CALIFORNIA HIGH-SPEED RAIL EARLY TRAIN OPERATOR

Side-By-Side Comparison: Southern California High-Speed Rail Financial Study, Peninsula Corridor Financial Study, Central Valley Segment Financial Study

Draft Qualitative Report, October 31, 2019

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Document ID Number

ETO_MGM_Side-By-Side Study Qualitative Report_R01.0_20191031_1700

Submission No.

Rev. 1.0

Effective Date: **2019-10-18**

Language: **En**

Revision Log

Revision	Date of Release	Description of Changes
1.0	October 31, 2019	Initial Release

Table of Contents

List of Figures

List of Tables

Abbreviations

ACE	Altamont Corridor Express (San Jose to Stockton rail service)
Amtrak	National Passenger Railroad Corporation
Authority	California High-Speed Rail Authority (CAHSRA)
BNSF	BNSF Railway Company (also known as Burlington Northern and Santa Fe Railway)
Board	California High-Speed Rail Authority Board
CalSTA	California State Transportation Agency
CHSRA	California High-Speed Rail Authority
CMF	Metrolink's Central Maintenance Facility
CP	Control point (Signal and/or track connection in network)
CTC	Centralized Traffic Control (CTC) signal system
CVS	Central Valley Segment (Merced to Bakersfield), previously referred to as Central Valley Corridor (CVC)
CVC	Central Valley Corridor (Merced to Bakersfield), currently referred to as Central Valley Segment (CVS)
ETO	Early Train Operator
HSR	High-Speed Rail
LAUS	Los Angeles Union Station
LA Metro	Los Angeles County Metropolitan Transportation Authority

LinkUS	Link Union Station (Metro Project), project to convert Los Angeles Union Station from a stub-end terminal into a run-through station
LOSSAN	Los Angeles-San Diego-San Luis Obispo Rail Corridor Agency
MAS	Maximum authorized speed
Metrolink	Southern California Regional Railroad Authority
MPH	Miles per hour
OpEx	Operating and maintenance expenditures
CapEx	Capital expenditures
PenC	Peninsula Corridor (San Francisco to Gilroy)
PTC	Positive Train Control (PTC)
SCORE	Southern California Optimized Rail Expansion program
SJJPA	San Joaquin Joint Powers Authority is responsible for administration and management of the San Joaquin Rail Service
SJRRC	San Joaquin Regional Rail Commission owns, operates and is the policy-making body for the ACE service
TIRCP	Transit and Intercity Rail Capital Program are competitive capital grants awarded by the California State Transportation Agency for projects that demonstrate reductions in future greenhouse gas emissions
TOC	Train operating company
UPRR	Union Pacific Railroad
YOE$	Year of Expenditure Dollars

Executive Summary

Introduction and Background

In May 2019, the High-Speed Rail Authority Board (Board) approved a motion asking staff, through the Early Train Operator (ETO), to provide a "side-by-side" comparison analysis of options for potential early service investments in the Central Valley, San Francisco Bay Area and Los Angeles/Anaheim high-speed rail corridors with the focus on supporting investment decisions.

Components of the analysis were requested to include:

- Operating Expenditures (OpEx)
- Capital Expenditures (CapEx)
- Revenue
- Ridership
- Greenhouse gas savings
- Congestion relief
- Near-term benefits
- Completion date
- Any potential for private investment and local matching funds

The requested new study will use the material in the ETO's Central Valley and Peninsula Corridor Financial Plan Study released in May 2019 with the Authority's Project Update Report as well as additional analyses needed for these corridors to complete the side-by-side comparison.

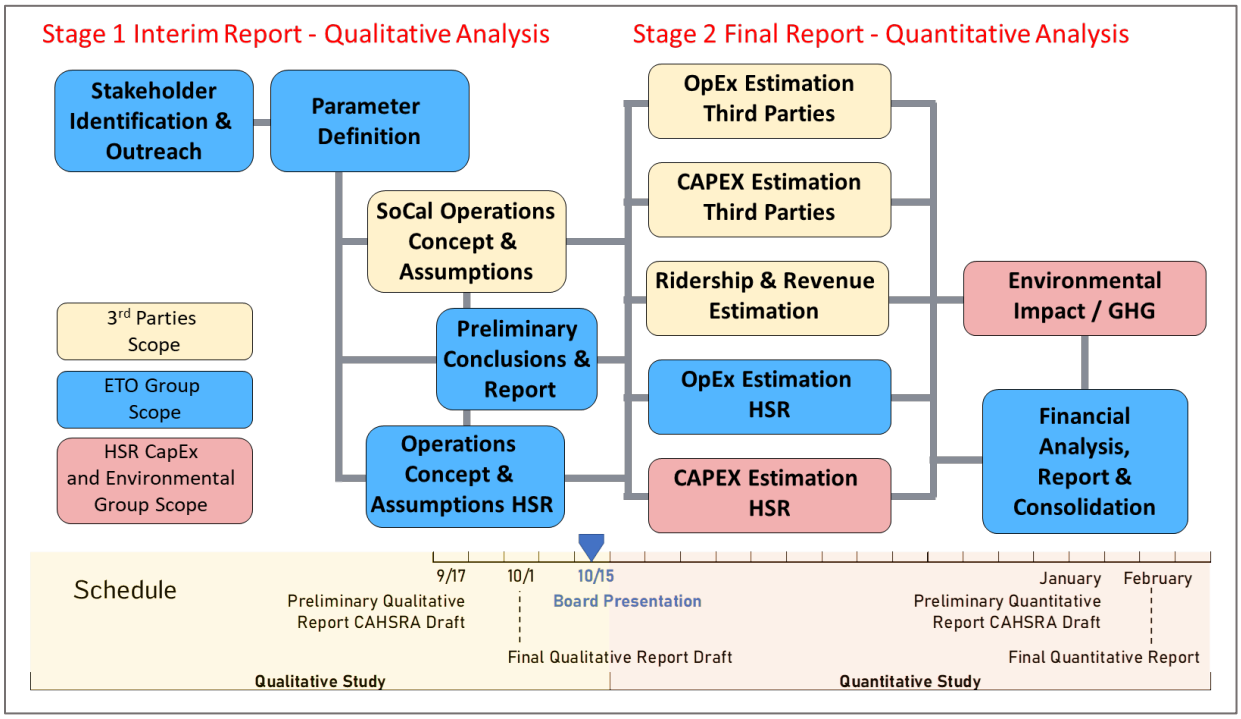
The Side-By-Side Study covers three different segments of the future California High-Speed Rail System:

- San Francisco / Bay Area (NorCal): 4th & King Street Station – Gilroy
- Central Valley Segment (CVS): Merced – Bakersfield
- Los Angeles / Anaheim (SoCal): Burbank Airport – Anaheim

The study is being performed in two stages: a preliminary Qualitative Phase and a second Quantitative Phase. This report summarizes the preliminary Qualitative Phase of the work undertaken.

Based on the study scope (Figure ES-1) ETO has completed the Stage 1 tasks including identification of and outreach to stakeholders, definition of parameters of the SoCal study, definition of service concepts for the SoCal corridor and preliminary conclusions based on a comparison of the PenC and CVS study information and the new information that has been gathered for the SoCal corridor.

Figure ES-1: Side-By-Side Study Scope



For this preliminary report the study team was tasked to define parameters, identify stakeholders, establish operating concepts for both the regional rail as well as the High-Speed Rail operation and to begin the data-gathering process and to draw a set of preliminary conclusions based on the initial qualitative review of the SoCal corridor and how it compares with the NorCal and CVS corridors.

This report, as well as a separate presentation to the Authority's Board, summarizes the work performed to date and the preliminary conclusions.

Scenario Definition

Within each of the three corridors, investment and service scenarios were developed (***Figure ES-2***) that reflect a varying amount of non-High-Speed Rail investment (i.e. regional, state, and federal), partial High-Speed Rail eligible investment and full High-Speed Rail eligible investment amounts.

Scenario 1 represents the current (No Build) situation and the investment levels increase from Scenario 2 through Scenario 4 and will facilitate regional service improvements in Scenario 2 and Scenario 3 as well as High-Speed Rail operation in Scenario 4 in each of the corridors. The scenarios assume a sequential implementation of the following investment:

- Scenario 2 - Committed regional investments (ongoing project implementation)
- Scenario 3 - Initial High-Speed Rail eligible investment and additional regional investment to facilitate increase in non-High-Speed Rail operation
- Scenario 4 - Full High-Speed Rail eligible investment with High-Speed rolling stock and the same regional investment as in Scenario 3 to facilitate the increase in non-High-Speed Rail operation as well as the High-Speed Rail operation

This sequential investment is tied to the constructability and the timeline of the completion of the various project scopes. The completion dates vary significantly depending on factors including the extent to which both regional and high-speed investments can be made concurrently versus whether they need to be made in a more sequential manner as to minimize disruptions to existing passenger services operating in the corridor. This process is also reflected in the summary of completion dates which vary significantly between the three different corridors and are based on estimates of how a sequential completion could realistically be achieved. This assumption results in different implementation horizons of the High-Speed Rail investment as compared with the 2018 High-Speed Rail Business Plan and the future 2020 Business Plan.

More specifically, because neither the Silicon Valley to Central Valley line nor the completion of the Phase 1 system in Southern California are fully funded, specific implementation plans and

timelines that take into account the timing of regional versus high-speed rail investments have been developed for the Side-By-Side Study. In order to develop year of expenditure (YOE) cost estimates, the Authority's business-planning process assumes that project development in these corridors is initiated and advanced at the completion of the environmental Records of Decision. That is, the business plan does not consider regional investments apart from the bookend investments as a precursor to the High-Speed Rail implementation for purposes of developing its YOE estimates. The Side-By-Study does evaluate whether certain regional investments are precursors to high-speed rail investments, particularly in operational corridors and conservatively assumes sequential investments rather than concurrent investments. This also affects the capital cost estimates since inflation adjustments to reflect the midpoint of construction will result in different absolute expenditure numbers as compared with the Business Plan 2018 due to a difference in time horizons and resultant inflation adjustments.

Figure ES-2 shows the different scenarios that are used to compare the investment into the three study corridors where the scenarios reflect a series of building blocks to improve rail service.

Figure ES-2: Side-By-Side Study Definition of Scenarios in Standalone Corridors

Northern California Corridor (NorCal)

The PenC Corridor Study as part of ETO's Central Valley and Peninsula Corridor Financial Plan Study released in May 2019 included three scenarios:

- A 2017 Baseline Service plan scenario (five trains per hour and direction in the peak).
- An electrification and increased Caltrain service scenario with partial High-Speed Rail investment (eight Caltrain trains per hour and direction in the peak, implemented by 2022).
- An increased Caltrain service scenario plus High-Speed Rail service and full High-Speed Rail investment (eight Caltrain trains plus two High-Speed Rail trains per hour and direction in the peak, implemented by 2029).

Since the PenC study has been completed in mid-2019, Caltrain has advanced its business-planning process and issued various growth scenarios in the Caltrain corridor. An eight-train per hour and direction-service concept was adopted by the Caltrain Board[1] as the preferred alternative (i.e. ETO study Scenario 3 in the NorCal corridor).

In order to perform the Side-by-Side Study, a fourth scenario has been included for the NorCal corridor that reflects the electrification scenario by Caltrain as a standalone service that includes the currently funded and committed investments in the NorCal corridor without High-Speed Rail investment (implemented by 2022). The quantitative analysis for this new scenario will rely on readily available information from Caltrain. The ridership and benefits analysis will be performed at a 2028 horizon.

Central Valley Segment

The CVS corridor has a baseline (existing service) and the early High-Speed Rail operation starting in 2029 with 18 High-Speed Rail roundtrips per day. These scenarios are being updated in the ongoing CVS study to reflect new concepts regarding the connectivity to other conventional rail and bus services based on further network integration planning by SJRRC. The ridership and benefit analysis will be performed at a 2029 horizon.

The Side-By-Side study does not include a Scenario 2 for the CVS corridor since there are no regional plans to invest in the parallel freight corridor where San Joaquin currently operates before the High-Speed Rail corridor is implemented between Merced and Bakersfield. Any such regional investment would not be eligible for High-Speed Rail investment (outside of Phase 1 corridor) and will be throw-away cost once High-Speed Rail service is operational. Likewise, the regional operators have no plans to provide early investments into the High-Speed Rail corridor. Therefore,

[1] Caltrain, Choosing a Long Range Vision, JPB Board meeting, OCTOBER 3, 2019, Agenda Item#11, http://www.caltrain.com/Assets/__Agendas+and+Minutes/JPB/2019/2019-10-03+Caltrain+Business+Plan+Vision.pdf, Page 23

the comparison does not provide a Scenario 2 in the CVS Corridor.

Based on the analysis performed by the ETO for the Central Valley Corridor Study, it was determined that a partial High-Speed Rail investment in the Central Valley that would only implement improvements between Madera and Poplar Avenue or between Madera and Bakersfield do not provide benefits that would make an early High-Speed Rail operation attractive. Therefore, the Side-By-Side study does not include a Scenario 3 for the CVS corridor.

Southern California Corridor (SoCal)

In the SoCal Corridor the ETO developed the four scenarios in consultation with stakeholders to reflect varying amounts of regional, state, federal and High-Speed Rail investments. The scenarios are defined as:

- Scenario 1: Existing
- Scenario 2: Regional Investment Only (No CHSR Service)
- Scenario 3: Partial High-Speed Rail Investment (No CHSR Service)
- Scenario 4: Full High-Speed Rail Investment (With CHSR Service)

The scenarios were developed with the same methodology that was deployed for the CVS and the NorCal corridors. The implementation is assumed in a sequential process where regional investment is completed by 2026, the initial High-Speed Rail investment is completed by 2033 and the full High-Speed Rail investment is complete by 2040. It is possible that some of the investments could be made concurrently but this analysis would require extensive and detailed implementation planning, including service operations impacts and issues that would need to be mitigated, which is beyond the scope of this study. The ridership and benefit analysis will be performed at a 2028 horizon for each scenario to allow for a comparison against the SoCal and CVS corridors using the same time horizon.

Side-By-Side Study

Comparison of Investment Scenarios in the Study Corridors

ETO continues to consult with stakeholders such as SJRRC, SJJPA, LOSSAN, Metrolink, LA Metro, CalSTA and Caltrain to consider additional information and further refine scenario assumptions prior to the quantitative phase of the study.

Table ES-1 shows the comparison of the service levels that are facilitated by the different investment levels, whether they will be operated as electric zero-emission trains and an order of magnitude estimate of the required capital cost that occur for the Authority to provide capacity and infrastructure enhancements (Scenario 3) or enable future High-Speed Rail operation as a standalone corridor (Scenario 4) prior to completion of the statewide High-Speed Rail system. The estimated additional regional investment needed for these scenarios will be developed with the stakeholders during the Quantitative Phase of the Side-By-Side Study.

In the NorCal corridor the full High-Speed Rail investment (Scenario 4) will enable eight Caltrain services and two additional High-Speed Rail services per direction and hour during peak periods north of San Jose. This scenario compares to the existing condition with five Caltrain diesel-hauled services per hour and after electrification with four electric and two diesel trains per hour (Scenario 2).

In Southern California the regional investment in Scenario 2 will enable six Diesel trains per hour and direction compared to the full High-Speed Rail investment that allows for eight regional services and two additional High-Speed Rail services per hour and direction.

Table ES-1: Investment Scenario Comparison: Cost Versus Service Benefits ($YOE)

Project Corridor	Type	Scenario 1 Existing	Scenario 2 Regional Investment only (No CHSR Service)	Scenario 3 Partial High-Speed Rail Investment (No CHSR Service)	Scenario 4 Full High-Speed Rail Investment (With CHSR Service)
Peninsula Corridor (NorCal) San Francisco –Gilroy (North of San Jose)	Service	5 Caltrain 5 Total	4 Electric Caltrain* 2 Diesel Caltrain 6 Total	8 Caltrain* 8 Total	8 Caltrain* 2 High-Speed* 10 Total
	Cost	(No Build)	(Regional $)**	(+ $4B HSR+ Regional $)	(+ $3B HSR+HSR Rolling Stock)
Central Valley Segment (CVC) Merced –Bakersfield (Entire Corridor)	Service	0.5 San Joaquins (7 Per Day)	N/A	N/A	1 High-Speed* 1 Total (18 per Day)
	Cost	(No Build)			(+ $4.8B HSR incl. HSR Rolling Stock+ Regional $)
Southern California Corridor (SoCal) Burbank –Anaheim (Section North of LAUS)	Service	0.5 Express 3 Regional 3.5 Total	2 Express 4 Regional 6 Total	2 Express 6 Regional 8 Total	2 Express 6 Regional 2 High-Speed* 10 Total
	Cost	(No Build)	(Regional $)**	(+ $7B HSR+ Regional $)	(+ $5B HSR+HSR Rolling Stock)

Note: Investment levels by Regions, State, Others and High-Speed Rail eligible investment increases in steps when comparing Scenario 2 to Scenario 3 and to Scenario 4.

In both corridors the early High-Speed Rail operation will be an overlay in addition to the significantly improved regional rail services operating in a shared corridor. In contrast, the Central Valley Segment between Merced and Bakersfield will be a standalone High-Speed Rail service that will be providing intercity passenger rail service as a standalone service with a dedicated right-of-way. The proposed service will more than double the existing service in the Merced to Bakersfield section with service increasing from seven to 18 roundtrips per day.

Table ES-2 shows a qualitative comparison of the corridor parameters, the required High-Speed Rail investment to achieve early High-Speed Rail infrastructure implementation (partial

investment, Scenario 3) and to achieve High-Speed Rail operation (full investment, Scenario 4) and the expected benefits from the High-Speed Rail investment as a qualitative description.

Table ES-2: Preliminary Findings – Qualitative Comparison Between Study Corridors

Project Corridor	Length of Corridor	Improved Rail Service	Ridership and Revenue Increment	Increment GHG Benefits	Expected Congestion Relief	High-Speed Rail Capital Cost (YOE$)	Prior Regional Investment Required?	High-Speed Rail operational within next 10 Years?
Peninsula Corridor (NorCal) San Francisco to Gilroy	77 Miles Shared	Frequency, Slightly Increased Speed, All Electric	Incremental	Auto and Diesel Trains to Electric Trains	Incremental	Range: $4 to $7 billion +HSR Rolling Stock TBD	Shared Corridor/ Caltrain Electrification complete	Maybe At 110 mph
Central Valley Segment (CVS) Merced to Bakersfield	171 Miles Dedicated	Frequency, Full High Speed, 90 Minute Savings, All Electric	Significant	Auto and Diesel Trains to Electric Trains	Significant	$4.8 billion including Rolling Stock	Independent Corridor/ Can be developed in parallel	Yes At 220 mph
Southern California Corridor (SoCal) Burbank to Anaheim	44 Miles Shared	Frequency, Slightly Increased Speed, Only High-Speed Rail Electric	Incremental	Auto to Mainly Diesel Trains	Incremental	Range of $7 to $12 billion +HSR Rolling Stock TBD	Shared Corridor/ Regional Investment (Part of SCORE) complete	Unlikely At 110 to 125 mph

The NorCal Corridor is expected to have incremental benefits from a full High-Speed Rail investment and operation since the regional Caltrain improvements already capture significant benefits and the High-Speed Rail operation only serves four out of the 29 stations with weekday service. The resultant ridership impact and related environmental benefits are incremental since the major benefits are realized with the electrification scenario (Scenario 2). This analysis was already part of the ETO's Central Valley and Peninsula Corridor Financial Plan Study released in May 2019

Capital Cost for Early High-Speed Rail Investment in the NorCal Corridor

ETO used cost estimates from the Authority for a partial High-Speed Rail investment (Scenario 3) that enables full electric regional (Caltrain) service from Gilroy to San Francisco and the full High-Speed Rail investment that enables High-Speed Rail operation in the corridor. The cost information is based on the preferred High-Speed Rail alternatives and therefore differs from prior estimates and is subject to refinement in the Quantitative Phase of the study. The Scenario 3 capital cost in Year of Expenditure (YOE$) Dollars using the midpoint of construction to escalate the cost to future year Dollars is estimated at $4.1 billion and Scenario 4 capital cost is estimated at $7.2 billion for the infrastructure investment. Scenario 4 also requires capital for High-Speed Rail rolling stock which will be calculated during the quantitative Phase of the project.

Capital Cost for Early High-Speed Rail Investment in the CVS Corridor

Based on the project update report issued by the Authority in May 2019, the capital cost to complete the Merced – Madera and Poplar Avenue – Bakersfield sections and to purchase rolling stock are estimated at $4.8 billion Year-of Expenditure Dollars ($YOE)[2]. This estimate is based on a P70 case using risk analysis to establish the cost data with the understanding that final cost estimates at a P100 level could vary from the P70 level estimates. A concurrent investment by San Joaquin and ACE rail services will enable the required improved connectivity north of Merced.

Capital Cost for Early High-Speed Rail Investment in the SoCal Corridor

The initial estimates that the ETO used are derived from prior planning efforts and indicate that the initial as well as the full High-Speed Rail investment in the Burbank to Anaheim corridor will be significant when expressed in Year of Expenditure Dollars. The cost estimates assume a sequential implementation of the investment. The High-Speed Rail eligible investment in Year of Expenditure (YOE$) Dollars using the midpoint of construction to inflate the cost to future year

[2] California High-Speed Rail Authority, Project Update Report to the California State Legislature, May 1, 2019, https://www.hsr.ca.gov/docs/about/legislative_affairs/SB1029_Project_Update_Report_050119.pdf

Dollars is $6.8 billion for Scenario 3 and $12.4 billion for Scenario 4, respectively. Both scenarios (see Section 4.7.1 for scenario definition) require significantly higher investment as compared to the completion of the Merced to Bakersfield segment (CVS) with the extension form Madera to Merced and from Polar Avenue to Bakersfield estimated at $4.8 billion.

Eligible High-Speed Rail Capital Investments in Study Regions

The Study assumes that High-Speed Rail funds can be invested only within the boundaries of the High-Speed Rail Phase 1 implementation; therefore, “Eligible High-Speed Rail” capital investments only include High-Speed Rail infrastructure, High-Speed Rail rolling stock and High-Speed Rail systems.

The additional Capital investments required in each scenario for “Non Eligible High-Speed Rail” infrastructure or components are assumed to be covered by other regional or state funds.

