6 The State's Rail Service and Investment Program

California's multimodal transportation network is a complex system that moves people, goods, and services, furthering the state's robust economy. As California moves forward to implement sustainable practices and build climate resiliency and adaptability while maintaining a technological and economic edge, effective solutions must be found to maintain efficiency in strategic interregional transportation corridors.

Chapter 6 presents the proposed capital plan; federal, state, and local funding sources; program effects; and current and future rail studies and reports necessary for the implementation of the 2040 Vision. Details of the passenger rail Capital Program include implementation goals for the short-term (2022), mid-term (2027) and long-term (2040 Vision) time horizons, with appropriate funding sources; as well as the freight rail funding strategy, along with relevant shared-use corridor and safety programs. This chapter also explains the 2040 Vision program effects and benefits to both the passenger and freight networks, economic benefits, shared environmental impacts and benefits, and the regional balance in the distribution of benefits. Finally, ongoing coordination between existing rail plans is important for future implementation planning, and this chapter identifies those as well as other identified future planning needs and proposed studies.

6.1 Passenger and Freight Rail Capital Program

California needs to decide how best to invest public dollars strategically to maximize benefits without compromising LOS, while building and phasing investments in a manner that does not duplicate efforts over time.

As identified in the ITSP and further expanded on in the Rail Plan, a modernized and integrated statewide rail network is an investment that allows the State to strengthen regional transportation corridors and provide viable alternatives to the movement of goods, people, and services.

The Rail Plan offers an investment strategy that allows the State to focus on corridor-level rail investments to achieve service goals that will help in closing capacity gaps, improving corridor safety, and increasing frequency and reliability of intercity passenger rail.

Metropolitan Los Angeles and San Francisco both rank in the top five for most congested urban areas in the world.[173] Los Angeles was ranked as having the worst automobile congestion in the world, with drivers spending an average of 104 hours stuck in congestion in 2016, costing the city an estimated $9.7 billion—or $2,408 per driver. Meanwhile, the San Francisco Bay Area has the most congested arterial and city streets in the United States during commute hours.

Automobile congestion, coupled with the economic losses attached to congestion, along with aggressive air quality and GHG emissions targets, make the case for shifting travel mode shares away from driving.

Passenger Rail Program

Passenger rail services across California, where strategic and timely investments have been made, are serving record numbers of passengers and achieving record growth rates. Where passenger service is provided and well-planned to meet customer needs, it is successful—and often overwhelmed by passenger demand. The passenger rail program presented in the 2040 Vision represents a series of strategic investments to continue maximizing the return from existing and ongoing investments, and then connect them with fully integrated regional and statewide service networks.

As detailed in Chapter 4, the 2040 Vision sets forth specific service goals to deliver a fully integrated statewide network of passenger rail services. The following sections describe the capital costs associated with the service delivery goals presented in Chapter 4 necessary for achieving full connectivity in the 2040 Vision. The 2040 Vision assumes that the completed California HSR will serve as the backbone of a statewide system of interconnected regional networks.

Capital Planning

This section details the methodology used to identify capital improvements, compile cost estimates, and phased improvements over short-term (2022), mid-term (2027), and long-term (2040 Vision) time horizons, ensuring that infrastructure scales to meet market needs and is not redundant or stranded by future investments. Based on the service goals established for the 2040 Vision, the planned and required capital investments are defined to detail the needed infrastructure improvements and understand their related costs.

173 INRIX, *Los Angeles Tops INRIX Global Congestion Ranking, Global Traffic Scorecard,* 2017.

Methodology

Assembling the Capital Program for the Rail Plan followed two tracks: citing costs for established projects; and estimating costs for additional projects. The majority of the Capital Program in the 2040 Vision represents previously identified projects that improve the safety and capacity of existing infrastructure and realize its potential; and aligns investments for improved accessibility, reliability, safety, and sustainability of the multimodal connectivity of the state. It leverages existing assets and connects and evolves regional rail and local transit networks.

First, established costs for existing and defined projects were identified and citied from publicly available documents. Where relevant, these costs were escalated to 2018 dollars for consistency. Such cited costs make up the bulk of projects listed in the 2022 time horizon, when projects included in the capital plan are further along in the development process.

Second, additional capital costs in the Rail Plan include planning-level estimates that consider complexity, environment, geographic location (urban, suburban, and rural), proximity to active tracks, and other factors that may influence costs. Planning-level estimates of capital cost are within a rough order of magnitude—intended to inform investment decisions, and not be interpreted as engineering-level estimates.

The cost catalog developed for this process follows FRA's Standardized Cost Categories, with unit costs for typical elements identified based on an average project cost. For high-cost improvements, such as intermodal hubs, a lump-sum cost is assumed, based on comparable costs from recent projects of similar scope.

The 2040 Vision provides the service type, frequency (system pulse), required average service speed, departure and arrival times, and route nodes used to develop corridor-specific improvements and build related capital cost estimates. These service plans were used to identify capacity requirements at the corridor level throughout the state, which are the primary basis for all project descriptions and assumptions in this estimate. The corridors were investigated through a survey of the existing infrastructure and conditions. The capacity and capabilities of that infrastructure was compared with future capacity requirements.

State Capital Investments

The service and connectivity goals, along with corridor-level improvements required to achieve the 2040 Vision, are described in a phased plan with capital projects identified for the next 4 years (2022); mid-range needs identified for the next decade (2027); and long-range improvements and investments for long-range (2040) planning toward the envisioned future.

- **2022** catalogs the Capital Plan of ongoing and committed projects as part of an enhanced existing conditions assessment of present and near-term rail services across the state.
- **2027** captures new and established projects and planning studies intended to maximize capacity and utility of the existing passenger rail network, and to begin using HSR while connecting it to the statewide integrated network.
- **2040** identifies additional corridor-level investments and service goals needed to fully realize the 2040 Vision, connecting regional networks into a statewide, integrated system.

To achieve the 2040 Vision Network described in Chapter 4, the Rail Plan identifies a robust, strategic capital investment program that catalogs near-term projects, maximizes returns from existing investments, and builds out and connects regional networks into an integrated statewide system. The full spectrum of passenger rail modes is included in the capital investment program, from Urban Rail projects to potential future HSR extensions.

2022 (Near-Term) Infrastructure Investment

The 2022 services goals and Capital Program are focused on identifying the planned, committed, or otherwise under-construction projects that will ultimately serve the network identified in the 2040 Vision. Goals for the 2022 Capital Programs and projects list, which will potentially be achieved earlier than 2022, include relevant state-level projects that are already scoped, scheduled, and budgeted; and establish existing conditions for future capital cost analysis. Although capital projects identified for 2022 have specific operators and modes associated with the service, the subsequent time horizons are intended to be mode- and operator–neutral, and assign costs to service types rather than any specific entity or jurisdiction.

Intercity Rail improvements for 2022 include capacity expansion and speed improvements to existing intercity rail services; grade separations and other safety improvements; and shared freight corridor improvements, like new sidings and double-tracking sections. In addition, a number of planning studies have been identified and included in the Capital Program to explore project implementation for future service goals. These projects positively impact the statewide network, improving interregional corridors and overall connectivity goals, inciting State interest in project sponsorship and funding.

There are a number of commuter rail improvements identified in the 2022 Capital Program, including the SMART extension and Caltrain's Peninsula Corridor Electrification Project.

Table 6.1 catalogs capital costs for projects supporting the integrated statewide network in 2022. Costs attributed to locally led, privately sponsored, or CHSRA-programmed projects are included in the overall 2040 Vision.

Table 6.1: 2022 Short-Term Project List (thousands $)[174]

Planning Area	Corridor	2022 Capital Projects	2022 Capital Cost (thousands $)	2022 Pricing Source
South Bay Area	San Francisco-San Jose	Peninsula Corridor Electrification Program	$1,980,000	Caltrain
		Completion of Full Electrified Service + Targeted Corridor Infrastructure Improvements/Grade Separation Planning	$280,000	Caltrain + Regional Programming
		Caltrain CBOSS PTC	$248,000	Caltrain
		25th Avenue Grade Separation	$165,000	Caltrain
		South San Francisco Station Improvements	$61,000	Caltrain
	San Jose-Gilroy	PTC Expansion + Added Frequency	$47,000	FRA Award + Regional Programming
	San Jose-Stockton	ACEforward Capacity Expansion	$26,000	TIRCP/ Air Quality Management District Award
	Oakland-San Jose	Coast Subdivision Rail Corridor Improvements	$20,000	Caltrans 2018 Interregional Transportation Improvement Program (ITIP)
	Multiple	Regional Network and Service Integration Project Development (Peninsula, Dumbarton, East Bay, Altamont)	$6,000	CSRP Pricing Catalog
North Bay Area	San Francisco-Oakland	New Transbay Crossing Planning	$10,000	BART
	Multiple	North Bay to Sacramento Network and Service Integration Project Development (Marin, Sonoma, Napa, Solano, Yolo, Sacramento, Contra Costa, Alameda)	$3,000	CSRP Pricing Catalog
	Larkspur-Cloverdale	SMART Windsor - Larkspur Connection Ferry Connection to San Francisco	$139,000	SMART
		Two New Trainsets for Expanded Capacity	$11,000	TIRCP Award
		San Rafael Transit Center	$45,000	SMART

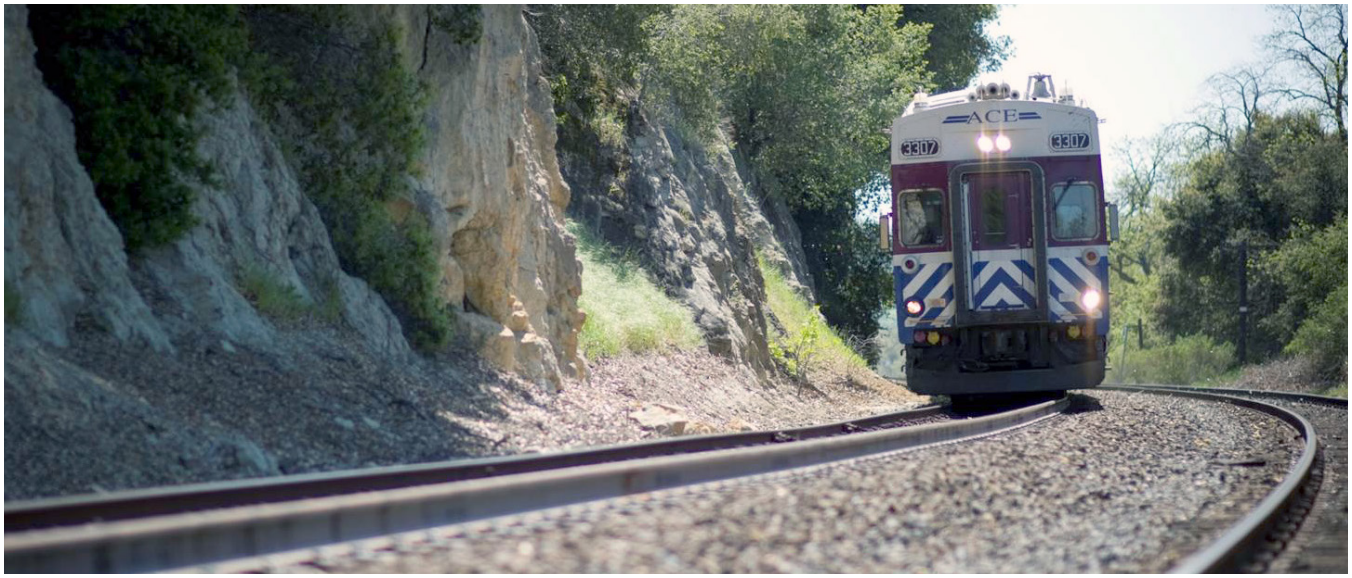
174 Estimated costs in 2018 dollars. These costs are planning-level estimates and require further study in implementation.

Table 6.1: 2022 Short-Term Project List (thousands $)(continued)

Planning Area	Corridor	2022 Capital Projects	2022 Capital Cost (thousands $)	2022 Pricing Source
Central Valley/ Sierra Nevada	Sacramento-Roseville	Placer County Service Expansion (Increased Capitol Corridor Service)	$79,000	TIRCP Award
	Fresno-Stockton	Merced Station Double-Tracking	$10,000	CTC Allocation
		Stockton to Escalon Double-Tracking	$23,000	CTC Allocation
		Stockton Maintenance Facility Lead Track and Stockton Wye	$32,000	Caltrans
		Bi-Hourly + Morning Express Service Expansion	$186,000	Caltrans
Central Valley/ Sierra Nevada	Multiple	HSR-Connected Corridors Network and Service Integration Project Development	$4,000	CSRP Pricing Catalog
		Regional Network and Service Integration Project Development (Kern, Kings, Tulare, Fresno, Madera,Shasta,Yuba, Butte, Tehana, Shasta)	$2,000	CSRP Pricing Catalog
Central Coast	San Jose-Goleta	Central Coast Network and Service Integration Project Development	$2,000	CSRP Pricing Catalog
	San Jose-Goleta	Central Coast Layover Facility and Station Expansion	$12,500	Caltrans
	Salinas-San Jose	Kick-Start Service	$81,000	TAMC + CSRP Pricing Catalog
LOSSAN North	San Luis Obispo-Los Angeles	LOSSAN North Frequency Expansion Corridor Performance and Travel Time Improvement, Including Van Nuys Station Double-Tracking	$236,000	Caltrans
	Goleta to Chatsworth	Seacliff Siding and Extension	$23,000	Caltrans
Vegas to Palmdale	Victorville to Las Vegas	Nevada-HDC Network and Service Integration Project Development	$1,000	CSRP Pricing Catalog
	Palmdale to Victorville			
Los Angeles Urban Mobility Corridor	Multiple	LA Metro Statewide Network Service Integration Project Development	$2,000	CSRP Pricing Catalog
	Los Angeles-Fullerton	Rosecrans/Marquandt Avenue Grade Separation	$155,000	Project Funding Plan
	LAUS	Metro Frequency Improvement at LAUS	$162,000	TIRCP Award
Inland Empire	San Bernardino-Redlands	Redlands Passenger Rail Project	$265,000	San Bernardino County Transportation Authority
	Multiple	HSR-Connected Corridors Network and Service Integration Project Development; Blue Ribbon Commission for CA-AZ Rail Service	$4,000	CSRP Pricing Catalog

Table 6.1: 2022 Short-Term Project List (thousands $)(continued)

Planning Area	Corridor	2022 Capital Projects	2022 Capital Cost (thousands $)	2022 Pricing Source
LOSSAN South	Irvine-Oceanside	Laguna Niguel to San Juan Capistrano Passing Siding	$25,000	TIRCP Award
		San Onofre-Pulgas Phase 2	$29,000	NCTD
	Oceanside-Sorrento Valley	San Elijo Lagoon Double-Tracking	$76,000	San Diego Association of Governments (SANDAG)
		Batiquitos Lagoon Double-Tracking	$69,000	SANDAG
		Poinsettia Station Improvements	$29,000	SANDAG
	Sorrento Valley-Santa Fe Depot	San Diego River Bridge, Elvira-Morena Double-Tracking	$286,000	TIRCP Award
		Maintenance and layover facility project study	$250	CSRP Pricing Catalog
	San Diego-Mexican Border	United States-Mexico Network and Service Integration Project Development	$1,000	CSRP Pricing Catalog
Statewide	Multiple	Amtrak Equipment Replacement, Fleet Capacity Expansion and Maintenance Facility Planning, Americans with Disabilities Act Access Improvements	$300,000	Caltrans
		Mobility Hub Project Development	$5,000	CSRP Pricing Catalog
		Fare Integration and Demonstration	$27,500	Caltrans
		Statewide maintenance facility study	$500	CSRP Pricing Catalog
Total				**$5,168,750**



2027 (Mid-Term) Infrastructure Investment

The 2027 Capital Program and service goals are focused on maximizing the potential of existing infrastructure, making full use of available passenger rail capacity, and making key investments in regional networks to prepare for integration with HSR. In identifying service goals for 2027, every rail network in the state was carefully examined to identify latent capacity for additional service, while assessing it against the ridership potential of the corridor. Goals for the 2027 Capital Program include identifying achievable mid-term improvements that affordably increase opportunities for additional long-distance passenger rail trips per day, while strengthening an integrated rail network that leverages HSR investments and enables rapid statewide travel by rail, creating more options for automobile-dependent communities.

Key projects in the 2027 Capital Program include preparing regional networks to connect to and leverage HSR service. Additional service frequencies and improved speeds connecting greater Los Angeles, Orange County, and the Inland Empire to HSR hubs at Burbank, LAUS, and Anaheim are key investments in this time period. Similarly, investments include improving blended-speed regional service expansions in the Central Valley, for interim connections from HSR in Merced to Stockton and Sacramento.

HSR capital costs include projects necessary to complete Silicon Valley to Central Valley service delivery.

Intercity rail improvements include further capacity improvements, service expansions, and infrastructure around the state. The 2027 Capital Program includes supporting extended service in Sonoma County to Cloverdale; enhanced capacity between San Jose and Sacramento, with improved travel times, frequency, and other right-of-way improvements building toward electrification of the corridor; and increasing service frequencies north of Sacramento to Placer County.

The plan supports increased service on the coastal corridors, using strategic track investments, sidings, layover facilities, and other capacity and speed improvements to bring service to the coast throughout the day. Additional service on the Central Coast, providing connections north to the San Francisco Bay Area, and connections south to the Los Angeles area, will provide residents and businesses with frequent, fast, and reliable connections within the Central Coast, and beyond to high-speed hubs in Gilroy and Burbank.

Urban Rail investments include expansions of Los Angeles, San Diego, Sacramento, and San Francisco Bay Area rail transit networks, largely funded through local ballot initiatives. These projects are extensions and connections in the existing transit networks, identified and led by relevant local stakeholders. Major investments include the completion of BART service to San Jose, numerous expansions of the LA Metro system, and the extension of rail service to the Sacramento International Airport.

The Las Vegas HSR project is included in the 2027 capital project time horizon.

Table 6.2 catalogs capital costs for projects supporting the integrated statewide network in 2027. Costs attributed to locally led, privately sponsored, or CHSRA-programmed projects are included in the overall 2040 Vision.

