6 PROJECT COSTS AND OPERATIONS

Since publication of the Draft Environmental Impact Report (EIR)/Environmental Impact Statement (EIS), the following substantive changes have been made to this chapter:

- Table 6-1, Capital Cost of the High-Speed Rail Alternatives (2021$ millions), was updated to reflect design changes in the Preliminary Engineering for Project Definition (PEPD) Draft Set Capital Cost Estimate Report provided in Appendix 6-A. The updated appendix and table reflect escalated costs to 2021 dollars.
- In Section 6.2.2, Maintenance of Way Facilities and Sidings, cross-references to Sections 2.4.11.1, Maintenance of Way Facility, and 2.4.11.2, Maintenance of Way Siding, were added to provide more detail on lighting at these types of facilities.
- A note was added to Table 6-2 to state that the Valley-to-Valley service operational date was refined from 2029 to 2031 in the California High-Speed Rail Authority's (Authority) 2020 Business Plan (Authority 2021).

6.1 Introduction

This chapter discusses the estimated costs for building, operating, and maintaining the San Jose to Central Valley Wye Project Extent (project extent or project), based on a preliminary level of design used in preparing this Final EIR/EIS. For the approach and details used to prepare the capital cost estimates, refer to the project-level *San Jose to Merced Project Section: PEPD Record Set Capital Cost Estimate Report* in Appendix 6-A. As stated in that report, the construction cost estimates were developed for each alternative based on the PEPD design plans, which are the same plans used in this Final EIR/EIS. Additional details are provided in Volume 2 of this Final EIR/EIS and include:

- Appendix 2-C, *Operations and Service Plan*, provides background information on the intended service and operations of the California High-Speed Rail (HSR) System at sufficient detail for the environmental assessment of proposed HSR operations.
- Appendix 6-A, *San Jose to Merced Project Section: PEPD Record Set Capital Cost Estimate Report*, presents the capital cost estimating methodology and summary of capital cost estimates.
- Appendix 6-B, *High-Speed Rail Operating and Maintenance Cost for Use in EIR/EIS Project-Level Analysis*, summarizes the assumptions used to estimate full system HSR operations and maintenance (O&M) costs.

The following sections discuss capital and O&M costs.

6.2 Capital Costs

Capital costs represent the total cost associated with the design, management, land acquisition, and construction of the HSR system. The estimated long-term O&M costs include both train operations and infrastructure maintenance. To evaluate and compare project capital costs, the Authority has developed 10 main standardized capital cost categories (SCC). Each standard cost category is briefly described as follows:

- **10 Track Structures and Track**—Includes elevated structures (bridges and viaducts); embankments and open cuts; retaining-wall systems; tunnels, culverts, and drainage; track (ballasted and nonballasted); and special trackwork
- **20 Stations, Terminals, Intermodal**—Includes rough grading, excavation, station structures, enclosures, finishes, and equipment; mechanical and electrical components, including heating, ventilation, and air-conditioning; station power, lighting, and public address/customer information systems; station site elements, such as pedestrian/bike access and accommodation; landscaping for parking lots; automobile, bus, and van access ways,

including roads; and safety systems, such as fire detection and prevention, security surveillance, access control, and life safety systems

- **30 Support Facilities: Yards, Shops, Administration, Buildings**—Includes HSR train service, inspection, and storage; heavy maintenance and overhaul facilities; and storage equipment, associated yard tracks, and electrification. This category also includes maintenance-of-way facilities
- **40 Sitework, Right-of-Way, Land, Existing Improvements**—Includes cost of demolition, hazardous materials removals, environmental mitigation, utility relocations, noise mitigation, intrusion protection, grade separations, roadway improvements, acquisition of real estate, and temporary facilities and other indirect costs
- **50 Communications and Signaling**—Includes all costs associated with implementing automatic train control systems, including positive train control and intrusion detection where it is applicable
- **60 Electric Traction**—Includes costs of traction power supply system (e.g., supply, paralleling, and switching substations); connections to the power utilities; and the traction power distribution system in the form of the overhead contact system
- **70 Vehicles**—Includes costs for acquisition of the trainsets (design, prototype unit, and production and delivery of trainsets to the project site[s] on an annual basis); acquisition of trainsets is considered a systemwide cost and is not included as part of the cost of individual HSR study alternatives
- **80 Professional Services**—Includes all professional, technical, and managerial services related to the design and construction of infrastructure (SCC 10–60) during the preliminary engineering, final design, and construction phases of the project/program (as applicable)
- **90 Unallocated Contingency**—Includes program reserves
- **100 Finance Charges**—Includes finance charges expected to be paid by the project/program/sponsor/grantee prior to either the completion of the project/program or the fulfillment of the Federal Railroad Administration funding commitment, whichever occurs later in time (not included in the estimate)