Apart from the already committed High-Speed Rail bookend investment in Los Angeles Union Station (Link US) and the Rosecrans/Marquardt Grade Separation Project, there are no committed capital expenditure plans for CHSRA early investments in the SoCal corridor.

Scenario 3 and Scenario 4 High-Speed Rail Eligible investment needs in SoCal will exceed the estimated $4.8B assumed to be potentially available (Section 4.7.4). Any reduced implementation (less than Scenario 3 investment) of an early High-Speed Rail investment in the SoCal corridor will result in a situation with very marginal regional benefits that would not contribute to the High-Speed Rail mission in the State and would not provide a building block approach that would also benefit the regional SoCal rail system.

As explained, in addition to the projected High-Speed Rail eligible cost estimates, regional capital investments will be required for completion of regional non High-Speed Rail eligible infrastructure to support the higher service frequency in the corridors as well as the additional regional rolling stock that is not eligible for High-Speed Rail funding. The ETO team will obtain the respective investment numbers from the stakeholders to provide a complete summary in the quantitative phase of the project.

The breakout between High-Speed Rail eligible capital cost and investment that will need to be performed by the regional partners does not represent a funding commitment by any party but rather illustrates how the Authority could contribute to the investment in the study corridors.

It is important to note that, considering the Central Valley section is under construction and if investment is prioritized in other sections of the future High-Speed Rail network, significant benefits could be lost in the Central Valley since the Madera – Poplar Avenue corridor will not provide the benefits of a High-Speed Rail service and would result in an underutilized segment. It will likely resemble a slightly improved service over the existing San Joaquin service with similar frequency and only slightly higher operating speeds. In addition opportunity costs are likely to occur due to the partial investment in the Central Valley without corresponding benefits since the Authority will lose the opportunity to showcase a High-Speed Rail corridor, later completion of the Merced and Bakersfield extensions will incur cost increases and the infrastructure maintenance cost for a Diesel train-based service will be proportionally higher due to the higher maintenance standards for a High-Speed Rail line as compared to a conventional diesel-based operation at lower speeds. The diesel operation also will require throwaway investments to facilitate a diesel train-based service. These throw-away investments include:

- Adaptation of the signal system for non-High-Speed Rail rolling stock
- Building the connecting tracks between the High-Speed Rail alignment and freight rail tracks in Madera and at Poplar Avenue
- Construction of interim station infrastructure on the High-Speed Rail alignment to accommodate diesel-hauled rolling stock

Status of Comparative Analysis CVS and PenC Studies

In parallel to the side-by side comparison, the Authority requested the ETO to update the CVS Study to reflect revised plans regarding the connectivity with ACE and San Joaquin services in the Central Valley as well as to accommodate a different approach of the High-Speed Rail operation in the Central Valley. The time horizon for the CVS ridership analysis has also been adjusted to 2029 to accommodate the latest implementation schedule.

The PenC study is under further review to incorporate another Scenario (six trains per hour, electrification investment only) to reflect a committed and approved regional investment scenario. The information for this new scenario will be based on data available for the current Caltrain Business Plan.

The analytical phase of the Side-By-Side Study including establishment of GHG impacts, congestion relief opportunities as well as implementation schedules and opportunities for third party funding and private sector contributions will commence shortly for all three corridors.

Initial Findings and Conclusions

Based on the initial review of the information available at completion of this report, the ETO provides the following preliminary conclusions:

Benefits from Early High-Speed Rail Investment in SoCal Corridor

The ETO will begin to quantify the benefits of the SoCal scenarios in more detail in the next Phase of the study. However, the following conditions will apply:

- The relatively small size (44 miles) and the location of the Burbank – Anaheim corridor within the larger SoCal network,
- The standalone operation missing connectivity of the SoCal High-Speed Rail operation with the Central Valley High-Speed Rail operation
- And the constraints of a Shared corridor imposed on the High-Speed Rail service that limits the speed of High-Speed Rail to almost the same speed achieved by the regional services

Based on these conditions the following impacts are expected:

- In Scenario 4, limited benefits of an early High-Speed Rail operation in the SoCal High-Speed prior to the implementation of the connection to the Central Valley High-Speed Rail system that would enable statewide benefits in addition to the regional benefits.

- The full High-Speed Rail operation in Scenario 4 will provide service only in the Anaheim to Burbank corridor and add service to an already frequent Metrolink service in Scenario 3. The High-Speed Rail trains will be serving only four out of the 62 stations in the Metrolink system with similar travel times as compared to the regional trains.

- In Scenario 3, the "minimum building block" of High-Speed Rail infrastructure in the Burbank-Anaheim corridor (High-Speed Rail eligible capital investments) will exceed the estimated $4.8B assumed to be potentially available (see Section 4.7.4). Any reduced implementation of an early High-Speed Rail investment in the SoCal corridor will result in a situation with very marginal regional benefits that would not contribute to the High-Speed Rail mission in the State and would not provide a building block approach that would also benefit the regional SoCal rail system:

- The "Minimum building block" of High-Speed Rail infrastructure in the Burbank-Anaheim corridor (Scenario 3) will require approximately $7B in High-Speed Rail eligible capital investments.

- The SoCal High-Speed Rail corridor Burbank-Anaheim is only about 44 miles long which is part of a regional rail network where benefits derive from a network situation rather than a corridor specific situation. Therefore, to materialize the benefits of an early investment in the Burbank-Anaheim "High-Speed Rail eligible" infrastructure, substantial regional or state investment in addition to the $7B will be required for "Non High-Speed Rail eligible" investment to improve the remaining parts of the SoCal network and required regional rolling stock.

- At this point in time the ETO has not been able to identify such committed investments or their availability. ETO will review and consider input from other planning scenarios such as those included in the recently provided report by Metrolink to continue the Quantitative Phase of the Side-By-Side Study.

Benefits from Early High-Speed Rail Investment in NorCal Corridor

- In both the SoCal and the NorCal corridors the significant expansion of regional rail

services under the respective Scenario 2 will provide a step change in network-wide benefits. The additional High-Speed Rail investments in Scenario 3 will enable incremental improvements for regional service but with several limitations since the High-Speed Rail investment cannot be applied to non-High-Speed Rail infrastructure or non-High-Speed Rail rolling stock.

- Similar to the SoCal corridor, the NorCal corridor requires a regional investment level in addition to the High-Speed Rail eligible investment beyond the electrification project to maximize the benefits of the early High-Speed Rail investment. The Caltrain Business Plan is under development and highlights these funding requirements for various growth scenarios. ETO is working with Caltrain to obtain data that reflects the Moderate Growth Caltrain Business Plan data and incorporate that information for Scenario 2, Scenario 3 and Scenario 4.

- Scenario 4 In NorCal with a High-Speed Rail service running in parallel to the improved electrified Caltrain service before the Pacheco pass is built was already studied and discussed in the previous ETO report released in May 2019. It was found to be not an attractive operating opportunity after reviewing the ridership and operational costs.

Benefits from Early High-Speed Rail Investment in CV Corridor

Early High-Speed service in the Central Valley was already discussed and analyzed in the previous ETO report released in May 2019. The benefits are summarized below:

- Potential improvements on the financial balance for the state in the total corridor operational costs including San Joaquin and ACE regional services with the extension to Merced and Bakersfield

- Benefits for the Central Valley communities in travel time, frequency and service quality

- Better access to health, education and employment

- From the three High-Speed Rail standalone corridors in the study, the Central Valley will

be the only Corridor that will provide true High-Speed Rail service and will represent a major step in implementing California High-Speed Phase 1 program within the identified funding sources while improving the regional services

- Opportunity costs can occur in the Central Valley Segment if capital is shifted between corridors and leads to the lack of a "meaningful building block". These opportunity costs are related to:
    - Construction cost increases if the completion of the Merced and Bakersfield extensions is significantly delayed
    - Additional throw-away cost to connect the Madera – Poplar Avenue section back to the freight railroad alignments to enable non-HSR service on the infrastructure.
    - Interim rail systems for this diesel operation
    - Interim stations for diesel service in the High-Speed Rail corridor
    - Underutilization of High-Speed Rail infrastructure as well as the proportionally higher maintenance cost for the asset without utilizing the benefits of the High-Speed Rail designed infrastructure.

There may be regional benefits that would accrue from additional regional service in all corridors, but the substantial benefits of High-Speed Rail service accrue only in longer segments where the true benefits of high speed can materialize. The Central Valley dedicated High-Speed Rail Corridor provides such benefits where travel time advantages are much larger compared to the shorter shared corridors in the NorCal and SoCal corridors.

Next Steps

ETO will continue with the Quantitative Phase of the Side-By-Side Study utilizing information from the Caltrain Business Plan as well as a proposed Metrolink Scenario. The tasks that will be completed include a continued analysis of capital cost including High-Speed Rail rolling stock, continue to work with stakeholders in all three corridors to provide insights in needed regional

investment and related operating cost for regional rail services, summarize benefits for the PenC corridor electrification and medium growth scenarios and highlight regional funding needs and work with PenC stakeholders to provide insights in needed investment.

Lastly based on the refined information identify GHG and congestion benefits for all three corridors and provide an investment summary for High-Speed Rail eligible cost and cost that is not eligible to be paid with High-Speed Rail funds to enable planning and coordination.

The side-by-side comparison in the Quantitative Phase will present the following parameters and summaries for each performance indicator:

- Operations and Maintenance Expenditures:
  Summary of annual regional and High-Speed Rail operating cost by scenario and corridor for the horizon year based on data from the regional operators and estimates for the HSR operation. The data will show absolute numbers and the increment between No-Build and the Scenarios.
- Capital Expenditures:
  Estimates from the regional operators and for eligible High-Speed Rail investment for infrastructure and rolling stock in YOE dollars by scenario and corridor.
- Ridership:
  Ridership estimates will be based on the State Rail Model and will include daily and annual ridership totals for the regional operators and the High-Speed Rail service by scenario and corridor.
- Revenue:
  Annual fare box revenue calculated based on the ridership estimates differentiated by regional services and High-Speed Rail services as well as ancillary revenue where applicable for operators.
- GHG benefits:
  Annual GHG benefits are calculated based on passenger miles travelled from the ridership model and train miles provided by type of propulsion using ARB standard processes. The

passenger miles represent the demand of Auto to Rail diversion and related avoided vehicle miles travelled on highways by scenario and corridor.

- Congestion relief:
  Congestion relief is calculated using passenger miles travelled from the ridership model as a measure of how many highway miles travelled can be avoided in each of the investment scenarios. In addition, for each scenario and corridor a comparison of the peak load point between the scenarios will identify the amount of reduced highway trips at that location and an equivalent of highway lanes will be derived.
- Other benefits:
  Near-term benefits, the completion date, as well as any potential for private investment and local matching funds will be summarized and compared by scenario and corridor.

This report includes information available at the point in time when it was produced. Due to the preliminary character of the collected data and information and the longer-term character of the scenarios, the numbers and data presented in the report are subject to change.

1 Introduction and Background

1.1 Board Request

In May 2019, the High-Speed Rail Authority Board (Board) approved a motion asking staff, through the Early Train Operator (ETO), to provide a "side-by-side" comparison analysis of options for potential early service investments in the Central Valley, San Francisco Bay Area and Los Angeles/Anaheim high-speed rail corridors with the focus on supporting investment decisions.

Components of the analysis were requested to include:

- Operating Expenditures (OpEx);
- Capital Expenditures (CapEx);
- Revenue;
- Ridership;
- Greenhouse gas savings;
- Congestion relief;
- Near-term benefits;
- Completion date; and
- Any potential for private investment and local matching funds.

The Southern California comparison will use the material in the ETO's Central Valley and Peninsula Corridor Financial Plan Study as well as additional analyses needed for these corridors to complete the side-by-side comparison.

1.2 Study Scope

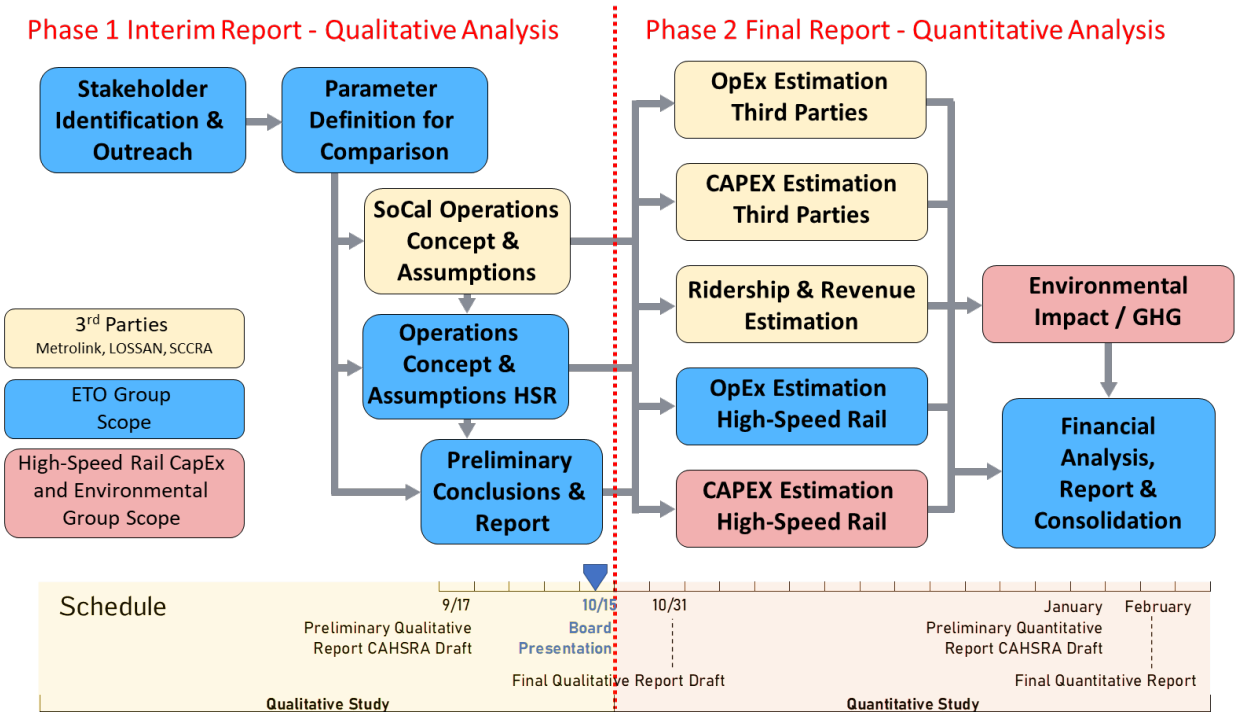
ETO provided a scope to the Authority to perform the Side-by-Side Study in two phases as shown in (Figure 1-1). The study is structured into a preliminary qualitative phase and a final quantitative phase that will provide a basis for the side-by-side comparison of all three study corridors. Some of these quantitative measures were already provided in the PenC Study for Northern California and the CVS study for the Central Valley whereas the team will need to analyze the SoCal scenarios to provide comparable figures for the SoCal corridor. ETO also is updating the CVS

analysis and will include refined output of this parallel effort in the Side-by-Side Study. In addition, adjustments will be performed as required to the PenC study output for the purpose of comparability. This includes changes to the assumptions for the costing of the High-Speed Rail operation as well as the inclusion of the Caltrain Electrification Scenario (Scenario 2).

For the preliminary report the study team was tasked to define parameters, identify stakeholders, establish operating concepts for the regional rail as well as the High-Speed Rail operation and to begin the data-gathering process and to draw a set of preliminary conclusions based on the initial qualitative review of the SoCal corridor and how it compares against the PenC and CVS corridors.

This report as well as a separate presentation delivered to the Authority's Board summarize the work performed to date as well as the preliminary conclusions.

Figure 1-1: Side-By-Side Study Scope



1.2.1 Workflow

The study scope includes the following steps to perform the side-by-side comparison:

- ETO will lead and coordinate a team to develop a comparative analysis of the different operating sections of the alignment. The team will consist of members of:
  - CHSRA
  - ETO
  - CalSTA
  - Caltrans
  - Additional stakeholders as required (e.g. Metrolink, LA Metro, BNSF, UPRR, OCTA, LOSSAN, SJJPA, NCTD, SANDAG and RCTC);
- Consolidate an Assumptions Register;
- Perform the estimation of Operations and Maintenance costs and Revenue for the High-Speed Rail service;
- ETO will use the information provided by 3rd parties as a basis for the study;
- Near-term benefits, the completion date, as well as any potential for private investment and local matching funds will be reviewed with local partners; and
- Consolidate a report and the conclusions to be presented to the CHSRA Board.

1.2.2 Scenarios and Criteria for the Comparative Analysis

The analysis will include the following Criteria:

- CAPEX (capital expenditure)
- OPEX (operational expenditure)
- Revenue
- Ridership
- GHG
- Congestion Relief

The analysis will include the scenarios for comparison shown in Figure 1-2.

The SoCal Corridor is defined as the corridor between Burbank to Anaheim. No further analysis will be done north of Burbank or south of Anaheim. The NorCal and CVS corridor limits remain unchanged from the PenC and CVC study limits.

1.2.3 Qualitative Report

This initial "Qualitative Report" summarizes the results of previous studies for comparison to Southern California, identifies the planning parameters for current and future service scenarios as inputs for analysis of potential benefits, identifies quantitative analysis outputs (ridership, greenhouse gas savings and congestion relief), and raises important strategic policy questions to be addressed in a subsequent quantitative report. Preliminary findings will conclude the qualitative report and were presented to CHSRA's Board in October 2019.

1.2.4 Quantitative Report

The "Quantitative Report" will be released in early 2020 and include the ridership estimates, greenhouse gas emissions, congestion, and operating revenues. These estimates will allow for a side-by-side comparison of the three initial operating segments in the Central Valley, the Peninsula and Southern California. This part of the study will draw on the PenC and the CVS study content as well as further ongoing analyses to compare the three corridors in a consistent manner.

1.3 Definition of Corridors and Scenarios

1.3.1 Corridor Definition

The ETO was tasked to compare options for potential early service investments in the following three High-Speed Rail corridors:

- San Francisco / Bay Area (NorCal): 4th & King Street Station – Gilroy
- Central Valley Segment (CVS): Merced – Bakersfield
- Los Angeles / Anaheim (SoCal): Burbank Airport – Anaheim

The basis of the analysis is the understanding that High-Speed Rail funds can only be used for

High-Speed Rail infrastructure and High-Speed Rail rolling stock within the Phase 1 project limits.

1.3.2 Scenario Definition

Within each of the three corridors, investment and service scenarios were developed (Figure 1-2) that reflect a varying amount of non-High-Speed Rail investment (Regional, State, Federal), partial High-Speed Rail eligible investment and full High-Speed Rail eligible investment amounts.

The investment levels increase from Scenario 2 through Scenario 4 and will facilitate regional service improvements in Scenario 2 and Scenario 3 as well as High-Speed Rail operation in Scenario 4 in each of the corridors. The scenarios assume a sequential implementation of the following investment:

- Committed regional investments (ongoing project implementation) in Scenario 2
- Initial High-Speed Rail eligible investment and additional regional investment to facilitate increase in non-High-Speed Rail operation in Scenario 3
- Full High-Speed Rail eligible investment with High-Speed rolling stock and the same regional investment as in Scenario 3 to facilitate the increase in non-High-Speed Rail operation as well as the High-Speed Rail operation in Scenario 4.

This sequential investment is tied to the constructability and the timeline of the completion of the various project scopes. This process is also reflected in the summary of completion dates which vary significantly between the three different corridors and are based on estimates how a sequential completion could realistically be achieved. This assumption results in different assumed implementation horizons of the High-Speed Rail investment as compared to the 2018 High-Speed Rail Business Plan and the 2020 Business Plan where a concurrent implementation is assumed since the business plan does not consider regional investments apart from the bookend investments as a precursor to the High-Speed Rail implementation. This also affects the capital cost estimates since inflation adjustments to reflect the midpoint of construction will result in different absolute expenditure numbers as compared to the Business Plan due to a difference in time horizons.

Since the PenC study was completed in mid-2019, Caltrain has advanced its business-planning process and issued various growth scenarios in the Caltrain corridor. An eight-train per hour and direction service concept was adopted by the Caltrain Board as the preferred alternative (ETO study Scenario 3 in the NorCal corridor). Figure 1-2 shows the different scenarios that are used to compare the investment in the three study corridors where the scenarios reflect a series of building blocks to improve rail service.

Figure 1-2: Side-By-Side Study Definition of Scenarios in Standalone Corridors

NorCal Corridor

The PenC corridor study from May 2019 included three scenarios:

- A 2017 Baseline Service plan scenario (five trains per hour and direction in the peak)
- An electrification and increased Caltrain service scenario with partial High-Speed Rail investment (eight Caltrain trains per hour and direction in the peak, implemented by 2022)
- An increased Caltrain service scenario plus High-Speed Rail service and full High-Speed Rail investment (eight Caltrain trains plus two High-Speed Rail trains per hour and direction in the peak, implemented by 2029)

Since the PenC study has been completed in mid-2019, Caltrain has advanced its business planning process and issued various growth scenarios in the Caltrain corridor. An eight-train per hour and direction service concept was adopted by the Caltrain Board[3] as the preferred alternative (ETO study Scenario 3 in the NorCal corridor).

In order to perform the Side-by-Side Study, an additional scenario (Scenario 2) has been included for the NorCal corridor that reflects the electrification scenario by Caltrain as a standalone service that reflects the currently funded and committed investments in the NorCal corridor without High-Speed Rail investment (implemented by 2022). No new analysis for this scenario is anticipated and the quantitative analysis will rely on readily available information from Caltrain for this scenario. The ridership and benefit analysis will be performed at a 2028 horizon.

CVS

The CVS corridor has a baseline (existing service) and the early High-Speed Rail operation starting in 2029 with 18 High-Speed Rail roundtrips per day. These scenarios are currently being

[3] Caltrain, Choosing a Long Range Vision, JPB Board meeting, OCTOBER 3, 2019, Agenda Item#11, http://www.caltrain.com/Assets/__Agendas+and+Minutes/JPB/2019/2019-10-03+Caltrain+Business+Plan+Vision.pdf, Page 23

updated in the ongoing CVS update study to reflect new concepts regarding the connectivity to other conventional rail and bus services based on further network integration planning by SJRRC. The ridership and benefit analysis will be performed at a 2029 horizon.