Table 6.2: 2027 Capital Costs[175]

Planning Area	Capital Cost [thousands $]
South Bay Area	$3,570,000
North Bay Area	$225,000
Central Valley/Sierra Nevada	$1,150,000
Central Coast	$262,000
LOSSAN North	$550,000
Vegas to Palmdale	$8,395,000
Los Angeles Urban Mobility Corridor	$2,500,000
Inland Empire	$950,000
LOSSAN South	$950,000
Statewide	$1,210,000
Total	**$19,762,000**

175 Estimated costs in 2018 dollars. These costs are planning-level estimates and require further study in implementation.

Table 6.3 contains high-level capital cost estimates for projects supporting the integrated statewide network in 2027. Costs attributed to locally led, privately sponsored, or CHSRA-programmed projects are included in the overall 2040 Vision.

Table 6.3: 2027 Mid-Term Project List (thousands $)[176]

Planning Area	Corridor	2027 Capital Projects	2027 Capital Cost (thousands $)
South Bay Area	San Francisco-San Jose	San Francisco-San Jose Grade Separations, Level Boarding, Longer Trains, and Performance Improvement (Phase 1)	$1,250,000
		San Jose-Gilroy Service Increase	
		Diridon Station Mobility Hub Phase 1	
		Corridor Capacity and Safety Improvement Project Development	
	Altamont, East Bay (south of Oakland) and Dumbarton	Oakland-San Jose Capacity Increase for Passenger and Goods Movement	$2,300,000
		Tri-Valley Connectivity Between BART and the Statewide Rail Network	
		Dumbarton Rail Crossing Integration with Statewide Rail Network (Phase 1)	
		Altamont Corridor Capacity Increase for Passenger and Goods Movement	
		I-680 Integrated Express Bus	
	Multiple	Regional Network and Service Integration Project Development (Peninsula, Dumbarton, East Bay, Altamont)	$20,000
North Bay Area	San Francisco-Oakland	New Transbay Crossing Project Development	$60,000
	Oakland-Sacramento	Martinez Station Capacity Improvement for Corridor Connectivity	$100,000
		Stockton-Martinez Capacity Upgrades for Bi-Hourly Service	
		Corridor-Wide Station Capacity and Safety Improvements	
	Multiple	North Bay to Sacramento Network and Service Integration Project Development (Marin, Sonoma, Napa, Solano, Yolo, Sacramento, Contra Costa, Alameda)	$10,000
	Larkspur-Cloverdale	SMART Windsor to Cloverdale Extension, Including Fleet	$55,000
Central Valley/Sierra Nevada	Sacramento-Roseville	Placer County Service Expansion (Phase 2)	$200,000
	Fresno/Merced-Stockton-Sacramento	Regional Rail Expansion to Merced and Sacramento	$950,000
		Hourly Service from Fresno to Sacramento	
		Madera Mobility Hub	
		Sierra Nevada Integrated Express Bus	
		North State Integrated Express Bus Expansion	

176 Estimated costs in 2018 dollars. These costs are planning-level estimates and require further study in implementation.

Table 6.3: 2027 Mid-Term Project List (thousands $)(continued)

Planning Area	Corridor	2027 Capital Projects	2027 Capital Cost (thousands $)
Central Coast	Gilroy-Goleta	Bi-Hourly Integrated Service from Salinas and Hollister to Gilroy	$262,000
		San Luis Obispo-Salinas Intercity Rail Increase and Bi-Hourly Integrated Service	
		Central Coast Layover Facility and Station Expansion	
		Bi-Hourly Integrated Service from Paso Robles to the Central Valley	
		Goleta-San Luis Obispo Intercity Rail Increase and Bi-Hourly Integrated Service	
LOSSAN North	Goleta/ Santa Clarita-Burbank-Los Angeles	Bi-Hourly Express Service Goleta-Los Angeles	$550,000
		Hourly Local Service Chatsworth-Los Angeles	
		Hourly Local Service Santa Clarita-Los Angeles	
Vegas to Palmdale	Victorville to Las Vegas	HSR Palmdale-Las Vegas	$8,395,000
Los Angeles Urban Mobility Corridor	LAUS	LAUS Passenger Capacity Expansion and Run-Through Tracks	$2,500,000
	Burbank-Los Angeles-Anaheim	Corridor Capacity and Grade Separation Projects for First Phase of Integrated Local and Express Service	
Inland Empire	Multiple	First Phase Integrated Local and Express Service Los Angeles-San Bernardino	$950,000
		First Phase Integrated Local Service Los Angeles-Riverside-Perris Valley	
		First Phase Integrated Local Service Riverside-Orange County	
		Initial Service to Coachella Valley	
LOSSAN South	Anaheim-San Diego	First Phase Integrated Local and Express Service Los Angeles-Anaheim-San Diego	$950,000
Statewide	Multiple	Amtrak/State Equipment Replacement, Fleet Capacity Expansion and Maintenance Facility Investment	$900,000
		Corridor Service Improvement - Capitalized Maintenance	$20,000
		Integrated Express Bus in Partnership with Regional Service	$150,000
		Project Development for Statewide Network Investments	$100,000
		Fare Integration - Phase 2	$40,000
Total			**$19,762,000**

2040 (Long-Term) Infrastructure Investment

The 2040 Capital Program is focused on completion of the full build-out of regional networks to integrate the statewide system and HSR with unified service throughout the state. The program represents the long-term investments needed to achieve the passenger rail service goals described in the 2040 Vision (see Chapter 4). These include incremental projects built to expand and connect previously described services in the 2022 and 2027 programs; wider-scale investments to modernize services through electrification and connectivity improvements at station hubs; and large infrastructure projects like HSR expansion, intermodal hubs, new Transbay tube, and urban rail transit investments.

HSR expansion is of key importance to the 2040 Capital Program, and includes electrified blended service from Sacramento to Merced and through the Inland Empire, as well as HSR service to San Diego.

Intercity rail improvements for 2040 include electrification of express services in both Northern and Southern California, complementing HSR in network hubs with pulsed service schedules to achieve the 2040 Vision.

This includes wide-scale electrification of intercity services in the San Jose-Oakland-Sacramento corridor; Central Valley from Merced to Sacramento; and Inland Empire, from Los Angeles separately to San Bernardino and Riverside, and on to the Coachella Valley. Large investments are identified for a shared second Transbay tube (hosting regional and intercity rail) to improve San Francisco-to-Oakland capacity, and improve overall Northern California network functionality. Complementary services to the HSR expansion are included in both the Sacramento-to-Merced corridor, east-west in the Central Valley, and throughout the Inland Empire. These projects require numerous grade separations and track improvements to support service speeds and safety in identified corridors.

The end result is a modern, energy-efficient, and fully integrated statewide network, providing the frequent, fast, and pulse-scheduled services described in the 2040 Vision. This network will provide seamless service to passengers, and serve as the high-level State investment needed for California to be increasingly economically competitive while true to its environmental and equity goals, improving quality of life across the state.

Table 6.4 catalogs capital costs for projects supporting the integrated statewide network in 2040.

Table 6.4: 2040 Capital Projects Details

Planning Area	Corridor	2040 Capital Projects	2040 Capital Cost (thousands $) [176]
South Bay Area	San Francisco-San Jose	San Francisco-San Jose Grade Separations, Level Boarding, Longer Trains and Performance Improvement (Phase 2)	$6,000,000
		Implement Regional Rail Utilizing New Transbay Crossing	
		Downtown Extension from 4th and King	
		HSR Corridor Investment for Phase 1 Service	
	Altamont, East Bay (south of Oakland) and Dumbarton	Implement Regional Rail Utilizing New Transbay Crossing, including East Bay services in Alameda County	$1,700,000
		Implement Integrated Regional Rail Service Utilizing Altamont and Dumbarton Rail Corridors	
North Bay Area	Multiple	New Transbay Crossing	$18,400,000
		BART-Conventional Rail Mobility Hub Investments	
		Implement Express & Regional Rail Utilizing New Transbay Crossing, including new alignment with high-level crossing to Solano County and significantly faster travel times between Sacramento and the Bay Area	
		Stockton-Richmond Capacity Upgrades for Hourly Service	
		Regional Rail Expansion from Marin and Napa Counties to Solano County	
Central Valley/Sierra Nevada	Multiple	Implement Full Integrated Rail Service to Placer County	$4,900,000
		Implement Blended Rail Service from Merced to Sacramento with Express and Local Service	
		Implement Regional Rail Connecting Lemore, Hanford, Porterville and Visalia with the Statewide Rail Network	
Central Coast	Gilroy-Goleta	Hourly Integrated Rail Service from Salinas to Gilroy	$1,500,000
		Implement Regional Rail Connecting Monterey and Santa Cruz to the Statewide Rail Network	
		Implement Central Coast Rail & Express Bus Service from Salinas to Goleta	
LOSSAN North	Goleta/ Santa Clarita-Burbank-Los Angeles	Hourly Express Service Goleta-LA	$700,000
		Implement Half-Hourly Express & Local Rail Service Chatsworth-LA	
		Implement Half-Hourly Local Rail Service Santa Clarita-LA	

177 Estimated costs in 2018 dollars. These costs are planning-level estimates and require further study in implementation.

Table 6.4: 2040 Capital Projects Details (continued)

Planning Area	Corridor	2040 Capital Projects	2040 Capital Cost (thousands $) [176]
Inland Empire	Multiple	Integrated Local and Express Service Los Angeles-San Bernardino	$17,300,000
		Integrated Local and Express Service Los Angeles-Riverside	
		Integrated Local Service Riverside-Orange County	
		Blended Rail Services from Los Angeles, Riverside, and San Bernardino to Ontario Airport	
		High Speed Rail Services from San Diego to Ontario Airport, continuing to Inland Empire and Los Angeles on Blended Service corridors	
		Integrated Local Service Extension to Hemet	
		Integrated Express Rail Service on New Alignment to Coachella Valley	
LOSSAN South	Anaheim-San Diego	Implement Half-Hourly Local and Express Services LA-Anaheim-San Diego	$1,200,000
	San Diego-Mexican Border	Implement Enhaced Rail Service to Mexican Border	
Statewide	Multiple	Statewide Fleet and Maintenance Facility Investments	$550,000
		Corridor Service Improvement - Capitalized Maintenance	$50,000
		HSR Phase 1 Service (including completion of LA Urban Mobility Corridor Investments, excluding capital investment included in other projects)	$67,490,000
Total			**$119,790,000**

Table 6.5: 2040 Capital Costs[178]

Planning Area	Capital Cost [thousands $]
South Bay Area	$7,700,000
North Bay Area	$18,400,000
Central Valley/Sierra Nevada	$4,900,000
Central Coast	$1,500,000
LOSSAN North	$700,000
Inland Empire	$17,300,000
LOSSAN South	$1,200,000
Statewide	$68,090,000
Total	**$119,790,000**

178 Estimated costs in 2018 dollars. These costs are planning-level estimates and require further study in implementation.

6.1.1 Passenger and Freight Rail Integration

Intercity and commuter railroad operations in shared-use corridors are quite common across the country.

A shared-use corridor generally involves passenger and freight operations using the same track plant.

Most of California's intercity and commuter-rail operations occur on shared track, with the exception of the SCRRA line segment between Palmdale and Lancaster. This situation is expected to change with HSR implementation. Some HSR sections will be classified as shared right-of-way or shared corridors.

As defined by the FRA, shared-use corridors can take on three different forms:

Shared tracks. In this form, the trains of two or more service providers operate over the same tracks. The most common arrangement is that of a freight carrier and an intercity or regional passenger service provider, all sharing the same track, with dispatching performed by the track owner.[179]

Shared Right-of-Way. In this form, two rail services are operated independently on separate parallel tracks having a track centerline separation of less than 30 feet[180]. Separation of 30 feet or less triggers the application of certain FRA safety regulations.

Shared corridors. In this form, two rail services are operated independently on separate parallel tracks having a track centerline separation between 30 and 200 feet. Two hundred feet is considered the outer limit of separation, where an accident on one line could interfere with operations on the other. Shared right-of-way operations exist on a broad scale in several metropolitan regions where FRA-compliant railroads share right-of-way with rapid transit systems (e.g., Washington, D.C., New Jersey, and Chicago). Most of California's intercity and commuter rail operations occur on shared track (as discussed above), with the exception of the SCRRA line segment between Palmdale and Lancaster, where SCRRA's line is operated separately from the parallel UPRR freight line. This situation is expected to change with HSR implementation. Some HSR sections will be classified as shared right-of-way or shared corridors.

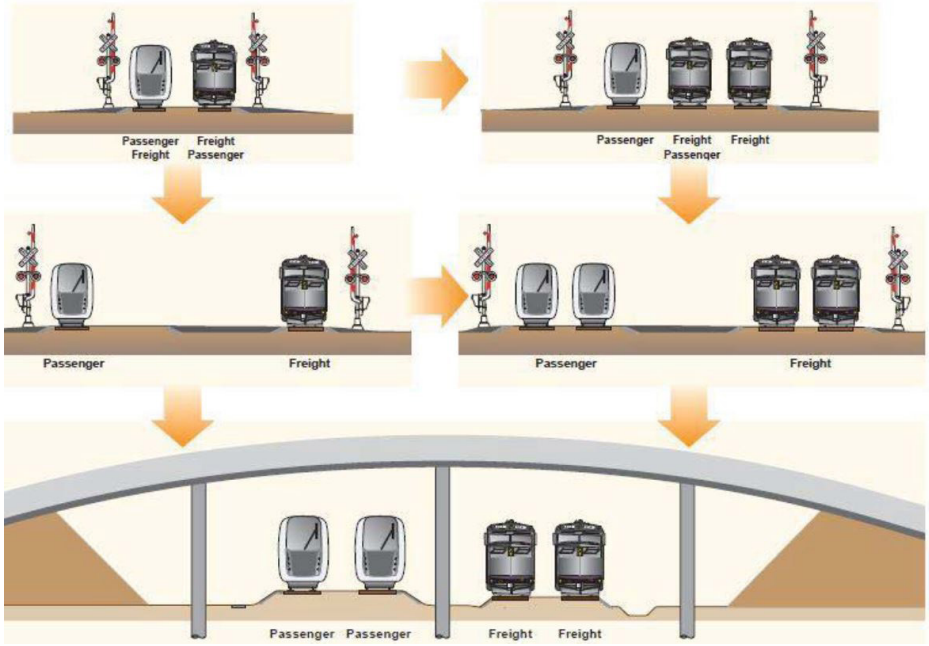


Exhibit 6.1: Corridor Separation Evolution; Shared Track (80/110 mph), Shared Corridor (80/110 mph), Blended Passenger (80-125 mph)

179 Time of day separation" is a distinct category of shared tracks that is not covered in this overall definition. Such an arrangement is required when the passenger rail vehicles are not compliant with FRA standards. California hosts two such operations: the San Diego Trolley on two branches, and the SPRINTER between Oceanside and Escondido

180 49 Code of Federal Regulations (CFR) Appendix A to Part 211, Statement of Agency Policy Concerning Waivers Related to Shared Use of Trackage or Rights-of-Way by Light Rail and Conventional Operations.

6.2 Funding for California Passenger and Freight Rail

California's rail system is funded by a number of sources and programs, including state fuel taxes and fees, federal fuel taxes, federal grant programs, state bonds, the cap-and-trade program, and local sales tax measures. Currently, the largest sources of funding include the state's Public Transportation Account (PTA) (funded by the diesel fuel tax and other state accounts), the Greenhouse Gas Reduction Fund (GGRF) from the Cap-and-Trade program, and federal fixed guideway capital investment grants. Detailed descriptions of these funding sources are provided later in the chapter.

Passenger rail capital projects draw funding from a number of sources at the federal, state, and local levels. Funding sources are more likely to have committed to near-term projects than to long-term projects, which are more open-ended. Due to the private-sector nature of freight rail, less detail is known regarding freight capital spending. However, public funding sources for shared corridor improvements are identified in the next section, and delineated in the 2022 projects list. This section describes the full breadth of funding options available at the federal, state, and local levels.

6.2.1 Operating Costs and Funding

Capital costs are only half the equation to establishing a financially sustainable passenger rail service. The other half consists of O&M costs for providing the service. Although operating passenger rail service is costly, there are massive efficiencies and economies of scale to be captured through well-planned, fast, and frequent service. In this way, the more frequently and faster the trains run, the more people ride, and the more cost-effective it is to provide the service per passenger mile traveled.

Key factors to lowering costs include:

- more efficient train rolling stock, largely through electrification and modern DMU trains that are cleaner and lighter than traditional diesel locomotive-hauled trains;
- faster train speeds, allowing for shorter trips and more hours of revenue service, with more efficient train crew service;
- faster turn-arounds, reducing the amount of time trains are idling at station or in rail yards; and
- changes in travel distances, largely through integrating regional and statewide services to ensure market sensitivity in route and service planning.

Several studies have shown that DMU trains are a practical alternative to diesel locomotive-hauled trains when train lengths are less than about four to five passenger cars. DMUs similar to the new trains operating in Marin County are not likely to replace current locomotive-hauled service on existing commuter rail lines directly, but could be used to extend or feed current routes, provide off-peak service, or replace locomotives in a high-service-frequency operating scenario where shorter, more frequent DMUs replace longer, less frequent locomotive-hauled trains. In addition to significant operating efficiencies gained by operating DMU on light-density routes, DMU are quieter and less polluting.

Taken together, these changes reduce unit costs for train operations, crews, and other overhead, resulting in more service available for far lower unit prices.

Although the O&M costs for the 2040 integrated network seem higher than the O&M costs for existing (i.e., today's) rail services, increased train speeds and frequencies, newer equipment, longer consists (i.e., higher capacity), longer travel distances, and increased operating efficiencies all contribute to driving down the average cost per train mile and cost per seat mile. The 2040 integrated network has a 45 percent lower cost per train mile, and a 65 percent lower cost per seat mile over today's service.

Fares

Higher ridership and lower cost of providing service ultimately means that the "fare box recovery ratio," or the portion of the cost of providing a ride that is paid for by rider fares, improves to the point that certain operations and services can be self-funding. Although it may not be the goal for public passenger rail service or transit to be profitable, local, express, and HSR services all benefit from the financial sustainability of self-funding their operations through low costs and high ridership.

