California Rail Electrification

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1. Introduction

>You can always spot the pioneers by the arrows in their backs.

— William H. Calvin, PhD

The California High Speed Rail System (HSR) is an important part of our state's efforts to reduce our greenhouse gas emissions. Currently, there is a huge amount of travel between the San Francisco Bay Area and the Los Angeles Area, and this is mostly by Auto or Airlines. Although there are efforts to reduce the greenhouse gas from both of these transports (go through the link below, section 3.3), a viable rail system between these two areas will contribute mightily to this effort.

My first content on the ongoing effort to electrify California's rail passenger service was a page or so on the California High Speed Rail project in the paper linked below. This project currently seems to be devolving into a political and legal contest, so I thought I would write an update of this project.

https://www.energycentral.com/c/cp/path-net-zero---part-1

The good news is that the current change in direction appears to be likely to bring more benefits to more of California's citizens sooner than the original plan.

2. Recent Developments

Currently work has begun on the HSR Central Valley Segment (Merced to Bakersfield) and several sections are nearing completion (go through the link below). Our former governor (Brown) was a strong supporter of HSR, but it is well behind schedule, and well over budget. Thus our current governor (Newsom) decided to scale it back to just the Central Valley segment for now. I feel that this decision is reasonable. This is by far the most ambitious high-speed rail project in North America, and it was just a bridge too far. Even just the Central Valley segment is the most ambitious project in North America, and it's the easiest HSR segment.

https://buildhsr.com/

Developing the construction infrastructure for such a large high-speed rail project, and also the required specialized engineering expertise, regulatory expertise and all of the required interpersonal relationships are a major development that must be accrued before such a major project can be executed efficiently. After the easiest segment of this project is completed and operating, ensuing segments and other high speed rail projects can be more accurately appraised, and more efficiently executed.

The Central Valley segment mainly goes over flat farmland near major highways and existing rail lines. High-speed rail tracks are very specialized (verses normal rail lines used for cargo transport and commuter service), and their construction over challenging terrain greatly increases the difficulty. Both the planned northern route from the Central Valley to Gilroy (south of San Jose) and the southern route from Bakersfield to Palmdale
(in northern Los Angeles County) must cross over many miles of hilly to mountainous terrain. It is much better to gain experience with the easy segment before attempting the more challenging northern and southern segments. This was the original plan, and this plan is still in place – with a few slight detours.

3. A Rail Line to Nowhere?
The current schedule is to complete the Central Valley segment sometime between 2026 and 2030. However there has been much wrangling over specifics lately, particularly in consideration of the current federal administration's cancelling almost a billion dollars of funding for the project, and threatening to make California pay back $3 billion already spent.

As we pointed out above, this project started out with no expertise in California nor the U.S. on how to build such a system. So how does one estimate and manage such a program when they don't have the required skills? In this case the state hired many very expensive consultants. Those consultants are probably the primary reason for the budget overrun, and schedule slips. The California State Auditor, Elaine Howle released a report last November with an intro statement that said: "California High-Speed Rail Authority: Its Flawed Decision Making and Poor Contract Management Have Contributed to Billions in Cost Overruns and Delays in the System's Construction." 

I believe the only choice now is to, take a step back and:

- Put most of the project on hold except construction currently being executed on the Central Valley Segment

- Hire some strong managers (state employees, not consultants) with extensive experience in managing high-speed rail projects (possibly from Europe, Japan and/or Korea).

- Allow this core team to build a reasonable staff while:
  - First, assessing the construction of the Central Valley Segment and assuring this construction is completed on-time and on-budget
  - Second, assessing the remainder of the project and cost-effectively hibernating it

- Implementing work on the project to link it to existing commuter and passenger rail systems at the southern and northern end of the Central Valley segment.

- Get everything operating by 2030

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I believe the above is consistent with Governor Newsom’s current vision and also the vision of the California High Speed Rail Authority’s Board.3

"The initial cost projections and timelines were simply unrealistic. In 2008, voters were told the project would cost $45 billion. Now, the actual cost appears closer to $80 billion. The federal government chose that the project begin in the Central Valley nearly a decade ago when it deemed that segment worthy of federal funding.

"Having spent more than a decade and billions of dollars, high-speed rail is under construction – progress you can see throughout the Central Valley. And in this document, you will find a report that focuses the limited resources the state has identified to get a working section that can demonstrate the viability of the broader project.