The Side-By-Side study does not include a Scenario 2 for the CVS corridor since there are no regional plans to invest in the parallel freight corridor where San Joaquin currently operates before the High-Speed Rail corridor is implemented between Merced and Bakersfield. Any such regional investment would not be eligible for High-Speed Rail investment (outside of Phase 1 corridor) and will be throw-away cost once High-Speed Rail service is operational. Likewise, the regional operators have no plans to provide early investments into the High-Speed Rail corridor. Therefore, the comparison does not provide a Scenario 2 in the CVS Corridor.

Based on the analysis performed by the ETO for the Central Valley Corridor Study, it was determined that a partial High-Speed Rail investment in the Central Valley that would only implement improvements between Madera and Poplar Avenue or between Madera and Bakersfield do not provide benefits that would make an early High-Speed Rail operation attractive. Therefore, the Side-By-Side study does not include a Scenario 3 for the CVS corridor.

SoCal Corridor

In the SoCal Corridor the ETO developed the four scenarios in consultation with stakeholders to reflect varying amounts of Regional, State, Federal and High-Speed Rail investments. The scenarios were developed to reflect different investment levels:

- Scenario 1: Existing
- Scenario 2: Regional Investment only (No CHSR Service)
- Scenario 3: Partial High-Speed Rail Investment (No CHSR Service)
- Scenario 4: Full High-Speed Rail Investment (With CHSR Service)

The scenarios were developed with the same methodology that was deployed for the CVS and the NorCal corridors. The implementation is assumed in a sequential process where regional investment is completed by 2026, the initial High-Speed Rail investment is complete by 2033 and the full High-Speed Rail investment is complete by 2040. The ridership and benefit analysis will

be performed at a 2028 horizon for each scenario to allow for a comparison against the SoCal and CVS corridors at the same time horizon.

1.4 Previous Studies

On May 1, 2019, the ETO submitted the Central Valley and Peninsula Corridors Operations Financial Plan Study. The focus of this study was to compare revenues vs OPEX. That study provided an analysis of costs and benefits of initial high-speed rail operations on in the Central Valley and on the Peninsula, respectively. The analysis required assumptions related to infrastructure availability and improvements to connecting services to determine inputs for ridership and revenue.

The Qualitative Report for the SoCal Financial Study documents similar assumptions to be carried forward in to the quantitative analysis to complete the regional side-by-side comparisons. Those assumptions, with input from regional stakeholders in Southern California, are documented in Chapter 4 of this report, “Southern California Corridor”.

1.4.1 CVC Study (Central Valley Corridor)

The review of the ridership benefits, underlying assumptions and projected financial balance for operation of early High-Speed Rail services in the Central Valley Corridor lead to the following principal conclusions:

Central Valley Early High-Speed Rail Service Creates Significant Value

Introduction of early high-speed service in the Central Valley will produce significant value and benefits to communities, public transport passengers and operators, as well as to the State of California.

Benefits may include:

- Optimal use of State assets as dependency on the current private freight railroad infrastructure is reduced. The freight railroad infrastructure currently has limited capacity for additional passenger services;

- Using dedicated High-Speed Rail infrastructure allows for higher frequencies of public transport services to be offered;
- Achievement of higher frequencies in turn helps to improve critical connectivity available to local communities and allows the High-Speed Rail operator to test and adjust the optimal rail service offered to the communities, while at the same time allowing for familiarization by and instruction to local communities;
- It will also contribute to economic development and ease of access to economic opportunities throughout the Central Valley;
- Furthermore, High-Speed Rail service introduction lowers the cost per train mile and reduces CO2 emissions from public transportation across the wider Central Valley corridor;
- Introduction of High-Speed Rail service also results in shorter travel times for the passengers, enhancing the attractiveness of public transport and resulting in higher ridership as well as in a higher percentage of operations and maintenance costs recovered from fare collection across the wider the corridor;
- Finally, early High-Speed Rail operations in the Central Valley may reduce the ramp-up time of Valley to Valley (V2V) High-Speed Rail services once the required infrastructure has been completed.

Early High-Speed Rail Service May Improve the Financial Balance of the Total Combined Regional Corridor

- The study shows that integrating the early High-Speed Rail service into the regional corridor may improve San Joaquins and ACE's combined existing farebox recovery ratio. It is best practice in railway financial planning to measure the impacts to the total combined regional corridor (instead of one part of the alignment).
- HSR early services analysis of the total corridor, including San Joaquins, ACE and High-Speed Rail shows the value of High-Speed Rail services from the passengers' travel perspective and financial point of view.

Based on the assumption that a TOC can provide High-Speed Rail train services as a service provider to the SJJPA, the following advantages can be noted:

- Increase in farebox recovery ratio for the combined corridor up to an estimated 73%, up from 41% without High-Speed Rail operation;
- While in parallel, enhancing the train service offered in the total Central Valley Corridor (doubling of train miles).

1.4.2 PenC Study (Peninsula Corridor)

The PenC study came to the principal conclusion that operating an early High-Speed Rail service on the Peninsula Corridor in addition to the Caltrain service does not create a substantial beneficial ridership and revenue impact.

The study shows that:

- Operations and maintenance costs significantly exceed the forecasted revenues for this segment, San Francisco 4th & King – Gilroy. The PenC incremental O&M costs is approximately $75.2 million (including contingency and profit margin) and the incremental revenues (including ancillary revenues) is approximately $31.4 million;
- Overlaying early High-Speed Rail operations in the Peninsula corridor servicing only 4 High-Speed Rail stations (difference between the 2028 Electrification Scenario and the 2028 Electrification + High-Speed Rail Scenario) will result in an increment of only approximately 6% in ridership;
- Most of the improvements are already captured by the 2028 Electrification Scenario by Caltrain (without High-Speed Rail).
- HSR service attending only these 4 stations cannot produce a significant impact in the Peninsula corridor before the tunnel section connects the Central Valley (these 4 stations represent less than 12% of the total number of passengers traveling in the Peninsula Corridor);
- The proposed High-Speed Rail service without the connection to the Central Valley will compete with a well-established commuter rail corridor and except for the Gilroy to San Jose segment, adds incremental service to existing service (Caltrain baby bullet service). Therefore, the capture rate of these markets is limited since the High-Speed Rail service will not be able to open new ridership markets that can be served with a High-Speed Rail

service due to limited travel distances, competing fast regional express rail service and the lack of state-wide connectivity due to the isolated operation within the Gilroy to San Francisco market.

2 Northern California Corridor (NorCal)

2.1 PenC Study Output and Caltrain Business Plan

The PenC study output will be utilized in the Side-By-Side Study to inform the cost and benefits comparison for the NorCal corridor. ETO also will rely on the Caltrain Business Plan data to inform the Scenario 2 analysis as well as the compilation of the regional GHG and Congestion benefits.

ETO will continue to coordinate with the NorCal corridor stakeholders to refine the data and to represent the benefits of the investment scenarios in the NorCal corridor.

2.2 Revisions to NorCal Corridor Assumptions

2.2.1 Revised Scenario Definition

The following three scenarios were analyzed in the ridership analysis of the PenC study:

- No-Build with existing service of five peak hour Caltrain diesel trains per direction (Scenario 1 of the Side-By-Side Study)
- Partial High-Speed Rail eligible investment enabling full electric operation and eight peak hour electric Caltrain trains per direction (Scenario 3 of the Side-By-Side Study)
- Full High-Speed Rail eligible investment enabling full electric operation and 8 peak hour electric Caltrain trains per direction plus two High-Speed Rail trains per hour and direction (Scenario 4 of the Side-By-Side Study)

In order to provide a comparison between the NorCal and SoCal corridors, ETO added a fourth scenario that reflects only the committed regional investment for the Caltrain Electrification. This scenario enables four electric and two diesel trains per hour and direction in the peak hour (Scenario 2 of the Side-By-Side Study).

Scenario 1, Scenario 3 and Scenario 4 will use the PenC study output to perform the side-by-side comparison and Scenario 2 benefits will be based on the Caltrain business plan output for that scenario. ETO is working with Caltrain stakeholders to summarize the relevant data.

2.2.2 Service Concepts

The service concepts for Scenario 1, Scenario 3 and Scenario 4 in the NorCal corridor will remain identical to the PenC study. Scenario 2 will use the Caltrain Electrification service plan as a basis as well as the related benefits analysis that is part of the Caltrain business plan analysis.

2.3 HSR Eligible Capital Costs NorCal

The previous PenC study has not identified capital costs since the incremental revenue from the High-Speed Rail operation did not cover the incremental operating cost for such a service. The ETO team meanwhile has obtained the relevant High-Speed Rail eligible capital cost information for the NorCal scenarios (***Table* 2-1**) and is in the process of estimating the required rolling stock cost.

Table 2-1: Comparison of Investment for High-Speed Rail Infrastructure in the NorCal Corridor

FRA STANDARD COST CATEGORIES YEAR OF EXPENDITURE (Millions)**	NorCal Scenario 3 (Partial High-Speed Rail investment)	NorCal Scenario 4 (Full High-Speed Rail investment)
10 TRACK STRUCTURES & TRACK	$545	$1,001
20 STATIONS, TERMINALS, INTERMODAL	$269	$400
30 SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS	$308	$707
40 SITEWORK, RIGHT OF WAY, LAND, EXISTING IMPROVEMENTS	$1,890	$3,447
50 COMMUNICATIONS & SIGNALING	$265	$265
60 ELECTRIC TRACTION	$250	$389
70 VEHICLES	$0	$0
80 PROFESSIONAL SERVICES (applies to Cats. 10-60)	$433	$663
90 UNALLOCATED CONTINGENCY	$189	$297
100 FINANCE CHARGES	$0	$0
TOTAL:	**$4,148**	**$7,168**

**Assumes completion of the Scenario 3 or Scenario 4 by 2029.

Notes: 1. Does not include NorCal bookend contributions ($798 million).
2. Includes allowance for compensation to UPRR ($300 million).

The cost in Scenario 3 to implement the track additions, signal system improvements, catenary

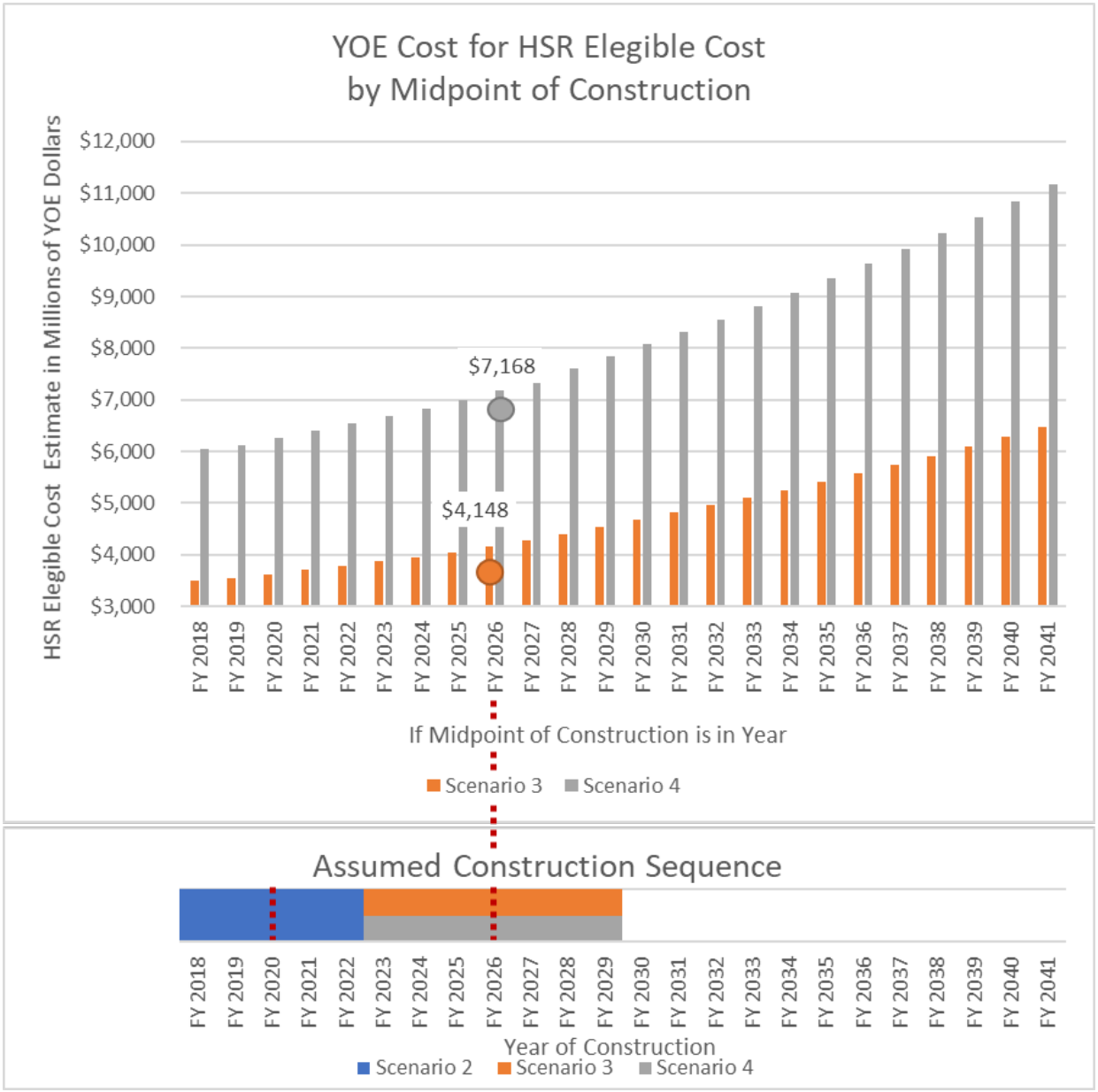
and structures to allow electric operation between Gilroy and the 4th & King terminus that is eligible to be funded with High-Speed Rail funds is $4.1 billion in YOE$. To implement High-Speed Rail operation in Scenario 4 requires an incremental cost of $3.1 billion with a total of $7.2 billion and additional cost for High-Speed Rail rolling stock. There will be also additional regional expenditures required for regional rolling stock and possibly an increased capacity at the maintenance facility to operate the 8 train service plan.

ETO continues to work with Caltrain to summarize the needed investment during the quantitative phase of the study including the need for regional rolling stock. The summary will show a breakout between High-Speed Rail eligible capital cost and investment that will need to be performed by the regional partners. However, this summary does not represent a funding commitment by any party but rather illustrates how the Authority could contribute to the investment in the NorCal corridor. The Caltrain business plan also highlights potential contributions and investment options by local and other partners in the corridor.

The High-Speed Rail eligible estimates are based on the data developed in support of the presentations to the November 2018 Authority Board recommending and selecting the preferred alternatives for the subject sections. These presentations were made well after the 2018 BP estimates had been finalized and published, and therefore are not consistent with the cost information provided in the published 2018 BP due to the more refined planning knowledge at this later point in time.

In addition, the NorCal scenarios are based on the assumption of a sequential implementation of the investment: First Scenario 2 with regional investment completed by 2022, followed by the partial High-Speed Rail investment in Scenario 3 completed by 2028 and the full High-Speed Rail eligible investment completed by 2028. The resultant CapEx totals are inflated to the midpoint of construction since detailed expenditure schedules are not available at this time due to the preliminary design of the infrastructure. (Figure 4-7) presents the assumed construction sequence of Scenario 2, Scenario 3 and Scenario 4 as well as the resultant YOE expenditure total for Scenario 3 and Scenario 4 for High-Speed Rail eligible investment.

Figure 2-1: Comparison of NorCal Eligible High-Speed Rail CapEx in YOE$ by Midpoint of Construction



In a case where the construction sequence differs from the assumptions in this study, the YOE cost will change correspondingly due to necessary inflation adjustments. This also explains

differences between previously published CapEx totals such as the 2018 Business Plan where different implementation horizons are assumed and the investment is assumed to be independent from the completion of regional investments.

The initial High-Speed Rail eligible cost estimates presented in this report are based on estimates for the environmental planning purpose and will likely differ from the cost for the High-Speed Rail Business Plan due to the differing scope that is considered in each process. Therefore, the numbers presented in this report are subject to change and refinement during the Quantitative Phase of the Side-By-Side Study.

3 Central Valley Segment

The CVS Study is being updated and the revised information will be used in the Side-By-Side Study to compare the benefits and cost between the corridors.

The Side-By-Side study does not include a Scenario 2 for the CVS corridor since there are no regional plans to invest in the parallel freight corridor where San Joaquin currently operates before the High-Speed Rail corridor is implemented between Merced and Bakersfield. Any such regional investment would not be eligible for High-Speed Rail investment (outside of Phase 1 corridor) and will be throw-away cost once High-Speed Rail service is operational. Likewise, the regional operators have no plans to provide early investments into the High-Speed Rail corridor. Therefore, the comparison does not provide a Scenario 2 in the CVS Corridor.

Based on the analysis performed by the ETO for the Central Valley Corridor Study, it was determined that a partial High-Speed Rail investment in the Central Valley that would only implement improvements between Madera and Poplar Avenue or between Madera and Bakersfield do not provide benefits that would make an early High-Speed Rail operation attractive. Therefore, the Side-By-Side study does not include a Scenario 3 for the CVS corridor.

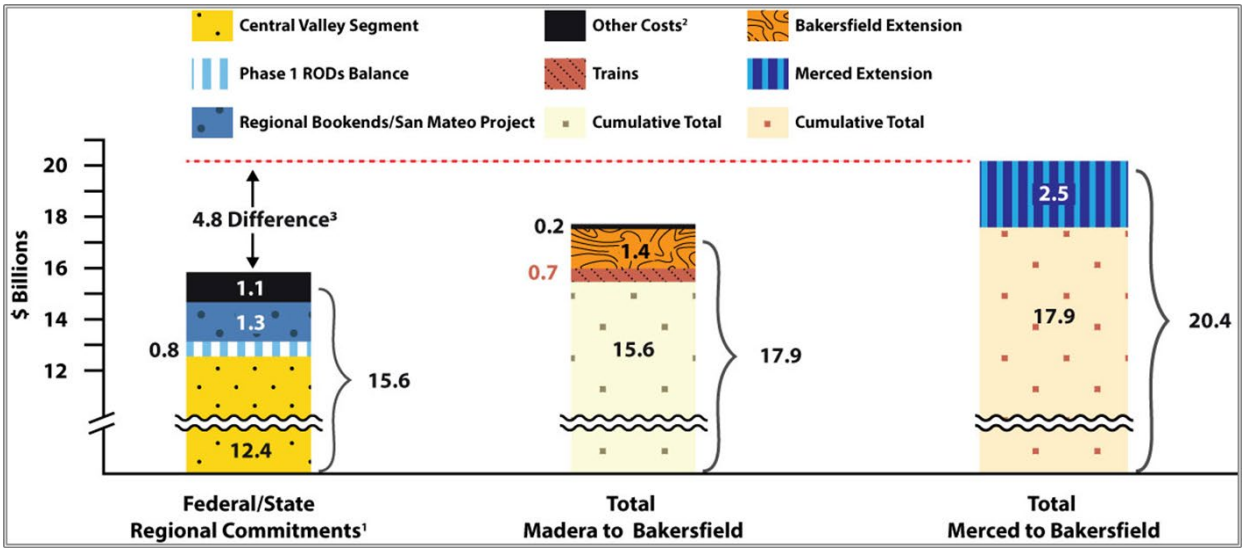
3.1 High-Speed Rail Eligible Capital Costs CVS

Based on the Project Update Report from May 2019, the capital cost for the Central Valley Segment between Madera and Poplar Avenue is estimated at $15.6 billion in year of expenditure (YOE) Dollars and has been approved by the Authority Board of Directors. The total investment to complete the extensions to Merced and Bakersfield as well as to purchase the High-Speed Rail rolling stock is estimated at $20.4 billion (

Figure **3-1**).

The Side-By-Side Study will evaluate if the cost difference of $4.8 billion could be invested earlier in the NorCal or SoCal corridors and if such an investment would provide considerable benefits in these corridors.

Figure 3-1: Central Valley Segment Investment Summary



NOTES:

Federal/State/Regional Commitments – These include completion of the Federal grant agreements to complete all Phase 1 Environmental Documents and 119 miles of civil and structural rail infrastructure from Madera to Poplar; completion of state and regional projects including SB 1029 Bookend projects (Caltrain Electrification Project, Rosecrans/ Marquardt Grade Separation and Link US) and the regional San Mateo Grade Crossing project.

Other Costs – Other costs include program support costs and historical Phase 2 expenditures.

Based on P70 estimates, potential for change with P100 estimates and due to FY 10 law suit ($926 million)

3.2 Implications of Partial CVS Investment

If investment is prioritized in other sections of the future High-Speed Rail network, ETO expects that significant benefits are lost in the Central Valley since the Madera – Poplar Avenue corridor will not provide the benefits of a High-Speed Rail service.

It will likely resemble a slightly improved service over the existing San Joaquin service with similar frequency and only slightly higher operating speeds. In addition opportunity costs are likely to occur due to the partial investment in the Central Valley without corresponding benefits since the

Authority will lose the opportunity to showcase a High-Speed Rail corridor, later completion of the Merced and Bakersfield extensions will incur cost increases and the infrastructure maintenance cost for a Diesel train based service will be proportionally higher due to the higher maintenance standards for a high-speed rail line as compared to a conventional diesel-based operation at lower speeds.

The diesel operation will also require throw-away investments to facilitate a diesel train-based service. These throw-away investments include:

- Adaptation of the signal system for non-High-Speed Rail rolling stock;
- Connecting tracks between the High-Speed Rail alignment and freight rail tracks in Madera and at Poplar Avenue; and
- Modifications to station platforms on the High-Speed Rail alignment to accommodate Diesel hauled rolling stock.

The limited use of High-Speed Rail infrastructure in the Central Valley by San Joaquin trains will resemble the current situation with only minor improvements and will create high operational expenses for a then-underutilized infrastructure asset. There also will be very limited or minimal environmental improvements since the service will not change considerably from today's service. ETO will not analyze such a partial completion scenario in the side-by-side comparison but the decision-making process for setting investment priorities will need to consider these implications.