6.2.2 Funding Opportunities

California's transportation system is at a precipice for making pivotal decisions and setting course for the mobility of the state and the rest of the country for several years to come. State and local spending has outpaced federal spending over the past few decades. Exhibit 6.2 shows the amount of spending by year on mass transit and rail by federal, state, and local sources across the United States. In 2014, state and local governments accounted for 77 percent of the nation's mass transit and rail spending. Combined nationwide spending was an estimated $68.4 billion.

With the passage of SB 1, the Road Repair and Accountability Act of 2017, California has increased its transportation investment to rebuild by fixing neighborhood streets, freeways, and bridges in communities across California, and by targeting funds toward transit and congested trade and commute corridor improvements. SB 1 invests an average of $5.2 billion annually over the next decade to fix California's transportation system—and invests at an even higher level beyond the first decade. It will address a backlog of repairs and upgrades, while ensuring a cleaner and more sustainable travel network for the future.

California's state-maintained transportation infrastructure will receive $26 billion, roughly half of SB 1 revenue. The other half will go to local roads, transit agencies, and an expansion of the state's growing network of pedestrian and cycle routes. Each year, this new funding will be used to tackle deferred maintenance needs both on the state highway system and the local road system.

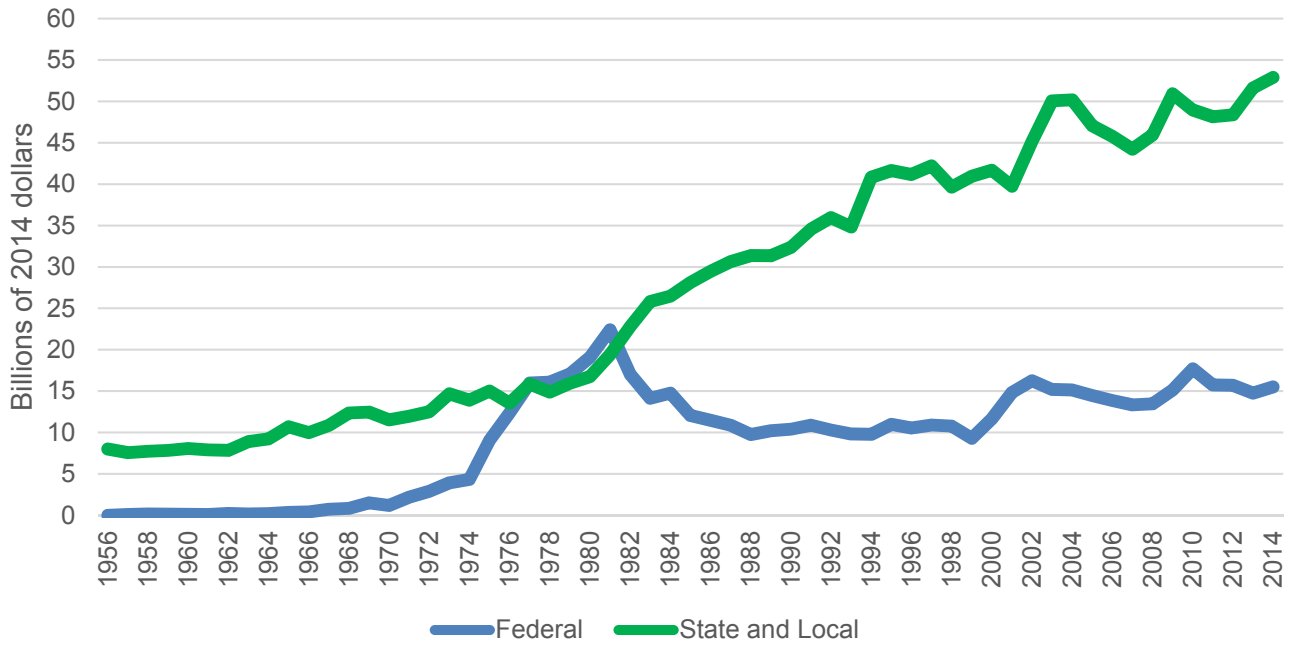
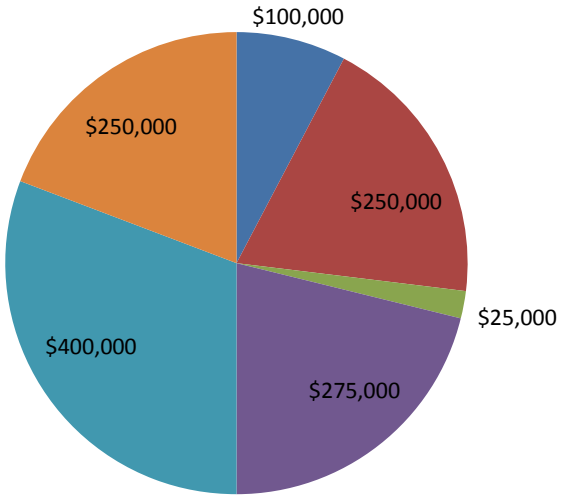


Exhibit 6.2: Federal Government and State and Local Government Spending on Mass Transit and Rail across the U.S., 1956 to 2014 (billions of 2014 dollars) [181]



- Active Transportation
- Local Partnership Grants
- Local Planning
- Corridor Mobility
- Transit Capital
- Trade Corridors

The State of California and Caltrans have made a commitment to funding improvements in the rail, transit, and local transportation systems necessary to work toward achieving the 2040 Vision. The 2017-2018 Budget proposed more than a billion dollars annually in funding for transit, congested and trade corridors, and active transportation.

Source: Governor's Budget Overview 2017-2018 (http://www.lao.ca.gov/Publications/Report/3694/10)

Exhibit 6.3: Caltrans-Anticipated Annual Rail and Transit Investment Funding (Capital and Planning)

181 Congressional Budget Office, *Public Spending on Transportation and Water Infrastructure, 1956 to 2014 (Data Underlying Figures)* (2015), accessed 2016.

6.2.3 Federal Rail Funding Fixing America's Surface Transportation Act[182]

The FAST Act of 2015 authorized $10.4 billion nationally for passenger rail (equivalent to about $2.1 billion annually over 5 years). Of this overall amount, the FAST Act authorizes $2.2 billion over 5 years for three new competitive rail development grant programs that build off of an earlier $10 billion investment through the High-Speed Intercity Passenger Rail Program:[183]

Consolidated Rail Infrastructure and Safety Improvements (Sec. 11301). The purpose of this grant program is to improve the safety, efficiency, and reliability of passenger and freight rail systems. Eligible activities include a wide range of capital, regional, and corridor planning; environmental analyses; research; workforce development; and training projects.

Federal-State Partnership for State of Good Repair (Sec. 11302). The purpose of this grant program is to reduce the state of good repair backlog on publicly owned or Amtrak-owned infrastructure, equipment, and facilities. Eligible activities include capital projects to (1) replace existing assets in-kind or with assets that increase capacity or service levels; (2) ensure that service can be maintained while existing assets are brought into a state of good repair; and (3) bring existing assets into a state of good repair.

Restoration and Enhancement Grants (Sec. 11303). The purpose of this grant program is to provide operating assistance to initiate, restore, or enhance intercity passenger rail transportation. Grants are limited to 3 years of operating assistance per route and may not be renewed.

The FAST Act investments are expected to increase spending by $1.7 billion over 5 years, controlling for inflation. [184]

Federal Transit Administration Formula Grants

The FAST Act reauthorized funding of FTA formula grants through 2020, providing more stability and predictability in funding for transit agencies. There are also competitive grant programs, but the FTA formula funds that support Rail Plan service and delivery goals are:

Rural Areas – 5311
Tribal Transit Formula Grants – 5311(c)(2)(B)
Urbanized Area Formula Grants – 5307
State of Good Repair – 5337
Rural Transportation Assistance Program – 5311(b)(3)

National Highway Freight Program

Section 1116 of the FAST Act created the formula-funded National Highway Freight Program, which funds projects that support the movement of goods on the National Highway Freight Network, including rail crossings, with $1.2 billion annually in funding. California is expected to receive $600 million over the next 5 years, or an average of $117 million per year, from the National Highway Freight Program. As much as 10 percent of these funds may be put toward improvements to freight rail or ports.

182 FRA, *FAST ACT Overview*, 2017.
183 FRA, *FAST ACT Overview*, 2017.
184 America Road and Transportation Builders, 2015 *"Fixing America's Surface Transportation Act" – A Comprehensive Analysis* (2015), accessed 2016.

National Surface Transportation and Innovative Finance Bureau

The FAST Act reorganized federal loan and discretionary programs under the new Surface Transportation and Innovative Finance Bureau.[185] The Bureau houses the following programs:

Transportation Infrastructure Finance and Innovation Act (1998) (TIFIA). The act provides federal credit and financing assistance with flexible repayment terms to projects of national and regional significance, including rail transit programs. To date, California has received roughly $2.8 billion in TIFIA assistance, $1.7 billion of which has gone to rail transit programs, primarily intercity rail in Los Angeles. The FAST Act reauthorized TIFIA, but with funding levels significantly lower than Moving Ahead for Progress in the 21st Century Act (MAP-21). [186]

Railroad Infrastructure Financing and Improvement Act (RRIF) (2015). The FAST Act expanded eligible projects for railroad rehabilitation and improvement financing to include transit-oriented and station development. The FAST Act also shortens review time and allows joint public-private ventures to encourage more applications to apply. As of May 31, 2015, the program has executed 35 loans for approximately $2.7 billion nationally. Some California projects have received loans through RRIF.[187]

Nationally Significant Freight and Highway Program (2015). Section 1105 of the FAST Act created the Nationally Significant Freight and Highway Program, a competitive grant program. The program is planning to allocate $4.5 billion in grants in fiscal years 2016 through 2021. The minimum grant awarded is $25 million.

FASTLANE/INFRA Grants Program

The FAST Act established the FASTLANE/INFRA grant program, which provides competitive grants to nationally and regionally significant freight and highway projects that demonstrate cost-effectiveness and the ability to generate national or regional economic, mobility, or safety benefits. Eligible projects include freight rail and freight intermodal facility improvements and improvements within the border of freight rail and intermodal facilities.[188] The FFY 2016 FASTLANE/INFRA grants awarded $759 million to 18 projects nationally.[189] California received one of the grants, although it was for a highway rather than rail project. FASTLANE/INFRA grants were authorized $4.5 billion from FFY 2016 to FFY 2020.[190]

Fixed Guideway Capital Investment Grants (Section 3005) The Fixed Guideway Capital Investment Grants Program is a discretionary program that provides funding for new or expanded commuter rail, ferry, or bus rapid transit projects. It includes four categories: New Starts, Small Starts, Core Capacity, and Programs of Interrelated Projects. It is programmed to fund $2.3 billion of projects nationally each year from FFY 2016 through FFY 2020.[191] The FFY 2017 funding recommendations for the program included nine California projects across the four categories. These California projects were allocated over $2.3 billion in federal funding through FFY 2016, and had $4.4 billion in remaining federal funding needs after FFY 2016. The FFY 2017 budget recommendations cover more than $1.1 billion of these remaining needs in that year.[192]

185 FRA, *FAST ACT Overview*, 2017.

186 Squire Patton Boggs, FAST Act: Opportunities for Private Sector Investment and P3s (2015), accessed 2016. TIFIA funding will be $275 million in FFY 2016 and 2017, $285 million in 2018, and $300 million in 2019 and 2020.

187 FRA, *RRIF Program Fact Sheet* (2015), accessed 2016.

188 FRA, *FAST ACT Overview*, 2017.

189 U.S. DOT, *Fiscal Year 2016 FASTLANE Awards Annual Report* (2016), accessed 2016.

190 U.S. DOT, *FASTLANE Grants FAQs* (2016), accessed 2016.

191 FTA, *Fixed Guideway Capital Investment Grants,* accessed 2016.

192 FTA, *Annual Report on Funding Recommendations, Fiscal Year 2017, Capital Investment Grant Program,* (2016), accessed 2016.

BUILD - Better Utilizing Investments to Leverage Development

The U.S. DOT awards competitive federal Better Utilizing Investments to Leverage Development (BUILD; formerly TIGER) discretionary grants to fund capital investments in surface transportation infrastructure. BUILD grants focus on capital projects that generate economic development and improve access to reliable, safe, and affordable transportation. Both rail and port projects are eligible. In FFY 2017, the ninth round of former TIGER grants awarded nearly $500 million in transportation improvement projects, including rail. A California project received $9 million from this round.[185] TIGER had previously funded $5.5 billion of grants nationally from 2009 to 2017.[193]

Railroad Safety Risk Reduction Program (Section 130)

Section 130 of the RSIA of 2008 established the Railroad Safety Risk Reduction program. This program has been continued under the FAST Act as a set-aside from the Highway Safety and Improvement Program, and is apportioned to eligible states by formula. About 50 percent of the state's allocation must go to installing protective devices at at-grade crossings. Under the FAST Act, California is expected to receive $82 million via this program for crossing safety enhancement projects between the years 2016 and 2020.[194]

U.S. Department of Transportation
Federal Railroad Administration

Workers supporting high speed rail construction in Fresno

193 U.S. DOT, *Tiger Discretionary Grants*, 2016, accessed 2017.
194 Caltrans, *FAST Act Memorandum* (2015), accessed 2017.

6.2.4 State Funding

The California State Legislature passed SB 1 and the Road Repair and Accountability Act of 2017 to reform the transportation program and increase transportation revenue. In the 2016-2017 budget documentation, the Governor presented a transportation funding and reform package that included a new road improvement charge; stabilization of the gasoline excise tax to 18 cents, with an adjustment annually of the broader gasoline tax to inflation; an increase in the diesel excise tax; additional money provided by the cap-and-trade program; and costs savings from increasing Caltrans' efficiency.[195] This funding package will generate $5.4 billion annually, and establishes new funding sources like a new annual vehicle fee, amongst other things. The Transportation Improvement Fee and Road Improvement Fee generate $16.35 billion and $191 million, respectively, over the next 10 years. This section describes all the opportunities to pursue state funding.

WHERE DOES THE MONEY GO?

California's State-maintained transportation infrastructure will receive roughly half of SB 1 revenue: $26 billion. The other half will go to local roads, transit agencies, and an expansion of the state's growing network of pedestrian and cycle routes. Each year, this new funding will be used to tackle deferred maintenance needs, both on the state highway system and the local road system, including:

- Maintenance and Rehabilitation of the State Highway System: **$1.5 billion**
- Maintaining and Repairing the State's Bridges and Culverts: **$400 million**
- Repairs to Local Streets and Roads: **$1.5 billion**
- Matching Funds for Local Agencies: **$200 million**
  Will go to local entities that are already making their own extra investment in transportation. These matching funds will support the efforts of cities and counties with voter-approved transportation tax measures.
- Bicycle and Pedestrian Projects: **$100 million**
  Will go to cities, counties, and regional transportation agencies to build or convert more bicycle paths, crosswalks, and sidewalks. It is a significant increase in funding for these projects through the Active Transportation Program.
- Freeway Service Patrol: **$25 million**
  Assists stranded motorists on the most congested freeways to keep drivers moving during peak hours.
- New Funding to Transit Agencies to help them increase access and service and build capital projects: **more than $750 million**
- TCEP: **$300 million**
  Will fund freight projects along important trade corridor routes.
- Solutions for Congested Corridors Program: **$250 million**
  Will go to projects from regional agencies and the state that will improve traffic flow and mobility along the state's most congested routes, while also seeking to improve air quality and health.
- Local Planning Grants: **$25 million**
  Addresses community needs by providing support for planning that may have previously lacked funding; good planning will increase the value of transportation investments.
- Transportation-Related Research at state universities: **$7 million**
  Will help identify cost-effective materials and methods to improve the benefits of transportation investments.
- Workforce Training Programs: **$5 million**
  Every $1 billion spent on infrastructure projects creates more than 13,000 jobs, according to federal government estimates. California needs to ensure there is a ready workforce to carry out these transportation projects.

Source: http://www.rebuildingca.ca.gov/overview.html

195 Legislative Analyst's Office, Governor's Budget Summary 2016-17 – Transportation Summary (2016), accessed 2016.

State Transportation Accounts

State Highway Account

The bulk of State Highway Account (SHA) funding goes to the State highway system. The SHA receives its funds from state gasoline fuel taxes, state vehicle weight fees, and reimbursements from the Federal Trust Fund for Federal Aid projects and other smaller sources of funds.

The SHA had an estimated $11.4 billion available for distribution in FY 2016-2017.[196] The SHA is funded 60 percent from state sources and 40 percent from federal sources. It does not fund passenger rail directly, but rather flows into the PTA and STIP.

Public Transportation Account

The PTA is a trust fund to be used "only for transportation planning and mass transportation purposes." The PTA is now almost exclusively funded through the sales tax on diesel fuel, and there is a transfer of $25 million from the SHA. The 2016-2017 State Budget includes $1.24 billion in PTA resources.

PTA funds are apportioned between state and local programs in accordance with Proposition 22, passed by the voters in 2010.[197] Approximately 60 percent of the funds go to the local State Transit Assistance (STA) program, through which funds are apportioned on a formula basis to local transit agencies. The state portion goes to intercity rail operations ($130.8 million in the 2016-2017 state budget), state-owned equipment rehabilitation, staff support to Caltrans and other state agencies that support mass transportation, and rail projects in the STIP. The PTA is the only state funding source for state-supported intercity rail service operations.

SB 1 significantly increased the amount of funding in the PTA, but low fuel prices, along with greater fuel-efficient vehicles may erode the future revenue in this account.

State Transportation Improvement Program

The STIP is a program and not a funding source; it is funded through the SHA, the Federal Trust Fund, and a small amount from the PTA. The STIP devotes 25 percent of its expenditures to the Caltrans ITIP, which includes intercity rail improvements; and 75 percent of its expenditures to the Regional Agencies' Regional Transportation Improvement Program, which funds local projects, including regional rail transit.[198]

The amended 2016 STIP Capacity for 2015-2016 through 2020-2021 is $1.95 billion, with $250 million for transit (including passenger rail) from the PTA,[199] and the remaining amount from the SHA. Available funding for the 2016 STIP was not sufficient to fund existing programed projects from the 2014 STIP; therefore, the 2016 STIP was reduced by $167 million for PTA projects, and by a similar percentage for road projects. This caused the CTC to rescind funding for previously committed STIP projects.

SB 1 stabilized and increased funding in the STIP program, which will be reflected in forthcoming years.