6.2.1 High-Speed Rail Alternatives

The Authority developed the conceptual level cost estimates prepared for each of the project alternatives using recent bid data from large transportation projects in the western United States and by developing specific, bottom-up unit pricing to reflect common HSR elements and construction methods with an adjustment for regional labor and material costs in the project extent. The engineers estimated all material quantities for the project based on preliminary level of design. The Authority generally defines this level of design as encompassing at-grade, below-grade, or elevated profiles; structure types, placement of retaining walls, and amounts of earth fill. Stations are still conceptual, but roadway and utility relocations have been identified and any necessary power substations have been sized and located.

The capital cost estimates include the total labor and materials to build the project, including the track structures, stations, support facilities, communications and signaling, electric traction and any necessary utility relocations, upgrades, and roadway modifications. The capital cost estimates reflect all related project improvements but do not include costs associated with the No Project Alternative.

The SCC 40 estimated costs include right-of-way, property acquisition, and environmental mitigation. Right-of-way costs were estimated based on the preliminary design and are documented in Appendix 6-A. However, as the design of the project is refined, the right-of-way limits would be reassessed to reflect refined property acquisition needs. As a result, property acquisition costs are estimated in broad categories (i.e., urban, suburban, and rural and by land use density level) and based on local land values rather than relying on a parcel-by-parcel

assessment at this phase of project development. Right-of-way costs include the estimated cost to acquire properties needed for the future right-of-way, as well as costs associated with temporary easements for construction that are assumed to be part of the construction contractor's responsibility to negotiate for use. Environmental mitigation costs are estimated at approximately 3 percent of the capital cost, given potential project impacts and typical mitigation costs in the region (Appendix 6-A).

The capital cost estimates for the project alternatives do not include the cost of acquiring HSR vehicles (SCC 70) because the vehicles would be part of the statewide system and are not associated with constructing individual project sections. Consistent with the Authority's *2018 Business Plan: Connecting California, Expanding Economy, Transforming Travel* (2018 Business Plan) (Authority 2018a), the cost of vehicles was determined using publicly available data regarding recent sales of comparable equipment to other HSR projects around the world. Additional costs are included for adaptation of existing trainset designs to meet U.S. safety regulations and to comply with "Buy America" requirements.[1] The systemwide cost of vehicle procurement is divided into two milestones: (1) Silicon Valley to the Central Valley and (2) Phase 1, which extends from San Francisco in the north to Anaheim in the south. Vehicle procurement cost is estimated at $4.5 billion in 2017 dollars for the complete Phase 1 system.

Professional services (SCC 80) represent the cost of engineering, project construction and management, contract administration, permits and fees, and training/startup/testing. These costs are estimated at 15.5 percent of the construction costs divided between preliminary engineering (2 percent), program management (3 percent), final design (6 percent), construction management (4 percent), and agency costs (0.5 percent). In addition, an allowance for system startup and pre-revenue testing is added to the professional services cost category in the amount of 6 percent of the train controls, communications, and electrification construction costs.

At this early stage of design, the capital cost estimates include contingencies to account for changes in material costs and changes during project design. Currently, allocated contingencies (i.e., money reserves assigned to each cost category to cover risks associated with design uncertainty) are assumed to be between 10 percent and 25 percent of the estimated construction and right-of-way acquisition costs, and unallocated contingency (i.e., project reserves intended to cover unknown risks) is estimated at 5 percent of the construction and right-of-way acquisition costs (Appendix 6-A).