The study will continue to summarize the costs and benefits of a full investment in the Central Valley Corridor after completion of the CVS study in late November 2019.

4 Southern California Corridor (SoCal)

4.1 Southern California Comparison Assumptions and Methodology

In Phase 1 of the Side-By-Side Study, ETO completed an initial data-gathering and qualitative comparison process and preliminary conclusions. This step allowed for definition of the SoCal investment and operating conditions in each of the scenarios. Based on this information ETO will complete in the second quantitative study phase an analysis in a stepped approach:

Step 1: Analysis of regional services and planned improvements

- Current service schedules were analyzed against future service goals provided by regional stakeholders. This provides a foundation for an understanding of current and future operating environments and the context for potential early High-Speed Rail service.

Step 2: Analysis of an early High-Speed Rail service vision and corridor improvements between Burbank and Anaheim

- An early service vision and capital improvements similar to the approach in the PenC corridor study for high speed rail service were modeled and analyzed as a stand-alone section form Burbank to Anaheim (proposed southern terminus of the Phase 1 High-Speed Rail alternative).
- Optimization of the required track and systems infrastructure;

Step 3: Future Service Scenarios in SoCal Corridor

- Reflect an integrated service planning process including regional, express, and high-speed rail service to optimize the connections and maximize the service offerings to Southern California;
- Assume a synchronized integrated service timetable for a seamless journey;

- Assume an optimization and integration of ticketing and fare policy in the combined corridor;
- Evaluate further opportunities to optimize bus connections;

Step 4: Capital Improvements

- Receive inputs from regional stakeholders for planned and committed capital investments;
- Receive inputs from CHSRA for High-Speed Rail infrastructure in the SoCal corridor (based on the Phase 1 High-Speed Rail planned investments);
- Definition of the required fleet in the integrated corridor;
- Update the service concept;

Step 5: Ridership Analysis

- The State Rail Ridership Model will be used to update the ridership and revenue forecasts based on the revised inputs from the operations planning process. This process is consistent with the approaches taken for the PenC and the CVS corridor studies and the analysis horizon is 2028. This allows a comparison of ridership impacts between the studies since the PenC study has been modelled at a 2028 level as well and the CVS ridership modeling is being updated to a 2029 horizon; and
- The ridership analysis of the High-Speed Rail operations between Burbank – Anaheim will be using the existing Metrolink and Pacific Surfliner fare structures for these services in order to understand how much ridership can be gained and how much service to provide to carry that ridership. The High-Speed Rail service will assume a 10% surcharge of fares for coach seats and a 75% surcharge for business class seats. With an assumed 80% / 20% split of coach versus business users the weighted surcharge is therefore 23% on top of the Metrolink fare. This assumption is identical to the PenC study corridor and reflects the character of High-Speed Rail service in an established regional rail corridor. The model settings are identical to the assumptions for the PenC and CVS studies regarding the transfer between High-Speed Rail and other regional rail services, mode split calculations

and perception of travel time, cost and frequency of service.

Step 6: Operations Analysis

- After understanding the ridership and revenues impact, the ETO will analyze the High-Speed Rail operations across the Burbank to Anaheim corridor and the impact on revenue, ridership and cost from a total integrated corridor view. The purpose is to provide an understanding and identify the benefits that High-Speed Rail operations will bring, in terms of train miles offered, quality of service, efficiency in cost per train mile and improvement in costs covered by fare revenues.
- Associated High-Speed Rail operations and maintenance (O&M) costs are calculated the Burbank-Anaheim segment for a High-Speed Rail Train Operating Company (TOC). The study assumes that the corresponding Metrolink and LOSSAN services will be funded by the regional partners and ETO will utilize data from the stakeholders to summarize the projected regional operations and maintenance costs.

Step 7: Benefits Analysis

- Greenhouse gas savings;
- Congestion relief;
- Near-term benefits;
- Completion date; and
- Any potential for private investment and local matching funds.

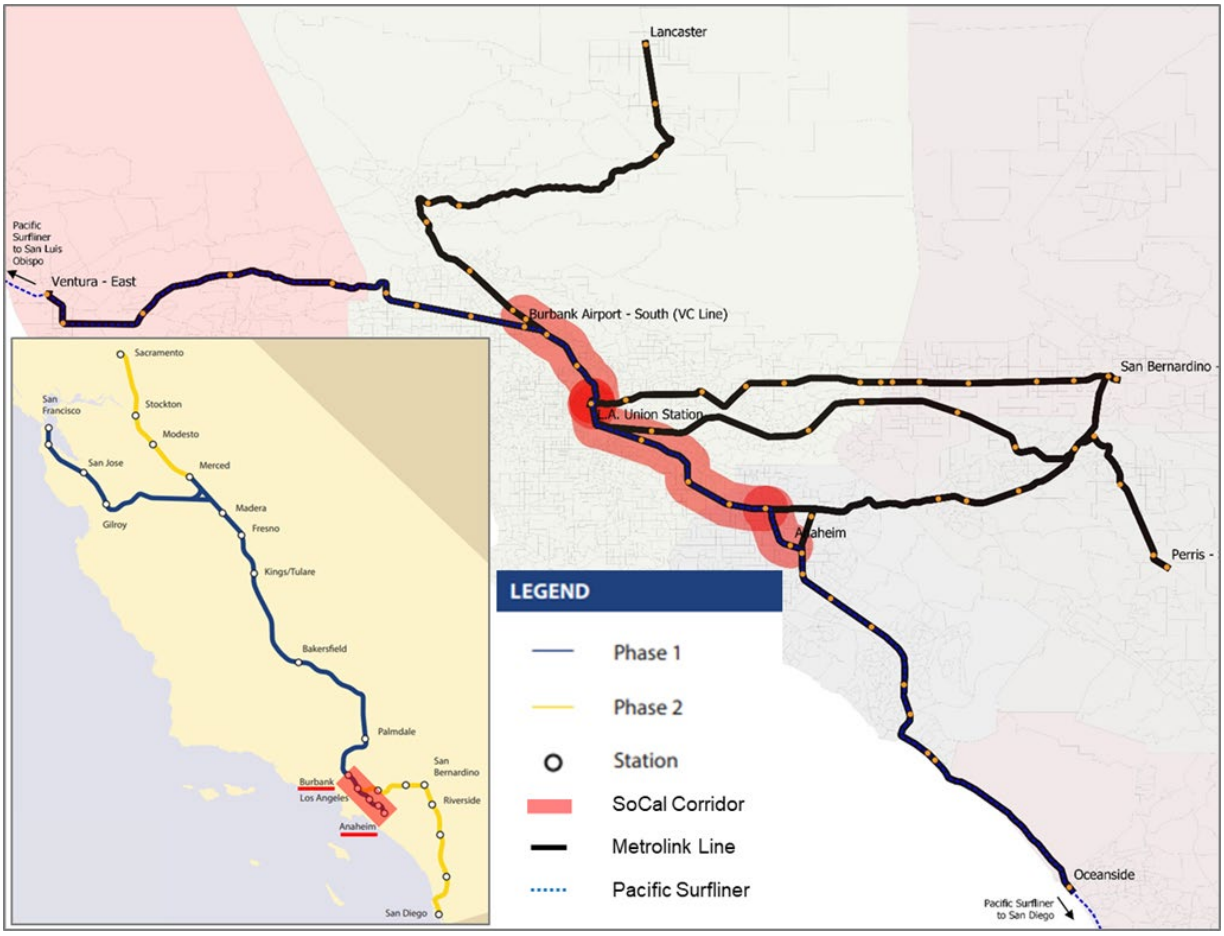
Step 8: Side-By-Side Comparison of Benefits and Cost between NorCal, CVS and SoCal

ETO will use the same process and evaluation tools for all three corridors and will utilize to the degree possible information from the PenC and CVS studies, information from the stakeholders and other third party information to complete the quantitative phase of the Side-by-Side study.

4.2 SoCal Project Corridor

The project corridor is defined as the section of the future High-Speed Rail corridor between Burbank Airport (new underground High-Speed Rail station at the airport), Los Angeles Union Station (Link US with run-through tracks assumed) and the Anaheim Station (***Figure* 4-1**). The SoCal corridor is situated within the wider Metrolink and Pacific Surfliner rail network and is unique in that there are multiple lines branching from the study corridor in the North and the south.

Figure 4-1: Burbank – Anaheim Corridor Location in SoCal Rail Network

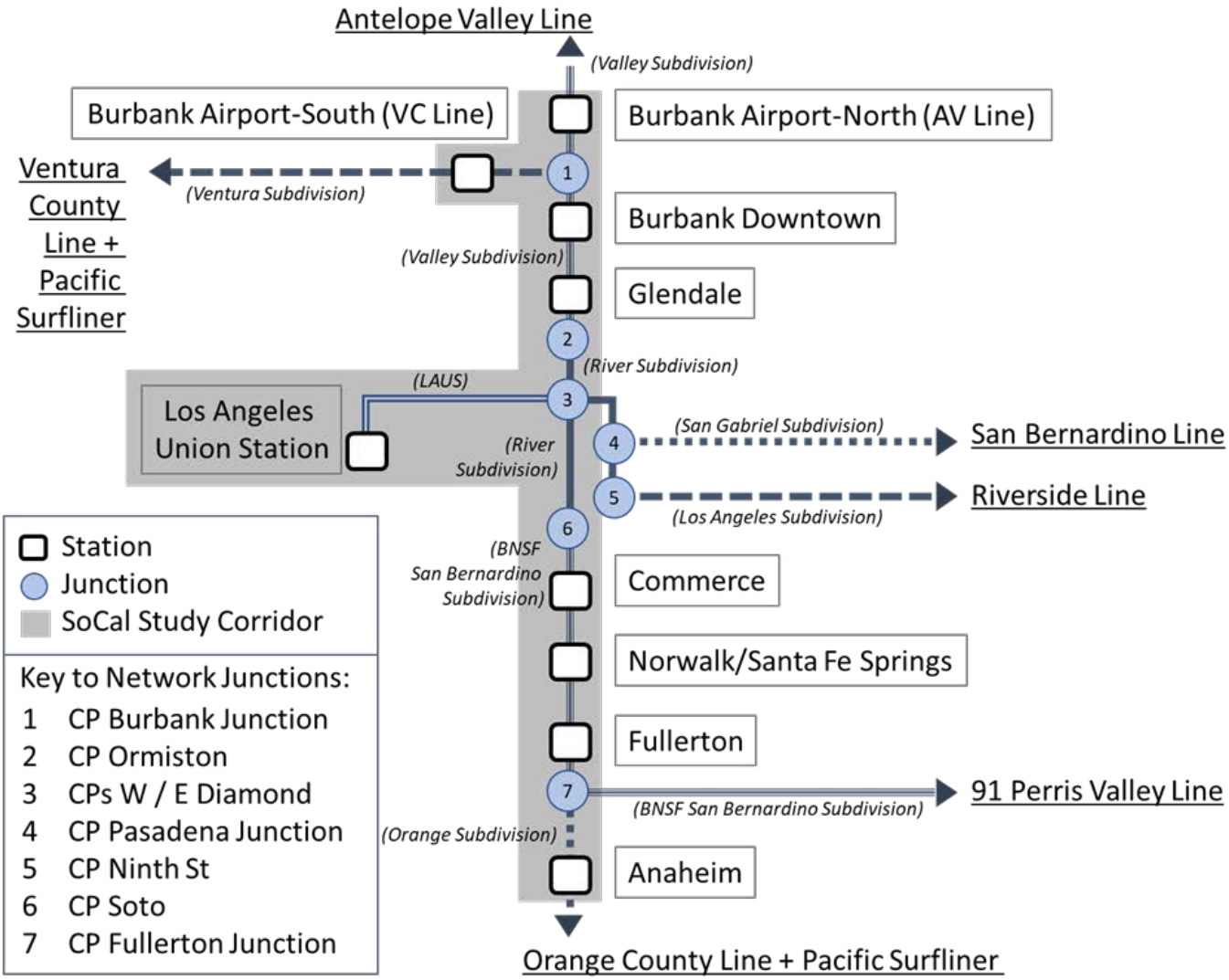


In contrast, the PenC and CVS corridors are linear rail corridors without branches that operate in the study corridors. While a High-Speed Rail operation in the PenC corridor will be an overlay on the electrified Caltrain service, the CVS corridor is a standalone High-Speed Rail service. The

SoCal High-Speed Rail operation will be an electric overlay service on top of the regional rail network that is operated with Diesel engines in the foreseeable future.

The SoCal Corridor is in the center of the Metrolink and Pacific Surfliner service area and the alignment extends over several subdivisions with three different infrastructure owners: Los Angeles County, BNSF Railroad an Orange County. (Figure 4-2) gives an overview of the network location and the following chapters describe in more detail the sections of the SoCal corridor.

Figure 4-2: Subdivision in the Burbank – Anaheim (SoCal) Corridor



4.3 Overview of SoCal Infrastructure Owners/Participants

The following sections of the report describe the existing network situation and operating conditions in the SoCal region. This information provides the context how an infrastructure investment of the Authority will improve the corridor and also set the stage for a future interaction of Metrolink, Pacific Surfliner, High-Speed Rail as well as UP and BNSF freight services in a mixed service corridor between Burbank and Anaheim. Detailed negotiations and agreements will be necessary to define the roles of railroad owners and tenants in this complex operating environment.

4.3.1 Statewide Network Assumptions for SoCal Corridor

- Improvements in Southern California assume high-level policy changes at the state level related to integrating ticketing and fare collection, pulse scheduling, frequency increases, and timed transfers to enable seamless connectivity. This assumption aligns with the State Rail Plan and the same assumptions were used for the PenC and the CVS studies as well.

- The study assumes that the High-Speed operation will be a standalone operation between Burbank and Anaheim and that the tunnel section to Bakersfield is not completed.

Coordinated Schedules

- These improvements assume integrated bus connections to the Central Valley from LA Union Station as well as from Newhall depending on the scenario assumptions;
- Within Southern California, connections between services are assumed to be cross-platform and utilize universal fare payment systems to minimize perceived transfer penalties by riders in such an integrated service scenario.

Increased Frequency

- In the SoCal corridor increases in frequency are assumed to be the most significant network improvement in terms of ridership gains and network connectivity since the proposed investments are largely geared toward capacity improvements rather than travel

time improvements. High-Speed Rail trains cannot achieve very high travel speeds due to train sequencing and stopping patterns for these trains that require

- More frequent trains allow for greater connectivity between services and more productive use of investments. Travel time reductions are limited due to train sequencing and stopping patterns in the SoCal corridor.

4.3.2 Burbank to LA Union Station

The rail infrastructure from Burbank to Los Angeles Union Station is owned by Los Angeles County and operated by Metrolink. The Metrolink Valley Subdivision operates on the north side of Burbank Airport with Metrolink *Antelope Valley* line trains stopping at Burbank Airport North station. The Metrolink Ventura Subdivision operates to the south of Burbank Airport. The Burbank Airport South station serves Metrolink's *Ventura County* line. Additionally, the Burbank Airport South and Glendale stations are served by Amtrak's *Pacific Surfliner*.

Within the study area the Ventura Subdivision is a two main track railroad with a Centralized Traffic Control (CTC) signal system with a Positive Train Control (PTC) safety overlay. The Valley Subdivision is combination of single track and double track with CTC and PTC.

Both lines join at Control Point Burbank just north of the Burbank Downtown station and continue to Los Angeles Union Station with a station at Glendale. The line is a combination of two, three or four main tracks with CTC and PTC. Three- and one-half miles from LAUS is Metrolink's Central Maintenance Facility (CMF). The CMF serves as the primary rolling stock maintenance facility for all Metrolink equipment.

The current maximum authorized speed for passenger trains for most of the corridor is 79MPH.

4.3.3 Los Angeles Union Station

Los Angeles Union Station is owned by the Los Angeles County Metropolitan Transportation Authority (LA Metro). The rail infrastructure is owned by Los Angeles County and maintained by Metrolink.

LAUS is composed of 13 platform tracks serving as an operational hub for Metrolink and Amtrak's *Pacific Surfliner* trains. Additionally, Amtrak's *Southwest Chief, Sunset Limited, and Coast Starlight* long distance trains all begin or terminate their journeys at the station. All tracks within LAUS have CTC and PTC.

4.3.4 LAUS to CP Soto

The rail infrastructure from LAUS to CP Soto is owned by Los Angeles County and operated by Metrolink. The route is operated as the West Bank line of Metrolink's River Subdivision. Metrolink's *Orange County* and *91/Perris Valley* line trains operate on the River Sub. The line also hosts Amtrak's *Pacific Surfliner* trains. There are no stations along the section. The West Bank line has two main tracks with CTC and PTC.

4.3.5 CP Soto to Fullerton

At CP Soto the Metrolink River Sub connects with BNSF Railway Company's San Bernardino Subdivision. BNSF Railway owns, maintains, and dispatches the line from CP Soto to Fullerton. The San Bernardino Sub serves as BNSF Railway's conduit for freight traffic coming in and out of the Los Angeles area. BNSF has intermodal facilities at Hobart, six miles from LAUS and Commerce, nine miles from LAUS. In addition, there are several spur tracks between CP Soto and Fullerton to serve industrial customers receiving rail cars directly into a facility.

Metrolink's *Orange County* and *91/Perris Valley* line trains operate on the San Bernardino Sub. The line also hosts Amtrak's *Pacific Surfliner* trains. There are Metrolink stations at Commerce, Norwalk/Santa Fe Springs, Buena Park, and Fullerton. *Pacific Surfliner* trains also stop at Fullerton. The San Bernardino Sub is predominately three main tracks with CTC and PTC with one section of two tracks totaling one mile in length.

4.3.6 Fullerton to Anaheim

At Fullerton station the Metrolink Orange Subdivision diverges from the BNSF San Bernardino Subdivision. The Orange Sub is owned by Orange County and operated by Metrolink. Metrolink's *Orange County* and Amtrak's *Pacific Surfliner* trains operate on the Orange Sub.

Within the study area the Orange Subdivision is a two main track railroad with a Centralized Traffic Control (CTC) signal system with a Positive Train Control (PTC) safety overlay. There is one station at Anaheim.

Table 4-1: Route Characteristics

Section	Ownership	Main Tracks	Mileage	PTC
Burbank to LAUS	Los Angeles County	2 to 4	13 miles	Implemented
LAUS	Los Angeles County	13	1 mile	Implemented
LAUS to CP Soto	Los Angeles County	2	4 miles	Implemented
CP Soto to Fullerton	BNSF Railway	2 to 4	21 miles	Implemented
Fullerton to Anaheim	Orange County	2	5 miles	Implemented

4.4 Existing Passenger Service

Passenger service within the study area is provided by Metrolink and Amtrak. Metrolink operates 101 trains systemwide on weekdays. Most of these trains start or terminate their run at LAUS. No Metrolink trains at present time are scheduled to operate through LAUS.

Amtrak's *Pacific Surfliner* provides 25 runs within the study area. The *Pacific Surfliner* corridor operates from San Luis Obispo through Los Angeles to San Diego with some trains running through LAUS.

4.4.1 Metrolink

Metrolink's *Ventura County* and *Antelope Valley* lines serve the northern portion of the study area.

The *Ventura County* line has 33 total runs within the study area (a run is defined as one train per direction). Thirteen of these runs operate entirely within the study area with a start or end at the Burbank Airport South station. The remaining 20 trains start or terminate outside of the study area at Ventura, Moorpark, or Chatsworth. All trains traveling through the Burbank – LAUS corridor stop at Burbank Airport South, Burbank Downtown, and Glendale stations.

Service operates roughly at 30-minute intervals during peak periods with off peak frequencies varying from hourly to every other hour service.

The *Antelope Valley* line has a total of 30 daily runs. All runs start or terminate at Lancaster, Palmdale, Via Princessa, or Santa Clarita. Most runs stop at Burbank Airport North, Burbank Downtown, and Glendale stations.

Service generally operates hourly all day with select additional runs during peak periods.

Metrolink's *Orange County* and *91/Perris Valley* lines serve the southern portion of the study area.

The *Orange County* line has a total of 29 runs within the study area. Ten of these runs operate from Laguna Niguel/Mission Viejo station at terminate Fullerton with no through service to LAUS. The remaining 19 trains begin or end at Oceanside, Laguna Niguel/Mission Viejo, or Irvine.

Service operates twice an hour during the peak periods. There is no mid-day service between LAUS and Fullerton on the *Orange County* line.

The *91/Perris Valley* line has a total of 9 runs with the study area. Most trains begin or end at Perris South station with 3 runs beginning or ending at Riverside Downtown station.

Most service on the *91/Perris Valley* line operates towards LAUS during the morning rush period and outbound during the evening rush period. There is one "reverse peak" train in each direction during the morning and evening rush periods.

Metrolink operates three other routes that do not serve stations within the study area except for LAUS. The *San Bernardino* line operates 38 trips between LAUS and San Bernardino-Downtown station. The *Riverside* line operates 12 trips between LAUS and Downtown Riverside via Ontario. Finally, the *Inland Empire/Orange County* line operates 16 trips between San Bernardino-Downtown station and Oceanside without serving LAUS.

4.4.2 Amtrak/LOSSAN

Amtrak's *Pacific Surfliner* provides 25 runs within the study area. The *Pacific Surfliner* corridor

operates from San Luis Obispo through Los Angeles to San Diego. Nine trains provide service through the entire study area by operating through LAUS. Fifteen trains provide service between Los Angeles and San Diego with stops at Fullerton and Anaheim within the study area. One train operates north from LAUS toward Goleta in the morning. Service south of Los Angeles runs approximately once every hour. Service north of Los Angeles runs approximately once every three hours.

4.5 Planned Improvements

4.5.1 SCORE Program

Metrolink is pursuing the Southern California Optimized Rail Expansion (SCORE) Program, which will upgrade the regional rail system to meet the current and future needs of the traveling public. By adding tracks, grade separations and upgrading signal systems across the entire Metrolink system, trains can operate more frequently and reliably, making regional rail easier and more convenient to use. The crossings will also be upgraded so the majority of the system will be Quiet-Zone-ready, enabling cities to apply for a designation so trains horns aren't routinely blown. Communities throughout Southern California will also benefit from a reduction in vehicle miles traveled which will reduce greenhouse gas emissions by 51.6 million metric tons. This multi-year program will pursue funding from several grant programs at the state and federal levels. If funding is received, the program could be complete as soon as 2028.