State Transit Assistance Program

The STA funds day-to-day transit operations and capital infrastructure. The revenue for the STA comes from diesel fuel sales taxes and distributes funds to MPOs/RTPAs based on population, or to transit agencies based on revenue. SB 1 provides $250 million annual to the STA. SB 1 also creates an STA Capital Program of $105 million annually to fund transit, with a specific focus on state of good repair.

196 CalSTA, *2016-17 California State Transportation Financing Package* (2016). Accessed 2016.

197 Per Proposition 22, passed by voters in 2010.

198 California Streets and Highways Code Section 164.

199 CTC, *Adoption of 2016 State Transportation Improvement Program (STIP) Resolution G-16-19* (2016), accessed 2016.

The Section 190 Grade Separation Program

This is a State-funded safety program that supports projects that replace and upgrade existing at-grade railroad crossings, primarily with grade separations. The CPUC establishes a project list, and the Caltrans DRMT administers the program.

Section 190 of the California Streets and Highways Code requires the State's annual budget to include $15 million for funding these projects.[200] The maximum funding per project is $5 million annually.

Trade Corridors Improvement Fund

The Highway Safety, Traffic Reduction, Air Quality, and Port Security Bond Act of 2006 (Proposition 1B) created the Trade Corridors Improvement Fund; and provided for allocation by the CTC of $2 billion in bond funds for infrastructure improvements on highway and rail corridors that have a high volume of freight movement, and for specified categories of projects eligible to receive these funds.

Automatic Grade-Crossing Warning Device Maintenance Fund

Caltrans sets aside a minimum allocation of $1 million per year for this fund, which is administered by CPUC. As indicated in Table A.28 in Appendix A, claims have continued to exceed fund allocations in recent years. In response, the CTC has approved allocations of $2 million per year. In the FY 2015-2016 State Budget, funding was increased to $3.8 million to help close this funding gap.[201]

200 Caltrans DRMT, *Grade Separation Program Section 190 Guidelines* (2016), accessed 2016.

201 CPUC, Rail Crossing Engineering Section, "Grade Crossing Maintenance Fund Program," February 2016.

State Bonds

State bonds used to fund California's rail system include the following.

Proposition 108 – Passenger Rail and Clean Air Bond Act (1990)

Officially known as the Passenger Rail and Clean Air Bond Act of 1990, Proposition 108 provided a bond issue of $1 billion exclusively for intercity rail ($225 million), commuter rail, and rail transit. The bond provided funds for purchase of right-of-way and rolling stock and other capital investments. The bond's funding capacity is almost entirely exhausted.

Proposition 116 – Clean Air and Transportation Improvement Bond (1990)

The Clean Air and Transportation Improvement Bond of 1990 authorized a bond of $1.99 billion to fund passenger rail and transit projects, including approximately $382 million for intercity rail projects, $1.37 billion for urban and commuter rail projects, and $235 million for other transit and transit-related projects. The bond's funding capacity is virtually exhausted.

Proposition 1A – High-Speed Passenger Train Bond Program (2008)

Known as the Safe, Reliable High-Speed Passenger Train Bond Act for the 21st Century of 2008, Proposition 1A authorized a total of $9.95 billion in bond funding for rail investments, including $9 billion for HSR directly; the remaining $950 million was dedicated to intercity and commuter rail that provides connectivity to the HSR system under the High-Speed Passenger Train Bond Program (HSPTB).

The HSPTB program funds, allocated by the CTC, funds both the $190-million Intercity Rail Program and the $760-million Urban and Commuter Rail formula-funded program. As of the third quarter of FY 2015-2016, $124 million of the Intercity Rail Program funding had been allocated ($68 million to the competitive portion of the program, and $56 million to the formula-based portion of the program); and $687 million of the Urban and Commuter Rail Program had been allocated.[202]

Proposition 1B – Highway Safety, Traffic Reduction, Air Quality, and Port Security Bond Act (2006)

Proposition 1B authorizes $19.9 billion in general obligation bonds for a wide variety of programs. The CTC was authorized to manage $12 billion[203] of this money, including the following programs that impact rail funding:

Public Transportation Modernization, Improvement, and Service Enhancement Account

Proposition 1B authorized the Public Transportation Modernization, Improvement, and Service Enhancement Account with $3.6 billion, $3.49 billion of which has been committed.[204] The account had an estimated $87 million available for distribution in FY 2016-2017.[205]

Intercity Rail Improvement Program

Proposition 1B authorized the Intercity Rail Improvement Program (IRI Program) with $400 million, of which $125 million were reserved for intercity passenger rail equipment. The IRI Program consists of seventeen projects: two projects that remain unallocated, two projects that are partially allocated, five projects are fully allocated, and eight projects that are completed. The total programmed amount is $392 million.

Highway Railroad Crossing Safety Account (Freight)

Proposition 1B authorized the Highway Railroad Crossing Safety Account with $250 million for high-priority grade separation and railroad crossing safety improvements. The Highway Railroad Crossing Safety Account program has a total of 37 projects programmed; $242,354,000 has been allocated to these projects, and $19 million has been expended. Twenty-two of the 37 projects have completed construction. The amount of unprogrammed available funds is $0.6 million[206] as of March 2016, all of which has been committed.[207] The account had an estimated $9.4 million budgeted for distribution in FY 2016-2017.[208]

202 Caltrans, *Fiscal Year 2015-16 3rd Quarter Report High-Speed Passenger Train Bond Program* (2016), accessed 2016.

203 CTC, *Proposition 1B: Promises Made, Promises Kept* (2015), accessed 2016.

204 State of California, *Strategic Growth Plan Bond Accountability – Proposition 1B* (2016), accessed 2016.

205 CalSTA, 2016-17 *California State Transportation Financing Package* (2016), accessed 2016.

206 CATC, *Quarterly Reports '15-'16* (2016).

207 State of California, *Strategic Growth Plan Bond Accountability – Proposition 1B* (2016), accessed 2016.

208 CalSTA, 2016-17 *California State Transportation Financing Package* (2016), accessed 2016.

Cap-and-Trade Program California Greenhouse Gas Reduction Fund

In 2006, the California State Legislature passed AB 32, with the ambitious goal of reducing GHG in the state. AB 32 created the Cap-and-Trade Program, and authorized CARB to establish a carbon permit auction. A series of subsequent bills allocated the revenue from the Cap-and-Trade Program to the newly created California GGRF, which is also known as the California Climate Investments Program.[209]

Transit and Intercity Rail Capital Program

One program under GGRF allocates 25 percent of revenues to HSR, and 10 percent to the TIRCP. The TIRCP is a competitive grant program that receives annual appropriations equivalent to 10 percent of the State's Cap-and-Trade auction revenues. This program is dedicated to transformative transit and rail projects that will have a significant impact on increasing ridership and reducing GHGs. TIRCP will receive an average of $300 million annually from SB 1; a minimum of 25 percent of that will fund projects that benefit disadvantaged communities. This program has also received funds from sources other than Cap-and-Trade auction revenues, including early debt repayment appropriated to the TIRCP.

Low Carbon Transit Operations Program

Another transportation program now available through the GGRF includes the Low Carbon Transit Operations Program (LCTOP), under which funds are allocated to local agencies to support new or enhanced bus and rail services and intermodal transit facilities, and to prioritize projects that support disadvantaged communities. The LCTOP receives a continuous allocation of 5 percent of the Cap-and-Trade revenues via GGRF.

Revenue from the Cap-and-Trade Program is allocated to GGRF. To date (FY 2013-2014 through FY 2015-2016), GGRF funding has included $707 million to the HSR program, $224 million to the TIRCP, and $116 million to the LCTOP, in addition to other non transit programs. For FY 2016-2017, GGRF allocated 25 percent of funds to the HSR program, $135 million plus 10 percent of funds to the TIRCP, and 5 percent of funds to the LCTOP.

Road Repair and Accountability Act (SB 1)

In addition to enhancing and stabilizing existing funding sources such as the TIRCP, the STA, and the STIP, SB 1 created new funding programs that will help fund rail and transit projects and deliver the Rail Plan.

State Rail Assistance Program

The State Rail Assistance Program is specifically designed as a revenue source for intercity and commuter rail. The revenue comes from 0.5 percent of a new diesel sales tax revenue, as defined in SB 1. Half of the revenue will be evenly distributed between the five commuter rail operators, and half is allocated to intercity rail corridors. CalSTA announced the first round of awards, totaling $51.9 million, in January 2018. It is estimated that the annual revenue for this program will be $44 million.

Solutions for Congested Corridors Program

The Solutions for Congested Corridors Program aims to reduce congestion and support multimodal, accessible, and equitable transportation projects. The program prioritizes comprehensive corridor plans that reflect coordinated planning. This competitive program makes an average of $250 million available annually.

Trade Corridor Enhancement Program

The TCEP is funded through SB 1, with revenues of approximately $300 million annually. This program establishes the Trade Corridor Enhancement Account to provide stable funding for freight that prioritizes corridor-based freight projects nominated by local agencies and the State. As of July 2017, with the passage of SB 103, the TCEP was combined with the National Highway Freight Program.

209 CARB, *California Climate Investments from the Greenhouse Gas Reduction Fund* (2016), accessed 2016.

6.2.5 Local Funding

As noted Chapter 1, Article XIIIB of the State Constitution allows for local sales tax measures subject to voter approval. The majority of county sales tax measures are used to fund urban transit, but also support commuter rail services and intercity rail stations.

There are already many local sales tax measures throughout the state. In November 2016, voters approved many new local sales tax measures, including Los Angeles Measure M, LA Metro's transportation ballot measure. This measure includes funding to expand the rail and rapid transit system, to accelerate rail construction and build new rail lines, to enhance local regional and express bus service, and to improve system connectivity. Measure M included $1.9 billion for regional rail improvements (i.e., for the Metrolink commuter rail system) over the next 40 years. Table 6.6 outlines other local tax measures that were approved on the November ballot and that support the statewide rail network and connectivity goals.

Table 6.6: New 2016 Local Tax Measures

Location	Explanation of Funding Source	Amount	Description of Proposed Improvements
BART Region (San Francisco, Contra Costa, and Alameda Counties) (Measure RR)	Property tax, for 40 years	$3.5 billion	Repairs and maintenance on BART transit: electrical systems, rail replacement, fixing leaking tunnels, and upgrading central computer control system.
Alameda and Contra Costa Counties (Measure C1)	20-year parcel tax extension	$30 million/ year	AC Transit bus O&M.
Santa Clara County (Measure B)	0.5% sales tax for 30 years	$6.5 billion	$1.5 billion for BART Phase II; $250 million for bicycle/pedestrian projects; $2.85 billion for highways; $1.2 billion for local streets; $500 million for transit operations.
Santa Cruz County (Measure D)	0.5% sales tax for 30 years	$500 million	Portion of the money for analysis of rail as a transit option.
Merced County (Measure V)	0.5% sales tax for 30 years	$450 million	Half of the funding to local jurisdictions (nondiscretionary); of the remaining half, 20 percent on bicycle/pedestrian and 5 percent on transit.
Stanislaus County (Measure L)	0.5% sales tax for 25 years	$975 million	Local street and road improvements, traffic management, bicycle/pedestrian improvements and transit connection improvements.
Los Angeles County (Measure M)	0.5% sales tax increase, plus continue the existing (Measure R) 0.5% sales tax, set to expire in 2039, in perpetuity	$860 million/ year, estimated $100 billion over 40 years	Big expansion of rail, bus transit, bicycle/ pedestrian projects, and 10 highway projects. 17 percent of funds would go to cities for local streets projects.

6.3 Benefits of the State's 2040 Vision

The service and connectivity goals analyzed for plan assumptions outlined in this section were developed for planning purposes to enable ridership and revenue forecasting. Service planning continues in many corridors, and specific operating plans and timetables have not been finalized at this time. Service plan implementation will require funding and agreements that are yet to be established. Therefore, the service plan assumptions described below are illustrative and do not reflect a commitment to provide the indicated services.

The illustrative service plan assumptions reflect phased implementation of the California HSR System and blended operations with intercity rail routes to deliver integrated statewide passenger rail service. The assumptions are consistent with the California HSR 2018 Business Plan (2018 Business Plan), and planned near-term expansion of the California intercity and regional rail network. Finally, the assumptions include increased passenger service on those corridors shared with freight traffic that freight rail operators have agreed to evaluate, or are currently evaluating.

The expenditures will result in nearly 463,000 full-time jobs, and labor income surpassing $28 billion across industries.[210] By 2040, state and local tax revenues anticipated from the expenditures will be close to $2 billion, and federal tax revenues will be $5.4 billion. New federal and state trade corridor funding will accelerate many of these investments, bringing the economic benefits sooner.

The Rail Plan identifies $40.8 billion of direct expenditures planned by private railroads and regional agencies, resulting in a total economic output of nearly $77.5 billion by 2040—a payout of nearly two dollars for every dollar invested.

210 Steere Davies Gleave, 2018 State Rail Plan Analysis, Appendix A.6.

6.3.1 Regional Balance and Distribution of Benefits

The equitable distribution of public investments and their returns is a key metric to successful economic development and good stewardship of the state's fiscal resources. When properly planned, integrated rail networks are effective tools for connecting people to jobs, and goods to markets. By focusing investment on connecting and expanding existing regional networks into a statewide system, benefits are distributed in a balanced way throughout the state.

Distribution of Passenger Rail Benefits

By increasing service frequencies, expanding coverage areas, and improving speeds, direct and indirect benefits will accrue throughout the state. In an integrated statewide system, a grade separation in San Bernardino can improve service connections from Sacramento or Oakland. An electrification project in Sacramento can improve service speeds in San Jose when that investment is part of a coordinated program to improve an entire corridor and build an integrated system. Double-tracking in Los Angeles can improve service frequency in Fresno. Furthermore, by connecting and coordinating these services, regional hubs can be established throughout the state in places like Suisun-Fairfield, Burbank, Ontario, Stockton, Palmdale, or Escondido.

Taken together, the 2040 Vision has the potential to change the shape of the State of California. Bakersfield will be an hour and a half from Los Angeles; Fresno would no longer be a 3.5-hour drive from San Francisco, but rather a 2-hour train ride; Sacramento and Los Angeles would go from a nearly 7-hour drive to a 3-hour train ride. Time savings will be realized even within regional networks; San Bernardino will be 45 minutes closer to Los Angeles, cutting half the time required when driving. The power of the integrated statewide network is to move markets closer to one another, and expand economic opportunity for all.

Even places without direct passenger rail service will experience benefits ranging from improved connections to vastly improved services. Integrated bus service from Redding, Calexico, Arcata, or Yosemite National Park can offer timed and direct passenger services to the rail network, connecting these communities to the rest of the state by passenger rail.

The 2040 Vision is strategic in its approach to scaling phased, market-oriented investments toward an integrated statewide network. Through specific investments that support the vision, the benefits of an integrated network will be distributed to system users and their communities throughout the state.

Mode Shift and Safety Benefits

Mode shifts from driving to rail will benefit California in many ways, resulting in travel time and connectivity benefits across the state, safety improvements, and congestion mitigation. Based on the 2040 Vision and the associated system enhancements, intercity and regional rail ridership will increase to more than 1.3 million riders per day. For all travel on all modes, rail passenger miles will account for 30 percent of the total growth in trips, resulting in 7 percent of the total statewide mode share.

Of the expected total growth on the transportation system, mode shift to rail will draw 74 million of the daily VMTs from roads. This will significantly mitigate congestion on roads and aid in achieving statewide GHG emissions reductions targets. Because rail is many times safer than driving, the mode shift of 74 million VMTs away from highways can potentially reduce more than 250 fatalities per year and 19,000 transportation-related injuries in California by 2040. At a value of a statistical life of $9.6 million, this represents a net gain of $2.4 billion to the economy of California per year.

Ridership and Revenue Analysis

The rail vision is being implemented through a strategic approach using conceptual planning techniques. It begins with an estimation of the available infrastructure required to meet the service and connectivity goals, as described in Chapter 4. A dynamic simulation is then used to validate the assumptions and analyze multiple alternatives that generated a statewide netgraph model, with precise running times between hub stations and overlapping frequencies of multiple trains, to achieve pulse schedules and set daily running patterns.

Once a feasible alternative was arrived at using the statewide netgraph model and the capacity analysis, a ridership analysis was performed to determine the volume of passengers that can be accommodated by these corridors. The ridership numbers were developed to match the conceptual planning for the 2040 Vision, and the results show a large increase in ridership demand across the entire network resulting from network integration. The county-to-county travel results (Exhibit 6.2) indicated that a significant portion of the transit market can be captured with improved rail and public transit connections. The analysis used the State "Rail Market Analysis Tool" and an assignment model; and the demand was estimated based on rail and transit service impedances and the assignment model to allocate demand to the tested network. The data represent only trips that use a rail service on one leg of a trip, so the visual representation provides an overview of the strength demand for connections between different counties.

The statewide ridership model produces high-level results for the corridors. Subsequent analysis with a more detailed model would be required to better understand the demand at hubs and regional connectivity for prioritizing service improvements and investments in a corridor.

Distribution of Freight Rail Benefits

The success of freight rail networks depends on how well they connect freight generators to markets. Freight network constituents include the main-line and short-line railroads, ports, and shippers. The Rail Plan identifies a host of improvements and programs, from grade separation on main-line freight railroads to assistance for short-haul and short-line services to increase capacity and access throughout the freight network. In this way, a safety or capacity investment to a main line in one part of the state and a short-line investment to another all build toward a more robust transportation network that spurs economic development throughout the entire state.

6.3.2 Passenger Rail Effects and Benefits

The passenger rail improvements detailed in Chapter 4 represent significant investments in passenger services and capital projects. Beyond better connectivity and an improved statewide transportation network, these investments will have benefits to several important areas, including but not limited to significant returns to local, regional, and statewide economies; increased ridership; reduced per-capita operating costs; and, of course, the benefits of the newer technology and efficiencies in transportation on the environment.

Economic Benefits

Benefits include employment (measured as person-years of full-time employment), income (wages and salaries) associated with this employment, and firm output (essentially the same as expenditures).

Improvements in California's rail system are investments that will pay off in terms of greater economic activity: new construction, more jobs, and growing tax revenues.

