PAGES 4-5: SANTA CRUZ–WATSONVILLE RAIL IS BEST CHOICE

California Rail News

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New Governor Must Pause High-Speed Rail Plans, Decide Future

New book outlines essential principles for HSR success

By Dr. Gregory Thompson
Special to California Rail News

Editor's Note: Recently, California leaders were quoted by the Sacramento Bee, urging that the current high-speed rail be "paused" and reviewed. For example, University of Califonria Chancellor Janet Napolitano said "...In short, the next governor should take a deep breath, have a project review conducted, and then decide whether to proceed."

TRAC agrees. Thus we present an in-depth review of a recent book on high-speed rail by two highly respected academics from Stanford and UC Berkeley that outlines the essential principles for HSR success.

If California HSR is ever to succeed, it will require a new approach. Photo: RSA, own work

Drs. Blas Luis Perez Henriquez of Stanford University and Elizabeth Deakin of the University of California, Berkeley recently edited an excellent book on high-speed rail (HSR) titled *High Speed Rail and Sustainability: decision-making and the political economy of investment.* Its purpose is to provide an objective context for California's efforts to build a high-speed HSR route connecting San Francisco and Los Angeles.

Roughly the first half of the book is composed of chapters that provide a synopsis of the planning, construction, operation and evaluation of HSR development in a particular country (Japan, France, Spain, Germany, Taiwan, China, Great Britain). The authors are experts on HSR in their particular countries. Most countries with currently operating systems are included. Chapters in the last half of the book focus on various planning and development aspects of the proposed California HSR line.

While the book mildly supports HSR development in California, some of its chapters implicitly criticize the justification for the project. Many advocates of California HSR believe that HSR's primary benefit is its ability to shape dense urban development around its stations. Chapters with benefit-cost analyses of HSR dispute that assertion. What follows are points from those chapters and from those that support the advocates' analyses.

Two chapters examine the urban development consequences of the world's oldest HSR line, between Tokyo and Osaka, which has been in operation for 52 years, a long enough

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Pausing California HSR

(continued from Page One)

period to evaluate its impact on urban investment:

- “It is widely accepted that the primary benefits of HSR investments are the direct ones that accrue to users, mainly in the form of travel-time savings. To the degree that they occur, economic development benefits are mostly second-order and indirect in nature.” (Murakami and Cervero, p. 228)
- “Japan’s commercial redevelopment efforts aim not only to increase business passengers on the Tokaido Shinkansen but also to promote land value capture around the terminal stations... Tokyo, Shinagawa, and Nagoya [terminal or first tier cities] have experienced rising commercial land prices within 5 km of the Shinkansen stations, fueled by large-scale redevelopment projects created through public-private partnerships.” (Murakami and Cervero p. 245)
- **“In contrast, other HSR station settings [in Japan] have seen commercial property values fall.”** (Murakami and Cervero p. 245; emphasis added)
- “The implications are that secondary cities both grow and lose position as a result of vastly increased interregional accessibility. They can resist [downward] trends and protect their regional economies if they have unique assets --- less so if the industries they host are not firmly anchored in place and can be lured elsewhere by lower wages, larger markets, higher level services, more amenities.” (Hayashi, Mimuro, Han and Kato, p. 42)
- “Japanese experiences reveal that very small and intermediate cities failed to reap economic benefits from HSR largely because of their manufacturing and service industry economic bases.” (Murakami and Cervero p. 250)
- **“If the trends and experiences in Japan are repeated in the United States, planned HSR investments are likely to be associated with territorially uneven and highly localized economic development impacts. This is because there are many station areas in the US cases where there is little currently in place for which HSR will be a significant contributor.”** (Murakami and Cervero, p. 245; emphasis added)
- “The comparative advantage of the small intermediate cities in areas like agriculture and traditional manufacturing are the kinds of economic activities that find little value in being near a high-speed passenger rail station in a clustered configuration.” (Murakami and Cervero, p. 251)

In California, examples of agricultural and traditional manufacturing towns that the proposed HSR line must deviate to serve and that likely will not benefit from HSR include Merced, Fresno, Bakersfield, Stockton, and Modesto. The city for which HSR would make its largest detour is also the one with the least attractive chances of benefitting from HSR. This is Palmdale. Palmdale has fewer than 1,500 jobs, all manufacturing, within 5 km of HSR (Table 15.2, p. 238 for definition of job categories; Table 15.5, pp. 246-247 for employment specialization in cities proposed to be served by HSR).

Areas surrounding the San Francisco, Los Angeles and Sacramento terminals as well as Burbank airport will likely see development boosts. If HSR ever gets to San Diego, University City will also likely see development boosts.