Finance charges, or the cost of borrowing money, would be included in SCC 100 but have not been estimated at this phase of project development. These costs will be developed prior to the start of construction after the Authority's construction bonds are sold.

Table 6-1 shows the capital cost estimates for each project alternative for the San Jose to Central Valley Wye Project Extent. Project costs were updated in Table 6-1 and Appendix 6-A to reflect the engineering and design refinements that were incorporated into the alternatives and to reflect escalated costs to 2021 dollars. The alternative alignments range in distance from 87.3 to 88.9 miles and are estimated to have construction costs between approximately $18,993 million and $28,698 million (2021$).

Table 6-1 Capital Cost of the High-Speed Rail Alternatives (2021$ millions)

Standard Cost Categories[1, 2]	Alternative 1	Alternative 2	Alternative 3	Alternative 4
10 Track structures and track	$16,383	$11,744	$16,644	$9,870
20 Stations, terminals, intermodal	$882	$875	$931	$786

[1] Buy America requirements apply to mass transit projects and give preference to the use of domestically produced materials on any procurements funded at least in part by federal funds. Administered by the Federal Transit Administration, the requirements are described at 49 Code of Federal Regulations 661.

Standard Cost Categories[1, 2]	Alternative 1	Alternative 2	Alternative 3	Alternative 4
30 Support facilities: yards, shops, administration, buildings	$255	$255	$299	$279
40 Sitework, right-of-way, land, existing improvements	$5,503	$7,589	$5,413	$4,201
50 Communications and signaling	$332	$345	$330	$3837
60 Electric traction	$674	$689	$671	$642
70 Vehicles	Considered a systemwide cost and not included as part of individual project section alternatives			
80 Professional services (applies to Categories 10–60)	$3,310	$2,709	$3,402	$2,222
90 Unallocated contingency[4]	$995	$873	$1,007	$658
100 Finance charges	Estimate to be developed prior to project construction			
Total capital costs[13]	$28,334	$25,079	$28,698	$18,993

Totals may not sum due to rounding.
[1] Capital cost estimates exclusive of all costs for standard capital cost (SCC) categories 70 Vehicles and 100 Finance charges.
[2] Project construction costs were updated to reflect design changes in the PEPD and to reflect 2021 dollars.
[3] The capital costs for all four alternatives include the costs associated with the tunnel design variant. The capital costs for Alternative 4 also include the costs associated with the Diridon design variant.
[4] All cost categories include allocated contingencies. Category 90 Unallocated contingency, is only unallocated monies.

6.2.2 Maintenance of Way Facilities and Sidings

O&M of the HSR system would require construction of maintenance facilities along the alignment. A maintenance of way facility (MOWF) provides storage of infrastructure inventory as well as stockpile areas for ballast and other bulk materials. MOWFs provide for dispatch, maintenance, and repair of rail-mounted equipment and include support quarters for maintenance personnel. The MOWF would occupy a linear site adjacent to the HSR mainline tracks (rail side unloading dock as well as 1,600 feet of train storage) with a maximum width of seven tracks (six yard tracks plus one siding track). It would be approximately 0.75 mile long, encompassing approximately 50 to 75 acres, depending on the alternative. While most access would be by rail, MOWFs would also provide road-rail vehicle access locations. Security fencing 8 to 15 feet high and (depending on local conditions) a noise barrier 20 to 40 feet high would enclose the site. The site would be staffed by 75 to 150 personnel with continuous 24-hour operation; however, nighttime hours (9:00 p.m. to 7:00 a.m.) would be busiest, with deployment of rail-mounted equipment. Pole-mounted floodlights 50 to 100 feet tall would provide lighting for buildings, pathways, and trackwork. Lighting at this type of facility is described in more detail in Section 2.4.11.1, Maintenance of Way Facility. The South Gilroy MOWF is described in more detail in Chapter 2, Section 2.6.2.5, Alternative 1, and the East Gilroy MOWF is described in more detail in Chapter 2, Section 2.6.2.7, Alternative 3.