- The $40.8 billion of direct expenditures identified in the Rail Plan will result in a total output for the economy of nearly $77.5 billion by 2040—a payout of nearly 2 dollars for every dollar invested.
- The expenditures will result in a total employment impact across affected industries of nearly 463,000 full time jobs, and labor income of more than $28 billion.
- By 2040, state and local tax revenues anticipated from the expenditures will be close to $2 billion, and federal tax revenues will be $5.4 billion.

The tax impacts pertain to taxes for which revenues can be directly inferred from economic expenditures, such as sales or income taxes.

Direct Economic Benefits

463,000 full-time jobs
$28 billion in labor income

$77.5 billion in new state
economic output by 2040

Increased Ridership

The 2040 Vision anticipates an increase in intercity passenger rail ridership, including HSR, to approximately 1.3 million riders per day. Current daily state intercity passenger rail ridership is approximately 115,000 trips per day. This is nearly a twelvefold increase in ridership from current levels, as shown in Exhibit 6.4. This increase assumes faster rail service and smooth transfers at hubs; better accessibility and timed connections to transit and rail services at stations; and integrated ticketing throughout the transportation network.

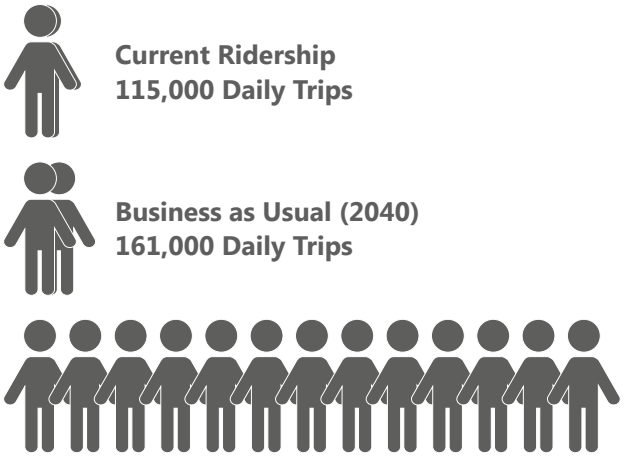


Exhibit 6.4: 2040 Vision Ridership Growth

Rail Capacity and Congestion

The 2040 Vision projects a volume of passengers be carried throughout the state on the intercity and local rail system that will result in large numbers of passenger miles being served by the rail system instead of the highway system. The 2040 Vision projects an additional 90 million passenger miles per day on the rail system, exclusive of urban transit. This is equivalent to the rail network accommodating 1.5 times the current daily traffic volumes of the entirety of I-5, from the Oregon state line to the border with Mexico. Likewise, it would accommodate the equivalent of 1.8 times the current daily traffic volume on Highway 101 from the Oregon state line to Los Angeles.

In addition to increased rail ridership, improved systemwide connectivity will expand the efficiency and reach of the rail and transit networks, as well as the entire transportation system. Currently, California accommodates 3.9 million daily transit boardings. Rail has more capacity on existing rights-of-way than any other transport mode; therefore, coupled with better connectivity, rail presents an opportunity to capture more riders, complementing and relieving some of the growing transportation pressures on the highway system. Rail also provides connections to the vast transit network that is expected to accommodate 9 million daily riders by 2040, further expanding the impact the rail network and increased rail ridership has on statewide mobility.

As shown in Exhibit 6.4, translating the ridership growth numbers in Exhibit 6.2, the number of passengers using rail instead of highways in key corridors could increase dramatically. The rail travel patterns between counties seen after the implementation of the 2040 Vision plan is much denser and more diverse. Reduced travel times and better network connectivity can provide more options for travelers. It is anticipated that of total transportation trips made on all modes, 30 percent of the growth will be made by rail instead of by automobile. Of the expected growth by 2040, 74 million fewer daily VMTs will occur on and need to be managed on highways, due to mode shift from roads to rail. This has the additional benefit of removing travelers from highways, thereby eliminating some of the anticipated congestion and improving the level and quality of service on the transportation network as a whole. Under the "No Build Scenario," whereby the status quo is maintained, only a modest increase would occur in intercounty travel on rail, and possibly all the additional growth that could have been accommodated by rail would end up on highways.

Exhibit 6.5 shows intercounty travel for current conditions, "No Build" scenario, and 2040 Vision.

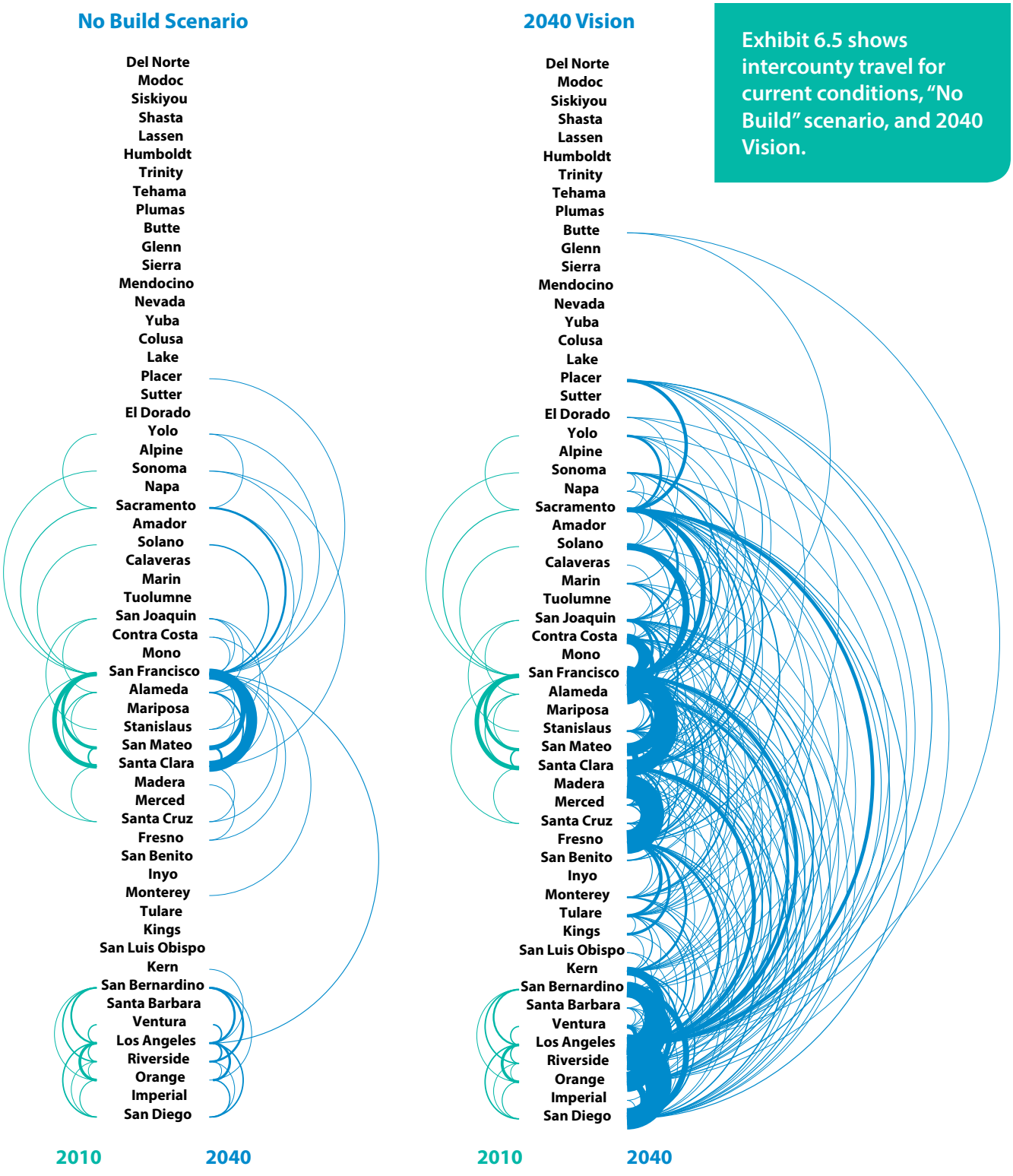


Exhibit 6.5: County-to-County Ridership Demand "No Build" vs. 2040 Vision [211]

211 Includes routes with a minimum of 500 trips per day (both directions) with at least one leg on passenger rail service. Transit trips are not shown.

The "No Build" Scenario

California has already made significant investments in passenger rail, and has one of the most robust statewide rail networks in the nation. Many rail services across the state have seen tremendous amounts of ridership growth, and there have been increasing concerns regarding overcrowding, infrastructure constraints, and efficient schedule operations to meet peak demand. Based solely on population growth, 2040 ridership in the "No Build" scenario is expected to increase by approximately 50,000 per day.

2040 Vision

As detailed in Chapter 2, statewide travel is forecast to continue to increase across all travel modes, including passenger rail, highway, and air travel. Highway travel VMTs are increasing, and California's highways are already the most congested in the nation. The status quo will only result in increased congestion, longer travel times, and an overall loss in economic productivity. As part of the environmental analysis detailed in subsection 6.3.4, Californians are expected to drive an additional 150 million miles per day. It is imperative that the passenger rail network investments meet the needs of additional travel demand to avoid further degradation of the traffic network and environment. Full integration of the state rail network is expected to meet an additional passenger demand of approximately 90 million passenger miles of daily travel.

Land Use

A good land use plan is a good transportation plan because it will efficiently organize development to minimize travel distances and the need for expensive public infrastructure to connect development. However, a good transportation plan is a good land use plan because it organizes the movement of people and goods around high-value nodes that signal where development should be concentrated to maximize efficient use of the public investment. This Rail Plan is a long-term, strategic transportation plan that coordinates and maximizes use of highly efficient infrastructure. It provides key incentives and guidance to regional and local levels, the market, and private citizens to organize land use and development around the state's key transportation hubs (identified in the 2040 Vision) in a way that can reduce sprawl, contribute to equitable economic development, and minimize environmental impacts.

Rail Capacity and Congestion

Carrying so many passengers throughout the state on the intercity and local rail system, as is projected in the 2040 Vision, will result in large numbers of passenger miles being served by the rail system instead of the highway system. The 2040 Vision results in an additional 90 million passenger miles per day on the rail system, exclusive of urban transit. This is equivalent to the rail network accommodating 1.5 times the current daily traffic volumes of the entirety of I-5, from the Oregon state line to the border with Mexico. Likewise, it would accommodate the equivalent of 1.8 times the current daily traffic volume on Highway 101 from the Oregon state line to Los Angeles.

Significantly, the projected growth of 90 million passenger miles per day on rail accounts for nearly a third of all projected growth in passenger miles over this period. Although this does not account for urban transit ridership, many of the trips will use local transit for first- or last-mile connections. Because of the longer nature of intercity, regional, or statewide train trips, urban transit systems stand to additionally benefit from travelers using the system in off-peak hours.

6.3.3 Freight Rail Effects and Benefits

The planned investments in freight rail would generate a range of public and private benefits. In this case, "public benefits" refer to net increases in public goods.[212][213] Public benefits from freight rail investments can accrue in several ways: they increase the efficiency of the freight system, reducing travel times, costs, and emissions of existing trips. The freight rail efficiency and capacity improvements can attract trips away from other modes, primarily trucks, potentially saving costs, emissions, and time, as well as improving safety of those trips relative to their original mode. These diversions can also lower congestion, positively impacting emissions and safety on the roadway networks generally. The investments can also make a region more competitive economically, attracting development from other regions. These benefit transfers from one geographic area to another are not always counted as net benefits, and benefit tabulation varies by methodology.

"Private benefits" accrue to either shippers or railroads, or in many cases both. Shippers can potentially benefit from freight rail investments in the form of business cost reductions, access to service, service reliability, and transit time, while maintaining the competitive edge of the region. Railroads can potentially benefit from system velocity improvements, reduced delay, reduced yard dwell time, increased revenue traffic, and improved rolling stock use and resulting labor productivity.

The remainder of this section discusses how freight rail investments create public and private benefits. It is organized around the five categories of freight rail investments identified in Chapter 5: trade corridor investments, economic development and short-line investments, grade-crossing improvements, terminal and yard capacity investments, and short-haul rail investments. For each investment category, the general type of benefit (i.e., public or private) is identified, along with the specific gains accrued from that investment. In many cases, freight rail investments yield both public and private benefits.

Trade Corridor Investments

The shorter, more reliable travel times associated with many of the proposed investments decrease the cost of goods movement by rail. Although these cost savings are private benefits, the growth in tax revenue resulting from subsequent increased profits is public. Likewise, if private firms use these cost savings to hire more workers, then the tax revenue from these workers would be a public benefit.

Lower freight costs could also attract existing economic activity away from other regions. This is a benefit transfer, although if activity is diverted to California or the United States from other states or countries, the transfer is a net benefit for California or the United States. Calculations of these net benefits should account for any subsequent increase in emissions or safety costs resulting from the shift in activity.

212 Public goods are by definition nonexcludible and nonrivalrous. Cowen, Tyler, P*ublic Goods*, The Concise Encyclopedia of Economics (2008), accessed 2017.

213 There can be overlap between both components of this definition. For example, lower maintenance costs could be characterized as an increase in a public good (well-maintained roads), or as public-sector cost savings.

Public Benefits

Perhaps the most significant public benefit that could result from trade corridor investments is the potential to divert freight traffic from highways to rail. By decreasing the average and variation of freight rail travel time, trade corridor investments improve overall reliability. As a result, these investments can potentially spur a diversion of freight trips to rail from highway; which, in turn, can alleviate congestion for the general public on highways. Public benefits are equivalent to the monetary value of time multiplied by the reduction in hours traveled. An analogous mobility benefit can occur for passenger rail travelers traveling on shared freight and passenger rail lines that undergo improvements.

Reduced truck miles traveled due to a shift in freight traffic from truck to rail also has a public safety benefit in the form of lower crash risks on the state's highways. Public costs associated with crashes can include medical costs, public property damage, foregone tax revenue given lost productivity, and intangible costs such as a diminished quality of life. Shifting freight traffic to rail reduces the opportunities for conflict between passenger vehicles and freight vehicles.

There are also public benefits to trade corridor investments in the form of mobility improvements and roadway maintenance costs. Public mobility benefits are generated through lower fuel costs both for passenger vehicles and for public passenger rail operators, which experience less congestion and therefore higher fuel efficiency. The state's highways can experience lower maintenance costs when freight truck traffic is diverted to rail.

As part of its *Comprehensive Regional Goods Movement Plan and Implementation Strategy*, the Southern California Association of Governments (SCAG) estimated the economic impacts of freight rail investments in the region. SCAG estimated that grade separations, rail, and intermodal improvements would contribute $2.9 billion to gross domestic product (GDP) in public-sector activities over the 2021-to-2045 time period. Public sector activities include government-related work (e.g., permitting, project management, planning, and design) that would be required to facilitate these investments.

Private Benefits

Trade corridor investments would potentially yield a number of benefits to both California railroads and shippers in the areas of competitiveness and system maintenance. Trade corridor investments would allow railroads to operate at higher velocities and increase operating efficiency. This improved service performance would make freight rail service in California more competitive, potentially increasing its market share as goods shift from trucks to rail. Furthermore, these types of investments would bring the rail system to an overall better state of repair as capacity and operational upgrades necessitate the replacement of aging components of the rail infrastructure with state-of-the-art components.

For Southern California, SCAG estimated that the private-sector economic impact of freight rail investments would yield a $64.2-billion contribution to GDP over the 2021-to-2045 time period. Furthermore, SCAG estimated that freight-dependent industries would be the biggest beneficiaries in terms of economic output and job creation. These include the transportation and warehousing, construction, administrative and waste services, manufacturing, and wholesale trade industry sectors.

At the statewide level, the California trade corridors that are likely to most benefit from these investments are identified by the state's top trading partners by total tonnage, as shown in Exhibit 6.6. Illinois is the state's top trading partner, accounting for more than 29 percent of total tonnage in 2013. Both the UPRR and BNSF networks connect California to Illinois. There are currently more than $8 billion worth of trade corridor investments planned for the Southern California, Central Valley, and Northern California regions, which largely define the BNSF and UPRR routes through California toward Illinois. These investments will improve the overall LOS between California and its most important rail trading partner, and yield direct benefits to the private sector.

More than $7.3 billion (nearly 92 percent) of the $8 billion in planned trade corridor investments occur in Southern California. These investments will help improve the overall LOS on the portions of the BNSF and UPRR networks that connect California to Texas, the state's second most important trading partner by total tonnage. Texas accounts for 16.5 percent of California's total rail tonnage. Also along this route is Louisiana, which accounts for 3.1 percent of California's total tonnage. Not only do California's Class I rail carriers benefit from these investments in the form of direct infrastructure upgrades, shippers who transport goods along these routes benefit in terms of lower transportation costs (as captured by decreased travel times and improved reliability).

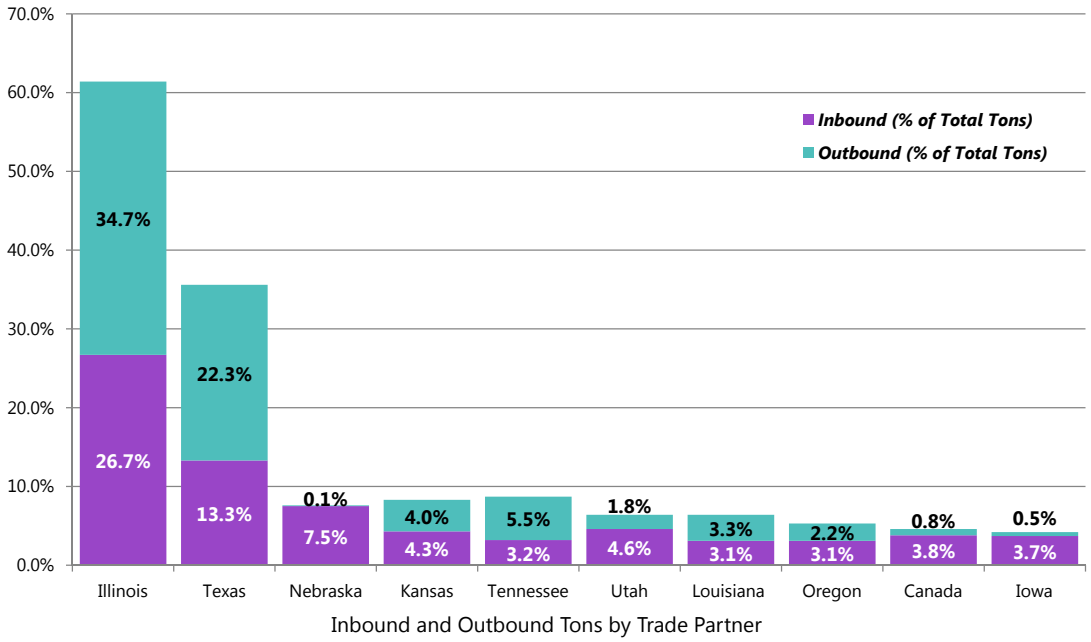


Exhibit 6.6: Trends: California's Top Ten Trading Partners by Rail

Grade Crossings

The benefit most commonly associated with grade-crossing investments (either their separation or the closure of a roadway) is the reduction in highway traffic delays, followed by safety improvements. Although often presented as a public-sector benefit, improved safety is actually both a public- and private-sector benefit, albeit with modest impact. By eliminating interaction between trains and roadway users, the possibility of train-roadway user incidents decreases. Crossing safety enhancements improve the workplace safety of rail employees, and reduce the railroad's exposure to the legal and financial liabilities associated with crashes—such as worker's compensation, injuries to motorists or pedestrians, and damages to property.

