipment used in European and Asian high-speed trains. In order to meet this strength requirement, manufacturers would have to structurally redesign their trains, at significant additional development cost and time, resulting in higher costs to the Authority, but with uncertain effect on the ultimate safety of the operation. Such a redesign would make high-speed rolling stock heavier, jeopardizing the low axle loadings that have efficiently enabled the high speeds, low operating and maintenance costs, and positive cash flows like those enjoyed by high-speed train operations in Europe and Asia. In addition to being more costly to purchase and operate, heavier equipment may cause changes in other system components such as track or bridges and result in higher maintenance costs.

In the late 1990s, the FRA considered waiving U.S. equipment strength requirements to allow operation of a Florida high-speed line because it was to be operated on rights-of-way dedicated to high-speed train operation and separate from other railroad lines. However, suspension of the Florida project meant that FRA rule-making was never completed. Under any circumstance, California will have to start a similar federal regulatory process that will lead to an FRA "Rule of Particular Applicability" governing operations up to 220 mph on the high-speed-train-only lines.

While the majority of the high-speed train system is being planned with dedicated separate tracks, there are two sections of the system that are proposed to be shared with existing commuter and intercity trains at reduced speeds. Under current regulations, either the selected European or Asian equipment would have to be modified

Figure 3.3
Shinkansen in the countryside, Japan

structurally to meet the FRA requirements or the proposed system would have to be modified in other ways to avoid compatibility conflicts with freight trains and conventional passenger trains.

The Authority will engage the FRA and a group of pre-qualified high-speed train manufacturers to investigate safety approaches that have been applied successfully in other countries and to consider how existing high-speed train vehicles and systems might need to be modified for use in California. Manufacturers would be pre-qualified for future California contracts based upon their existing ability to produce very high-speed trains and their willingness to work with the state and federal governments. Pre-qualification of manufacturers and safety studies will also improve price competition and quality of bids on the trains and systems as well as improve the Authority's ability to evaluate those bids.

Pre-qualification is intended to help streamline FRA rule-making for California's unique circumstances. Once the FRA/high-speed train systems compatibility studies are completed and financing is secured, the Authority will proceed to a competitive procurement of the high-speed train and related systems from among the pre-qualified high-speed train manufacturers. A decision on which high-speed train system to use will then allow the Authority to formally apply to the FRA for the Rule of Particular Applicability.

The California high-speed train has been developed with criteria and standards that allow use of any of the existing European and Asian technologies. Prior to selecting a train technology, progress can be made on numerous planning, environmental approval and preliminary design tasks that will take several years. However, detailed design will be made more efficient by the selection of a specific train type and system, and in some cases will require coordinated, technology-specific parameters such as electric power supply and signal systems. Optimally, the train technology selection will be made and rule-making will be substantially completed within two to three years of obtaining significant funding for the project and before the planning and environmental work is completed.

Figure 3.4 High-speed train station with multiple platforms available for arrivals and departures

3.4
Phasing and Staging Construction

The California high-speed train project is over 700 miles long, with 30 potential station locations. The estimated cost for the entire project is over $33 billion. The sheer scale of this proposal makes it impractical to construct and initiate operations of the entire project all at once. Even if sufficient funds were secured, constructing a project this large all at once would strain the California economy through excessive demand for construction materials and labor. Like other large transportation projects, the high-speed train system can be divided into smaller segments that can be operated before the full system is complete.

New ridership and revenue forecasts are being prepared and further studies must be done for the Authority to select a preferred route for the northern mountain crossing between the Bay Area and the Central Valley. Both are critical to determining operable segments and in which order to construct and open them for service. Moreover, the amount of capital available to implement the system and any limitations on the use of those funds should be known prior to making commitments regarding the phasing of construction.

Selection of workable segments and the order in which they are phased should include these considerations:

- the availability of capital to construct the segment/s and procure train systems
- ridership and revenue potential and the ability of the segment/s to be operated without state subsidy
- the ability to service trainsets at appropriate maintenance facilities
- a distribution of construction and initiation of service in regions of both Northern and Southern California
- the avoidance of cost increases related to labor or material scarcity.

