6 PROJECT COSTS AND OPERATIONS

6.1 Introduction

This chapter discusses the estimated costs for building, operating, and maintaining the Fresno to Bakersfield Locally Generated Alternative (F-B LGA) of the Fresno to Bakersfield Section of the California High-Speed Rail (HSR) System, based on a 15 percent level of design (Preliminary Engineering for Project Definition) used in preparing this Draft Supplemental Environmental Impact Report/Environmental Impact Statement (EIR/EIS). It also discusses the estimated costs for building, operating, and maintaining the comparable portion of the Fresno to Bakersfield Section Preferred Alternative (the "May 2014 Project"). The approach and details used to prepare the construction cost estimate are provided in the *Hybrid-LGA Cost Estimate Comparison Report* (California High-Speed Rail Authority [Authority] and Federal Railroad Administration [FRA] 2016), which is available upon request from the Authority. Table 6-1 provides the capital cost estimate for both the May 2014 Project and the F-B LGA. Changes in this table primarily reflect changes in quantity estimates in the areas of track, track structures, site work, and right-of-way as a result of refinement in the project design.

Table 6-1 Capital Cost of the High-Speed Rail Alternatives

FRA Standard Cost Categories Base Year FY 2010 Dollars (millions)	Alternatives	
	May 2014 Project	F-B LGA
10 Track Structures & Track	1,266.6	1,150.7
20 Stations, Terminals, Intermodal	260.8	250.3
30 Support Facilities: Yards, Shops, Admin. Bldgs., MOWF/MOIF	25.8	26.0
40 Site work, Right-of-Way, Land, Existing Improvements	766.8	716.4
50 Communications & Signaling	39.0	37.7
60 Electric Traction	127.8	123.5
70 Vehicles	Considered a system wide cost and not included as part of individual HSR study alternatives.	
80 Professional Services (applies to Categories 10–60)	297.9	282.4
90 Unallocated Contingency	109.0	100.4
100 Finance Charges	Estimate to be developed before project construction.	
Total	2,893.7	2,687.5

Source: Authority, 2016
F-B LGA = Fresno to Bakersfield Locally Generated Alternative
FRA = Federal Railroad Administration
FY = Fiscal Year
HMF = heavy maintenance facility
HSR = high-speed rail
MOWF = Maintenance-of-way facility
MOIF = Maintenance-of-infrastructure facility (also = MOWF)

6.2 Capital Costs

Capital costs represent the total cost associated with the design, management, land acquisition, and construction of the HSR system. The estimate of long-term operating 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 HSR 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, the FRA and the Authority have developed ten main Standardized Capital Cost Categories. Each standardized cost category is briefly 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 heating, ventilation, and air conditioning; 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 and Signaling** – includes all costs of implementing Automatic Train Control systems, inclusive of Positive Train Control 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; and traction power distribution system in the form of 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 on annual basis). Acquisition of trainsets is considered a system wide cost and is not included as part of the cost of individual HSR 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).

6.2.1 High-Speed Rail Alternatives

The conceptual HSR cost estimates prepared for the May 2014 Project and the F-B LGA were developed by utilizing estimating methodology and basis of unit prices presented in the “Capital Cost Estimate Report - Fresno to Bakersfield Section High-Speed Train Project Final EIR/EIS” dated January 2014, recent bid data from Construction Package 1 contractor estimated costs, and by developing specific, bottom-up unit pricing to reflect common HSR elements and construction methods with an adjustment for Central Valley labor and material costs. All material quantities for the F-B LGA and the May 2014 Project are estimated based on a 15 percent level of design. This level of design has generally defined at-grade or elevated profiles, structure types,

placement of retaining walls, and earth fill. The proposed F Street Station and roadway and utility relocations have been identified, and power substations have been sized and located.

The costs include the total effort and materials to construct the F-B LGA, including modifications to roadways required to accommodate HSR grade-separated guideways and elevation of BNSF through the city of Shafter, as well as utility upgrades, the proposed station, and the proposed maintenance of infrastructure facility. It should be noted that the capital cost estimate reflects only HSR-related infrastructure improvements.

Right-of-way costs were estimated based on the 15 percent design and are provided in the *Fresno to Bakersfield Section Preliminary Right-of-Way Requirements Report* (Authority 2013; May 2014 Project) and the *Fresno to Bakersfield Section Locally Generated Alternative (F-B LGA) Preliminary Engineering For Project Definition Record Set Design Submission Preliminary Right-of-Way Requirements Report* (Authority 2016; F-B LGA). However, as the design of the project evolves, 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 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 HSR right-of-way but do not include costs associated with temporary easements for construction that are assumed to be part of the Design Build Contractor responsibilities to negotiate use.