In April 2018 the California State Transportation Agency (CalSTA) awarded $876 million in Transit and Intercity Rail Capital Program (TIRCP) grants to Metrolink for various projects within the SCORE program.

In June 2019 the United States Department of Transportation (USDOT) awarded $30 million for improvements at Fullerton Junction and for 4.8 miles of third mainline on BNSF's San Bernardino Subdivision between Placentia and Yorba Linda.

4.5.2 LOSSAN

Due to the efforts of LOSSAN member agencies, several capital improvement projects along the

LOSSAN rail corridor have progressed and were recently completed or are currently under construction with completion expected by 2020. A summary of those projects as provided by LOSSAN member agencies is included.

Table 4-2: LOSSAN Capital Improvements

County	Project	Open to Public
San Diego	Los Penasquitos Lagoon Bridge Replacements	November 2017
San Diego	Oceanside station pass-through track	November 2017
San Diego	San Diego River Bridge	September 2019
San Diego	San Elijo Lagoon Double Track	October 2019
San Diego	Chesterfield Drive Crossing Improvements	October 2019
San Diego	Poinsettia Station Improvements	May 2020
San Diego	Elvira to Morena Double Track	July 2020
Orange	Laguna Niguel Passing Siding	December 2020
Orange	Control Point 4th	Spring 2018
Los Angeles	Van Nuys North Platform	Fall 2019

4.6 Standalone High-Speed Service

For purposes of this study, high speed rail is presumed to have all of the infrastructure envisioned according to the full Phase 1 system in the section from Burbank to Anaheim. On board service would consist of a premium service with greater speed and amenities over conventional regional rail service. Per Proposition 1A, Phase 1 service is envisioned as a continuation of service from San Francisco to Anaheim operating through Los Angeles Union Station on a system of dedicated and blended infrastructure. Within the study area both the Phase 1 service and the stand-alone Burbank to Anaheim service would be on blended infrastructure with dedicated infrastructure at Burbank Airport underground station, LAUS, and Anaheim station only.

4.7 SoCal Study Scenarios

For the purposes of this report four scenarios are analyzed at a 2028 horizon for ridership and revenue purposes. Actual constructability will likely vary from this horizon but the need to compare

the ridership estimates and benefits between the three studies requires this common time horizon. The scenarios are showing distinct investments into the Burbank to Anaheim corridor (trunk section of the network) and the various lines of the regional rail network (branches). High-Speed Rail investment can only be utilized for improvements in the trunk section and only for purposes of enabling future High-Speed Rail service within the study corridor following the Phase 1 assumptions of the California High-Speed Rail Program.

(Table 4-3) shows a comparison of the key differences of the four scenarios including the infrastructure assumptions, throughput in the Los Angeles – Fullerton section, levels of LAUS build-out as well as the service improvements.

Table 4-3: Definition of SoCal Scenarios

Scenario 1	Scenario 2	Scenario 3	Scenario 4
SoCal Baseline (2017)	SoCal Non-High-Speed Investment	SoCal High-Speed Investment (no HSR Service)	SoCal All High-Speed Investment (with HSR Service)
Existing infrastructure	SCORE TIRCP + Limited Additional Projects	HSR infrastructure (Burbank – Anaheim)	HSR service (Burbank -Anaheim)
LA–Fullerton: up to 84 trains / day	LA–Fullerton: up to 110 trains/day	LA–Fullerton: up to 140 trains / day	LA–Fullerton: up to 140 + 52 HSR trains / day
Existing LA Union Station	2 run-through tracks at LA Union Station	8/9 run-through tracks at LA Union Station	8/9 run-through tracks at LA Union Station
Existing service levels	Half-hourly peak regional service with express overlays	HSR investment allows for increased regional service	HSR between Burbank and Anaheim

4.7.1 Scenario 1: Baseline Existing Conditions (2017)

The first scenario is a baseline of existing service levels and infrastructure within the Southern California region assuming 2028 population and demand growth but no improvements from today's service and line capacity. The scenario assumes the current rolling stock fleet operating with diesel engines.

4.7.2 Scenario 2: Full State/Regional Investment 2028

Scenario 2 is increased service levels with all currently funded SCORE projects and two run-through tracks constructed as part of the Link US project. No High-Speed Rail service is assumed in this scenario and all service is either an all-stop regional rail service or a limited-stop Express service. The scenario is assumed to be operator-neutral and therefore there is no association of which operator is responsible for performing the rail services. The scenario assumes operation of the expanded service with the current but expanded rolling stock fleet using diesel engines as a propulsion system.

4.7.3 Scenario 3: Partial High-Speed Rail Investment 2033

Scenario 3 includes additional regional and express service beyond Scenario 2 assuming an initial High-Speed Rail infrastructure within the study area but not including high level platforms, Burbank Airport underground station, Anaheim stub terminal tracks, LAUS storage tracks, or overhead electrical catenary. All service including the additional Burbank – Irvine service (as compared to Scenario 2) will be operated with the current but expanded rolling stock fleet with diesel engines. Due to the sequential construction of Scenario 3 after improvements in Scenario 2 are completed, it is anticipated that the Scenario 3 investment is complete by 2033 assuming a sequential implementation after completion of the regional investment in Scenario 2. This sequencing differs from the Authority's Business Plan assumption where a concurrent implementation does not require an early regional investment. The ridership modeling will be performed at a 2028 horizon to enable a comparison against other corridors.

4.7.4 Scenario 4: Full High-Speed Rail Investment and High-Speed Rail Service 2040

In addition to the partial High-Speed Rail investment in Scenario 3 this scenario incorporates the high level High-Speed Rail platforms, the Burbank Airport underground station, Anaheim stub terminal tracks, LAUS storage tracks and electrical overhead catenary with electric High-Speed Rail trains operating between Burbank Airport, LAUS, Fullerton, and Anaheim. All of the other regional and express services will operate with an expanded existing rolling stock fleet operating with diesel engines. Scenario 4 investment will follow Scenario 3 investment and therefore a completion is anticipated by 2040 assuming a sequential implementation after completion of the regional investment in Scenario 2 and the partial High-Speed Rail investment in Scenario 3. This sequencing differs from the Authority's Business Plan assumption where a concurrent implementation does not require an early regional investment. The ridership modeling will be performed at a 2028 horizon to enable a comparison against other corridors.

4.8 Scenario 1 Service Assumptions: Baseline - Existing Service

The baseline scenario is the existing Metrolink and Amtrak service levels and infrastructure within the Southern California region.

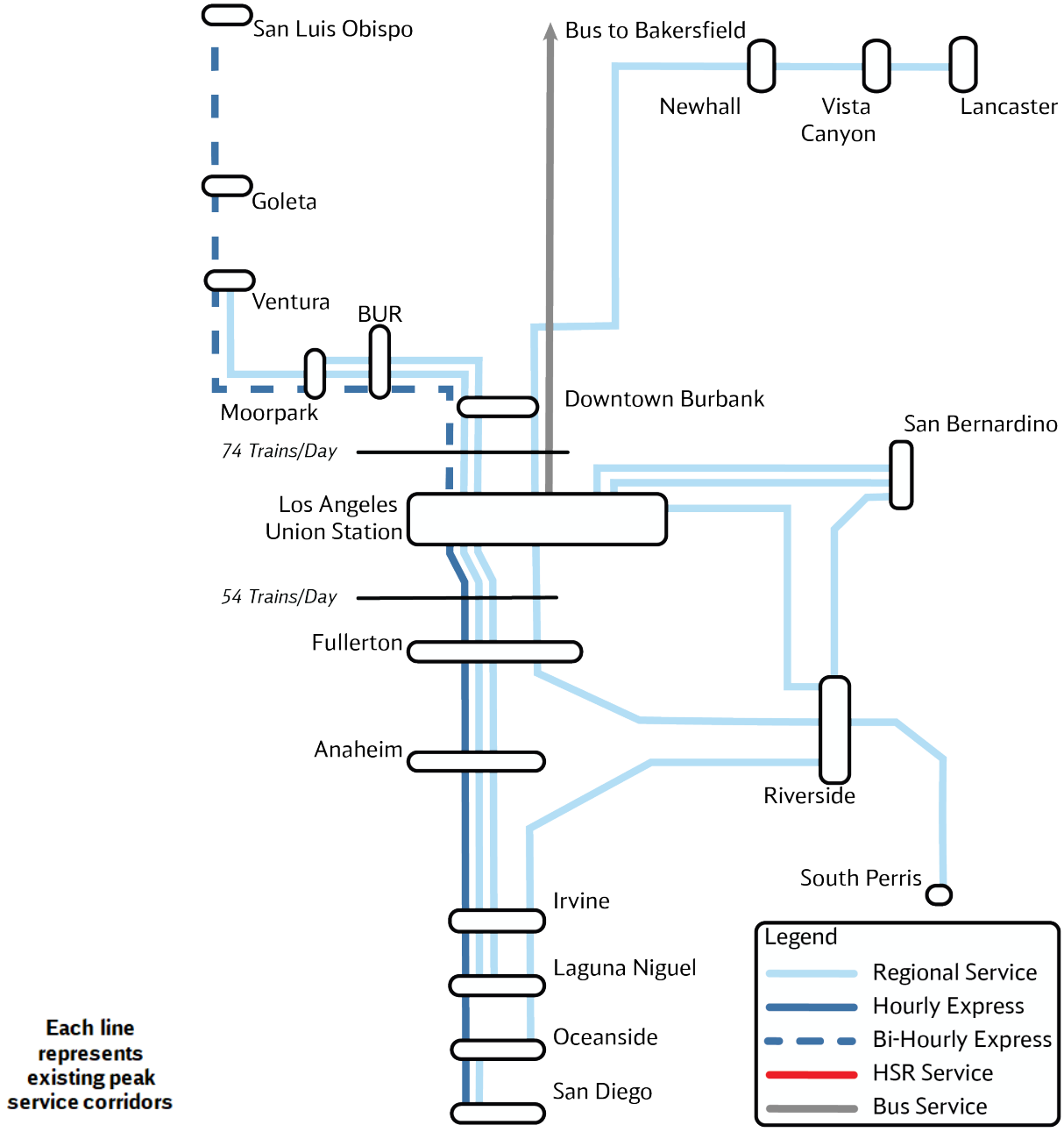
4.8.1 Infrastructure Improvements

The baseline scenario includes all infrastructure in the Southern California region as of 2017.

4.8.2 Service Levels

In the baseline scenario service is operated by Metrolink and Amtrak. Service in the peak direction (inbound in the morning, outbound in the afternoon) operates roughly at 30-minute intervals during peak periods with off peak frequencies varying from hourly to every other hour service.

Figure 4-3: Scenario 1 (Baseline) Service Plan



The *Antelope Valley* line has a total of 30 daily runs with the number of runs being defined as the total number of trips for both directions together (e.g. 30 runs are equal to 15 round trips). Service generally operates hourly all day with select additional runs during peak periods.

The *Orange County* line has a total of 29 runs within the study corridor north of Anaheim. Service operates twice an hour during the peak periods. There is no mid-day service between LAUS and Fullerton on the *Orange County* line.

The *91/Perris Valley* line has a total of 9 runs with the study area north of Fullerton. Most service on the *91/Perris*

Valley line operates towards LAUS during the morning rush period and outbound during the evening rush period. There is one “reverse peak” train in each direction during the morning and evening rush periods.

Amtrak’s *Pacific Surfliner* provides 25 runs within the Burbank – Anaheim corridor. The *Pacific Surfliner* corridor operates from San Luis Obispo through Los Angeles to San Diego.

Service south of Los Angeles runs approximately once every hour. Service north of Los Angeles runs approximately once every three hours.

In total there are 85 Metrolink and Amtrak trains travelling within the Burbank – Anaheim corridor. This number is comprised of 75 trains operating Burbank to LAUS and 52 trains LAUS to Anaheim (Total of both directions).

4.8.3 Benefits

In the first 25 years of service, Metrolink has established itself as a platform for developing a sustainable public, regional rail service in Southern California.

The Amtrak/LOSSAN *Pacific Surfliner* is the second busiest corridor on the entire Amtrak system outside of the Washington D.C.-New York-Boston Northeast Corridor.

In aggregate, Metrolink and LOSSAN provide an essential base level of passenger rail service within Southern California.

4.8.4 Challenges

Southern California service in the baseline scenario (i.e. existing service) encounters multiple

challenges to sustain and promote ridership growth. These include:

- Irregular service offerings with predominant directions of service (inbound AM, outbound PM) without many opportunities for reverse commute travelers or a high frequency schedule;
- Significant periods throughout the day without train service between major destinations;
- Potential conflict with freight traffic in corridor prevents additional service;

4.9 Scenario 2 Service Assumptions: No High-Speed Rail Investment – No High-Speed Rail Service

4.9.1 Infrastructure Improvements

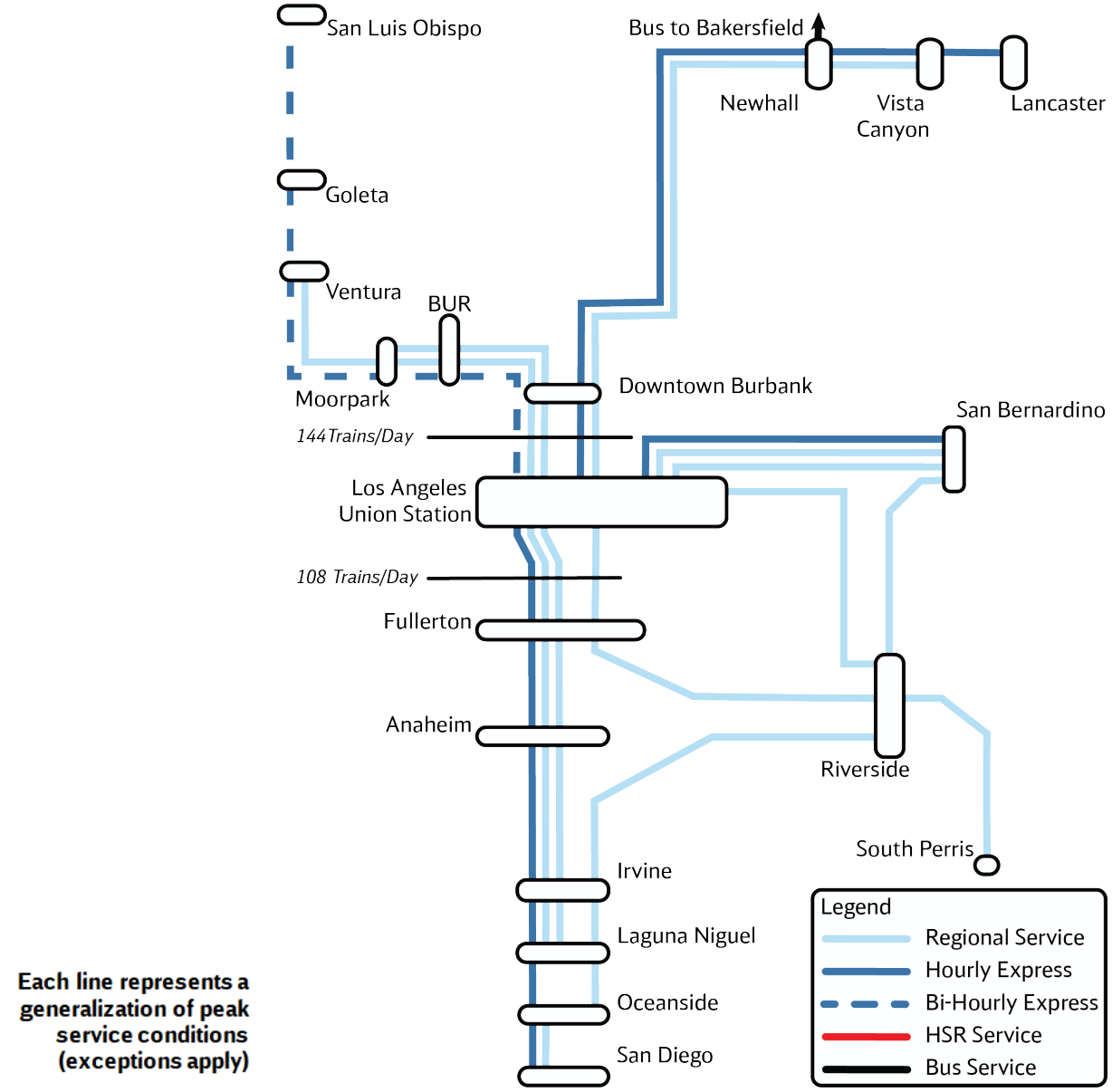
Scenario 2 assumes all 52 SCORE projects funded by the 2018 TIRCP grant are fully constructed and in service. Scenario 2 does not include any high-speed rail infrastructure between Anaheim and Burbank but does assume the early bookend investment by CHSRA for the Rosecrans/Marquardt grade separation as well as the early investment in the LAUS run-through track improvements are implemented.

In Scenario 2 service is composed of regional service and express service. The Metrolink Ventura Subdivision would be assumed to have two regional trains and one express train per hour for a total of 72 trains daily. The Metrolink Valley Subdivision would be assumed to have two regional trains and one express train per hour for a total of 88 trains daily.

The BNSF San Bernardino Subdivision is assumed to have 108 trains between CP Soto and Fullerton. This would be comprised of four regional trains and two express trains per hour during the peak period. The service would be split evenly with regional and express service. Half of the trains would continue toward Anaheim on the Metrolink Orange Subdivision and half of the trains continuing toward San Bernardino on the BNSF San Bernardino Subdivision.

There are 160 trains in total to and from Burbank to LAUS and 108 trains in total to and from LAUS to Anaheim.

Figure 4-4: Scenario 2 Service Plan



4.9.2 Benefits

Service levels in Scenario 2 allow for bi-hourly peak service on most regional rail lines with overlaying hourly express service.

4.9.3 Challenges

- Coordination with freight host railroads;
- Project delivery;
- Funding for core capacity projects and additional moderate investment on regional rail branches to enable the higher service frequency; and
- Funding for potential need for additional rolling stock to facilitate regional service increases.

4.10 Scenario 3 Service Assumptions: Initial High-Speed Rail Investment – No High-Speed Rail Service

4.10.1 Infrastructure Improvements

This reflects Scenario 2 regional rail improvements and initial High-Speed Rail investment except high level platforms, Burbank Airport underground station, Anaheim stub terminal tracks, LAUS storage tracks or overhead electrical catenary. Additional rolling stock for the regional rail operators will be needed to run the additional service between Burbank and Anaheim.

4.10.2 Service Levels

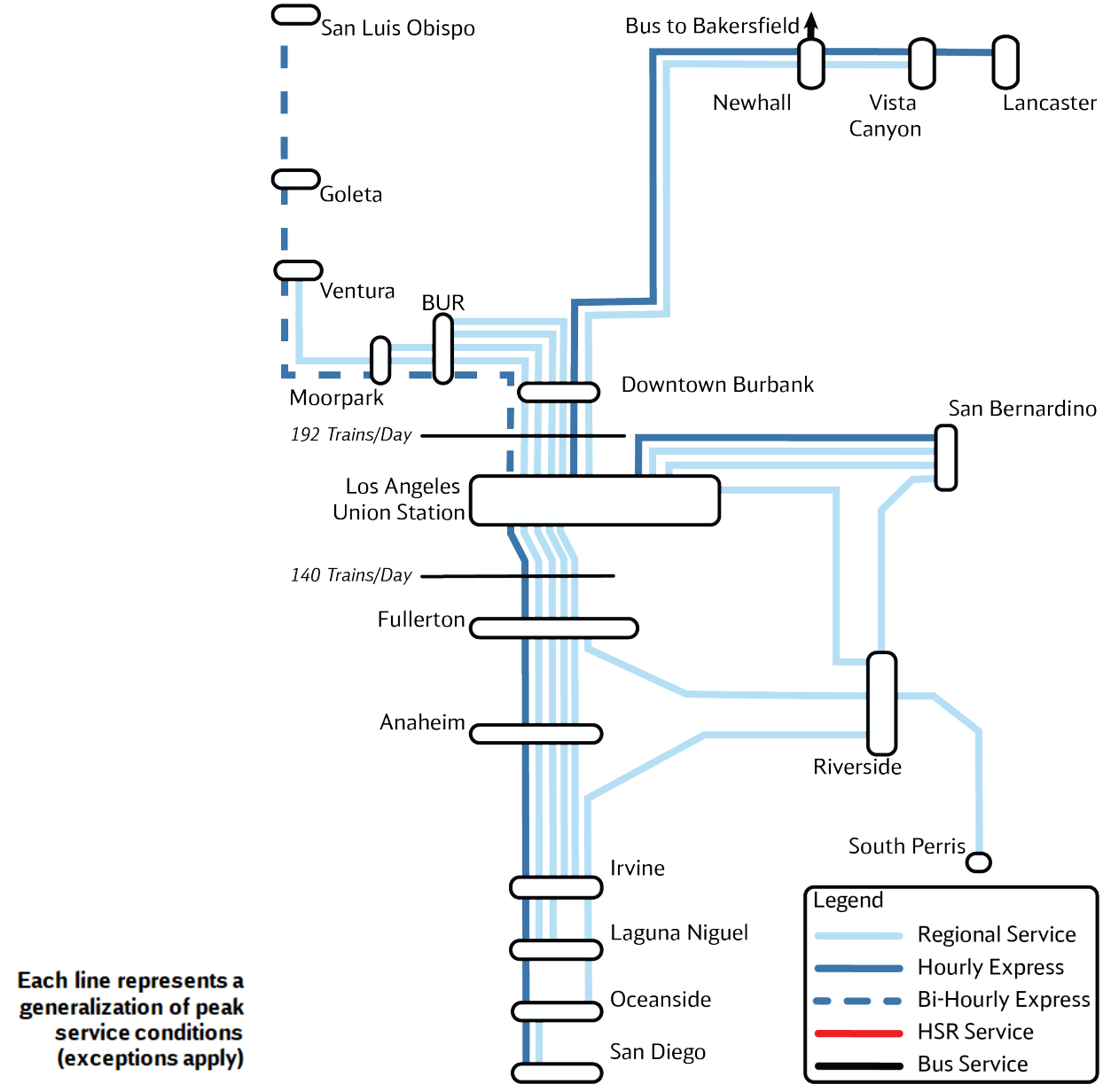
Scenario 3 service is composed of regional service and express service.