Low Usage HSR in Spain

The chapter on Spain’s 25 years of HSR experience provides some support for advocates of California’s HSR’s initiative:

- Despite low traffic density for the HSR lines that have opened in Spain,some analysts assert that the lines have stimulated urban development in intermediate-sized en-route cities. “Without undertaking specific project evaluations, most economic literature has viewed the spatial benefits of HSR as marginal . . . To the contrary, the Spanish example shows that spatial impacts of HSR at the interurban and urban scales are important economically as well as politically.” (Urena, Benegas, and Mohino, pp. 88-89)
- “HSR brings together two types of areas that have different and complementary characteristics: metropolises with high living cost, abundant professionals and high-quality services, and historic, dense small provincial cities that are comparatively less expensive and have plenty of available land, but a relatively small number of highly qualified professionals.” (Urena, Benegas, and Mohino p. 93)
- “However, this requires HSR travel times of an hour or less, frequent services, **cheap fares** and a high level of comfort.” (Urena, Benegas, and Mohino p. 94, emphasis added)
- Major Spanish cities are close enough together to allow HSR to stop more often than expected at small en-route cities and still remain under the 3-hour travel time limit required to be competitive with air service between the major end-point cities (Urena, Benegas, and Mohino, p. 94).
- “It is only in the larger metropolitan agglomerations (Madrid and Barcelona) and some of the major cities (particularly Zaragoza and Valladolid) where there are plans to locate major office buildings around HSR stations. In smaller cities residential uses

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Ensuring California HSR Success

(continued from Page Two)

dominate the redevelopment plans; however, studies in Spain show that HSR stations in small cities are an attractive residential location only for immigrants, while locals prefer to locate close to their families, friends and other amenities away from the stations." (Urena, Benegas, and Mohino, p. 96)

The Spanish experience suggests that an important policy objective was to use HSR to revitalize intermediate cities, but the chapter does not provide enough information to determine whether the objectives are being met.

The studies pointed out key attributes of HSR:

- "The value of business time is absolutely critical to the case of high-speed rail." (Nash, p. 168) Forecasts indicate that benefits to business travelers will total 55% of all benefits generated by HS2 in England. Business travelers value time saved more than commuter and leisure travelers. (Nash, pp. 169 & 180).
- Where rail journey times can be brought close to or below 3 hours [between very large cities], HSR can be expected to take a significant market share of origin-destination aviation markets (Nash, p. 180).
- Many business travelers prefer HSR over air even when door-to-door times for HSR are slightly longer, because HSR offers greater comfort and ability to work undisturbed for longer periods of time (Nash, p. 169).
- "However, the evidence relates to countries with dense cities, where well-located city rail terminals are more convenient for most passengers than are airports, and shorter rail journey times may be needed to compete with air where cities are less dense, as in the United States." (Nash, p. 180).

Making HSR Work in California

Applied to California these points suggest that the only HSR market with heavy traffic potential is between San Francisco and Los Angeles, IF travel time can be kept to around 3 hours. However, the sprawling nature of both areas compared to those served by HSR lines in other parts of the world create doubts.

Also damaging to the California case is the fact that the San Francisco and Los Angeles metro areas each are served by several airports, each offering fre-quent departures to every airport in the opposite metro area. Many residential and business locations have better access to airports than to proposed HSR terminals, particularly in Southern California.

HSR has secondary benefits that include congestion relief for air and auto modes, reduction of energy use, and reduction of greenhouse gas emissions.

- "Of the measured external [secondary] benefits of HSR investment, reduced congestion [of auto and air modes] is the most significant." (Nash, 180)
- "Environmental benefits are unlikely to be a significant part of the case for high-speed rail when all relevant factors are considered, but nor are they a strong argument against it provided that high load factors can be achieved." (Nash, 180)

Two other points call out for further commentary:

- Capital costs per kilometer [or mile] of route are one of the major variables affecting a HSR project's social worth. A project with an estimated capital cost that is evaluated as being beneficial to society will cease being beneficial if capital costs increase substantially without estimated benefits increasing commensurate with capital cost increases. (Nash, p. 181).

This point seems fundamental, but it is ignored by those in California who continue to support HSR regardless of run-away capital costs without any increase in estimated benefits. It would seem that a design objective for the California proposal should have been to minimize the length of the route in mountainous terrain, in order to constrain such cost escalations. Instead, by choosing a circuitous route via Tehachapi Pass and Palmdale on the south, and Pacheco Pass on the north, the project team has maximized the number of miles in difficult mountainous terrain, greatly inflating capital (and likely future operating) expenses.

- NIMBYism is a threat so serious that it could stop HSR construction. It should have been minimized by judicious routing of the HSR line. (O'Hare and Audikana, pp. 322-336).

Again, the California HSR project team's choice of a circuitous alignment has unnecessarily pitted the project against homeowners and land owners through much of its route, particularly by sending it through rich farmland as well as city centers through much of the route in the San Joaquin Valley.

A direct route along I-5 and over Altamont Pass in the north and Tejon Pass in the south not only would garner much greater ridership than the chosen route, but would greatly reduce the threat of NIMBYism while slashing capital and operating costs through a shorter route with much less of it in mountains.

Dr. Gregory Thompson is Professor Emeritus of Urban Planning from Florida State University and a TRAC board member.