These costs do not include acquiring HSR vehicles because they are part of the statewide HSR system and are not associated with constructing individual sections. The cost of vehicles will be determined using the proposals submitted in response to the HSR 14-30 Draft Request for Proposals for Tier III Trainsets (Authority 2015), as well as using publically 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 United States safety regulations and to comply with 'Buy America' requirements. The system wide cost of vehicle procurement is divided into parts as the system is built: Initial Operating Section (Silicon Valley to Central Valley); the extension of the Initial Operating Section to the San Francisco Bay, Merced, and Bakersfield; and subsequent demand-based procurement as the Phase 1 Blended System (San Francisco to Los Angeles and Anaheim) build-out continues. Total vehicle procurement cost was previously estimated at $3.2 billion in 2011 dollars, which will be refined upon receipt of trainset manufacturer proposals.

According to the Hybrid-LGA Cost Estimate Comparison Report (Authority and FRA), professional services are estimated at 10.5 percent of the construction costs; these costs are divided between final design (4.3 percent), construction management (3.1 percent), program management (2.3 percent), and agency costs (0.4 percent), and start-up costs (0.4 percent). Environmental mitigation costs are estimated at approximately 1 percent of the capital cost, given 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 to be between 10 percent and 25 percent of the estimated construction and right-of-way acquisition costs, and unallocated contingency (project reserves intended to cover unknown risks) is estimated at 3.7 percent of the construction and right-of-way acquisition costs. Table 6-1 shows estimates for the May 2014 Project and the F-B LGA.

6.3 Operation and Maintenance Costs

Chapter 2 of this Draft Supplemental EIR/EIS describes O&M activities in greater detail. For purposes of comparison, the following assumptions for the O&M cost estimate from the Fresno to Bakersfield Final EIR/EIS have been carried forward for the F-B LGA O&M cost estimate. HSR service during Phase 1 would connect San Francisco with Los Angeles via the Central Valley by 2029. HSR service during Phase 2 would extend to Sacramento and San Diego starting after

2025. The plan is to offer express, limited-stop, and all-stop services, depending on the time of the day and projected needs. For Phases 1 and 2 there would be 24 HSR stations; up to three HSR stations would be located within the Fresno to Bakersfield Section. There is one proposed station in the F-B LGA. By 2035, multiple facilities for overnight storage, inspection, and routine maintenance of over 200 trainsets, each 656 feet long would be required. One maintenance of infrastructure facility would also be required approximately every 100 miles.

O&M costs account for staff and supplies required to run the HSR system and keep it properly maintained. O&M costs are estimated based on daily train miles, operation speeds, travel times, HSR station configurations, maintenance and storage facilities, and assumed operating frequencies (Parsons Brinckerhoff 2011). The apportionment of system wide O&M cost estimates to the F-B LGA is proportional to the O&M activity and facilities within the section.

6.3.1 Operating Speeds

The HSR would operate at high speeds (up to 220 miles per hour) throughout the Fresno to Bakersfield project section, not limited to the F-B LGA. Though train speeds could slow in residential areas and on station approach, this speed was chosen for analysis for the entire F-B LGA alignment in order to provide a conservative approach to related impacts.[1]

6.3.2 Travel Times

Table 6-2 shows the optimal express train times between Fresno, Bakersfield, and other destinations in the proposed statewide HSR system. Fresno and Bakersfield would connect to the Bay Area and Los Angeles in Phase 1. In Phase 2, the HSR system would extend to Sacramento and San Diego after 2025.

Table 6-2 Optimal Express Travel Times from Fresno to Bakersfield and Other Cities

	San Francisco	San Jose	Los Angeles	Anaheim	Sacramento (Phase 2)	San Diego (Phase 2)	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	N/A

Source: Authority and FRA, 2014
Note: All travel times are indicated in hours and minutes. Travel times are based on programmatic, system-wide estimates, and are not specific to station alternatives.
N/A = not applicable

6.3.3 Development of Operation and Maintenance Costs

O&M costs were estimated for the operations needed to serve and carry the forecast traffic for Phases 1 and 2, as described in Chapter 2 of this Draft Supplemental EIR/EIS; the maintenance necessary to keep the entire system in a state of good repair; and the administrative activities and costs. Unit prices were developed and applied to calculate the cost for each activity included in the operating plan. Although many of the O&M unit costs for the California HSR System would be similar to the costs of United States conventional rail operations and can be reliably estimated from United States practices and costs, the unit cost to maintain high-speed trainsets and dedicated high-speed rail infrastructure has no close analogy in the United States. Therefore, international O&M unit cost projections from comparable HSR operations were applied to planned California operations, HSR technology, and local cost levels and labor practices.