The High-Speed Passenger Train Bond Act (SB 1865/SB1169) directs that the first portion of the high-speed train system to be funded will be San Francisco to Los Angeles. Even along that route there may be regional segments that can be opened before construction is complete on the entire north-south line.

Figure 3.5
Laying tracks, Taiwan, ROC

3.5 Financing

The California high-speed train project is one of the world's largest public works projects, with estimated costs over $33 billion. Based on the experience of other countries, a "carefully planned" high-speed train system is a smart investment that is projected to return a benefit of at least two dollars for every public dollar invested. More importantly, once built, the service provided by the system is expected to yield annual operating surpluses in excess of $300 million ($1999/Business Plan 2000).

High-speed lines worldwide generate surpluses *(1)* from their operations, unlike traditional passenger service, because high-speed attracts more passengers, generates more revenues and lowers unit costs of production (e.g., a crew can make two round trips a day instead of one). The resulting combination of higher revenue and lower unit operating costs has made all high-speed train services net contributors to the financial performance of their operators. In Europe and Japan, high-speed train systems generate enough revenue to cover operational costs *(2)*, and most of the high-speed lines cover some of their construction costs (the Tokaido Line between Tokyo and Osaka generated enough operating surplus in the first decade to completely match the capital costs). In California, a high-speed train will compete with automobiles and airplanes, which have enjoyed a century of substantial public funding and are well-established. Until the high-speed train system operates at a surplus, public resources will be needed for capital and deployment costs.

In 2000, the Authority published its business plan, which presented two funding approaches:

- a full-funding scenario, which assumed that the entire system be constructed simultaneously
- a phased-funding approach that focused on securing resources required to complete discrete sequential phases of the project as expeditiously as possible.

The Authority concluded that the phased-funding approach is the most prudent and business-like approach and will ultimately be of better value to the state's taxpayers. The phased-funding approach calls for development of a detailed financing plan which would include state and federal funding sources as well as the Authority's broad contracting powers to secure private sector funds.

Since the preparation of the 2000 business plan, there have been some developments in potential funding sources for the high-speed train system.

(1) (2) see **Endnotes**

OVERSEAS HIGH-SPEED TRAIN COMPARISONS

	YEAR	PASSENGERS (millions)	REVENUE	OPERATING COST	NET OPERATING CASH FLOW	CAPITAL COST	MILES	COST PER MILE
Tokaido Shinkansen	1990	191	$9,100	$3,330	$6,770	$5,800	320	$18
Tohoku/Joetsu Shinkansen	1992	76	$3,230	N/A	N/A	$33,300	460	$72
TGV Paris-Lyon	1991	19	$1,100	$ 440	$ 660	$8,070	250	$32
TGV Atlantique	1991	18	$ 810	$ 355	$ 455	$5,000	170	$29
THSRC	2009	68	$1,920	$ 650	$1,270	$15,300-$19,400	210	$73-92

Figure 3.6
For sources see page 32

DOLLARS IN MILLIONS; 1999 $$ UNLESS ANNOTATED

In 2002, The Safe, Reliable High-Speed Passenger Train Bond Act for the 21st Century (SB 1856 -Costa) was signed into law by former Governor Gray Davis calling for voter approval in the November 2004 general election of $9.95 billion in General Obligation (GO) bonds for rail development in California. Nine billion was authorized for high-speed trains and $950 million was authorized for capital improvements to intercity and commuter rail lines and urban rail systems.

Due to the state's fiscal condition in 2004, SB 1856 was amended by SB 1169 (Murray) and signed by Governor Schwarzenegger delaying the vote until the November 2006 general election.

The potential availability of GO bonds, coupled with the refinement of the high-speed train program through environmental review, requires development of an updated financing plan. That plan will be developed concurrently with and based on a new ridership/revenue study currently underway *(3)* and will take into consideration the availability of GO bonds as a potential funding source.