Safety benefits are also derived from investments in technological upgrades to grade crossings. These include four-quadrant gates, extended cantilever arms, median barriers, in-pavement LED lights, barrier gates, stationary or wayside horns, and devices that instantly report active warning system failures via cellular technology. In 2014, the North Carolina Department of Transportation installed sensors atop crossing gate masts at certain grade-level crossings. The sensors can detect whether a vehicle is trapped within a four-quadrant gate, and lift the gates so that the vehicle can move to safety. The private sector benefits from investments like these, just as it benefits from the closure or separation of a crossing.

Public Benefits

Grade-crossing improvements accrue benefits differently than the other categories. They are specifically aimed at both rail and roadway users, including motor vehicles, bicycles, and pedestrians. They improve safety, a public good, across modes. Grade separations can also directly reduce roadway traffic congestion and emissions, in addition to making rail somewhat more efficient. SCAG's Comprehensive Regional Goods Movement Plan and Implementation Strategy examined certain grade separations and found that travel time and reliability (i.e., mobility) benefits to highway users constituted 65 percent of their overall benefits.[214] Safety benefits accounted for 34 percent of the benefits, and vehicle operating cost and emissions benefits each accounted for less than 1 percent of the benefits. The estimated monetary value of grade separation projects in the SCAG region is given in Table 6.7.

Table 6.7: Value of Economic Benefits of Grade Separation in the SCAG Region

Region	Travel Time and Reliability	Vehicle Operating Costs	Safety Costs	Emission Costs
SCAG	$414.1	$3.3	$219.6	$1.9

In Million Dollars, 2012
Source: SCAG, Comprehensive Regional Goods Movement Plan and Implementation Strategy, Appendix U (2012).

214 SCAG, *Comprehensive Regional Goods Movement Plan and Implementation Strategy*, accessed 2017.

Private Benefits

Private benefits associated with grade-crossing investments are the operational cost savings resulting from the closing of a crossing. Grade crossings require the installation and maintenance of safety equipment, including warning signs, flashing lights, crossing gates, and the signal control box and associated equipment to operate the crossing. Installing a crossing signal system can cost $250,000 or more.[215] Maintenance costs are also considerable, because BNSF is reported to spend approximately $45 million annually on crossing signal maintenance and repair.[216] With the closing or separation of a crossing, the railroad minimizes the cost of maintaining and operating this equipment.

It is important to note, however, that there are also private-sector costs associated with grade crossing improvements. In the case of a separation, the railroad still has some financial responsibility for the construction and/or maintenance of the resulting civil works. Only in the case of a closure does the railroad realize the full financial benefit of the safety improvements.

Short-Line Program

For industries that rely on bulk commodities (such as coal, gravel, and base metals) as inputs to the production process, rail access via short lines can be critical to their operations. Industries that produce heavy machinery or otherwise large, cumbersome equipment also require direct rail access, because these types of products are difficult to efficiently transport by truck over long distances. For example, the Pacific Harbor Line, serving POLA and POLB, lists among its customers companies representing the building materials, plastics, and petroleum manufacturing industries.[217] These industries ship and receive commodities such as steel products, liquid gas and petroleum products, and plastic pellets. Therefore, short-line rail investments directly benefit shippers and receivers in those types of industries.

Public Benefits

Short-line investments can contribute to economic competitiveness and attract investment from businesses that rely on short-line access. This would represent new economic activity to the state if these firms relocate from outside of California or are new businesses.

A related potential public benefit of short-line investments is the retention of businesses that may be forced to relocate if access is lost. Although it is difficult to measure the benefit of an event that did not occur, it stands to reason that preventing businesses that rely on short-line rail access from leaving the state would save a number of jobs, and the associated local economic activity that results from workers spending their wages.

California's short-line railroads have approximately 150 locomotives, of which approximately 100 are pre-Tier 0. Incentive funding has helped replace older locomotives with lower-emitting locomotives at several short-line railroads.[218]

215 Indiana Department of Transportation, accessed 2017.

216 Cotey, A., "Grade crossing equipment, technology help railroads continue quest to improve crossing safety," Progressive Railroading, January 2014, accessed 2017.

217 Pacific Harbor Line, Inc., accessed 2017.

218 CARB.

Private Benefits

The analysis of rail flows discussed in Chapter 2 found that one in five shipments (19 percent of total tonnage and 18 percent of rail carload traffic) originate on a short line; and one in 12 shipments (8 percent of total tonnage and 7 percent of carloads) end their journeys on a short line. The agricultural, chemical, and building material industrial sectors all represent significant users of the short-line rail system. Therefore, the amount of private-sector economic activity facilitated by California short lines is significant.

Short lines that cannot handle loaded car weights of up to 286K require shippers to either load a railcar to less than its maximum capacity, or to transload to truck at a location that can handle the heavier load. Investments that upgrade California's short lines to the 286K standard would benefit shippers by removing the additional transportation costs associated with transloading and sub-maximum railcar loading. Short-line railroads also benefit from these improvements, because they are direct investments on the short-line system, and help their ability to attract and retain business.

Similarly, upgrading California's short lines to the FRA Track Class 2 standard, which permits freight train speeds up to 25 mph, will also directly benefit shippers and railroads. Class 2 track allows carriers to operate at higher speeds (the maximum speed allowable on a Class 1 track is 10 mph), providing a productivity increase for the railroad and a decrease in transportation costs, except in the case of very short routes. Although investments in line rehabilitations and bridge and tunnel improvements do not effectively expand capacity in the same manner as improvements that yield speed and weight-capacity gains, they do bring the system to an overall better state of repair. In addition, points at which bridges, tunnels, or tracks are in poor condition represent chokepoints in the system. Repairing these components of the short-line system will improve the overall LOS of short-line operators.

Short-Haul Program

Public Benefits

The primary public benefit to short-haul rail investments is the diversion of freight traffic from highways to rail, which results in reduced highway maintenance costs and related improvements in air quality and congestion. A 2011 report estimated that rail was three times more fuel-efficient than trucking per ton-mile.[210] The same report projected 2,020 grams per ton-mile of carbon dioxide (CO_2) emissions of 209 for trucks, and 44 for rail (21 percent of the truck emissions rate). There is widespread interest in shifting more cargo from truck to rail to relieve road congestion and reduce GHGs. However, as truck technologies become cleaner, such a shift may lead to increases in certain criteria pollutants emissions, according to CARB. There is agreement in the industry that collaborative research should be done to study potential solutions and alternatives. This trend demonstrates a need for locomotive engines to be equipped with more advanced control technologies, and for a coordinated commitment to addressing this challenge.[219]

The aforementioned University of California Berkeley study found that short-haul rail intermodal service from the San Pedro Bay ports to the Inland Empire could yield a 180 percent reduction in emissions, if marine containers alone shift to rail. The air quality improvements could be even greater if a portion of domestic containers also shifted. In addition to air quality improvements, the study estimated that with a successful short-haul intermodal service, up to 2.6 million drays per year between the ports and the Inland Empire would be removed from busy Southern California's freeways. The significant funding for trade corridors as a part of SB 1 provides an opportunity to fund these critically important short-haul improvements.

219 CARB.

Private Benefits

The University of California Berkeley study found that the large nationwide original equipment manufacturers operating national distribution centers in the Inland Empire would be the primary customers of short-haul rail service, and therefore, the primary beneficiaries. Another group of potential beneficiaries comprises the retailers operating import warehouses and regional distribution centers in the Inland Empire. The same groups of shipping customers would likely benefit from short-haul rail service in the Bay Area.

Another private-sector benefit is the potential that a successful short-haul rail service would create for the private development of an inland port. The co-location of warehousing, distribution, and other logistics-related industries with intermodal rail service has been a key feature of several prominent large-scale logistics developments over the past decade. Importantly, these developments are some distance away from traditional seaport areas. The developments include the Virginia Inland Port, Alliance Texas Logistics Park, and CenterPoint Intermodal Centers in Illinois and Missouri. It is conceivable that many of these same development opportunities would be possible with the successful implementation of short-haul rail service. The San Joaquin Council of Governments' *California Inter-Regional Intermodal System* report identified the potential for industrial development as an important benefit of the successful implementation of short-haul service.

Terminal and Yard Capacity

Terminal expansions help to increase capacity at terminals that may be nearing constrained conditions. The University of California at Berkeley study, *Rail Transport and Containerized Imports Using California Ports: Past, Present, and Future*, found that rail intermodal volumes at Los Angeles Basin terminals were near or exceeding peak 2006 volumes.[220] Over this period, rail intermodal terminals throughout the Los Angeles Basin exhibited lift volumes that were, on average, 90 percent of peak 2006 levels. The only exception was the period from 2009 to 2010, during which the United States was experiencing a severe recession. Importantly, Inland Empire terminals exceeded the 2006 peak by 15 percent. The acquisition of terminal capacity in the Inland Empire is a significant impediment to short-haul rail service in Southern California.

Terminal expansions and access improvements could also help to improve regional access to freight rail. These expansions benefit California railroads by allowing them to achieve a higher LOS. In turn, decreased travel times and improved reliability would make rail service more competitive with trucks for statewide and multi-state freight movements for some commodities. This enhanced competitive position would yield a public benefit of decreased trucking activity on already busy highways. The private benefit would include increased revenue from new customers. However, capacity improvements at a single terminal or terminals in a single state are not likely to significantly decrease travel times or improve reliability for long-haul movements unless those improvements remove a severe bottleneck.

New terminals have the potential to open up additional markets that are currently not served by rail due to capacity constraints or distance from existing terminals. Such an expansion benefits both the public sector (in the form of increased economic activity and shipping options) and the private sector (in the form of increased market competitiveness). For example, the previously cited University of California at Berkeley freight rail case study examined the potential to shift perishable produce from truck to rail; the perishable market was one in which rail was once very competitive in California.[221] Although the Berkeley study primarily focuses on the public sector benefits to shifting perishable produce to rail, it also discusses the private sector benefits to rail service. According to studies from TAMC[222] and the Association of Monterey Bay Area Governments,[223] farmers in the Salinas Valley sometimes struggle to acquire reliable truck service.

220 Leachman, R., *Rail Transport of Containerized Imports Using California Ports: Past, Present and Future*, (2016).

221 Seeherman, J., and M. Hansen, *Freight Rail Case Study: Case Study #1 (Opportunity), Perishable Produce* (2016).

222 Monterey County Transportation Agency, Grower-Shipper Association of Central California. Rail Feasibility Study (2008).

223 Association of Monterey Bay Area Governments. Salinas Valley Truck to Rail Intermodal Feasibility Study (2011).

The lack of adequate truck service motivated the region to explore the feasibility of intermodal rail service. The studies concluded that there was reasonable demand to locate an intermodal ramp in the region, because it could generate 180 to 200 domestic refrigerated containers per day. The studies also found that Salinas Valley perishables would not be harmed by the switch from truck to rail. In fact, some perishables (such as broccoli and iceberg lettuce) would experience transportation cost savings. As illustrated by the case study of perishable produce, new terminals that are strategically located have the potential to capture new customers, and allow rail carriers operating in California to tap into new markets.

Public Benefits

Terminal expansions and new terminals could improve regional access to rail, and open up additional markets to rail service. In the event that freight traffic shifts from truck to rail, this shift could result in public benefits in the form of decreased pavement damage and GHG emissions, among others. The freight rail case study conducted by researchers at the University of California examined the potential to shift perishable produce from truck to rail. The scenario entailed rail-moving a full 75 percent of the state's top three crops currently moved by rail (carrots, oranges, and potatoes)—a large increase for rail compared to trucks.[224] The study estimated benefits of at least $45.5 million per year due to reduced pavement damage ($4.8 million), GHG reduction ($11.6 million), health care savings related to local pollution reduction ($2.8 million), and crash reduction ($26.4 million). This was the study's conservative benefit estimate; the potential healthcare savings ranged from $2.8 million to $77.0 million.

Private Benefits

The private benefit to terminal improvements represents a direct financial investment into infrastructure that is largely privately owned and maintained. Terminal investments (i.e., expansions, access improvements, and new construction) better position railroads to compete with other modes and capture larger shares of the market. However, these types of investments are costly and sometimes publicly unpopular, because they require the acquisition of land, and would generate new traffic through the selected community. The investment of public dollars would represent not only a cost benefit to railroads planning terminal expansions or new terminals, but also a show of public support for expanded freight capacity.

6.3.4 Key Environmental Effects

Freight and passenger rail implementation can bring tremendous positive environmental and economic benefits to the state. They can also impact communities and the natural environment. The most common effects include contribution to air pollution and GHG emissions, and physical impacts such as noise and light pollution.

Sea-Level Rise

Human activity has impacted the climate for some time. GHG emissions—including those coming from coal and oil (or fossil fuels) burnt to generate electricity and power motor vehicles, planes, ships, and trains—trap solar energy from reflecting back into space, thereby warming the earth's atmosphere (hence the term "greenhouse"). Warmer temperatures in turn melt glaciers and ice sheets, and the runoff flows into the oceans, causing sea levels to rise.

As GHG emissions have increased since the Industrial Revolution in the early 19th Century, the rate of sea-level rise has accelerated. Sea levels rose 2.4 inches during 19th Century and 7.5 inches in the 20th Century,[225] and the pace is not expected to slow anytime soon. For example, in the San Francisco Bay Area, projections of sea-level rise to Year 2100 appear in Table 6.8.

224 Seeherman, Joshua and Mark Hansen, *Freight Rail Case Study – Case Study #1 (Opportunity), Perishable Produce*, University of California Berkeley Institute of Transportation Studies (2016).

225 Geophysical Research Letters, Svetlana Jevrejeva, J. C. Moore, A. Grinsted, and P. L. Woodworth, *Recent global sea level acceleration started over 200 years ago?*, 2008.

Research undertaken by engineers and geologists at the United States Geological Survey (USGS) and published in early 2017 shows that between about 30 to 70 percent of southern California beaches from Santa Barbara to San Diego may become completely eroded by 2100 under scenarios based on 1 to 2 meters of sea-level rise.[226] This is not only potentially detrimental to the coastal habitats, but to the $18-billion coastal tourism industry.

The cost of maintenance associated with near-term (less than 20 years) sea-level rise is already proving significant, but the cost of adapting coastal rail routes to the effects of mid- and long-term seal-level rise, and potentially extreme sea-level rise (10 feet or more this century) could be catastrophic and even require wholesale abandonment and relocation of some rail corridor segments. Coastal rail corridors are commonly the first, or second, line of development adjacent to the sea, particularly in central and southern California. If reactive, emergency-based hard-armoring measures are constructed to protect corridors in place, beach loss may result. Thoughtful, long-term adaptation planning for sea-level rise is necessary to identify alternatives, including relocation of corridors where opportunities to do so exist, that would protect transportation corridors as well as California's popular beaches and other coastal resources.

Financial investments in increased rail system capacity and efficiency will, therefore, capture multiple layers of direct and indirect benefits, but must also be planned in light of emerging climate change threats. This interplay between cause and effect of transportation system emissions on our climate, and sea-level rise impacts on the transportation systems, suggests the high return California can expect from appropriate planning and investments in the rail network improvements as envisioned in the Rail Plan.