The cost of operation and maintenance of HSR equipment includes the cost of (1) crew, administration, and supplies to operate and dispatch the HSR services; (2) electric power for

[1] The May 2014 Project includes a curve that limits operating speed through the City of Bakersfield. This curve is needed to avoid specific critical community features as identified by the City. The F-B LGA does not require an operating speed limiting curve to avoid community features critical to the City of Bakersfield.

traction, onboard systems, stations, and maintenance/other facilities; and (3) cleaning, inspection, maintenance, and overhaul of trainsets.

Maintenance of infrastructure covers the costs of patrolling, inspecting, and maintaining the right-of-way, fencing, structures, bridges, tunnels, roadbed, track, signaling, overhead electric traction power system, substations and similar electrical facilities, communications, intrusion detection, and facilities.

Station 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 costs presented.

At the higher level of activity associated with HSR fares at 50 percent of airfares, maintenance of equipment activities around the state would employ 4,800 persons, transportation operations would employ 4,100 persons, maintenance of infrastructure activities would employ 800 persons, and all other activities would employ 1,600 persons. At the lower level of riders and operations associated with HSR fares at 83 percent of airfares, employment would be roughly one-third lower in the three categories, except maintenance of infrastructure, which would be similar to the estimated employment with fares at 50 percent of airfares.

Table 6-3 lists the total O&M costs estimated for the full system, on completion of Phases 1 and 2, of the California HSR System for the year 2035.

Table 6-3 Annual Phase Full System Operating and Maintenance Costs, Year 2035 (2010 $Millions)

O&M Activity	HSR Fares at 50% of Airfare	HSR Fares at 83% of Airfare
Operating & Maintenance of Equipment	$1,967	$1,312
Maintenance of Infrastructure	$165	$165
Stations	$101	$101
Insurance	$25	$25
Administration (10% of above)	$226	$161
Contingency (10% of above)	$248	$176
Total	$2,732	$1,940

Source: Authority, 2016
HSR = high-speed rail
O&M = operating and maintenance

O&M costs in 2010 dollars as apportioned to the Fresno to Bakersfield Section are shown in Table 6-4, and O&M costs in 2010 dollars as apportioned to the May 2014 Project and the F-B LGA are shown in Table 6-5, based on the levels of activity associated with the section as a proportion of full system costs. Costs associated with both the May 2014 Project and the F-B LGA are calculated here based on assumptions made in Chapter 5 of the Fresno to Bakersfield Section Final EIR/EIS (page 5-13), as described below.

The costs associated with “Operations & Maintenance of Equipment” of the Fresno to Bakersfield Section are apportioned on the basis of trainset miles operated within the Fresno to Bakersfield Section. The costs associated with “Maintenance of Infrastructure” of the Fresno to Bakersfield Section are apportioned as a ratio of 120 route miles to the total 800 route miles. The costs associated with “Stations” for the Fresno to Bakersfield Section are apportioned as a ratio based on 3 of the 24 stations being located in the Fresno to Bakersfield Section. The costs of “Administration” and “Contingency” are calculated as a percentage of the overall system costs.

Table 6-4 Annual 2035 Operating and Maintenance Costs Apportioned to the Fresno to Bakersfield Section (2010 $millions)

Annual O&M Cost	HSR Fares at 50% of Airfare	HSR Fares at 83% of Airfare
Operating & Maintenance of Equipment	$236	$158
Maintenance of Infrastructure	$25	$25
Stations	$13	$13
Insurance	$3	$3
Administration (10% of above)	$28	$20
Contingency (10% of above)	$30	$22
Total	$335	$241

Source: Authority and FRA, 2014
HSR = high-speed rail
O&M = operating and maintenance

Table 6-5 Annual 2035 Operating and Maintenance Costs Apportioned to the May 2014 Project and F-B LGA

Annual O&M Cost	HSR Fares at 50% of Airfare	HSR Fares at 83% of Airfare
Operating & Maintenance of Equipment	$57	$38
Maintenance of Infrastructure	$5	$5
Stations	$4	$4
Insurance	$0.7	$0.7
Administration (10% of above)	$7	$5
Contingency (10% of above)	$7	$5
Total	$80.7	$57.7

Source: Authority, 2016
HSR = high-speed rail
O&M = operating and maintenance

The May 2014 Project and the F-B LGA have approximately the same number of trainset miles, stations, and route miles. Therefore, O&M costs for each of these alignments are considered to be the same. The costs associated with "Operation & Maintenance Equipment" for the May 2014 Project and the F-B LGA are apportioned on the basis of trainset miles operated within the May 2014 Project and the F-B LGA. The costs associated with "Maintenance of Infrastructure" of the May 2014 Project and the F-B LGA are apportioned as a ratio of 23 route miles to the 800 total route miles. The costs associated with "Stations" for the May 2014 Project and the F-B LGA are apportioned as a ratio based on 1 of the 24 stations being located in the May 2014 Project and the F-B LGA. The costs of "Administration" and "Contingency" are each calculated to be ten percent of the overall system costs.