A maintenance of way siding (MOWS) would be built in the San Joaquin Valley Subsection west of Turner Island Road in the Central Valley. The MOWS would occupy an approximately 4-acre linear site adjacent to the HSR mainline tracks, with one 1,600-foot siding track and a 200-foot tail track. The MOWS would provide sufficient storage for on-track equipment required to be placed prior to the beginning of overnight maintenance access. The MOWS near Turner Island Road would support maintenance activities by providing a location for equipment and temporary storage of materials such as ballast and other bulk materials, as well as secured storage for nonbulk materials. The storage of materials at the MOWS would reduce worker travel time to and from maintenance locations, thereby enhancing the efficiency and productivity of these activities. The site would be secured with keypad access. Like activity cycles at the MOWFs, MOWS operations would be more active at night, with 30 to 40 staff members. Nighttime lighting would include perimeter lighting as well as floodlights for buildings, pathways, and trackwork. Lighting at this type of facility is described in more detail in Section 2.4.11.2, Maintenance of Way Siding.

Emergency access to this facility would parallel the canal west of Turner Island Road, south of Henry Miller Road. The MOWS is described in more detail in Chapter 2, Section 2.6.2.2, Summary of Design Features.

6.3 Operation and Maintenance Costs

The estimated long-term O&M costs include both train operations and infrastructure maintenance. Operations costs address labor, electrical power, and other aspects required to keep the HSR system in service. Maintenance costs include routine servicing of vehicles and maintenance of the tracks, signals, communications, and other systems needed to keep the system safe and reliable.

Chapter 2, Alternatives, describes O&M activities in detail. The Phase 1 system would operate the HSR trains on approximately 520 miles of track by 2040. Phase 1 would include 13 HSR stations serving the system; San Jose and Gilroy are the station cities in the project extent. Additional facilities would be required for overnight storage, inspection, and routine maintenance of more than 78 trainsets, each nearly 660 feet long. A heavy maintenance facility, serving the entire HSR system, would be located between Merced and Bakersfield. The heavy maintenance facility would store and maintain some of the trainsets. MOWFs would also be required along the railroad right-of-way approximately every 100 miles.

O&M costs account for staff labor and material supplies required to run the HSR system and to perform required maintenance. O&M costs are based on daily rail miles, operational speeds, HSR station configurations, maintenance and storage facilities, and operating frequencies in accordance with the 2018 Business Plan (Authority 2018a).

6.3.1 Operating Speeds

The HSR system would operate at high speeds (up to 220 miles per hour) along fully grade-separated, dedicated portions of the project extent. Under Alternative 4, the maximum speed would be 110 miles per hour in those portions of the HSR alignment that support blended operations.

6.3.2 Development of Operation and Maintenance Costs

An important goal of the Authority's business plan is to achieve a balance between O&M costs and projected farebox revenues as proof of the requirements mandated by Proposition 1A, the Safe, Reliable, High-Speed Passenger Train Bond Act, adopted by California voters in November 2008. The Authority has continued to refine its O&M cost model to reflect a more accurate cost basis for the program's current level of detail.

O&M cost estimates include operations activities needed to serve and carry the forecast train service for Phase 1 in 2040 for the medium and high ridership scenarios as described in Section 2.7.1, Ridership, of Chapter 2, the maintenance costs necessary to keep the system in a state of good repair, and administrative costs (Appendix 6-B). The estimated O&M costs in this chapter are based on the Authority's 2018 Business Plan. The current HSR O&M model is based on cost categories defined in the U.S. Department of Transportation Inspector General's *HSIPR [High-Speed Intercity Passenger Rail] Best Practices: Operating Costs Estimation* report (USDOT 2011), where applicable. The report defines the general parameters for estimating the preliminary, intermediate, final, and commercial closeout stages of a program. No program falls neatly into all of these parameters and there is usually some overlap between the stages. In this context, large parts of the Authority's O&M cost model fall into the intermediate stage, while others might be classified as preliminary and still others may have advanced to the final stage (USDOT 2011).