Table 6.8: Sea-Level Rise Estimates for San Francisco Bay

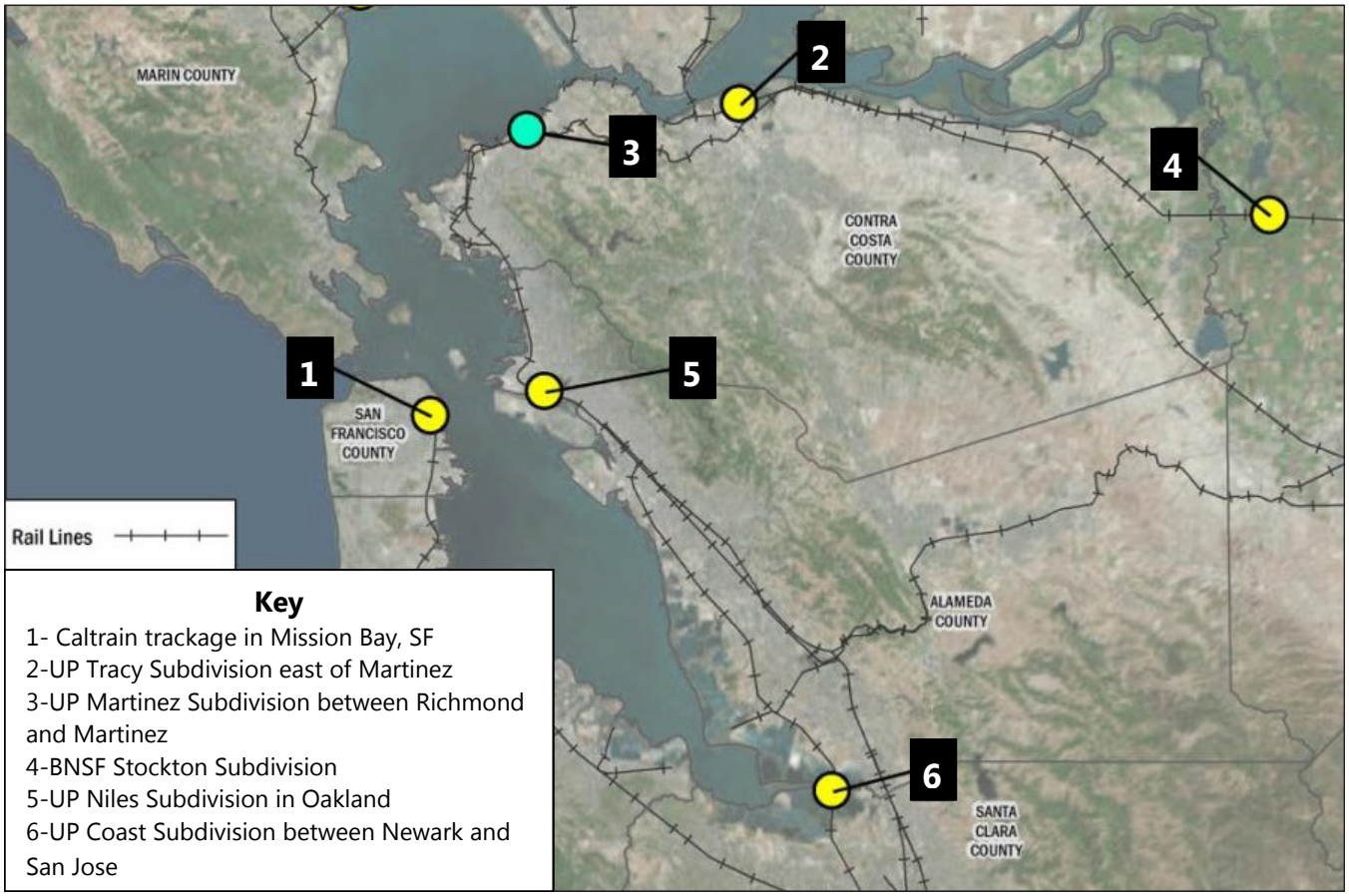
Year	Most Likely Projections	Upper Range
2030	6 inches	12 inches
2050	11 inches	24 inches
2100	36 inches	66 inches

Source: Sea-Level Rise for the Coasts of California, Oregon, and Washington, Past, Present, and Future, National Research Council, 2012.

226 California Coastal Commission, personal communication, December 2017.

Railroad Lines at Risk

Sea-level rise is putting California's infrastructure, including railroads, at risk. The risk to railroads comes largely in two forms: flooding of trackage in low-lying areas in San Francisco Bay and San Pedro Bay; and higher and fiercer storm surges eroding coastal bluffs that support rail lines atop them, such as those found along the Central Coast and in San Diego County. Several busy main lines and terminal trackage that appear to be at risk later in this century are shown in Exhibit 6.7 and Exhibit 6.8.

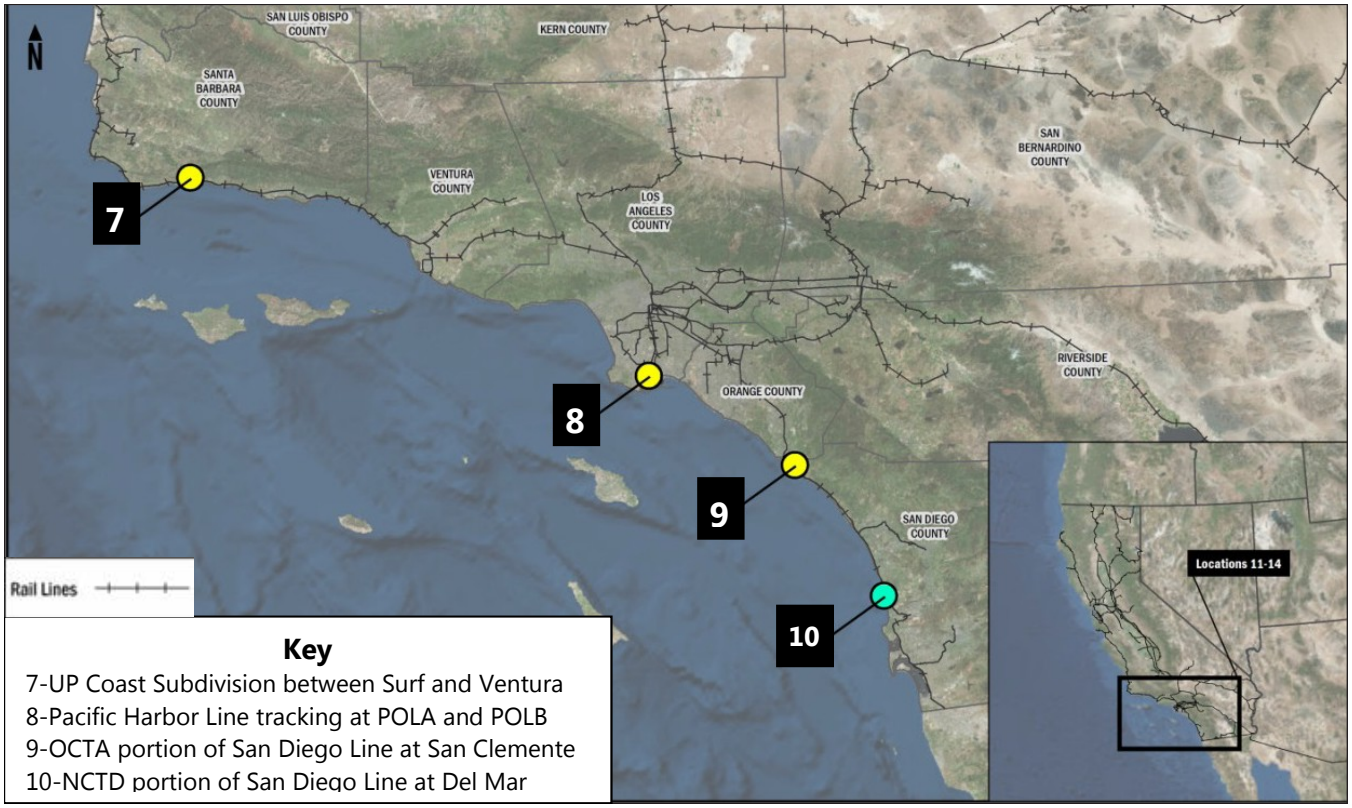


Sources: Inundation: NOAA 2012; Basemaps: ESRI 2017; Rail Lines: State of California.

Exhibit 6.7: Major Rail Line the Bay Area at Risk from Sea-Level Rise

Major Rail Lines in the Bay Area at Risk from Sea-Level Rise and not pictured in map include:

- SMART-owned line San Rafael to Petaluma
- SMART-owned line parallel to SR 37
- UP Martinez Subdivision between Benicia and Fairfield
- UP Coast Line along Elkhorn Slough



Sources: Inundation: NOAA 2012; Basemaps: ESRI 2017; Rail Lines: State of California.

Exhibit 6.8: Major Rail Lines in Central and Southern California at Risk from Sea-Level Rise

Both freight and passenger rail traffic (intercity and commuter) will be affected. Ensuring protection and resiliency from sea-level rise could include raising track, relocating rail lines to higher ground, and implementing water barriers such as dykes and berms. All solutions have pros and cons.

In the sections that follow, two locations with illustrative impacts of sea-level rise are discussed: the UPRR Martinez Subdivision at Rodeo in Contra Costa County; and the Del Mar Bluffs in San Diego County. The locations of these spots are identified by the greenish-blue dots in Exhibit 6.8.

Martinez Subdivision at Hercules

The UPRR's Martinez Subdivision is the busiest rail link between Central California and the Bay Area. In all, 70 to 80 trains traverse the line on weekdays. Most of the traffic is intercity passenger traffic, via the *Capitol Corridor* and *San Joaquin Corridor* trains, and Amtrak's long-distance *California Zephyr* and *Coast Daylight* trains. The line is also UPRR's primary freight route in and out of the Bay Area.

Exhibit 6.9 shows the impact of sea-level rise in 2100, with the inundation of the UPRR route at Hercules along the North Bay. The segments of the line in red indicate segments that are at risk of inundation. Solutions would include raising the track above the anticipated flood levels.

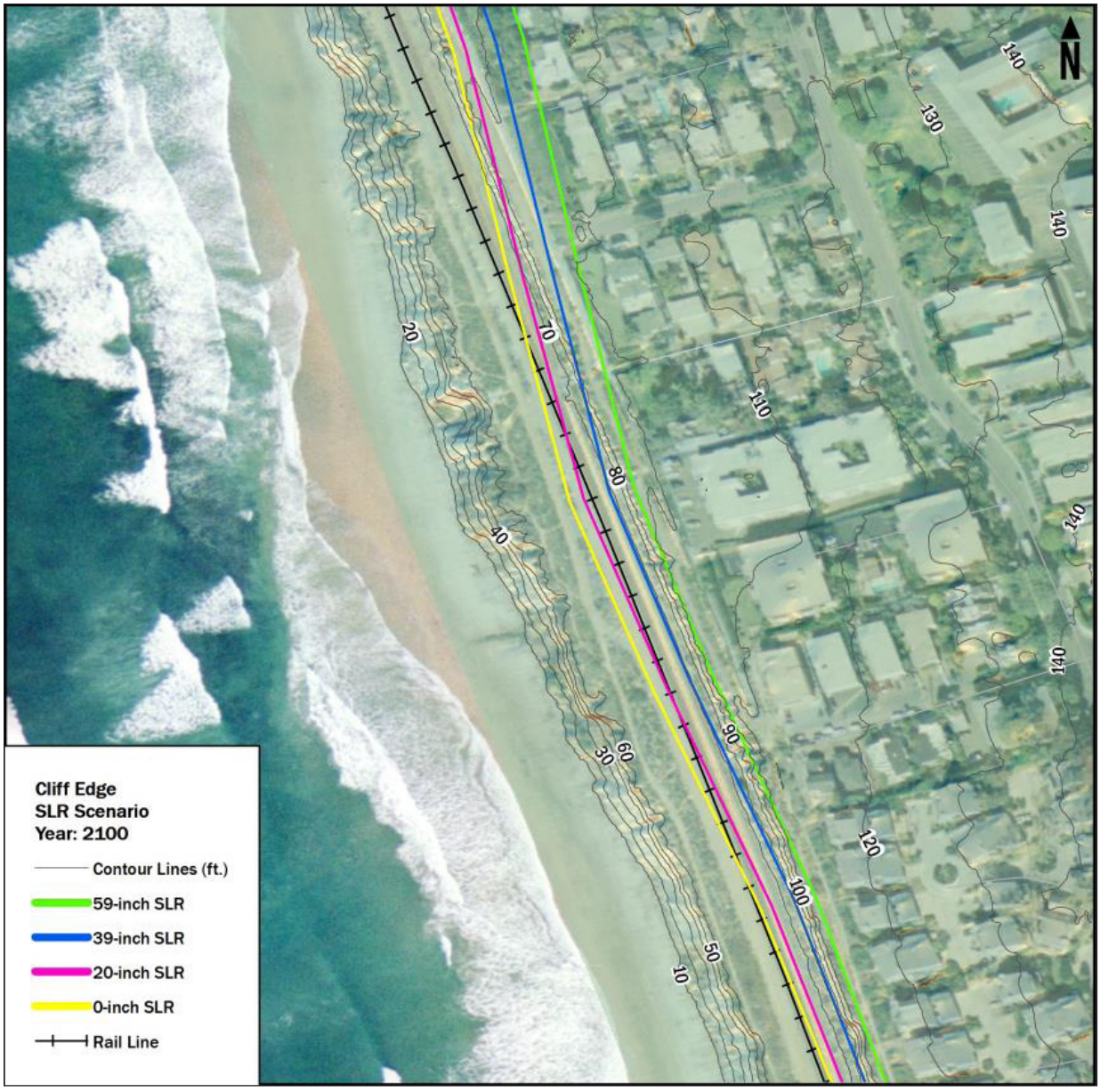
Sources: Streets, Contra Costa County 2017; Rail Lines: State of California.

Exhibit 6.9: Inundation of the UPRR Martinez Subdivision at Hercules

Del Mar Bluffs

The portion of the San Diego Line in San Diego County is owned by the NCTD, which purchased it from the former Atchison Topeka and Santa Fe Railway (now part of the BNSF) in the late 1980s. The line hosts *Pacific Surfliner* Corridor trains, COASTER commuter trains, and BNSF freight service. A section of the line runs across the Del Mar Bluffs above the Pacific Ocean. On weekdays, about 50 trains, mostly passenger, traverse the Del Mar Bluffs.

As seen in Exhibit 6.10, sea-level rise will accelerate erosion of the bluffs, threatening stability and the viability of the route. Indeed, erosion by 2100 could eliminate the rail line completely, as well as adjacent homes, absent preventative measures.



Sources: LiDAR Surface for Contours: NOAA Coastal LiDAR; SLR Retreat Lines: Coastal Storm Modeling System: USGS; Rail Lines: State of California.

Exhibit 6.10: Erosion of the Del Mar Bluffs in San Diego County

United States Environmental Protection Agency Criteria Pollutants

According to the U.S. EPA, there are six criteria pollutants that can affect human health, the environment, and property: reactive organic gases (ROG), particulate matter (PM), carbon monoxide (CO), NO_x, sulfur dioxide, and lead.[227] Freight and passenger rail operations emit CO, NO_x, ROG, and PM. The increased presence of these criteria pollutants has been linked to a variety of poor health conditions. These conditions may include:

- reduced lung function;
- asthma and other respiratory illnesses;
- increased cancer risk; and
- premature death (especially in vulnerable groups such as children and the elderly).

Emissions from rail activities also lead to ozone formation. Ozone is formed when emissions of NO_x chemically react with ROG under conditions of heat and sunlight. Ozone is linked to public health impacts, including chest pain, coughing, throat irritation, and congestion. Long-term exposure can worsen existing afflictions like asthma or bronchitis, or even lead to permanently scarred lung tissue.[228]

PM is divided into two subcategories: PM less than 10 microns in diameter (PM_{10}) and PM less than 2.5 microns in diameter ($PM_{2.5}$). Numerous studies have linked PM exposure to public health issues, including irregular heartbeat, asthma, decreased lung function, and increased respiratory ailments that can lead to premature death.[229]

Greenhouse Gas Emissions

Freight emissions comprise close to one-third of transportation GHG emissions in the United States. These emissions have grown by more than 50 percent since 1990.[230]According to the U.S. EPA, there are six key transportation-related GHG emissions that affect public health and welfare:

1. CO_2
2. Methane (CH_4)
3. Nitrous oxide (N_2O)
4. Hydrofluorocarbons (HFC)
5. Perfluorocarbons (PFC)
6. Sulfur hexafluoride (SF_6)

GHG emissions contribute to climate change. They are linked to regional and atmospheric changes that can exacerbate acid rain, ozone depletion, and damage to crops, plants, and property.

Emissions Analysis

The previous sections illustrate that improved rail services and HSR would reduce automobile and truck VMT throughout California. VMT reductions lead directly to reduced emissions of CO_2 and key mobile source pollutants.[231] Air quality emissions were forecast for years 2020, 2025, and 2040 using the CARB Emissions Factor (EMFAC) model,[232] coupled with the VMT forecasts.

Freight locomotive emissions forecasts are based on projected ton-miles traveled, coupled with emissions rates published by U.S. EPA,[233] and Locomotive Technology distributions available from CARB.[234] Passenger locomotive emissions were forecast by scaling CARB's emission inventory[235] by the estimated change in passenger miles of travel.

Passenger locomotive emissions were calculated for 2040 by scaling CARB's 2015 emissions inventory

227 U.S. EPA, *Urban Air*, 2016.

228 U.S. EPA, *Ozone Pollution,* 2016.

229 U.S. EPA, *Health*, 2016.

230 FHWA, Freight and Air Quality Handbook, May 2010.

231 The Rail Plan analysis included ROG, NO_x, CO, PM_{10}, and $PM_{2.5}$.

232 The 2018 Rail Plan analysis used the EMFAC 2011 model.

233 U.S. EPA Emission Factors for Locomotives, Office of Transportation and Air Quality, EPA-420-F-09-025, April 2009.

234 Nicole Dolney and M. Malchow, Locomotive Inventory Update: Line Haul Activity, CARB tech distribution ref. (Presentation), November 7, 2014, CARB, accessed 2016.

235 CARB, Emission Inventory Activities, CARB (2016).

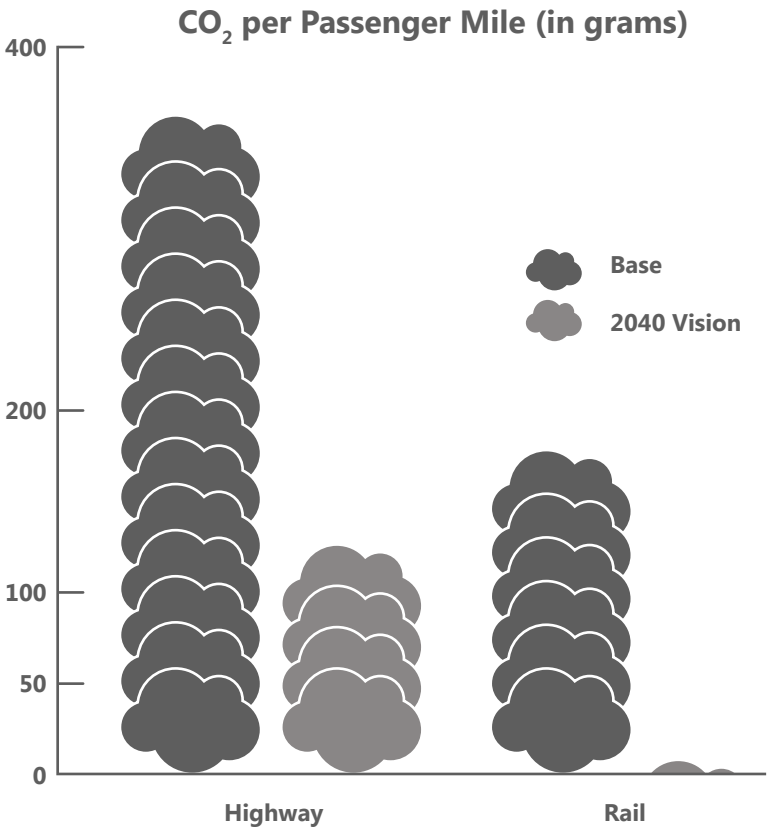
based on passenger miles traveled, then adjusting for electrification. Scaling CARB's original estimate accounted for anticipated locomotive upgrades over the next 20 years, but not the benefits of the additional electrification in the Rail Plan. About 93 percent of the passenger miles traveled are on services that are assumed to be electrified, based on the Rail Plan, and the passenger locomotive emissions are reduced proportionately. Therefore, the data reflect both upgraded diesel passenger locomotives and electrification.

