

5.0 Project Costs and Operations

5.1 Introduction

This chapter discusses the estimated costs for building, operating, and maintaining the Fresno to Bakersfield Section of the California HST System, based on a 15% level of design used in preparing this Draft EIR/EIS. The approach and details used to prepare the construction cost estimate are provided in the *Fresno to Bakersfield Section Cost Estimate Report* (Authority and FRA 2011a), which is available upon request from the Authority.

5.2 Capital Costs

Capital costs represent the total cost associated with the design, management, land acquisition, and construction of the HST system. The estimate of long-term operations and maintenance (O&M) costs include both train operations and infrastructure maintenance. Operations consists of labor costs, electrical power, and other factors required to keep the HST in service, whereas maintenance includes routine servicing of vehicles, maintenance of the tracks, signals, communications, and other systems needed to keep the system safe and reliable.

To help evaluate and compare project construction costs, FRA and the Authority have developed 10 main Standardized Capital Cost Categories (SCCC). Each standard cost category is briefly further described below:

- **10 Track Structures & Track** – includes elevated structures (bridges and viaducts), embankments and open cuts, retaining wall systems, tunnels, culverts and drainage, track (ballasted and non-ballasted), and special trackwork.
- **20 Stations, Terminals, Intermodal** – includes rough grading, excavation, station structures, enclosures, finishes, equipment; mechanical and electrical components including HVAC, station power, lighting, public address/customer information systems; and safety systems such as fire detection and prevention, security surveillance, access control, life safety systems, etc.
- **30 Support Facilities: Yards, Shops, Administration. Buildings** – includes rolling stock service, inspection, storage, heavy maintenance and overhaul facilities and equipment, as well as associated yard tracks and electrification. In addition, maintenance-of-way facilities are also included in this cost category.
- **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 & Signaling** – includes all costs of implementing Automatic Train Control (ATC) systems, inclusive of Positive Train Control (PTC) and intrusion detection where it is applicable.
- **60 Electric Traction** – includes costs of traction power supply system including supply, paralleling, and switching substations as well as connections to the power utilities; traction power distribution system in the form of Overhead Contact System (OCS).
- **70 Vehicles** – includes costs for acquisition of the trainsets (design, prototype unit, and production and delivery of trainsets to the project site on annual basis). Acquisition of

trainsets is considered a system wide cost and is not included as part of the cost of individual HST study alternatives.

- **80 Professional Services** – includes all professional, technical, and management services related to the design and construction of infrastructure (Categories 10 through 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 or the fulfillment of the FRA funding commitment, whichever occurs later in time (not included in the estimate).

5.2.1 High-Speed Train Alternatives

The conceptual HST cost estimates prepared for each of the study alternatives were developed by utilizing recent bid data from large transportation projects in the western United States and by developing specific, bottom-up unit pricing to reflect common high-speed rail elements and construction methods with an adjustment for Central Valley labor and material costs. All material quantities are estimated based on a 15% level of design for the Fresno to Bakersfield Section. This level of design has generally defined at-grade or elevated profiles, structure types, placement of retaining walls, and earth fill. HST stations are still conceptual, but roadway and utility relocations have been designed, and power substations have been sized and located.

The costs include the total effort and materials to construct the Fresno to Bakersfield Section, including modifications to roadways required to accommodate HST grade-separated guideways. It should be noted that the capital cost estimate reflects only HST-related infrastructure improvements and does not include costs associated with the No Project Alternative.

Right-of-way costs were estimated based on the 15% design and are provided in the *Fresno to Bakersfield Section Preliminary Right-of-Way Requirements Report* (Authority and FRA 2011b). However, as the design of the project evolves, the right-of-way limits will 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 density level) 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 HST right-of-way but do not include costs associated with temporary easements for construction that are assumed to be part of allocated contingencies added to right-of-way acquisition costs.

These costs do not include acquiring HST vehicles because they are part of the statewide HST System and are not associated with constructing individual sections. Consistent with the 2009 Report to the Legislature (Authority 2009), the cost of vehicles was determined by using publically available data regarding recent sales of comparable equipment to other HST projects around the world and by informally consulting with manufacturers. The systemwide cost of vehicle procurement is divided into two parts: opening day demand (assumes 60 trainsets in 2020) and optional orders, which accommodate the demand for increases in ridership (assumes 40 trainsets between 2025 and 2035). Total vehicle costs, including vehicles needed for opening day service and optional orders, is estimated at \$3.3 billion in year-of-expenditure dollars.