The Metrolink Ventura Subdivision would be assumed to have four regional trains and one express train per hour for a total of 104 trains daily.

The Metrolink Valley Subdivision would be assumed to have two regional trains and one express train per hour for a total of 88 trains daily.

The BNSF San Bernardino Subdivision is assumed to have 140 trains between CP Soto and Fullerton. This would be comprised of six regional trains and two express trains per hour. Four of the regional trains and one express train would continue toward Anaheim on the Metrolink Orange

Figure 4-5: Scenario 3 Service Plan



Subdivision. Two regional trains and one express train would continue toward San Bernardino on the BNSF San Bernardino Subdivision. There are 192 trains Burbank to LAUS and 140 trains LAUS to Anaheim.

4.10.3 Benefits

- Train service every fifteen minutes in the study area;
- Train schedules are pulsed to optimize connections;
- Opportunity for through service providing a single seat ride from Burbank to Anaheim; and
- Four track corridor between CP Soto and Fullerton allows for separation of passenger and freight traffic.

4.10.4 Challenges

- Project delivery;
- Funding for core capacity projects; and
- Funding for additional regional rail rolling stock.

4.11 Scenario 4 Service Assumptions: Full High-Speed Rail Investment and High-Speed Rail Service

4.11.1 Infrastructure Improvements

Final High-Speed Rail buildout the corridor with construction of the high-level platforms, Burbank Airport underground station, Anaheim stub terminal tracks, LAUS storage tracks, and electrical overhead catenary.

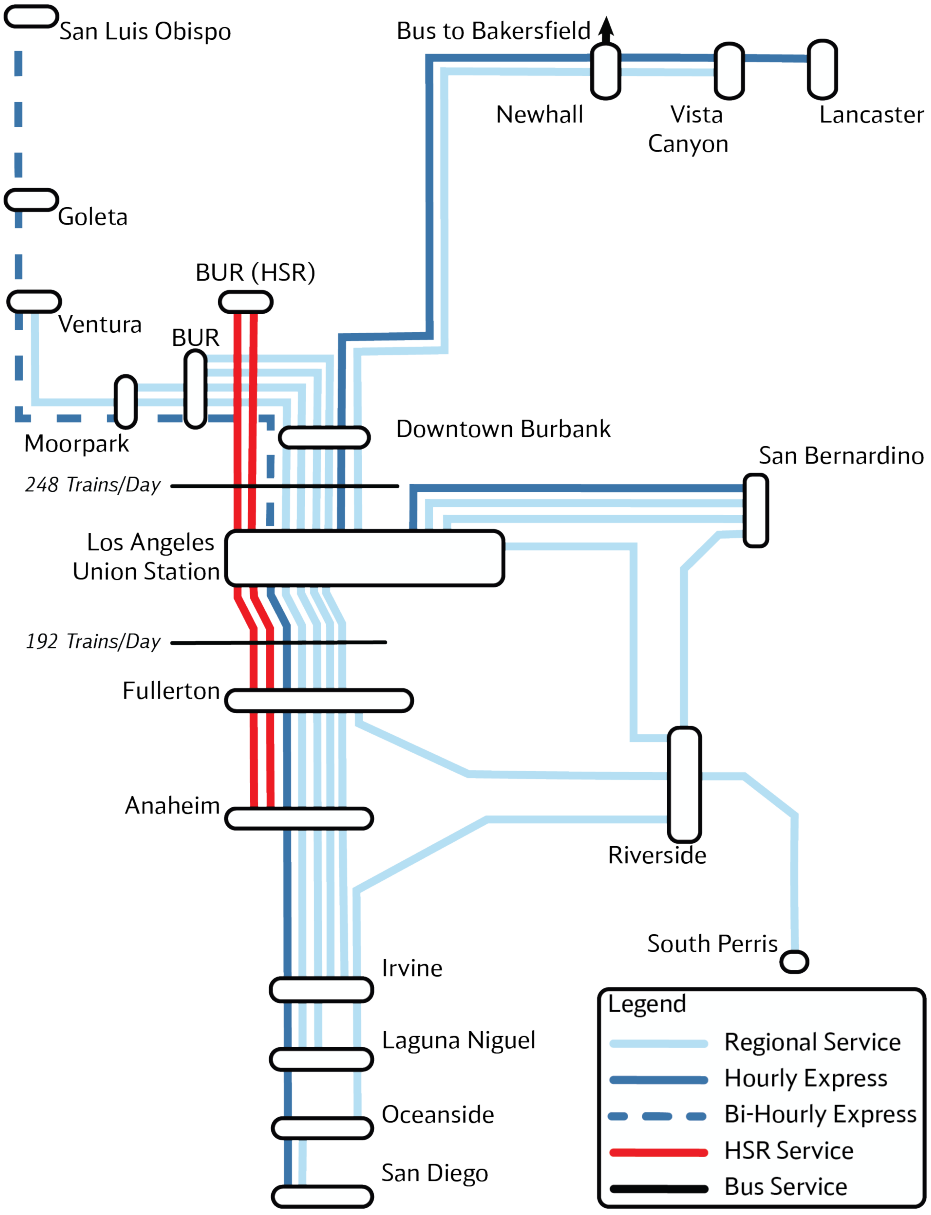
4.11.2 Service Levels

In Scenario 4 service is composed of High-Speed Rail, regional service, and express service.

The Metrolink Ventura Subdivision would be assumed to have four regional trains and one express train per hour for a total of 104 trains daily.

The Metrolink Valley Subdivision would be assumed to have two regional trains and one express train per hour for a total of 88 trains daily.

Figure 4-6: Scenario 4 Service Plan



Each line represents a generalization of peak service conditions (exceptions apply)

Two additional High-Speed Rail trains per hour and direction in the peak and one train per hour and direction in the off-peak would operate from Burbank Airport underground station towards LAUS and Anaheim in addition to regional and express service on the Metrolink Valley and River Subs. This would result in 52 daily trains.

The BNSF San Bernardino Subdivision is assumed to have 200 trains between CP Soto and Fullerton. This would be comprised of two High-Speed Rail, five regional trains and two express trains per hour. All High-Speed Rail, four of the regional trains and one express train would continue toward Anaheim on the Metrolink Orange Subdivision. One regional train and one express train would continue toward San Bernardino on the BNSF San Bernardino Subdivision. The resultant train throughput in this scenario will be 264 trains Burbank to LAUS and 200 trains LAUS to Anaheim.

4.11.3 Benefits

- Frequent service;
- Pulse schedule to optimize connections;
- One-seat travel opportunities through LAUS without the need to change of trains;
- Eliminates or minimizes conflicts with freight traffic since the trunk section of the network has 4 tracks and either freight operates on separate tracks or there is a significant capacity addition in the trunk section that minimizes such conflicts; and
- All-day bi-hourly Premium High-Speed Rail Service for travelers valuing reduced travel time and additional travel amenities.

4.11.4 Challenges

- Coordination with freight host railroads;
- Project delivery;
- Funding for core capacity projects; and
- Funding for High-Speed Rail rolling stock.

4.12 Corridor Throughput

Based on the service plan for each scenario ETO has derived a comparison of throughput capacity in the peak hour by direction in the trunk section of the SoCal corridor. Table 4-4 below shows the comparison of the number of trains per direction assumed in each of the scenarios with regional or High-Speed Rail eligible investment.

Table 4-4: Comparison of hourly Train Throughput in the SoCal Corridor

	Scenario 2		**Scenario 3**		**Scenario 4**	
Service Zone	Peak	Off Peak	Peak	Off Peak	Peak	Off Peak
Burbank to LA Union Station	2 Express 4 Regional	1 Express 3 Regional	2 Express 6 Regional	1 Express 3 Regional	2 Express 6 Regional 2 High-Speed	1 Express 3 Regional 1 High-Speed
LA Union Station to Fullerton	1 Express 3 Regional	1 Express 2 Regional	1 Express 5 Regional	1 Express 3 Regional	1 Express 5 Regional 2 High-Speed	1 Express 3 Regional 1 High-Speed
Fullerton to Anaheim	1 Express 2 Regional	1 Express 1 Regional	1 Express 4 Regional	1 Express 2 Regional	1 Express 4 Regional 2 High-Speed	1 Express 2 Regional 1 High-Speed

The increase in service frequency in scenario 3 and 4 is limited to additional service in the trunk section (Burbank – Anaheim) of the corridor. Without further investment into the branches of the regional rail network the trunk capacity cannot be utilized to also improve frequencies on the

regional rail network beyond the Scenario 2 improvements. Therefore, the investment in Scenario 3 or 4 will only enable service increases between Burbank and Anaheim.

4.13 SoCal Corridor Limitations and Constraints

4.13.1 Freight Interaction

The Burbank to LAUS section and CP Soto to Fullerton sections share track capacity with Class 1 freight railroads. Union Pacific Railroad operates freight trains on the Burbank to LAUS section under an agreement with track owner SCRRA (Metrolink). CP Soto to Fullerton is owned by BNSF Railway Company with Metrolink and Amtrak operating under an agreement with BNSF.

Occasionally, Metrolink and Amtrak trains are subjected to delay due to conflicts with freight trains operating within the region. The study assumes that sufficient capacity improvements have been made to mitigate most delays related to operating on routes with freight traffic.

4.13.2 Host Railroad Agreements

CHSRA or TOC may be required to enter into agreements with SCRRA and BNSF to operate service on or adjacent to their properties. As part of this analysis ETO has made the following assumptions regarding the potential agreements:

- CHSRA or TOC will be able to successfully negotiate agreements for shared track or right of way access;
- CHSRA or TOC will operate as a tenant on all tracks between Burbank, LAUS, and Anaheim; and
- Capacity improvement projects outside of the study area may be required in order to open track capacity within the Burbank - Anaheim corridor. The number of projects and cost have not been quantified for this report.

4.13.3 Capacity Constraints

Within the study area CHSRA service will operate in a blended environment with conventional

trains from other operators. Meeting the service goals outlined in the scenarios assumes that all operators on the shared corridor can develop an operating plan that maximizes utilization of the available capacity while meeting service goals.

Service patterns that do not maximize corridor throughput may artificially constrain the total carrying capacity of the Burbank-LAUS-Anaheim corridor. In addition, differentiation in rolling stock between operators can consume additional track capacity when blending equipment with different operating characteristics.

4.13.4 Ridership Expectations

Based on the proposed service improvements in Scenario 2, ETO expects a significant increase of ridership in Scenario 2 when a network-wide State and regional third-party investment will provide step changes in regional rail connectivity.

The incremental impact in Scenario 3 with additional service in the trunk of the system between Anaheim and Burbank is expected to be limited due to the geographic limitation of the capital improvements. Out of the 62 existing Metrolink stations, only 10 Stations will be directly affected by High-Speed Rail Investment (Burbank Downtown, the two Burbank Airport Stations, Palmdale, Los Angeles Union Station, Norwalk/Santa Fe Springs, Buena Park, Fullerton, Anaheim).

The full High-Speed Rail investment in Scenario 4 with High-Speed Rail operation will again only provide capacity and service increases in the Anaheim to Burbank corridor and add service to an already frequent service in Scenario 3. The High-Speed Rail Trains will only be serving 4 out of the 62 stations in the Metrolink system.

Without a significant additional investment into the other corridors of the SoCal regional rail network by the Southern California Region that would significantly increase the capacity on the branches of the system in addition to the High-Speed Rail investment, the added trunk capacity in Scenario 3 and 4 will not benefit service frequency on the branches of the SoCal regional rail network. The expected resultant ridership increases in Scenario 3 and 4 are therefore expected to be limited to increases within this trunk corridor and only benefit this sub-set of the overall

regional travel market.

Table 4-5) shows the existing Annual Ridership of the Metrolink lines and (Table 4-6) shows the existing LOSSAN annual ridership numbers, respectively.

Table 4-5: Metrolink Ridership by Line

Line	Annual Ridership – FY17
Ventura County	1,085,453
Antelope Valley	1,719,251
San Bernardino	2,745,469
Riverside	1,004,402
91/Perris Valley	881,795
Inland Empire	1,372,287
Orange County	2,831,611

Table 4-6: LOSSAN Ridership and On/Offs at Stations in Study Area

Fiscal Year 2017	2,989,871
Station	On/Offs
Los Angeles	1,446,990
Fullerton	374,501
Anaheim	287,415
Burbank	68,461
Glendale	55,032

4.13.5 Regional Connectivity

The 2018 State Rail Plan supports development of regional rail corridors, providing for statewide connectivity and access on the LOSSAN North, LOSSAN South, Antelope Valley, Inland Empire, and Los Angeles Urban Mobility corridors.

The SoCal study assumes that the Central Valley Segment from Merced to Bakersfield is in operation and that connecting bus services will enable transfers of passengers in Newhall (Scenario 2, Scenario 3 and Scenario 4) or at LAUS in Scenario 1 to the SoCal regional rail network.

4.13.6 Statewide Travel Demand related to SoCal Corridor

Due to the investment in the Burbank to Anaheim High-Speed Rail corridor only in Scenario 3 and 4 ETO expects only a very limited statewide impact on travel demand since the High-Speed Rail corridor is not connected to the Central Valley segment via a tunnel connection. Once such a connection is established, both the Scenario 2 regional rail investment as well as the High-Speed Rail corridor investment from Anaheim to Burbank will show state-wide benefits.

This situation is outside of the scope of the SoCal study and is covered by other planning efforts such as the 2020 Business Plan of the California High-Speed Rail Authority. Local and regional benefits of the investment will be evaluated using the State Rail Model.

4.13.7 Forecasting Horizons

In the qualitative phase of the SoCal Study, the ridership impacts for Scenarios 1 through Scenario 4 will be analyzed at a 2028 horizon using the State Rail Model. The model will be validated against using existing ridership count information on a station pair level. This time horizon was chosen to enable comparison against the PenC study (2028 horizon) and the CVS studies (initial 2026 horizon, updated study assumes a 2029 horizon) from a ridership perspective and to isolate the modeling from differences in natural travel demand growth over time.

4.13.8 Operations Costs

The SoCal study scope includes a comparison of operating and maintenance costs (OpEx) versus

the NorCal and the CVS corridor costs.

In the PenC study only O&M costs for the High-Speed Rail operation was analyzed as the parallel Caltrain service is being funded by a separate entity and the service as well as the related funding was assumed to remain constant between the situation with and without the High-Speed Rail service in the NorCal corridor. The CVS study considered the O&M cost of connecting services in the analysis since these services act as feeders to the High-Speed Rail service in the central Valley.

For the SoCal corridor the O&M costs will only be analyzed for Scenario 4 for the High-Speed Rail operation since the approach is identical to the one taken for the NorCal corridor. The regional operating program is assumed to be funded and the service is being kept constant between Scenario 3 and 4 except for the addition of the High-Speed Rail service between Burbank and Anaheim.

4.13.9 Cost Savings through Efficiency

While the study assumes that the operation of the regional rail service in each scenario is funded by farebox revenue and member agency contributions, ETO anticipates opportunities to increase the efficiency of the service due to more frequent and bi-directional service that allows for better equipment use and reduced idling times. Consequently, this improved efficiency should reflect in a reduced production cost of seat miles.

It is outside of the scope of this study to determine these efficiencies, but ETO expects that multiple ongoing or planned studies in the region will be analyzing and addressing such efficiencies and benefits. Since the actual operating costs of the regional operators will be neutral towards the expenditures of CHSRA, ETO will reflect such operations and maintenance cost (OpEx) for the regional rail services if available and provided by third parties, no new calculations will be performed for the regional rail services cost. ETO will calculate OpEx for the High-Speed Rail operation in Scenario 4.

4.13.10 Local Funding of Operations

The anticipated increases in services of the regional rail services are in line with various proposed service improvements and the scenario assumptions build on committed State and local funding for these regional capacity improvements. Therefore, the Side-By-Side Study assumes that regional entities will secure operating funding for the improved service concepts using the existing or amended regional rail fleet with diesel propulsion. Metrolink has also provided a concept that would deploy a zero-emission technology for the network. ETO will consider how such an operation would benefit such a GHG analysis.

4.13.11 Regional and other Funding Availability

It is assumed that all regional investment in the SoCal Scenario 2 is fully committed and complements the State funding including the TIRCP grant for the SCORE program as well as bookend investment provided by CHSRA.

A more detailed analysis outside of this study is needed to evaluate the Regional, State and Authority's funding capabilities to establish a detailed funding plan for the SoCal corridor.

4.13.12 Project Delivery

The Scenarios assume that all studies and environmental analyses as well as agreements between stakeholders and infrastructure owners are in place in a timely manner to enable the construction of the required infrastructure in each scenario. Due to the complexity of the SoCal corridor there will be the need to have multi-lateral agreements between the various stakeholders that own infrastructure, provide the investment, perform dispatching, are responsible for service agreements and that operate services. The study also assumes that a collaborative approach will enable the early investments in the Burbank to Anaheim corridor and that investment is implemented sequentially going from Scenario 2 to Scenario 4.

4.13.13 Constructability

The constructability of the Scenarios depends on various factors such as environmental

clearance, permitting, funding availability and implementation timelines. Based on these parameters, ETO estimates the completion of construction as follows:

- Scenario 2 by 2026 with implementation of the TIRCP-funded portion of the SCORE program and parallel limited investment per line to achieve capacity improvements;
- Scenario 3 by 2033 following completion of the Scenario 2 investments using the initial High-Speed Rail investment in the Burbank-Anaheim corridor; and
- Scenario 4 by 2040 applying the full High-Speed Rail investment in the Burbank-Anaheim corridor including High-Speed Rail rolling stock for the Burbank-Anaheim High-Speed Rail operation.

4.14 Capital Costs SoCal

ETO is working with the project stakeholders to establish an estimate for the required regional and High-Speed Rail capital costs for Scenario 2, Scenario 3 and Scenario 4 including rolling stock capital needs. The regional investments include TIRCP funds for certain SCORE projects, the LinkUS project, limited additional funds to improve capacity on each line to enable the Scenario 2 service program. The data will reflect very high-level assumptions for additional regional investment in the branches of the regional network to facilitate the service plan in Scenario 2 as well as capital cost for rolling stock for the regional rail service increase. The study assumes that the rolling stock fleet will be amended to provide the assumed services and all estimates will be refined in the quantitative phase of the study.

In parallel, estimates of the High-Speed Rail eligible cost and funded improvements have been compiled and the initial capital cost estimates for High-Speed Rail eligible infrastructure are summarized in Table ***4-7*** shown in Year of Expenditure ($YOE) dollars. The initial High-Speed Rail investment estimate is $6.8 billion for Scenario 3 and $12.4 billion for Scenario 4, respectively. Year of Expenditure (YOE$) Dollars were derived by using the midpoint of construction to inflate the cost to future-year dollars.

Table 4-7: Comparison of Investment for High-Speed Rail Infrastructure in SoCal Corridor ($YOE)

FRA STANDARD COST CATEGORIES YEAR OF EXPENDITURE (Millions)**	Scenario 3 (Partial HSR investment)	Scenario 4 (Full HSR investment)
10 TRACK STRUCTURES & TRACK	$1,552	$3,439
20 STATIONS, TERMINALS, INTERMODAL	$110	$808
30 SUPPORT FACILITIES: YARDS, SHOPS, ADMIN. BLDGS	$245	$293
40 SITEWORK, RIGHT OF WAY, LAND, EXISTING IMPROVEMENTS	$3,894	$5,514
50 COMMUNICATIONS & SIGNALING	$160	$191
60 ELECTRIC TRACTION	$0	$490
70 VEHICLES	$0	$0
80 PROFESSIONAL SERVICES (applies to Cats. 10-60)	$550	$1,189
90 UNALLOCATED CONTINGENCY	$298	$487
100 FINANCE CHARGES	$0	$0
TOTAL:	**$6,809**	**$12,410**

**Assumes completion of the Scenario 3 by 2033, and the Scenario 4 by 2040.

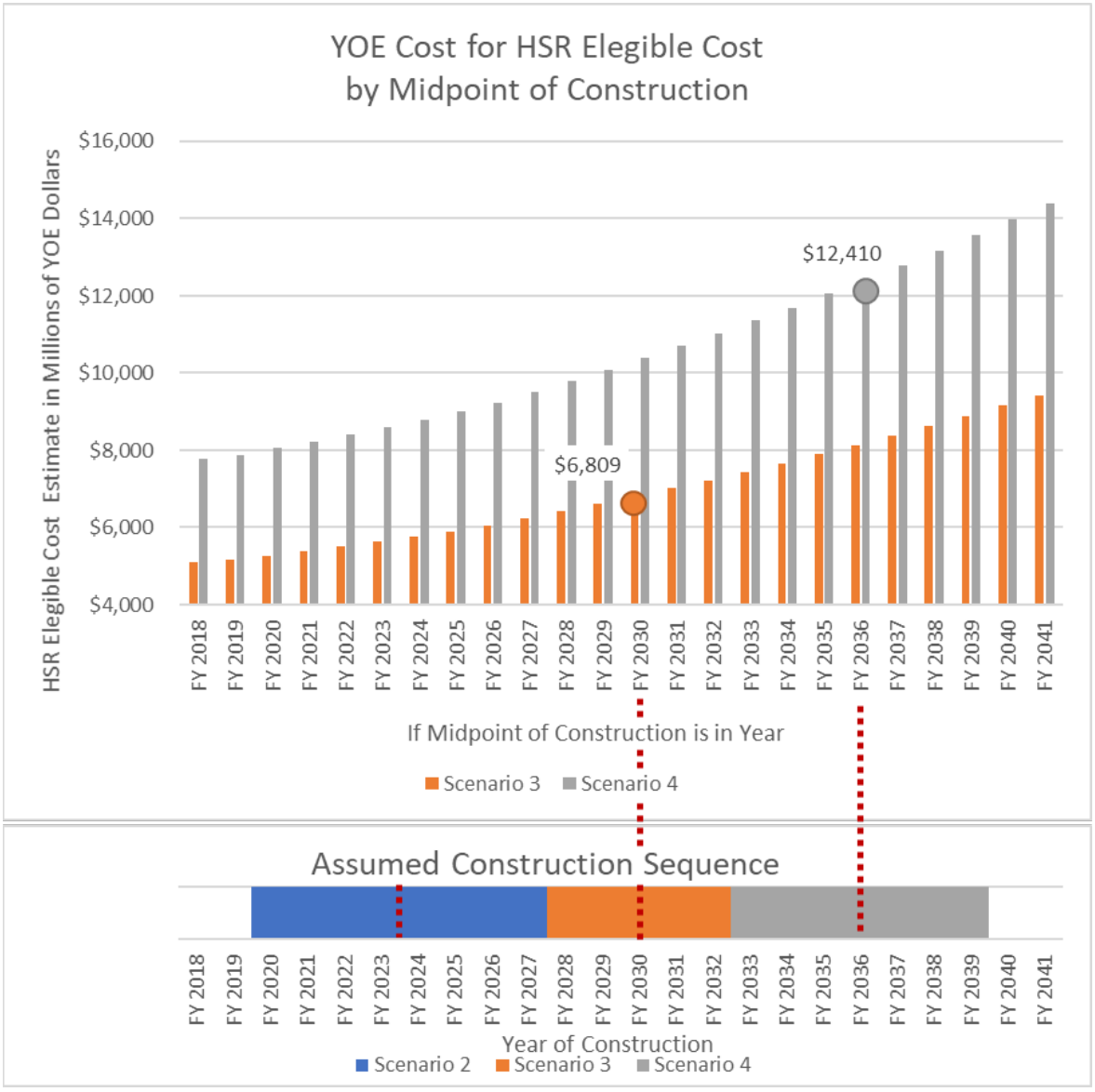
Exclusions: 1. Link US project costs. 2. Vehicle maintenance facilities. 3. High-Speed Rail and regional rolling stock

These estimates are based on the estimates developed in support of the presentations to the November 2019 Authority Board recommending and selecting the preferred alternatives for the subject sections. These presentations were made well after the 2018 BP estimates had been finalized and published, and therefore are not consistent with the cost information provided in the published 2018 BP due to the more refined planning knowledge at this later point in time.