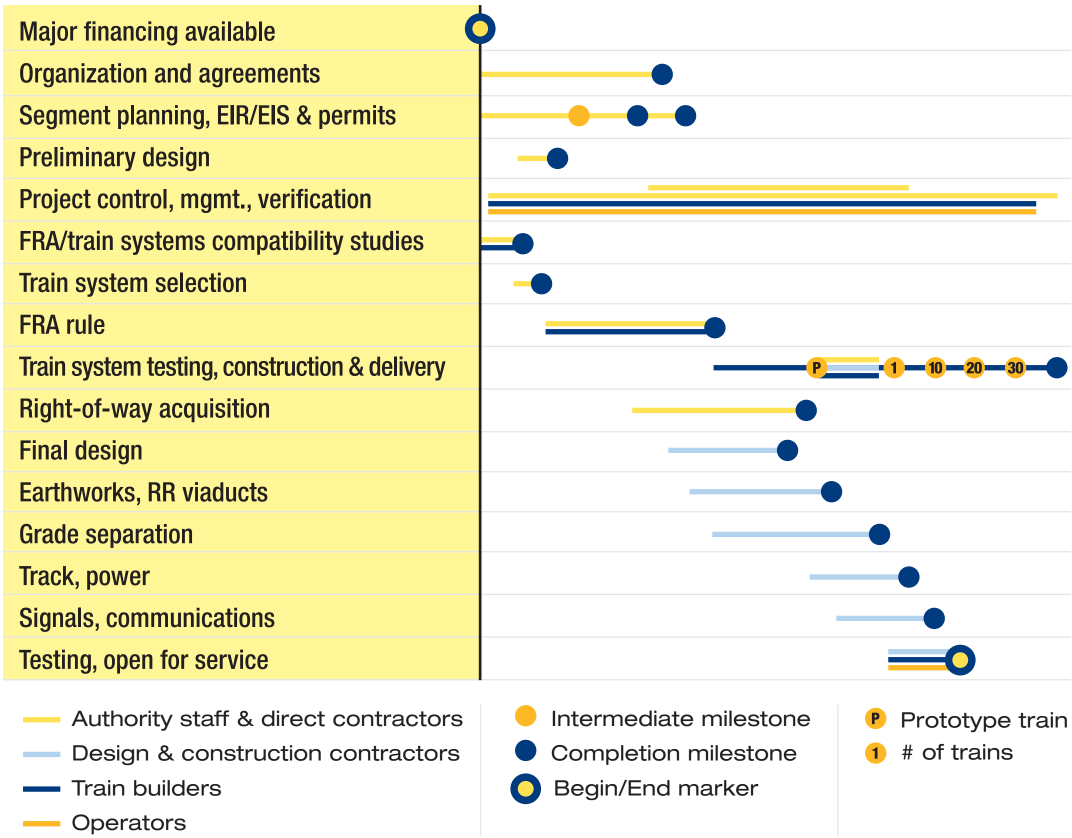
(3) see **Endnotes**

3.6
Overview of Sample Schedule

It will take from eight to 11 years to develop and begin operation of an initial segment. The schedule below illustrates the sequencing of major tasks, assuming that the Authority chooses a specific supplier of high-speed train technology as an early action. Each of the line items is briefly discussed on the following pages.

SAMPLE SCHEDULE

Figure 3.7



Major Financing Available

Completion of planning for the high-speed train system, program-level environmental impact reviews and FRA/high-speed train systems compatibility studies can be accomplished with annual appropriations until major financing is available. However, a significant portion of the funding for the first segment of the high-speed train will have to be available with a reasonably certain plan to secure the remainder before pre-construction/supply/installation work can begin. Key elements of that work include:

- bids from train systems suppliers
- specific FRA rules to govern the system and operations at planned speeds over 150 mph
- preliminary design of the alignment, structures, stations and facilities
- project-specific environmental review
- bids for final design and construction of the high-speed train.