The O&M cost of HSR equipment includes the cost of (1) crew, administration, and supplies to operate and dispatch the HSR services; (2) electric power for traction, onboard systems, stations, and maintenance/other facilities; and (3) cleaning, inspection, maintenance, and overhaul of the trainsets.

Maintenance of infrastructure covers the expense of patrolling, inspecting, and maintaining the right-of-way, fencing, structures, bridges, tunnels, roadbed, track, signaling, overhead contact

systems, substations and similar electrical facilities, communications, intrusion detection, and facilities.

Station O&M costs include the day-to-day operations of the station, ticket sales and machine maintenance, public safety, passenger handling, and cleaning. Insurance, administration, and contingency costs round out the categories of the O&M costs presented. For a more detailed discussion of how O&M costs were derived, please refer to Appendix 6-A. Station staffing assumes the following job categories:

- Station manager
- Ticket clerk/customer service representative
- Sworn and unsworn security
- Station and train cleaning
- Frontline supervisors

The O&M cost model includes the following categories of O&M costs:

- Train operations
- Dispatching
- Maintenance of equipment
- Maintenance of infrastructure
- Station and train cleaning
- Police and security positions
- Commercial costs and functions
- General administrative activities
- Insurance
- Unallocated contingency

The 2018 Business Plan updated the O&M cost model with the latest available information on socioeconomic forecasts, transit network plans, auto travel time, auto operating costs, parking costs, and operations planning (reflecting updated trip times, station assumptions and frequency and patterns of service). It also included an enhanced risk analysis relevant to the ridership and farebox revenue forecasts based on feedback received on the 2016 Business Plan forecasts (Authority 2016).

Table 6-2 shows the revenue and O&M costs at the key implementation phases for the Medium Scenario[2] from the 2018 Business Plan.[3] These forecasts demonstrate that the farebox revenue is expected to cover O&M costs. For example, in 2029 Phase 1 revenues would exceed annual O&M costs by $584 million, while by 2040 revenues would exceed annual O&M costs by $1,427 million (2017$).

[2] The Authority's 2018 O&M cost model produced medium (base case) and high forecasts to represent a range of future system operating costs. For additional detail, please refer to Appendix 6-A in Volume 2 of this Final EIR/EIS and to the Authority's *2018 Business Plan: Technical Supporting Document Operations and Maintenance Cost Model Documentation* (Authority 2018b).

[3] The Authority's 2018 Business Plan, adopted in June 2018, includes updated O&M costs. It states that "operations and maintenance costs in all scenarios are minimally impacted by the changes made since the 2016 Business Plan" (2018 Business Plan, chapter 7, p. 96). The Authority released a Draft 2020 Business Plan in February 2020 for public review and comment. Due to uncertainty from the ongoing COVID-19 pandemic, the Draft 2020 Business Plan final adoption was extended by the Newsom Administration and legislative leadership to April 15, 2021. A Revised Draft Business Plan was issued on February 9, 2021. The plan was adopted by the Authority Board of Directors on Thursday, March 25, and submitted to the Legislature on Monday, April 12, 2021. The Revised 2020 Business Plan forecasts were developed using the same travel forecasting model as the 2016 and 2018 Business Plans, updated for population and employment forecasts. The Phase 1 medium ridership forecast for 2040 is 38.6 million, and the high is 50.0 million.

Table 6-2 Medium Scenario Revenue and Annual O&M Costs

	Valley to Valley 2029[1]	Phase 1 2029	2040
Farebox revenue (2017$ millions)	$334	$1,380	$2,374
O&M Costs (2017$ millions)	$255	$796	$947

Source: Authority 2018a
O&M = operations and maintenance
[1] The Authority's 2020 Business Plan assumes a similar phased implementation strategy for Phase 1 of the HSR system, although the Valley-to-Valley service operational date was refined from 2029 to 2031 (Authority 2021).