In addition, the SoCal scenarios are based on the assumption of a sequential implementation of the investment: First Scenario 2 with regional investment completed by 2026, followed by the partial High-Speed Rail investment in Scenario 3 completed by 2033 and the full High-Speed Rail eligible investment completed by 2040. The resultant CapEx totals are inflated to the midpoint of construction since detailed expenditure schedules are not available at this time due to the preliminary design of the infrastructure. Figure 4-7 presents the assumed construction sequence of Scenario 2, Scenario 3 and Scenario 4 as well as the resultant YOE expenditure total for Scenario 3 and Scenario 4 for High-Speed Rail eligible investment. The cost ranges are subject

to change during the Quantitative Phase of the Side-By-Side Study with potential refinements to the cost basis.

Figure 4-7: Comparison of SoCal Eligible High-Speed Rail CapEx in YOE$ by Midpoint of Construction



In a case where the construction sequence differs from the assumptions in this study, the YOE cost will change correspondingly due to necessary inflation adjustments. This also explains

differences between previously published CapEx totals such as the 2018 Business Plan where different implementation horizons are assumed and the investment is assumed to be independent from the completion of regional investments. The initial High-Speed Rail eligible cost estimates presented in this report are based on estimates for the environmental planning purpose and will likely differ from the cost for the High-Speed Rail Business Plan due to the differing scope that is considered in each process. Therefore, the numbers presented in this report are subject to change and refinement during the Quantitative Phase of the Side-By-Side Study.

The total High-Speed Rail eligible investment is required in addition to the already committed bookend investment of $500 million for the Rosecrans/Marquardt Grade Separation and the Link US projects.

In addition to the projected High-Speed Rail cost estimates, regional capital expenditures will be required for completion of Link US Phase B, regional infrastructure to support the higher service frequency between Burbank and Anaheim as well as the additional rolling stock that is not eligible for High-Speed Rail funding. Table 4-8 provides a preliminary outline of the expected investment needs by Scenario for the SoCal corridor. The ETO team will obtain the respective investment numbers from the stakeholders to provide a complete summary in the quantitative phase of the project.

The summary shows a breakout between High-Speed Rail eligible capital cost and investment that will need to be performed by the regional partners. This summary does not represent a funding commitment by any party but rather illustrates how the Authority could contribute to the investment in the SoCal corridor.

Table 4-8: Preliminary Capital Cost Estimates by SoCal Scenario in Year of Expenditure Dollars

Investment	Scenario 2		Scenario 3		Scenario 4	
Estimated Infrastructure Investment / CapEx (in Millions of Year of Expenditure Dollars)	SCORE TIRCP + Limited Additional Projects		Partial HSR Infrastructure (Burbank – Anaheim)		Full HSR Infrastructure and Service (Burbank - Anaheim)	
	Low Range	High Range	Low Range	High Range	Low Range	High Range
TIRCP funded SCORE Projects [4]	$876	$876	$876	$876	$876	$876
Link US Full Build [5]						
Phase A ($950.4 million)	$950	$950	$950	$950	$950	$950
Phase B (not funded)			$1,150	$1,600	$1,150	$1,600
Limited Additional Regional Investment [6]	TBD	TBD	TBD	TBD	TBD	TBD
Regional Infrastructure Investment	TBD	TBD	TBD	TBD	TBD	TBD
Regional Rolling Stock Needs	TBD	TBD	TBD	TBD	TBD	TBD
HSR Investment						
Bookend Investment [1]	$500	$500	$500	$500	$500	$500
Initial Corridor Investment [2]			$6,809	$6,809	$6,809	$6,809
Ultimate Incremental Investment [3]					$5,601	$5,601
HSR Rolling Stock					TBD	TBD
Total Regional Investment incl. State Funds	**TBD**	**TBD**	**TBD**	**TBD**	**TBD**	**TBD**
Committed and funding secured [4]	$1,826	$1,826	$1,826	$1,826	$1,826	$1,826
Regional Funding to be determined [6]	*TBD*	*TBD*	*TBD*	*TBD*	*TBD*	*TBD*
Rolling Stock	*TBD*	*TBD*	*TBD*	*TBD*	*TBD*	*TBD*
Total Early Investment CAHSRA	**$500**	**$500**	**$7,309**	**$7,309**	**TBD**	**TBD**
Infrastructure	$500	$500	$7,309	$7,309	$12,910	$12,910
Rolling Stock					TBD	TBD
Total Scenario Investment	TBD	TBD	TBD	TBD	TBD	TBD

Notes:

(1)
CAHSRA provided 500 million for early bookend investments including the Rosecrans Ave/Marquardt Ave grade-separation project and Link US project funding
https://www.hsr.ca.gov/docs/newsroom/fact%20sheets/Connectivity_Bookends.pdf
($423 million for Link US and $77 million for Rosecrans/Marquart Grade Separation)

(2)
Burbank to Anaheim corridor less underground Burbank Airport station, catenary, high-level platforms, layover capacity for HSR trains, Anaheim HSR station improvements (Source: CAHSRA)

(3)
Burbank to Anaheim incremental HSR CapEx incl. underground Burbank Airport station, catenary, high-level platforms, layover capacity for HSR trains, Anaheim HSR station (Source: CAHSRA)

(4)
Funding to implement SCORE projects to improve capacity on the Metrolink rail network.
Source: https://www.metrolinktrains.com/news/metrolink-news/state-approves-more-than-$1.2-billion-in-sb-1-and-cap-and-trade-funds-for-socal-rail-to-improve-service-ease-freeway-traffic/

(5)
Funding from other sources less CAHSRA bookend investment of $423.34 million. Total cost of Phase A: $950.4 million.
Source: https://metro-pdf-merger.datamade.us/document/ocd-event-07185114-5504-409c-a9e1-afa45f7a6a4b

(6)
Funding is not committed but necessary to implement capacity improvements on each line of the Metrolink network to achieve higher-frequency bi-directional service during peak period. Funding requirements are estimates based on comparable improvements and are subject to change based on more detailed planning studies.

5 Side-By-Side Study

5.1 Disclaimers

This document is strictly for deliberative purposes. It should be noted that this is the first time since the Business Plan 2016 that a study is undertaken with some level of detail in understanding the benefits that early High-Speed Rail operations will create in Southern California and the Peninsula Corridor. It is neither a proposal nor an offer to perform such services. Financial projections included in this document will be high-level and indicative projections of costs and revenues based on the current plans and details available for purposes of the analysis. Given the uncertainty related to more refined plans and cost estimates, the numbers will be subject to change and can vary from the estimates used to perform this study.

Any of the investment requirements shown in this report are based on third party information and are subject to change once more refined and detailed corridor specific studies and planning steps are performed. The data does not imply a funding commitment from either Regional or State Stakeholders or the Authority.

5.2 Preliminary Comparison of Capital Costs by Corridor

The YOE$ values for the SoCal and NorCal corridors are compared against the cost increment to extend the Central Valley High-Speed Rail construction from Madera to Merced and from Poplar Avenue to Bakersfield (***Table* 5-1**). The incremental cost for this part of the project is $4.8 billion in YOE$ (difference between 15.6 and 20.4 billion YOE Dollars) and is significantly lower than the expected full cost for the SoCal or NorCal investment scenarios.

The capital cost estimates for the CVS corridor are based on a P70 case and there is still some uncertainty regarding the final cost for the Merced – Bakersfield segment. The capital cost for the SoCal corridor are estimates based on the most recent information available from the Authority . Given the high-level nature of these estimates, ETO expects changes and therefore the numbers have to be considered as preliminary values.

The NorCal Corridor capital cost estimates are subject to change as well and will be based on

Caltrain Business Plan numbers and Authority estimates for the High-Speed Rail investment.

The ETO team has not reviewed and will not be reviewing the validity and correctness of this data and any other third-party information.

The summary shows a breakout between High-Speed Rail eligible capital cost and investment that will need to be performed by the regional partners. The estimates for non-eligible investment cost will be provided in the quantitative phase of the study. This summary does not represent a funding commitment by any party but rather illustrates how the Authority could contribute to the investment in any of the study corridors.

Table 5-1: Preliminary High-Speed Rail Capital Cost Estimates for Side-By-Side Comparison in Year of Expenditure Dollars (YOE$) (Subject to Change)

Corridor	Scenario	Regional, State and Other Investment (in billions of $YOE)	Eligible HSR Infrastructure CapEx (in billions of $YOE)	HSR Rolling Stock CapEx (in billions of $YOE)	Total CapEx (in billions of $YOE)
NorCal	NorCal (8 Trains phpd) (With Partial HSR Investment)	TBD	**$4.1**	---	TBD
	NorCal (8 +2 HSR Trains phpd) (With Full HSR Investment)	TBD	**$7.2**	TBD	TBD
CVS	Madera - Poplar Ave	---	funded	---	funded (***)
	CVS (Merced - Bakersfield)	TBD	**$4.1**	**$0.7**	**$4.8 (*)**
SoCal	SoCal Scenario 3 (With Partial HSR Investment)	TBD	**$6.8 (**)**	---	TBD
	SoCal Scenario 4 (With Full HSR Investment)	TBD	**$12.4 (**)**	TBD	TBD

Note: (*) Cost difference might change depending on provisions for contingency and retainage for FY10 law suit. Cost is based on P70 case and impact of diversion of funds on Federal funding allocation needs to be evaluated.

(**) Does not include cost for Phase B of Los Angeles Union Station which could be eligible for HSR funding ($1.15 billion to $1.60 billion)

(***) Potential for additional investment needs to retain funding eligibility if only Madera - Poplar segment is completed.

If investment is prioritized in other sections of the future High-Speed Rail network, ETO expects that significant benefits are lost in the Central Valley since the Madera – Poplar Avenue corridor will not provide the benefits of a High-Speed Rail service. It will likely resemble a slightly improved service over the existing San Joaquin service with similar frequency and only slightly higher operating speeds. In addition opportunity costs are likely to occur due to the partial investment in the Central Valley without corresponding benefits since the Authority will lose the opportunity to showcase a High-Speed Rail corridor, later completion of the Merced and Bakersfield extensions will incur cost increases and the infrastructure maintenance cost for a Diesel train based service will be proportionally higher due to the higher maintenance standards for a high-speed rail line as compared to a conventional diesel-based operation at lower speeds. The diesel operation will also require throw-away investments to facilitate a diesel train-based service. These throw-away investments include:

- Adaptation of the signal system for non-High-Speed Rail rolling stock;
- Connecting tracks between the High-Speed Rail alignment and freight rail tracks in Madera and at Poplar Avenue; and
- Modifications to station platforms on the High-Speed Rail alignment to accommodate Diesel hauled rolling stock.

The SoCal cost estimates of $12.4 billion (less rolling stock) for an early High-Speed Rail operation significantly exceed the cost to complete Merced – Bakersfield including rolling stock of $4.8 billion. In the NorCal corridor the capital cost of $7.2 billion less rolling stock for an early High-Speed Rail operation exceeds the Central Valley cost as well.

A partial investment in the SoCal corridor that only provides benefits for regional service is estimated to cost $6.8 billion and the partial investment in the NorCal corridor is expected to cost $4.1 billion and also only benefits the regional service improvements. If only a sub-set of these High-Speed Rail eligible investments is made, the investment would not be a meaningful contribution to preparing the corridors for future High-Speed Rail operation and the implementation of Phase 1 of the High-Speed Rail system.

ETO will continue the analysis to also capture the needed non-High-Speed Rail eligible cost that

will have to be carried by other entities to complete the capital cost summary in the quantitative phase of the study.

5.3 Status of Comparative Analysis CVS and PenC Studies

The ETO is updating the CVS Study to reflect revised plans regarding the connectivity with ACE and San Joaquin services in the Central Valley as well as to accommodate a different approach of the High-Speed Rail operation in the Central Valley. The time horizon for the CVS ridership analysis reflects service in 202. .

The PenC study is under further review to incorporate another Scenario (six trains per hour, electrification investment only) to reflect a committed and approved regional investment scenario. The information for this new scenario is included in the current Caltrain Business Plan and no new analysis will be performed. The previous PenC report performed by the ETO will remain unchanged as compared to the Project Update Report published May 1, 2019.

The analytical phase of the SoCal study including establishment of GHG impacts, congestion relief opportunities as well as implementation schedules and opportunities for third party funding and private sector contributions will commence shortly for all three corridors.

6 Initial Findings and Conclusions

As part of the qualitative report and the data gathering effort for the Side-By-Side Study, the ETO presents the following initial findings and comments.

6.1 Summary of Observations

6.1.1 SoCal Corridor in a Regional Rail Network

The Burbank to Anaheim corridor is situated in the wider regional rail network of the LA Basin. This trunk section includes LA Union Station which is the key node of the network for passengers to transfer between regional rail and local transit services. The regional rail network will be improved by the region with contributions by the State through TIRCP funding prior to the potential early investment by the Authority in the Burbank to Anaheim corridor. In order to maximize the benefits of the High-Speed Rail investment in the trunk section significant further regional investment would be necessary to facilitate capacity improvements on the branches of the regional rail network.

At this point there are no plans from the regional stakeholders to fund such additional investments outside of the Burbank – Anaheim section and to provide support for a further expansion of the regional rail service. More detailed planning studies are necessary to get an understanding of the magnitude of investment and service expansions that would form such a significantly improved situation.

6.1.2 Linear NorCal and CVS Corridors

The NorCal corridor (77 miles) as well as the CVS corridor (171 miles) are linear corridors that connect to other transit and rail services. The CVS corridor connects in Merced to the ACE and the San Joaquins Rail service that will provide connections to Oakland (147 miles) to Sacramento (113 miles) and to San Jose (134 miles) establishing a long-distance intercity passenger rail corridor.

In the NorCal corridor the High-Speed Rail service is assumed as an overlay service on top of the

improved Caltrain service after electrification of the corridor. The High-Speed Rail service would supplement the Caltrain service as a limited stop Express service in the 77 mile corridor which is a regional rail corridor. The incremental benefits of this service are limited due to the already very high service level and quality of the underlying Caltrain service and the limited travel distances of the NorCal High-Speed Rail operation.

The CVS service will be a standalone High-Speed Rail service that operates as a true intercity high-speed service and replaces an existing diesel-traction intercity service operating at up to 79 mph track speed. The travel time savings, higher frequency and better comfort generates significant ridership increases and resultant reductions of vehicle miles and GHG emissions that are significant due to the longer travel distances and the electric propulsion system of the High-Speed Rail service.

6.1.3 Benefits in the NorCal Study Corridor

As shown in the PenC Study, ETO expects limited benefits from an early High-Speed Rail operation in the NorCal corridor. A partial High-Speed Rail investment paired with additional regional investment will enable additional peak hour service and full electric operation in the NorCal corridor. However, the relative benefits from this situation (Scenario 3) versus the benefits from the Electrification project are expected to be only incremental in nature since the major difference between Scenario 2 and 3 is the peak period service increase from 6 to 8 trains per hour but no major travel time savings. ETO will continue the analysis of the ridership benefits in the quantitative Phase of the study.

6.1.4 Benefits in the CVS Study Corridor

The CVS Corridor analysis in ongoing to reflect revised connectivity of regional rail and coach bus services with the High-Speed Rail service between Merced and Bakersfield. ETO expects similar benefits from an early High-Speed Rail operation in the CVS corridor with these revised assumptions.

A partial High-Speed Rail investment in the Central Valley (Madera – Poplar Avenue) will not enable a frequent High-Speed service since it will only accommodate today's diesel rail service with 7 train pairs per day instead of hourly high-speed service with 18 train pairs per day. Additional cost will occur to enable such an operation.

ETO will continue the analysis of the ridership benefits for the full investment in the Central Valley Segment in the quantitative Phase of the study.

6.1.5 Benefits in the SoCal Study Corridor

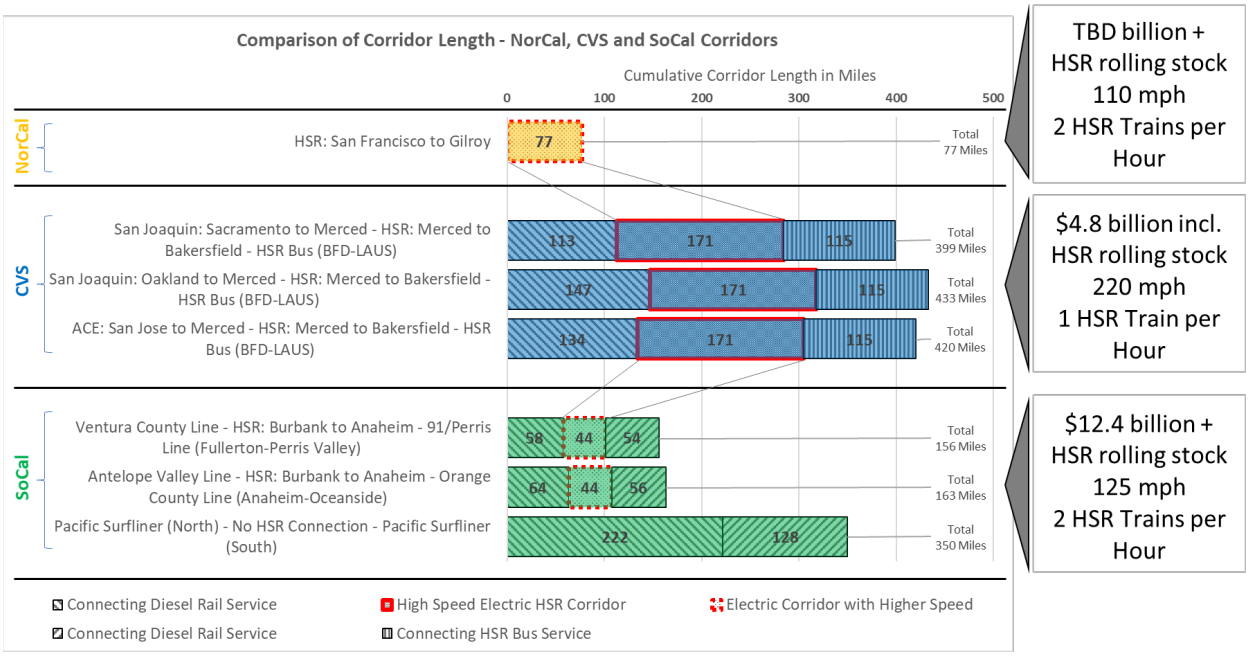
The Burbank Anaheim corridor (44 miles) is part of a large regional rail network with extensive service improvements prior to the High-Speed Rail investment. The regional rail system will likely remain in the near-term and foreseeable future a system that uses Diesel-traction for the train operation due to the extensive investment that would be needed to electrify the entire regional rail network. Any benefits form expanded service will therefore be lower due to reduced GHG impacts and lower ridership impacts due to travel time reductions as compared to an electrified system such as the NorCal corridor. In Scenario 4 in SoCal where the electrification of the Burbank to Anaheim corridor and High-Speed Rail operation are assumed, only the High-Speed Rail trains will use overhead catenary electric propulsion since the entire regional rail fleet will still need to operate on non-electrified network sections. Related ridership, GHG and congestion relief impacts from early High-Speed Rail operations are expected to be limited due to the short distance of the Burbank to Anaheim corridor, the addition of High-Speed Rail service in addition to already high regional service frequency and the limitation of the travel improvements to the region since the rail connection to the Central Valley is not implemented in Scenario 4.

The High-Speed Rail service will only be serving 4 out of the 62 existing Metrolink stations and only 10 Metrolink Stations will be directly affected by High-Speed Rail Investment (Burbank Downtown, the two Burbank Airport Stations, Palmdale, Los Angeles Union Station, Norwalk/Santa Fe Springs, Buena Park, Fullerton, Anaheim).

6.1.6 Best Case Summary of Electrified Route Miles

Each of the three corridors provides varying amounts of electrified service with benefits toward GHG emissions, congestion reduction and ridership benefits (Figure 6-1).

Figure 6-1: Comparison of Corridor Length Among Study Corridors



NorCal

HSR investment in the NorCal corridor would enable electrified High-Speed Rail service in conjunction with increased electrified Caltrain with speeds up to 110 mph in the corridor with an end-to-end distance of 77 miles. The actual train speed is likely lower due to train sequencing and stopping patterns and the blended service environment in the corridor. ETO is currently gathering the capital cost for this corridor investment. Due to the location of the Gilroy terminus, this corridor provides High-Speed Rail connectivity only within the 77 miles of the NorCal corridor.