Professional services are estimated at 13.5% of the construction costs and include final design (6%), construction management (4%), program management (3%), and agency costs (0.5%). Environmental mitigation costs are based on similar estimates, with approximately 3% of the

capital cost required to mitigate environmental impacts, considering potential project impacts and typical mitigation costs in the region.

At this stage of design, many project features have not been fully developed; therefore, early cost estimates include contingencies to account for changes in material costs and changes during project design. Currently, allocated contingencies (money reserves assigned to each cost category to cover risks associated with design uncertainty) are assumed between 10% and 25% of the estimated construction and right-of-way acquisition costs, while unallocated contingency (project reserve intended to cover unknown risks) is estimated at 5% of the construction and right-of-way acquisition costs.

Table 5.2-1 shows estimates for each alternative from the Fresno station to the Bakersfield station. There are two station alternatives in Fresno, one fronting Mariposa Street and the other fronting Kern Street. It is estimated that construction of the Kern Street station alternative would cost approximately \$27 million more than the Mariposa Street station alternative. For purposes of the table, the cost estimates for the alternatives use the Mariposa Street station alternative.

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Table 5.2-1
Capital Cost of the HST Alternatives

FRA Standard Costs Categories Base Year FY 2010 Dollars (millions)	Alternatives (See footnote at end of table for numbered alternative descriptions)																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
10 Track Structures & Track	\$2,638	\$2,887	\$2,608	\$2,620	\$2,473	\$2,577	\$2,869	\$2,722	\$2,826	\$2,676	\$2,808	\$2,615	\$2,661	\$2,590	\$2,443	\$2,547	\$2,397	\$2,529	\$2,336	\$2,382	\$2,427	\$2,559	\$2,366	\$2,412
20 Stations, Terminals, Intermodal	\$300	\$300	\$300	\$300	\$300	\$300	\$300	\$300	\$300	\$300	\$300	\$300	\$300	\$300	\$300	\$300	\$300	\$300	\$300	\$300	\$300	\$300	\$300	\$300
30 Support Facilities: Yards, Shops, Admin. Bldgs.	See Table 5.2-2 Cost for Heavy Maintenance Facilities Alternatives.																							
40 Sitework, Right-of-Way, Land, Existing Improvements	\$2,255	\$2,153	\$2,149	\$2,099	\$2,116	\$2,269	\$1,997	\$2,014	\$2,167	\$1,859	\$2,011	\$1,873	\$2,028	\$1,993	\$2,010	\$2,163	\$1,855	\$2,007	\$1,869	\$2,024	\$1,961	\$2,113	\$1,975	\$2,130
50 Communications & Signaling	\$195	\$195	\$196	\$195	\$193	\$194	\$195	\$193	\$194	\$193	\$194	\$192	\$192	\$196	\$194	\$195	\$194	\$195	\$193	\$193	\$193	\$194	\$192	\$192
60 Electric Traction	\$638	\$638	\$639	\$637	\$632	\$638	\$637	\$632	\$638	\$631	\$637	\$631	\$632	\$638	\$633	\$639	\$632	\$638	\$632	\$633	\$631	\$637	\$631	\$632
70 Vehicles	Considered a systemwide cost and not included as part of individual HST study alternatives																							
80 Professional Services (applies to Cats. 10-60)	\$726	\$748	\$710	\$702	\$684	\$715	\$724	\$706	\$737	\$679	\$713	\$668	\$695	\$686	\$668	\$699	\$641	\$675	\$630	\$657	\$657	\$691	\$646	\$673
90 Unallocated Contingency	\$259	\$266	\$254	\$251	\$245	\$257	\$258	\$252	\$264	\$243	\$256	\$241	\$250	\$246	\$240	\$252	\$231	\$244	\$229	\$238	\$236	\$249	\$234	\$243
100 Finance Charges	Estimate to be developed prior to project construction.																							
Total	\$7,011	\$7,187	\$6,856	\$6,804	\$6,643	\$6,950	\$6,980	\$6,819	\$7,126	\$6,581	\$6,919	\$6,520	\$6,758	\$6,649	\$6,488	\$6,795	\$6,250	\$6,588	\$6,189	\$6,427	\$6,405	\$6,743	\$6,344	\$6,582
*All cost estimates based of Fresno Station-Mariposa Alternative. **A combination of ballasted and non-ballasted track forms may be implemented and could result in cost increase of less than 5%. Acronyms and Abbreviations: Admin Bldgs = Administration Buildings Cats. = Categories FRA = Federal Railroad Administration FY = Fiscal Year HST = high-speed train Alternative Numberings: Each alternative combination was given a different number. Listed below is every single possible combination that may occur from the proposed alignment and alternatives. If an alternative alignment is not mentioned than the BNSF alternative is being used. 1. BNSF only 2. Corcoran Elevated 3. Corcoran Bypass 4. Allensworth Bypass 5. Wasco Shafter Bypass 6. Bakersfield South 7. Corcoran Elevated and Allensworth Bypass 8. Corcoran Elevated and Wasco Shafter Bypass 9. Corcoran Elevated and Bakersfield South 10. Corcoran Elevated and Allensworth Bypass and Wasco Shafter Bypass												11. Corcoran Elevated and Allensworth Bypass and Bakersfield South 12. Corcoran Elevated and Allensworth Bypass and Wasco Shafter Bypass and Bakersfield South 13. Corcoran Elevated and Wasco Shafter Bypass and Bakersfield South 14. Corcoran Bypass and Allensworth Bypass 15. Corcoran Bypass and Wasco Shafter Bypass 16. Corcoran Bypass and Bakersfield South 17. Corcoran Bypass and Allensworth Bypass and Wasco Shafter Bypass 18. Corcoran Bypass and Allensworth Bypass and Bakersfield South 19. Corcoran Bypass and Allensworth Bypass and Wasco Shafter Bypass and Bakersfield South 20. Corcoran Bypass and Wasco Shafter Bypass and Bakersfield South 21. Allensworth Bypass and Wasco Shafter Bypass 22. Allensworth Bypass and Bakersfield South 23. Allensworth Bypass and Wasco Shafter Bypass and Bakersfield South 24. Wasco Shafter Bypass and Bakersfield South												