"Some have suggested the state should walk away from the more than a decade of collaboration and progress that Republican and Democratic administrations and a generation of legislative leaders have made to bring the project this far. Such a path would leave California, having spent $5 billion, with nothing but lawsuits, job losses and billions of IOU’s with nothing to show for our debts.

"Given those two options, the path forward is clear. The California High-Speed Rail Authority will continue its efforts toward getting a working section completed in a responsible and transparent way.

"Already, the Newsom administration has made the project more transparent and accountable to the people of this state. During his first month in office, the Governor demanded change orders, cost overruns and travel expenses be made publicly available and published on the high-speed rail website. In his May Budget Revise proposal, the Governor will announce that critical oversight and management functions will be brought back in-house, replacing consultants with state staff. The Authority will also initiate an office-by-office review of other functions more appropriately performed by state officials - not private consultants.

"In keeping with that commitment to transparency, this update estimates the cost for the Bakersfield-Fresno- Merced section, regional bookend investments and Phase I (San Francisco to Anaheim) environmental clearance at $20.4 billion, all while acknowledging that -- as with any major infrastructure project -- those costs could rise with unpredictable developments."

The remainder of this paper will explore how to quickly link the completed Central Valley segment to the remainder of the commuter rail systems in the San Francisco Bay Area and suggestions on how we might do the same for Los Angeles.

4. Northern Linkage

First, for readers that are not familiar with the San Francisco Bay Area, I need to describe our challenges and innovations in commuter rail transit systems. Our first challenge is our topography.

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Let's start with the map below. What this map doesn't show is that is:

- There are several mountain ranges that generally run north and south and take up much of the land. There is one huge valley (Santa Clara, a.k.a. Silicon Valley), several medium sized valleys (Napa, Sonoma and Livermore (where I live: east of Hayward and I-680 and south of I-580))

- Much of the remaining land area is covered by protected wilderness areas and parks.

- There three major faults running north and south: San Andreas you have heard of, it runs near the coast, the Hayward Fault runs through Fremont, Hayward, Oakland, and points North. The Calaveras Fault runs through South San Jose, and then up interstate 680. It's on the east end of the Livermore Valley and continues north.

Because the Bay Area is "buildable-land-challenged" residents have been pushed out of the main part of the Bay Area into southern Santa Clara County and off the above map to the east into the Central Valley.

The transit systems in the Bay Area are really, really complicated. With a few exceptions I will not delve into these. The exceptions are those that pass through the Livermore Valley. This is not because I live here, but because this is how we will connect to the HSR Central Valley segment.

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4.1. BART

The Bay Area Rapid Transit System was another "Pioneer". This was started in the mid-1960s and completed in the mid-1970s (yes, I lived in the Bay Area then). More recently it expanded its original footprint to the east and south. This was really the first modern 100% electric commuter rail system. I remember all of the complaints in the late 1960s about it being over-budget and delayed (sound familiar?). From my travels I know that the electric rail transit systems that were built later in Atlanta and DC are virtual clones of BART. A recent BART line extends into the western Livermore Valley (blue in the map below). There is a really good article in Wikipedia on BART linked below.\(^5\)

![BART Map](image_url)

The second phase the BART link from Fremont to San Jose is scheduled to open before the end of 2019 (the first phase was the extension to the Warm Springs Station). This will have a station in Milpitas and one in Berryessa/ North San José. The third phase (currently unfunded) would add three stations and terminate in Downtown San Jose where it would link with the Cal Train line that provides service to the San Francisco Peninsula and southern Santa Clara County (see map in section 4.4).

4.2. ACE

Back when BART was originally completed (mid 1970s) the Livermore Valley was one of the easternmost bedroom communities in the Bay Area, but in the last decade or two

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commuters have been pushed out into the Central Valley. The freeway from the Livermore Valley to the Central Valley (I-580) goes through the Altamont Pass (yes, the oldest and one of the largest wind resource areas), and although it has been widened and otherwise improved over the last two decades, it still has some of the worst commute-traffic in California.

In 1997, the Altamont Commuter Express Joint Powers Authority (ACE JPA, or just ACE, "Commuter" was changed to "Corridor") was formed by the San Joaquin Regional Rail Commission, Santa Clara Valley Transportation Authority (VTA), and Alameda Congestion Management Agency (ACMA). The goal of this body was to quickly and inexpensively build a rail commuter line from the Central Valley, through the Altamont Pass and the Livermore Valley and to San Jose.