The most likely sources are the state bond referendum placed on the ballot by the California Legislature and federal matching funds.

Organization and Agreements

Critical to the success of the high-speed train system are: institutional development of the Authority, selection of project management and other consultants, agreements with significant stakeholders such as railroads and existing rail operators, and establishment of guidelines and agreements for station development. Agreements would be sought with local agencies to maximize infill transit-oriented joint development of station areas. Preliminary agreements with affected railroads and rail operators need to be reached before project-specific EIR/EIS work can progress, with final agreements after the EIR/EIS work and FRA rule-making.

Segment Planning, EIR/EIS & Permits

Project-specific EIR/EIS work supported by preliminary design will require one to two years to reach a draft EIR/EIS, followed by a final EIR/EIS and agency sign-off six to12 months later. Major permits from federal and state agencies would follow six to 12 months after that.

Preliminary Design

Preliminary design constitutes 15 to 30 percent of the total design required for a segment and is required to support the EIR/EIS, permitting, agreement and right-of-way acquisition.

Project Control, Management and Verification

The Authority must systematically control schedules, costs and system configuration as preliminary design and the EIR/EIS work are undertaken. As design and construction proceed, project management responsibilities grow along with quality control and construction inspection workload. Train and systems suppliers and future operators would have a formal role at this point. Rolling stock acceptance, warranty and project wrap-up extend beyond the start of service.

FRA/High-Speed Train Systems Compatibility Studies

An early requirement is consultation among the FRA, the Authority and a group of pre-qualified high-speed train manufacturers to investigate how existing high-speed trains and systems might need to be modified for use in California. This work likely would require six months to two years, would result in better-informed and refined bids from manufacturers and likely would shorten the subsequent FRA rule-making.

Train System Selection

The Authority intends to select the high-speed train technology and manufacturer/s as early as practical. Rolling stock specifications are needed for final systems design, and the manufacturer should participate in the oversight of the design and construction of the high-speed train infrastructure.

Thus, it is vital that the Authority has qualified staff and program management contractor/s to develop the appropriate bid requirements and oversee selection of contractors. In the project schedule of this document, the decision on technology is anticipated to be made two to three years after significant financing is secured. Project-specific environmental studies, preliminary engineering, and right-of-way preservation would all begin—and in some cases may be nearing completion—prior to the selection of the high-speed train technology.

An early selection of train and systems suppliers is assumed in this schedule, allowing the setting of final design criteria, finalizing preliminary design issues and allowing for the initiation of FRA rule-making.

Federal Railroad Administration Rule

Rule-making is estimated to require two to three years. The Authority and the selected train systems supplier would confer on issues to be addressed by the rule with the FRA and would consult with other affected rail operators. If the rule can be concluded more rapidly, train system testing, construction and delivery could be accelerated.

Trainset Testing, Construction and Delivery

This task depends on the completion of the FRA rule. Design, construction and testing of the prototype trainset is assumed to require two and one-half years (shown by "P" on the schedule (Figure 3.7)). Testing of a prototype for reliability, performance and compliance with FRA and other requirements is assumed to take one year. After testing of the prototype, six months are assumed before the delivery of the first trainsets, which then are delivered at the rate of one per month. Operations can begin when enough) trainsets are available to start a service. The schedule (Figure 3.7) shows the complete acquisition of 38 trainsets ending two years after the start of service.

Figure 3.8
TGV trains at Avignon station platform

Right–of-Way Acquisition

This task begins after the substantive completion of the environmental work and is expected to require up to three and one-half years. In instances where the right-of-way is already assembled, as in the shared segments and LAUS, this activity will be subsumed into the agreement negotiations, potentially saving a year of time.

Final Design and Construction/ Installation

The schedule assumes that the majority of the work is performed through design/build contracts in which substantial overlap of work will be possible through staging of subsegments by the contractors. Completion of design will require several years, and construction of long tunnels and grade separations will take the longest amount of time and will drive the construction schedule. Depending on the segment, civil works design and construction will require three and one-half to five years. Installation of track, power systems, signaling and other systems are estimated to require up to three years for the longer segments, but because work can start sequentially, it can be completed in only one additional year after the civil works.