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5.2.2 Heavy Maintenance Facility

Another project component of the Central Valley portion of the HST System is the construction and operation of an HMF. Four sites are under consideration for the HMF between the cities of Fresno and Bakersfield. Table 5.2-2 lists the projected costs for these design options, including connecting tracks and infrastructures. The costs for the HMF alternatives are estimated based on conceptual site and functional layouts and the unit costs for comparable rail equipment, maintenance, and storage facilities.

Table 5.2-2
Cost for Heavy Maintenance Facilities Alternatives

FRA Standard Cost Categories Base Year FY 2010 Dollars (thousands)	Heavy Maintenance Facility (Adjacent Site Alternatives)
10 Track Structures & Track	\$32,000
20 Stations, Terminals, Intermodal	0
30 Support Facilities: Yards, Shops, Admin. Bldgs.	383,000
40 Sitework, Right Of Way, Land, Existing Improvements	64,000
50 Communications & Signaling	3,000
60 Electric Traction	37,000
70 Vehicles	0
80 Professional Services (applies to Cats. 10-60)	66,000
90 Unallocated Contingency	21,000
100 Finance Charges	0
TOTAL:	\$606,000

All of the HMF sites would be adjacent to one or more of the HST alternative alignments, and their costs include relatively similar components. For instance, each potential HMF site would require approximately the same length of lead guideway. The site plan is standard; therefore, there is no major difference at this level of design. The sites were screened to eliminate major resource conflicts and difficult site constraints. The proposed HMF sites would generally require relatively low land costs; therefore, there are no noticeable cost differences between the sites.

5.3 Operation and Maintenance Costs

Chapter 2, Alternatives, describes O&M in greater detail. HST service during Phase 1 would connect San Francisco with Los Angeles via the Central Valley by 2020. HST service during Phase 2 would extend to Sacramento and San Diego starting in 2027. The plan is to offer express, limited-stop, and all-stop services, depending on the time of the day and projected needs. There would be 24 HST stations; up to 3 HST stations would be located within the Fresno to Bakersfield Section. Operation costs are projected to maintain 212 trainsets 656 feet long by 2035, one HMF for the entire HST system, and one maintenance-of-way facility approximately every 100 miles.