CVS

The CVS corridor enables High-Speed Rail service of up to 220 mph with an incremental cost to

extend the corridor to Bakersfield and Merced and to purchase rolling stock of $4.8 billion (YOE Dollars). This cost estimate is based on a P70 cost level and is subject to uncertainty.

The investment will enable travel on the High-Speed Rail service and on the connected corridors over a distance between 399 to 433 miles (depending on connecting corridor). The High-Speed Rail segment will operate at full High-Speed Rail speeds and will not need to share the tracks with other services.

SoCal

The SoCal corridor will be providing 44 miles of electrified High-Speed Rail service. However, the underlaying regional and express services will be operating as diesel trains under the electrified portion since the entire SoCal network will continue to be operating with diesel propulsion in the foreseeable future.

Metrolink has provided an alternative investment concept that includes zero-emission technology. ETO will review and consider this proposal in the quantitative phase of the project. The cost to implement the standalone High-Speed Rail service is estimated at $12.4 billion (YOE Dollars) plus cost for the High-Speed Rail rolling stock that ETO is currently determining. The corridor is expected to allow for a maximum speed of up to 125 mph where applicable, but the actual average operating speed will likely be lower due to train sequencing and stopping patterns.

If the extensions of the regional rail network to the north of Burbank and to the south / east of Anaheim are included, the 44 mile section would provide connectivity in end-to-end corridors of 156 to 163 miles, respectively.

6.1.7 HSR Service Benefits

(Figure 6-2) provides a summary of the expected annual High-Speed Rail train miles in comparison of the High-Speed Rail corridor lengths. The number of High-Speed Rail train miles in SoCal (about 850,000 miles annually) is limited due to the short corridor and the service speed is limited to up to 125 mph. Conventional rail services in SoCal corridor are expected to operate with Diesel propulsion and High-Speed Rail service will operate electric trains as an overlay

service using electric catenary.

The NorCal corridor provides roughly 2 million annual High-Speed Rail train miles over the 77-mile route with a maximum speed of up to 110 mph in the mixed service corridor. These train miles are provided in addition to the electric train miles provided by Caltrain.

CVS provides about 2.2 million annual High-Speed Rail train miles at speeds of up to 220 mph over the 171 mile corridor between Merced and Bakersfield. This service will operate as a full electric service and connect to conventional rail and bus services and enable statewide connectivity.

Figure 6-2: Comparison of High-Speed Rail Train Miles Among Study Corridors

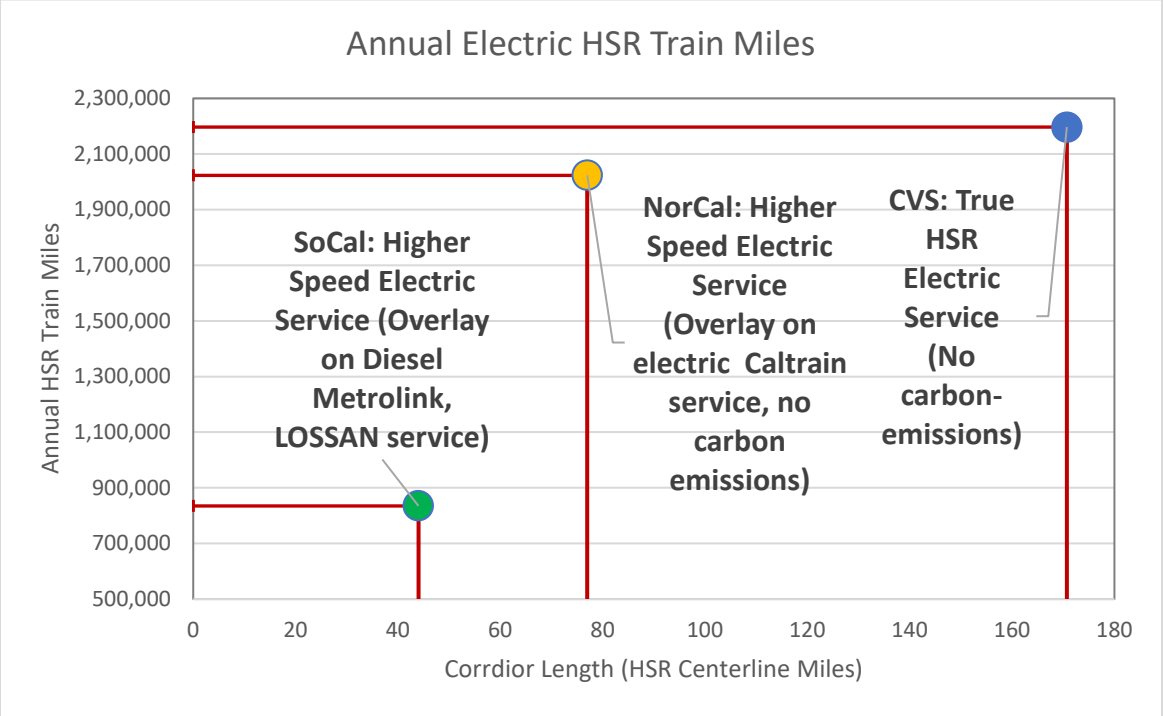


Table 6-1 shows peak hour corridor train throughput for each study corridor. The comparison includes situations with existing conditions, completion of regional investments, partial High-Speed Rail investment and full High-Speed Rail investment and High-Speed Rail operation.

Due to the structure of the SoCal network, even with full High-Speed Rail investment only two of the total 10 trains per hour and direction in the cross section north of Los Angeles Union Station operate as electric trains. The GHG benefits from this operation are therefore expected to be lower than the all-electric operation in the NorCal corridor with the same amount of throughput.

Table 6-1: Investment Scenario Comparison of Cost Versus Service Benefits

Project Corridor	Type	**Scenario 1**	**Scenario 2**	**Scenario 3**	**Scenario 4**
		Existing	Regional Investment only (No CHSR Service)	Partial High-Speed Rail Investment (No CHSR Service)	Full High-Speed Rail Investment (With CHSR Service)
Peninsula Corridor (NorCal) San Francisco – Gilroy (North of San Jose)	Service	5 Caltrain 5 Total	4 Electric Caltrain* 2 Diesel Caltrain 6 Total	8 Caltrain* 8 Total	8 Caltrain* 2 High-Speed* 10 Total
	Cost	(No Build)	(Regional $)**	(+ $4B HSR+ Regional $)	(+ $3B HSR+HSR Rolling Stock)
Central Valley Segment (CVC) Merced –Bakersfield (Entire Corridor)	Service	0.5 San Joaquins (7 Per Day)	N/A	N/A	1 High-Speed* 1 Total (18 per Day)
	Cost	(No Build)			(+ $4.8B HSR incl. HSR Rolling Stock+ Regional $)
Southern California Corridor (SoCal) Burbank –Anaheim (Section North of LAUS)	Service	0.5 Express 3 Regional 3.5 Total	2 Express 4 Regional 6 Total	2 Express 6 Regional 8 Total	2 Express 6 Regional 2 High-Speed* 10 Total
	Cost	(No Build)	(Regional $)**	(+ $7B HSR+ Regional $)	(+ $5B HSR+HSR Rolling Stock)

Note: Investment levels by Regions, State, Others and High-Speed Rail eligible investment increases in steps when comparing Scenario 2 to Scenario 3 and to Scenario 4.

The relative additional benefits from High-Speed Rail investments and High-Speed Rail operation are depicted in Table 6-2. The table includes a qualitative comparison of the corridor parameters, the required High-Speed Rail investment to achieve early High-Speed Rail infrastructure

implementation (Partial investment, Scenario 3) and to achieve High-Speed Rail operation (Full investment, Scenario 4) and the expected benefits from the High-Speed Rail investment as a qualitative description.

The Peninsula corridor is expected to have incremental benefits from a full High-Speed Rail investment and operation since the regional Caltrain improvements already capture significant benefits and the High-Speed Rail operation only serves 4 out of the 29 stations with weekday service. The resultant ridership impact and related environmental benefits are incremental since the major benefits are realized with the Electrification scenario (Scenario 2).

Table 6-2: Preliminary Findings – Qualitative Comparison Among Study Corridors

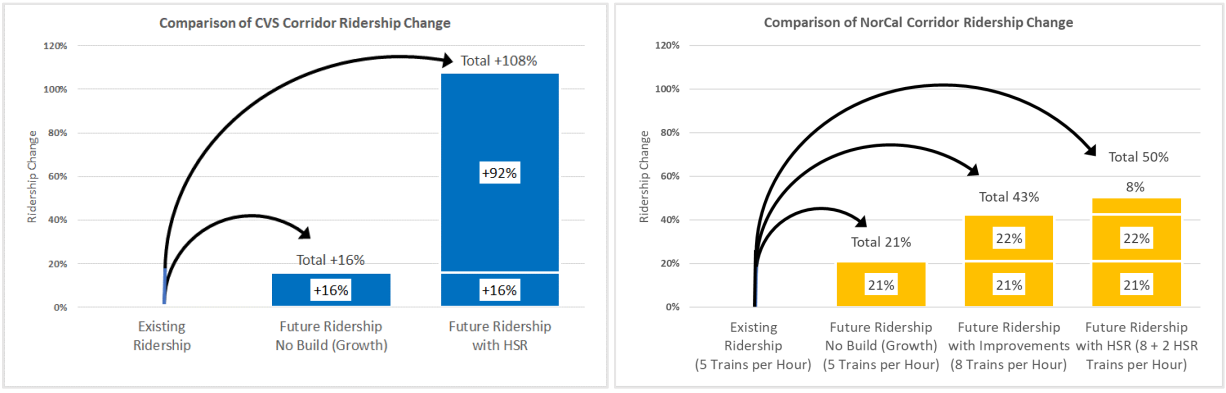
Project Corridor	Length of Corridor	Improved Rail Service	Ridership and Revenue Increment	Increment GHG Benefits	Expected Congestion Relief	High-Speed Rail Capital Cost (YOE$)	Prior Regional Investment Required?	High-Speed Rail operational within next 10 Years?
Peninsula Corridor (NorCal) San Francisco to Gilroy	77 Miles Shared	Frequency, Slightly Increased Speed, All Electric	Incremental	Auto and Diesel Trains to Electric Trains	Incremental	Range: $4 to $7 billion +HSR Rolling Stock TBD	Shared Corridor/ Caltrain Electrification complete	Maybe At 110 mph
Central Valley Segment (CVS) Merced to Bakersfield	171 Miles Dedicated	Frequency, Full High Speed, 90 Minute Savings, All Electric	Significant	Auto and Diesel Trains to Electric Trains	Significant	$4.8 billion including Rolling Stock	Independent Corridor/ Can be developed in parallel	Yes At 220 mph
Southern California Corridor (SoCal) Burbank to Anaheim	44 Miles Shared	Frequency, Slightly Increased Speed, Only High-Speed Rail Electric	Incremental	Auto to Mainly Diesel Trains	Incremental	Range of $7 to $12 billion +HSR Rolling Stock TBD	Shared Corridor/ Regional Investment (Part of SCORE) complete	Unlikely At 110 to 125 mph

Comparison of Ridership Data

The existing total SoCal network ridership is about 12 million annual riders (Metrolink and Pacific Surfliner combined) and is lower than the existing Caltrain (NorCal Corridor) ridership of about 19 million annual riders. Based on this comparison and the similarities of the High-Speed Rail service in the SoCal corridor as compared to the NorCal corridor, the ETO expects limited benefits from the High-Speed Rail standalone operation in SoCal. As stated above, in the PenC study the Incremental High-Speed Rail revenue was significantly lower than the additional High-Speed Rail operations and maintenance cost.

(***Figure* 6-3**) compares the ridership impacts in the CVS study and the NorCal corridors. The High-Speed Rail operation in the CVS corridor increase ridership by 92%, the increase in the NorCal corridor is 8% with High-Speed Rail stand-alone operation versus the existing demand. This will change once the statewide High-Speed Rail connectivity is established in the Valley-to-Valley project and Phase 1 of the High-Speed Rail implementation. The Central Valley Segment (CVS) with High-Speed Rail operation generates significant additional revenue due to longer travel distances.

Figure 6-3: Comparison of CVS and NorCal Ridership Impacts from May 2019 Report



ETO will continue the ridership analysis for the SoCal corridor, include information from the Caltrain Business Plan for the NorCal corridor comparison and use the updated CVS information as soon as it is available.

6.1.8 Capital Cost for Early High-Speed Rail Investment

The initial estimates that the ETO received by CAHSRA based on estimates derived from prior planning efforts indicate that the initial as well as the full High-Speed Rail investment in the Burbank to Anaheim corridor will require significant investment. The High-Speed Rail investment in Year of Expenditure (YOE$) Dollars using the midpoint of construction to inflate the cost to future year Dollars is $6.8 billion for Scenario 3 and $12.4 billion for Scenario 4, respectively. Both scenarios require significantly higher investment as compared to the completion of the Merced-to-Bakersfield segment (CVS) from 119 miles to 170 miles that covers the extension form Madera to Merced and from Polar Avenue to Bakersfield. This difference is currently estimated at $4.8 billion (difference between YOE$ 20.4 billion and YOE$ 15.6 billion).

6.1.9 Capital Expenditures for Early SoCal High-Speed Rail Investment

Apart from the already committed bookend investment in LAUS and the Rosecrans/Marquardt Grade Separation Project, there are no committed funding plans for CHSRA early investments in the SoCal corridor. A shift of capital spending from ongoing project implementation steps will not be sufficient to cover the Scenario 3 or Scenario 4 investment needs. Any reduced implementation (less than Scenario 3 investment) of an early High-Speed Rail investment in the SoCal corridor due to financial constraints will result in a situation with very marginal regional benefits that would not contribute to the High-Speed Rail mission in the State and would not provide a building block approach that would also benefit the regional SoCal rail system.

A parallel investment in the NorCal corridor cannot be made concurrent with funding of the SoCal High-Speed Rail investment (and vice versa) if the Authority does not receive additional funding adding to the committed and needed funding for the CVS corridor.

The ETO will begin to quantify the benefits of the SoCal scenarios in more detail in the next Phase of the study. However, given the relative size of the corridor and the location, ETO expects limited benefits from the SoCal High-Speed Rail investment prior to the full Implementation of Phase I of the High-Speed Rail system that would enable statewide benefits in addition to the regional benefits.

The SoCal corridor is only about 44 miles long as compared to the 77 miles of the NorCal corridor and the SoCal corridor is part of a regional rail network where benefits derive from a network situation rather than a corridor specific situation. Given the findings in the NorCal corridor which is a focused linear corridor in the Bay area and the limited ridership benefits from High-Speed Rail operation, ETO expects that the relative benefits in the SoCal study corridor will show similar limitations.

6.2 Preliminary Conclusions

Based on the initial review of the information available at completion of this report, the ETO provides the following preliminary conclusions:

Benefits from Early High-Speed Rail Investment in SoCal Corridor

The ETO will begin to quantify the benefits of the SoCal scenarios in more detail in the next phase of the study. However, the following conditions will apply:

- The relatively small size (44 miles) and the location of the Burbank – Anaheim corridor within the larger SoCal network,
- The standalone operation missing connectivity of the SoCal High-Speed Rail operation with the Central Valley High-Speed Rail operation
- And the constraints of a shared corridor imposed on the High-Speed Rail service that limits the speed of High-Speed Rail to almost the same speed achieved by the regional services

Based on these conditions the following impacts are expected:

- In Scenario 4, limited benefits of an early High-Speed Rail operation in the SoCal High-Speed prior to the implementation of the connection to the Central Valley High-Speed Rail system that would enable statewide benefits in addition to the regional benefits.
- The full High-Speed Rail operation in Scenario 4 will provide service only in the Anaheim

to Burbank corridor and add service to an already frequent Metrolink service in Scenario 3. The High-Speed Rail Trains will serve only four of the 62 stations in the Metrolink system with similar travel times as compared to the regional trains.

- In Scenario 3, the "minimum building block" of High-Speed Rail infrastructure in the Burbank-Anaheim corridor (High-Speed Rail eligible capital investments) will exceed the estimated $4.8B assumed to be potentially available (see Section 4.7.4). Any reduced implementation of an early High-Speed Rail investment in the SoCal corridor will result in a situation with very marginal regional benefits that would not contribute to the High-Speed Rail mission in the State and would not provide a building block approach that would also benefit the regional SoCal rail system:

- The "minimum building block" of High-Speed Rail infrastructure in the Burbank-Anaheim corridor (Scenario 3) will require approximately $7B in High-Speed Rail eligible capital investments.

- The SoCal High-Speed Rail corridor Burbank-Anaheim is only about 44 miles long which is part of a regional rail network where benefits derive from a network situation rather than a corridor specific situation. Therefore, to materialize the benefits of an early investment in the Burbank-Anaheim "High-Speed Rail eligible" infrastructure, substantial regional or state investment in addition to the $7B will be required for "Non High-Speed Rail eligible" investment to improve the remaining parts of the SoCal network and required regional rolling stock.

- At this point in time the ETO has not been able to identify such committed investments or their availability. ETO will review and consider input from other planning scenarios such as those included in the recently provided report by Metrolink to continue the Quantitative Phase of the Side-By-Side Study.

Benefits from Early High-Speed Rail Investment in NorCal Corridor

- In both the SoCal and the NorCal corridors the significant expansion of regional rail services under the respective Scenario 2 will provide a step change in network-wide

benefits. The additional High-Speed Rail investments in Scenario 3 will enable incremental improvements for regional service but with several limitations since the High-Speed Rail investment cannot be applied to non-High-Speed Rail infrastructure or non-High-Speed Rail rolling stock.

- Similar to the SoCal corridor, the NorCal corridor requires a regional investment level in addition to the High-Speed Rail eligible investment beyond the electrification project to maximize the benefits of the early High-Speed Rail investment. The Caltrain Business Plan is under development and highlights these funding requirements for various growth scenarios. ETO is working with Caltrain to obtain data that reflects the Moderate Growth Caltrain Business Plan data and incorporate that information for Scenario 2, Scenario 3 and Scenario 4.

- Scenario 4 In NorCal with a High-Speed Rail service running in parallel to the improved electrified Caltrain service before the Pacheco pass is built was already studied and discussed in the previous ETO report released in May 2019. It was found to be not an attractive operating opportunity after reviewing the ridership and operational costs.

Benefits from Early High-Speed Rail Investment in CV Corridor

Early High-Speed service in the Central Valley was already discussed and analyzed in the previous ETO report released in May 2019 the benefits are summarized below:

- Potential Improvements on the financial balance for the state in the total corridor operational costs including San Joaquin and ACE regional services with the extension to Merced and Bakersfield

- Benefits for the Central Valley communities in travel time, frequency and service quality

- Better access to health, education and employment

- From the three High-Speed Rail standalone corridors in the study, the Central Valley will be the only Corridor that will provide true High-Speed Rail service and will represent a

major step in implementing California High-Speed Phase 1 program within the identified funding sources while improving the regional services

- Opportunity cost can occur in the Central Valley Segment if capital is shifted between corridors and lead to the lack of a “meaningful building block”. This cost is related to:
    - Construction cost increases if the completion of the Merced and Bakersfield extensions is significantly delayed,
    - Additional throw-away cost to connect the Madera – Poplar Avenue section back to the freight railroad alignments to enable non-HSR service on the infrastructure
    - Interim rail systems for this diesel operation
    - Interim Stations for diesel service in the High-Speed Rail corridor
    - Underutilization of High-Speed Rail infrastructure as well as the proportionally higher maintenance cost for the asset without utilizing the benefits of the for High-Speed Rail designed infrastructure.

There may be regional benefits that would accrue from additional regional service in all corridors, but the substantial benefits of High-Speed Rail service accrue only in longer segments where the true benefits of high speed can materialize. The Central Valley dedicated High-Speed Rail Corridor provides such benefits where travel time advantages are much larger compared to the shorter shared corridors in the NorCal and SoCal corridors.

7 Next Steps

ETO will continue with the Quantitative Phase of the Side-By-Side Study utilizing information from the Caltrain Business Plan as well as a proposed Metrolink Scenario. The tasks that will be completed include a continued analysis of capital costs, including High-Speed Rail rolling stock. ETO also will continue to work with stakeholders in all three corridors to provide insights in needed regional investment and related operating costs for regional rail services, summarize benefits for the PenC corridor electrification and medium-growth scenarios and highlight regional funding needs as well as continuing to work with PenC stakeholders to provide insights in needed investment.

Based on the refined information, ETO will identify GHG and congestion benefits for all three corridors and provide an investment summary for High-Speed Rail eligible cost and cost that is not eligible to be paid with High-Speed Rail funds to enable planning and coordination.

The side-by-side comparison in the Quantitative Phase will present the following parameters and summaries for each performance indicator:

- Operations and Maintenance Expenditures:
  Summary of annual regional and High-Speed Rail operating cost by scenario and corridor for the horizon year based on data from the regional operators and estimates for the HSR operation. The data will show absolute numbers and the increment between No-Build and the Scenarios.
- Capital Expenditures:
  Estimates from the regional operators and for eligible High-Speed Rail investment for infrastructure and rolling stock in YOE dollars by scenario and corridor.
- Ridership:
  Ridership estimates will be based on the State Rail Model and will include daily and annual ridership totals for the regional operators and the High-Speed Rail service by scenario and corridor.

- Revenue:
  Annual fare box revenue calculated based on the ridership estimates differentiated by regional services and High-Speed Rail services as well as ancillary revenue where applicable for operators.
- GHG benefits:
  Annual GHG benefits are calculated based on passenger miles travelled from the ridership model and train miles provided by type of propulsion using ARB standard processes. The passenger miles represent the demand of Auto to Rail diversion and related avoided vehicle miles travelled on highways by scenario and corridor.
- Congestion relief:
  Congestion relief is calculated using passenger miles travelled from the ridership model as a measure of how many highway miles travelled can be avoided in each of the investment scenarios. In addition, for each scenario and corridor a comparison of the peak load point between the scenarios will identify the amount of reduced highway trips at that location and an equivalent of highway lanes will be derived.
- Other benefits:
  Near-term benefits, the completion date, as well as any potential for private investment and local matching funds will be summarized and compared by scenario and corridor.

This report includes information available at the time it was produced. Due to the preliminary character of the collected data and information and the longer-term character of the scenarios, the numbers and data presented in the report are subject to change.