Testing, Training and Service Opening

This task can begin after the first segments are completed, with substantial overlap with installation of systems. Service is assumed to begin six months after completing all the necessary facilities in a given segment.

Figure 3.9
Series 700 Shinkansen in Kyoto station

3.7
Next Steps Forward

In the next several years, coordinated action on several fronts will be needed to move the California high-speed train project forward:

Bay Area – Central Valley Program EIR/EIS

Through the programmatic environmental impact review, the Authority has selected preferred alignments and stations from Sacramento through Fresno, Bakersfield, Palmdale, and Los Angeles to Irvine, Riverside and San Diego. Portions of the alignment and the associated stations in the San Francisco Bay Area have been selected, but a preferred alignment is not yet defined to link the Central Valley to the Bay Area. Therefore, the Authority intends to develop a next-tier “Bay Area—Central Valley Program EIR/EIS” in order to identify a preferred alignment.

Statewide Ridership/ Revenue Forecasts

A detailed study of high-speed train ridership and revenue, conducted with the Bay Area Metropolitan Transportation Commission, will update statewide forecasts and determine the effect of specific combinations of alignments and stations between the Bay Area and Central Valley. Statewide ridership forecasts will be available in the first half of 2006.

Prepare Financial Plan

The financial plan will draw upon the results of the ridership and revenue studies, the alignment studies and the cost estimates of preferred alignments as well as developments in state and federal funding.

Develop Authority Staffing Plan and Scope-of-Work For Program Management Team and Select Program Management Team

Over the next several years, the Authority will begin the transition from a small study-oriented agency to a mid-sized flexible construction and operations oversight agency. As explained in the section on institutional structure, the Authority has decided to use a consultant team as program manager to ensure the necessary technical expertise without permanently enlarging state payroll. Before this step is taken, the Authority will develop a detailed organizational plan for the necessary administrative and technical skills to manage the consultants’ work and protect and advance the state’s interest in the project. The Authority will also develop a scope-of-work for the program manager’s contract. Once these steps have been completed, the Authority will then select the program management team by competitive bid.

Pre-Qualify Train System Suppliers and Undertake Joint Industry/FRA Studies

The Authority will identify a group of potential high-speed train system suppliers who can participate in a study with the FRA of how existing high-speed train vehicles and systems might need to be modified for use in California. High-speed train manufacturers will be pre-qualified to compete for future California high-speed train contracts based upon their existing ability to produce very high-speed trains and their willingness to work with the state and federal governments in an open, competitive process.

Project Specific EIR/EIS

At the completion of the program environmental review, implementation would begin with preliminary engineering and project-level environmental review to assess potential environmental impacts not already addressed in the Program EIR/EIS.

Project-level environmental review would focus on a portion of the proposed high-speed system and would provide further analysis of potential impacts and issues at an appropriate site-specific level of detail in order to obtain needed permits and to implement segments of the high-speed train system.

Figure 3.10 below shows the estimated cost to construct major segments where a preferred alignment has been chosen as well as a range of estimated costs for performing the necessary preliminary engineering and project-level environmental review. *(4)*

CAPITAL AND PROJECT LEVEL ANALYSIS COST ESTIMATES

SEGMENT	LENGTH (miles)	CAPITAL COST	ENGINEERING AND PROJECT-LEVEL EIR/EIS COST
Fresno to Bakersfield	116	$3,100	$31 - $46
Bakersfield to Palmdale	84	$3,900	$39 - $58
Palmdale to Los Angeles	61	$4,800	$48 - $72
Los Angeles to Irvine	43	$2,300	$23 - $34
Los Angeles to Riverside	66	$2,900	$29 - $43
Riverside to Mira Mesa	74	$4,000	$40 - $60
Mira Mesa to San Diego	19	$1,200	$12 - $18

Figure 3.10 (FIGURES IN MILLIONS, 2003 $$)

Right-of-Way Preservation

For the portions of the line where a general alignment has been selected, the Authority will conduct assessments to identify segments at risk of imminent development or other changes in use that could significantly increase implementation costs and difficulty. In conjunction with other state and local agencies, the Authority will develop a plan for protective advance acquisition consistent with state and federal requirements and available funds. As each project-level EIR/EIS is approved and normal acquisition is permitted, the Authority will conduct a similar review to prioritize the use of acquisition funds. All acquisitions will conform with the Federal Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, as amended.