O&M costs account for staff and supplies required to run the HST system and keep it properly maintained. O&M costs are estimated based on daily train miles, operation speeds, travel times, HST station configurations, maintenance and storage facilities, and assumed operating frequencies (Parsons Brinckerhoff 2011). The allocations of systemwide O&M cost estimates to the Fresno to Bakersfield Section are proportional to the number of miles and train frequency,

which is approximately 114 miles long. The estimate also takes into account the projected employment at maintenance facilities and stations in the Section.

5.3.1 Operating Speeds

The HST would operate at high speeds (up to 220 miles per hour) throughout the Fresno to Bakersfield Section.

5.3.2 Travel Times

Table 5.3-1 shows the optimal express train times between Fresno, Bakersfield, and other destinations in the proposed statewide HST System. Fresno and Bakersfield would connect to the Bay Area and Los Angeles in Phase 1. In Phase 2, the HST System would extend to Sacramento and San Diego by 2027.

Table 5.3-1
Optimal Express Travel Times from Fresno to Bakersfield and Other Cities (hours:minutes)

	San Francisco	San Jose	Los Angeles	Anaheim	Sacramento (Phase 2)	San Diego (Phase 2)	Fresno / Bakersfield
Fresno	1:20	0:51	1:24	1:43	0:59	2:42	0:37
Bakersfield	1:51	1:21	0:54	1:13	1:29	2:12	0:37

5.3.3 Development of Operation and Maintenance Costs

Maintenance costs are generated in part by using the routine maintenance-of-way and infrastructure staffing estimates prepared by operations analysis based on the train miles for the section and the operating schedule provided in Chapter 2, Alternatives. As described in Chapter 2, the HST System would include several types of maintenance facilities.

The maintenance-of-way (i.e., infrastructure, guideways, and systems), and vehicle maintenance costs were developed primarily from information about other HST systems (specifically the Train de Grand Vitesse HST system in France). Information from non-US national railway and transport ministries verifies that the costs developed for the California HST System are consistent with their experience. Maintenance-of-way labor is based on ratios per mile of guideway or rights-of-way, assuming more labor- and maintenance-intensive ballast guideway throughout, which would result in approximately 680 personnel in multiple specialized, mechanized teams over two shifts for the entire California HST System. The costs of maintenance-of-way materials were established as percentages of the capital cost per year, varying in accordance with the expected life of the investment and allowances for tools and equipment.

Maintenance of trainsets and other vehicle costs are based on a materials cost of per trainset mile per year for routine maintenance, and labor in two shifts spread throughout the facilities along the Phase 1 system. Heavy overhauls were estimated at \$1.02 per trainset mile per year (2009 dollars) including materials and additional staff in two shifts. In total, 2,120 persons will be working on vehicle maintenance and cleaning including administrative personnel.

The overall cost calculation for the HST operating costs is based on an average hourly wage per employee of \$34 per hour (2009 dollars) with an additional 32% increase to cover fringe benefits and employer paid taxes. In addition, a contingency of 15% was added to all labor costs for drivers and onboard HST crew, and 10% for all other labor. The total number of train operators

and other staff required for Phase 1 operations is estimated at 1,347, which includes positions in central control, station services, sales, marketing, general administration, and security. Calculated O&M costs were then escalated by 3% to 2010 dollars.

Table 5.3-2 lists the total O&M costs estimated for Phase 1 of the California HST Project.

Table 5.3-2
Phase 1 Annual O&M Cost (2010 \$Millions)

O&M Activity	Phase 1
Operations	\$633.0
Maintenance	531.8
Contingency	60.8
Insurance	51.5
TOTAL	\$1,277.1

O&M costs are apportioned to the Fresno to Bakersfield Section based on staffing and labor expenditures associated with the proposed O&M and other facilities and the trainset miles operated within this Section. Table 5.3-3 presents the estimated annual O&M costs allocated to the Fresno to Bakersfield Section, in 2010 dollars.

Table 5.3-3
Annual O&M Costs of the Fresno to Bakersfield Section (2010 \$Millions)

Annual O&M Cost	Without HMF	With HMF
Operations	\$136.5	\$136.5
Maintenance	64.2	164.9
Contingency	9.4	14.4
Insurance	12.3	12.3
TOTAL	\$222.3	\$328.1

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