Table 6.9 compares the CO_2 emissions from passenger rail service to on-road passenger vehicles, and shows the substantial emission reduction benefits of the Rail Plan. The 2020 baseline passenger train service emits about 2.4 times less CO_2 per passenger mile of travel than on-road motor vehicles. With the Rail Plan, that advantage grows to nearly 20 times less CO_2 per passenger mile of travel from passenger trains relative to on-road passenger vehicles.

Table 6.9:
Grams CO_2 per Passenger Mile of Travel by Mode

Region	2020	2040 with CSRP
On Road Passenger Vehicles (g/PMT)*	302	179
Passenger Locomotives (g/PMT)	127	9

* Based on assumed vehicle occupancy of 1.2 passengers per vehicle.
g/PMT = grams per passenger mile traveled



Offer a convenient and reliable alternative to private vehicle travel

Increase electric and zero emission trains

Provide alternative to truck transport of containerized cargo

Table 6.10 summarizes statewide air quality emissions by analysis year and passenger rail corridor. The column titled "No Action Emissions" shows total statewide on-road mobile source emissions by pollutant and analysis year. "No Action" assumes that the Rail Plan is not adopted. The remaining columns indicate emissions reduction attributable to both on-road mobile sources and locomotives in each passenger rail corridor, arising from the modeled planning scenarios. Each row shows emission reductions for the indicated year; the values are not cumulative between years.

Table 6.10: Annual Statewide Emission Reduction

No-Action Emissions (Tons/Day)				Change in Locomotive and On-road Emissions with the Rail Plan (Tons/Day)					
Year	On-Road	Loco-motives	Total (On-Road and Loco-motives)	Bay Area and N. Calif.	Greater LA and LOSSAN South	LOSSAN North and Central Coast	Las Vegas HSR and Inland Empire	Central Valley	Statewide Total
CO_2									
2020	470,828	8,101	478,929	(718)	(1,742)	(233)	(216)	(1,351)	(4,259)
2025	454,565	8,682	463,247	(1,077)	(2,612)	(349)	(324)	(2,026)	(6,389)
2040	405,777	10,424	416,201	(2,154)	(5,225)	(699)	(648)	(4,052)	(12,778)
2040 High	405,777	10,992	416,769	(2,154)	(5,225)	(699)	(648)	(4,052)	(12,778)
ROG									
2020	356.56	5.91	362.47	(0.29)	(0.65)	(0.08)	(0.09)	(0.50)	(1.60)
2025	294.35	6.30	300.65	(0.43)	(0.97)	(0.12)	(0.13)	(0.75)	(2.40)
2040	107.73	7.47	115.20	(0.87)	(1.94)	(0.24)	(0.26)	(1.50)	(4.81)
2040 High	107.73	7.85	115.57	(0.87)	(1.94)	(0.24)	(0.26)	(1.50)	(4.81)
NO_x									
2020	892.06	110.69	1,002.75	(0.70)	(0.34)	0.36	0.23	(0.67)	(1.11)
2025	723.03	118.02	841.05	(1.05)	(0.51)	0.54	0.35	(1.01)	(1.67)
2040	215.93	140.02	355.95	(2.09)	(1.03)	1.09	0.70	(2.01)	(3.34)
2040 High	215.93	147.16	363.09	(2.09)	(1.03)	1.09	0.70	(2.01)	(3.34)
CO									
2020	2,892.97	20.24	2,913.21	(1.74)	(4.37)	(0.67)	(0.69)	(3.17)	(10.65)
2025	2,354.50	21.59	2,376.09	(2.62)	(6.56)	(1.00)	(1.03)	(4.76)	(15.97)
2040	739.10	25.63	764.73	(5.23)	(13.12)	(2.00)	(2.06)	(9.52)	(31.94)
2040 High	739.10	27.11	766.21	(5.23)	(13.12)	(2.00)	(2.06)	(9.52)	(31.94)
PM_{10}									
2020	76.17	3.79	79.96	(0.16)	(0.36)	(0.05)	(0.05)	(0.29)	(0.91)
2025	74.26	4.05	78.30	(0.24)	(0.54)	(0.07)	(0.07)	(0.44)	(1.36)
2040	68.52	4.80	73.32	(0.48)	(1.08)	(0.14)	(0.14)	(0.88)	(2.72)
2040 High	68.52	5.06	73.58	(0.48)	(1.08)	(0.14)	(0.14)	(0.88)	(2.72)
$PM_{2.5}$									
2020	41.29	3.67	44.96	(0.07)	(0.15)	(0.01)	(0.02)	(0.12)	(0.37)
2025	37.98	3.92	41.90	(0.11)	(0.22)	(0.02)	(0.02)	(0.19)	(0.56)
2040	28.06	4.65	32.71	(0.22)	(0.44)	(0.04)	(0.05)	(0.37)	(1.12)
2040 High	28.06	4.90	32.95	(0.22)	(0.44)	(0.04)	(0.05)	(0.37)	(1.12)

Sources: AECOM, T. Kear Transportation Planning and Management, Inc., and Cambridge Systematics Inc., 2017.

The service plan assumptions, detailed in Chapter 4, are projected to reduce statewide emissions, but at a magnitude of only about 3 to 4 percent for all of the pollutants except NO_x. NO_x is reduced by about 1 percent, despite 88 million daily passenger miles diverted to rail from highways and an increase of 92 million daily passengers miles on rail as a result of Rail Plan investments. Reductions are largest in the regions directly served by the improvements to the rail system, and for corridors served by HSR. Calculation details are provided in Appendix A.

This emissions analysis reflects vehicle travel reduction due to mode shifts from personal vehicles to passenger rail, and residual congestion reduction from this mode shift. Additional emission reduction might arise from: 1) improved rail system efficiency through reduced locomotive idling and improved locomotive fuel economy; 2) reduced aircraft operations from air-to-rail modal shifts; 3) reduced vehicle acceleration and deceleration from highway bottleneck elimination; and 4) shifting of freight from trucks to trains.

Rail Mode Share

Current: 0.34%

2040 No Build: 0.52%

2040 Vision: 6.8%

- 88 million daily passenger miles diverted to rail from highway
- Overall daily increase of 92 million passenger miles by rail

Exhibit 6.11: Rail Mode Share Shift in 2040 Vision

6.4 Implementation

6.4.1 Coordinating Rail Policies and Plans

The 2022 project list and service goals were developed by reviewing recent and ongoing strategic, vision, and service plans published by stakeholder passenger rail agencies and service providers around the state. Those plans were used to identify near-term goals, and to begin the implementation planning toward the 2040 Vision.

Existing Rail Plans

Those plans include, but are not limited to:

- ACE*forward*, 2015
- Amtrak FY2015 Budget and Business Plan, 2015
- Amtrak Strategic Plan 2014-2018
- BART Sustainable Communities Operations Analysis, 2013
- Bay Area Council Economic Institute – The Northern California Megaregion, 2016
- Caltrain Strategic Plan, 2014
- Capitol Corridor Business Plan, 2015
- CCJPA Business Plan FY 2015-2017
- CCJPA Vision Plan, 2014
- CHSRA 2016 Business Plan
- CHSRA 2018 Business Plan
- CTC Annual Report to the California Legislature, 2014
- FRA Southwest Multi-State Rail Planning Study, 2014
- LA Metro Long-Range Transportation Plan, 2009
- LOSSAN Rail Corridor Agency Business Plan FY 2015-2017
- Metrolink Ten-Year Strategic Plan
- Monterey Bay – 2035 Metropolitan Transportation Plan/Sustainable Communities Strategy, 2014
- NCTD Comprehensive Strategic Operating and Capital Plan FY 2016
- Sacramento Regional Transit District – Strategic Plan 2015-2020
- SCAG – RTP/Sustainable Communities Strategy, 2012
- SFMTA Strategic Plan FY 2013-2018
- SJJPA 2015 Business Plan
- TAMC 2014 Monterey County RTP
- VTA – VTP2040

6.4.2 Environmental Policy

Freight and passenger rail implementation can bring tremendous positive environmental and economic benefits to the state. They can also impact communities and the natural environment. The most common effects include contribution to air pollution and GHG emissions, and physical impacts such as noise and light pollution.

As mentioned in Chapters 1 and 3, in recent years, California has enacted several laws and executive orders to reduce climate-change–inducing GHG emissions through efficient land use and transportation planning, increased energy efficiency, and other actions.

Executive Order S–3–05, signed in 2005, established state GHG emission reduction targets to reduce California's contribution to global climate change. The Global Warming Solutions Act, AB 32, signed into law in 2006, expanded on these goals. It requires that California's GHG emissions be reduced to 1990 levels by the year 2020 (Chapter 488). AB 32 is a multi-sector, interdisciplinary approach to reducing GHG emissions in the state. In accordance with its responsibilities under AB 32, CARB adopted a *Scoping Plan* in December 2008 (readopted in August 2011) that quantified the statewide GHG emission reduction target, and identified reductions that would result from specific programs. This included the HSR project, which is expected to reduce GHG emissions by 1 million metric tons annually in CO_2 equivalent. Other related legislative bills outline individual regulations for specific sectors.

Land Use

SB 375—the Sustainable Communities and Climate Protection Act of 2008—promotes integrated transportation and land use planning to reduce GHG emissions from passenger vehicle travel, and help California meet AB 32 goals. SB 375 requires CARB to develop regional GHG emissions reduction targets for passenger vehicle travel, setting benchmarks in 2020 and 2035 for each of the state's 18 MPOs. SB 375 requires that California's MPOs each draft an SCS as part of their RTP, which describes the transportation and land use strategies the MPO regions will use to meet the regional GHG emissions reduction targets established by the CARB.

Although SB 375 has a regional focus, SB 391 highlights the critical roles that Caltrans and other State agencies play in addressing interregional travel issues, including the reduction of GHG emissions associated with interregional travel. The California Interregional Blueprint defines strategies to address interregional travel needs, while ensuring that CTP 2040 identifies statewide policies and investment priorities needed to support the State's GHG emission reduction goals. These goals include reducing GHG emissions to 80 percent below 1990 levels by 2050, as called for in Executive Order S-3-05.

Freight

Executive Order S-32-15, signed in 2015, directs State agencies to develop an integrated freight plan that will increase efficiencies and reduce air and GHG pollutants. The executive order called for the completion of a Sustainable Freight Action Plan by July 2016 and includes the following participating agencies: CARB, Caltrans, California Energy Commission, and the Governor's Office of Business and Economics. The Action Plan is a comprehensive planning effort to integrate investments, policies, and programs across agencies to help realize a sustainable freight vision. The executive order mandates that "to ensure progress toward a sustainable freight system, these entities initiate work [beginning 2015] on corridor-level freight pilot projects within the State's primary trade corridors that integrate advanced technologies, alternative fuels, freight and fuel infrastructure, and local economic development opportunities." The cross-agency and corridor-level planning focus presents an opportunity for the Rail Plan to strengthen the policies and help deliver the actions needed for realizing the sustainable freight vision. Caltrans has begun attending the Sustainable Freight Interagency partners meetings to coordinate implementation between the Rail Plan and the Sustainable Freight Action Plan as a way to maximize the efficiency of the state rail system, while reducing emissions from the freight sector.

Future Planning Studies

The Rail Plan is ultimately an iterative strategic document. It will be updated every 4 years, scaled and adjusted as the state rail network is built out, and as market factors and other key indicators—such as climate change—dictate. Undoubtedly, the scope and detail of specific services and projects will continue to be refined in future revisions to this document. Ongoing planning studies are particularly important to integrating networks to ensure that the right investments are being made, in the right markets, at the right time. When done properly, thorough and consistent planning will guide State policymakers and regional stakeholders through the ongoing process of optimizing current investments, and scaling appropriately toward an effective and integrated regional and statewide network.

While capital rail improvements and studies across the state are ongoing, the Rail Plan intends to conduct planning studies with the help of local and regional partners in the rail planning regions. These studies are to be completed in the near-term (2022) time horizon for possible project implementation, either in the mid- or long-term time horizons.

Statewide

- **Statewide Grade Separation Corridor Prioritization Study.**
  Although Caltrans and the CPUC put out an annual lists of prioritized grade-separation projects, an additional study or criteria is needed to consider grade separations not as stand-alone safety or traffic relief projects, but rather as rail-corridor-based projects. When organized and pursued strategically as part of an identified corridor, grade-separation projects can dramatically improve rail capacity and passenger service.

- **Statewide Inter-Agency Service Integration Plan**
  The 2040 Vision describes in great detail the types and intensities of services to be provided in various corridors around the state. However, more study is needed to make recommendations on rail governance and service integration to ensure that the various rail providers can proactively align and scale their services as the statewide network comes online. This research will evaluate what existing institutions are already in place and how best various partner agencies can use their established expertise to collaborate and establish project prioritization. The State supports collaborative efforts to move forward with implementing the Rail Plan vision without reinventing organizational structures and creating cumbersome institutions. Future inter-agency service integration planning will inform how the state can continue to work to be a better partner in implementation.

- **Study of Potential Future Freight Rail Impacts Related to "Self-Driving" Trucking Technology**
  The Rail Plan is written in a dynamic time for new technology in the trucking industry. A number of private-sector efforts are underway to bring various self-driving or driverless vehicle technologies to trucking. These technologies are in relatively early stages of development, and exist on a spectrum from advances in driver assistance like automatic braking capabilities, to "platooning," where one or more driverless trucks automatically follow a traditional human-driven truck, to full automation of truck operations. The ultimate adoption and scalability of these technologies is unknown, but could have major impacts on the freight rail industry, including potential traffic diversions. A comprehensive study is needed to understand the opportunities and challenges these technologies may present for the rail industry; where and how the technology would be applicable in ways that compete or complement freight rail; potential impacts on highway maintenance resulting from new trucking volumes (some arising from diversions from rail); and the ways in which the State can plan for infrastructure investments accordingly.

6.4.3 Land Use Coordination

On the state level, there is proposed legislation, SB 827 (Weiner): Planning and zoning: transit-rich housing bonus, which seeks to incentivize dense, mixed-income housing within a half-mile of transit stations and within a quarter-mile of high-quality transit corridors. This type of land use and transportation coordination seeks to provide more housing for the housing-strapped state, while locating the housing close to transit access. This is intended to simultaneously decrease congestion and increase mobility options for mixed-income level residents. This is only one proposal, but it is an example of commitment by local and state leaders to better connect land use and transportation to create more housing in such a way that supports successful transit and rail systems. This type of legislation will maximize livability, affordability, equity ,and mobility.

Station Area Planning

Station area planning is a specific type of land use planning that should necessarily integrate different modes of transportation, as well as different types of access (i.e., on foot or on a bicycle) and mobility needs. Stations are the first point of contact for users exiting the rail system and a potential hurdle for entry for new users if the station and the surrounding areas are not designed to attract and accommodate all travelers.

One opportunity to deliver multimodal connectivity hubs is to engage with regional partners to pursue Sustainable Transportation Planning Grants. These planning grants include plans and studies for connectivity, multimodal transportation, transit hubs and station areas, corridors, and active transportation. They can help fund planning that

seeks to improve station area access and the overall user experience. The Sustainable Communities grants identify mobility deficiencies, including the needs of disadvantaged, often transit-dependent, communities. The Strategic Partnership grants encourage collaboration between regional partners and the State to address statewide and interregional transportation deficiencies. Both grant opportunities seek to better coordinate funding and planning to deliver a sustainable transportation system, and are well suited to help implement elements of the Rail Plan that require nuanced regional collaboration.

Delivering attractive, multifunctional, and easy-to-use stations and surrounding areas will require ongoing work with local and regional partners. At the station itself, the State is pursuing various actions to improve station functionality, including: coordinating implementation of Toward an Active California and the Rail Plan to provide guidance for bike parking at stations; co-locating hubs to improve bus connections; and planning for up to a mile radius around stations to improve safety and access for active transportation. The State supports the Smart Mobility Framework and working with entities who own stations and the land around stations to provide sustainable, equitable, multimodal connectivity hubs. Where HSR is co-located with other rail and transit services, the work the CHSRA is doing to develop a vision for station communities will help guide implementation. The state supports their vision that HSR stations will be about more than connecting transportation modes. These stations can become station communities and provide enhanced connectivity and economic opportunities for travelers and communities alike. Specific guidelines for all stations and station areas in the statewide rail network will be included in forthcoming implementation planning documents, and will be location- and context-specific. Decisions will be based on local community input during the project development process.

6.4.4 Public-Private Partnerships

Rail services that approach or exceed self-funding for operating specific services can be attractive for private operators looking to enter public-private partnership with government to take on some of the operating risk of providing passenger rail service, for the opportunity to earn a return on investment through fare revenues. For example, the Napa Valley Transportation Authority and the Napa Valley Railroad are exploring public-private partnership opportunities to better serve future passenger service along the rail line. Through a diverse range of options, governments can engage private partners via concessions, operating agreements, and other arrangements that offload some of the risk involved in operating investments, and capture further service efficiencies, while protecting taxpayers and delivering services that meet the service goals defined in the Rail Plan.

6.4.5 Positive Train Control

PTC implementation is a state and federal priority and impacts both passenger and freight lines. The Class I railroads are implementing PTC largely at their own expense, and installation is well underway in California and elsewhere. However, PTC poses costly challenges to some short lines that are handling hazardous materials, or more commonly must operate over PTC-equipped Class I main lines. The $100,000-plus cost of retrofitting older locomotives that are typical of short-line fleets is beyond the financial ability of many carriers.

Some passenger rail operators, like Metrolink, have led the way with PTC installation; Metrolink has become the first commuter rail operator in the nation to implement the advanced safety technologies. SMART became the first rail line in the United States to open with a fully outfitted PTC system. However, not all operators are as far along, and the 2018 deadline to install PTC is near. To ensure the safety of passengers, crews, and commodities, the State has formed a task force to monitor and enforce PTC implementation for Amtrak and the railroads by the end of the year.