The Authority also will seek to reach agreement on terms of access to shared rights-of-way with rail line owners and operators, shared capital and operating costs, types of improvement required to maintain existing operations while allowing high-speed train operations, and other critical matters such as liability indemnification, insurance requirements, and other legal and operational matters.

(4) see **Endnotes**

4.1
Endnotes

(1) – *page 24*

The "net contribution" or "net revenue from operations" or "operating surplus" is calculated as the difference between ticket revenues (on-board food purchases, sale of advertising space, station concessions and the like are generally a separate profit/loss center) and costs of operation: items such as driver and crew costs, including benefits, insurance and other overhead; fuel and electricity; maintenance of track, structures, signaling, power supply lines and stations; maintenance and overhaul of trainsets, locomotives and coaches, including replacement parts; station operations; commissions on ticket sales; ticket taxes, where applicable; personnel and administration. Where other services use track or other facilities, there may be a sharing of the cost with that other service. These costs do not include depreciation, amortization, interest payments, income taxes or opportunity costs of capital. High-speed train operators typically report revenues two to two and one-half times the operations costs.

(2) – *page 24*

The first TGV line between Paris and Lyon is reported by the French National Railway to have covered its cost of construction and trainset acquisition (around $2 billion in then current U.S. dollars) in less than 10 years, including depreciation and interest payments. As a quasi-government company, the French National Railway pays no income tax. This reported profit contrasts with the full non-TGV network, which is reported to require significant subsidy for freight operations, local light-density services, regional commuter services and slower conventional long-haul trains.

(3) – *page 25*

The Authority is working in cooperation with the MTC on statewide high-speed train ridership forecasts.

(4) – *page 30*

The estimated total capital costs (in 2003 dollars) for each of the corridor segments of the Authority's preferred system cover all aspects of implementation, including construction, rights-of-way, environmental mitigation, and design and management services. Construction costs include procurement and installation of line infrastructure (tracks, bridges, tunnels, grade separations and power distribution); facilities (passenger stations, storage and maintenance facilities); systems (communications, train control); and removal or relocation of existing infrastructure (utilities, rail tracks). The right-of-way costs are for acquisition of property. The environmental mitigation costs include a rough estimate of the proportion of capital costs required for mitigating environmental impacts based on similar completed highway and rail line construction projects. No specific mitigation costs are identified at the program level of review. Other implementation costs are included as estimated add-on percentages to construction costs to account for agency costs associated with administration of the program (design, environmental review and management).

Rough order of magnitude costs are also estimated for the project-level environmental review and associated preliminary engineering for each corridor segment. These costs are based on approximately one percent of the estimated capital costs for each segment; however, the costs may vary (up to 1.5%) according to the level of construction complexity (e.g., amount of tunnels, structures, etc.). These percentages are typical of large transportation projects.

5.1

Sources for figure 3.6, page 24

Tokaido Shinkansen

Construction and acquisition costs as reported in multiple English language sources based on original budgets, and clarified by JNR Vice President of Engineering1955-1963: Shima, Hideo, "Birth of the Shinkansen – A Memoir", Japan Railway and Transport Review, October 1994, pp 45-48. Operations, ridership, and revenue data derived from various sources including extensive interviews with senior JNR staff reported in Matthieu, Gérard, "High Speed in Japan: Accomplishments and Future", unpublished paper, SNCF, Paris, France, April 1992; JARTS, "The Shinkansen", Tokyo, Japan, 1979.

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