The initial purchase of rolling stock, construction of stations, and other start-up costs, amounted to some $48 million. Station improvements are the responsibility of the county in which the station is located. ACE pays the owner of the right of way, Union Pacific Railroad, about $1.5 million per year. Service began on October 19, 1998, with two daily round trips running to San Jose in the morning and Stockton in the evening. This service has been continually expanded, and now four trains make four daily round trips from Stockton to San Jose. Total daily ridership is 5,900 passengers.

There is just one problem: there is no direct link from ACE to BART (other than express buses). The planned project described in the next subsection hopes to fix that, and quickly. It will also take a different route than ACE for part of its tracks, which will facilitate rail travel for many more commuters.

### 4.3. Valley Link (future)

This important project will connect Northern San Joaquin County communities to the Livermore Valley and BART through frequent and fast rail service via the Altamont Pass. A 12-mile, abandoned right-of-way was deeded to Alameda County by Southern Pacific in 1984. Using this path will provide an unprecedented opportunity to deliver a fast and efficient inter-regional rail service - connecting people, housing and jobs in the Northern California Megaregion and will provide much-needed congestion relief in one of the Bay Areas most congested corridors.

Valley Link will extend initially from the planned ACE North Lathrop Station in the San Joaquin Valley through the Altamont Pass, then connect with the Dublin/Pleasanton BART terminus station in the Livermore Valley, with additional stations in River Islands, Downtown Tracy, Mountain House, Greenville Rd/I-580 in Livermore (shared with ACE), and Isabel Ave/I-580 in Livermore. Note that Mountain House and River Islands are planned communities west and east of Tracy. An initial analysis completed by the ACE found ValleyLink to have competitive travel time (73 minutes from planned ACE N Lathrop Station to BART), significant emissions reduction, and significant environmental benefits. Initial travel demand forecasting shows approximately 25,000 riders per day on Valley Link in 2040.

The California Legislature created the Tri-Valley San Joaquin Valley Regional Rail Authority when it passed Assembly Bill 758, signed by Governor Brown on October 13,

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6 Wikipedia, Altamont Corridor Express, [https://en.wikipedia.org/wiki/Altamont_Corridor_Express](https://en.wikipedia.org/wiki/Altamont_Corridor_Express)
7 Valley Link Project Page (edited), [https://www.valleylinkrail.com/project-concept](https://www.valleylinkrail.com/project-concept)
2017. The Authority will plan, develop and deliver cost-effective transit connectivity in the Tri-Valley between BART and ACE.

The current schedule plans on starting the project in July 2019 with a four to seven year execution time. I don't believe that currently even a preliminary budget has been released. I would guess that it will be in the one to two $Billion range, since a significant amount of new track must be laid (albeit standard gauge non-electrified rails). Also there will be new state-of-the-art rolling stock (see below). ACE uses existing Southern Pacific (SP) tracks that start over the Altamont Pass on the northern side of I-580, but these cross over to the southern side and curve further south to South Tracy. Valley Link will split from the SP tracks and use the abandoned rail path to remain north of I-680, go through the Northern side of Tracy and North Lathrop Station where it will rejoin ACE.

In a recent extension of a BART line from Pittsburg, CA to Antioch (about ten miles) they used eight diesel multiple-units (see below). Per early indications ValleyLink has indicated that they intend to use the same basic design and will use hybrid diesel-electric trains which at some point in the future are planned to evolve to a battery-electric design.

4.4. Detailed Future Northern Connectivity

When Governor Newsom was sworn in he already knew that the HSR project was off the rails (pun intended), so he started the process described above, including using ACE to link HSR to the southern Bay Area and the San Francisco Peninsula (see map below) and ultimately Valley Link to link to BART and most of the rest of the Bay Area.
5. Southern Linkage

After I graduated from college in 1975, I spent a couple of years in "The Southland" before returning to the Bay Area. I noticed a lot of differences between the latter and the former. One was that that LA had virtually no mass transit (other than buses). Although this situation has been remedied in the intervening years, they are still well behind the Bay Area. The really good news is that they appear to have a single agency coordinating most of the rail transit in the LA Area (Metrolink). The Bay Area has many agencies, and they sometimes cooperate, and sometimes not so much (part of our culture of constructive chaos).

The Metrolink Antelope Valley commuter rail route runs from Palmdale to into LA: Palmdale is about 70 miles southeast of Bakersfield. There is Amtrak service from (near) Bakersfield to Palmdale. I will let the Metrolink engineers (et al) decide the best route from the southern HSR terminus into LA, but at least this looks like it's possible.