Coast Observations

THE AGE OF HYDROGEN TRAINS hasn't quite begun, after all. TRAC sent a reporter to Northern Germany to ride the trains, who discovered one train is out of service and the other is used for only a 5:00 a.m. run daily. Apparently "new tech" teething problems…THE SALESFORCE TRANSBAY TRANSIT CENTER DEBACLE CONTINUES as multiple agencies investigate the cracked steel beams that caused the center's closure. On top of these troubles, a major contractor is suing for $150 million…DOING MEGA-PROJECTS RIGHT IS VITAL for the future of the Bay Area, according to an October 4th article in the San Francisco Chronicle. The authors suggest creating a regional agency focusing exclusively on mega-projects, rather than numerous agencies. But in CRN's view, MTC's track record is underwhelming…SPEAKING OF MEGA-PROJECTS, San Francisco's T-Third light rail line has never lived up to its hype since its opening, since it is so slow. Some people think that another mega-project, S.F.'s $1.8 billion Central Subway, will solve the T-Third St.'s problems. We'll see in 2019…MTC THROWS MONEY AT YET ANOTHER POTENTIAL MEGA-PROJECT, this time a proposed $2 billion commuter rail feeder to the Dublin-Pleasanton BART station duplicating existing Altamont Corridor Express train service… SPEAKING OF MTC, THE CLIPPER FARE CARD REPLACEMENT PROJECT is yet another mega-project, with a contract cost of nearly $500 million. Instead of taking advantage of smartphone transit ticketing apps available for a few years now in other regions, it will produce a newer version of the same old same old…MTC HAD REFUSED TO FORCE BAY AREA TRANSIT OPERATORS TO ADOPT A REGIONAL FARE SYTEM, even though updating Clipper is the ideal time to do so…SPEAKING OF MEGA-PROJECTS, THE SILICON VALLEY BART EXTENSION has been delayed again. Why? Get this! Installation of the wrong computer equipment. In Silicon Valley!…THAT 1960'S MEGA-PROJECT KNOWN AS BART now has four times the ridership it had in 1974, when the full system opened. …SPEAKING OF MEGA-PROJECTS, HIGH-SPEED RAIL MAY TRANSFORM FRESNO. Or it may not, according to a recent article by a think tank. Overseas experience indicates positive impacts are unlikely… FLORIDA'S BRIGHTLINE INTERCITY RAIL MEGA-PROJECT has bought into and, is gambling on, another proposed mega-project, high-speed rail between Victorville and Las Vega$. They've also begun service to their flagship Miami station…CALIFORNIA'S HIGH-SPEED RAIL PROJECT IS THE KING OF 21st CENTURY MEGA-PROJECTS at the moment. A ten-year effort to stop the project hit a roadblock this week, when a court in Sacramento rejected a motion to find unconstitutional the 2016 law that enabled the project to draw on HSR bond funds for construction for the first time…

Santa Cruz “Unified Corridor Study” Scenario B Focusing on

By Michael D. Setty
Editor, California Rail News

On September 28th, the Santa Cruz County Regional Transportation Commission (SCCRTC) released its *Unified Corridor Investment Study: Step 2 Analysis Results.* This study focused on the Highway 1 corridor between downtown Santa Cruz and Watsonville in southeast Santa Cruz County. Each study scenario included a number of individual improvements emphasizing differing strategies, as summarized in Figure 1.

Scenario A emphasized auto-oriented solutions: construction of a third lane on Highway 1 in each direction between Santa Cruz and Aptos Village, restricted to high-occupancy vehicles (HOVs) and transit vehicles during the weekday a.m. and p.m. peak periods, plus “Bus Rapid Transit Lite” (BRT Lite) on Soquel and Capitola Avenues paralleling Highway 1.

Scenario B emphasized implementation of local rail transit on the 22-mile Santa Cruz Branch Line rail-right-of-way between Santa Cruz, Watsonville and Pajaro (e.g., a potential Capitol Corridor connection), but included auto-oriented improvements including ramp metering on Highway 1 and the same BRT Lite.

Scenario C emphasized implementation of an 8.5-mile dedicated busway on the rail right-of-way between Santa Cruz and Aptos, with through buses from Watsonville operating onto the busway, as well as some low-cost auto improvements. Scenario D was eliminated by the SCCRTC board in late 2017. Scenario E was essentially an “All of the Above“ scenario, minus BRT lite.

All scenarios studied included significant improvements for bicyclists and pedestrians, including a trail adjacent to the rail right-of-way (with site-specific variations in how this trail would be implemented).

Figure 2 summarizes projected capital and operating costs for each project included in each scenario.

Why Not Highway Expansion?

The standard response to roadway congestion in the United States (unlike other countries) has been to widen the congested roadway. This approach is tested in Scenario A. Academic studies have concluded that wider highways tend to fill up quickly, due to the phenomenon of induced demand. This means that five years after a widening project, congestion typically is as bad as it had been before the project. However, highway computer models have never accounted for induced demand. This is why the proponents of highway widening are able to claim that their projects will produce benefits, despite the fact that the benefits don’t last long-term.

An entirely different approach to congestion is to build alternative modes of travel–especially those that don’t rely on highway capacity, such as rail. Alternatives can provide convenient reliable mobility, without every getting caught in congestion. Every new transit rider is a benefit for the overall population, because they are not trying to jam onto the freeway. Therefore, from a policy standpoint, the scenario producing the most transit riders–at a reasonable cost–is the most desirable scenario.

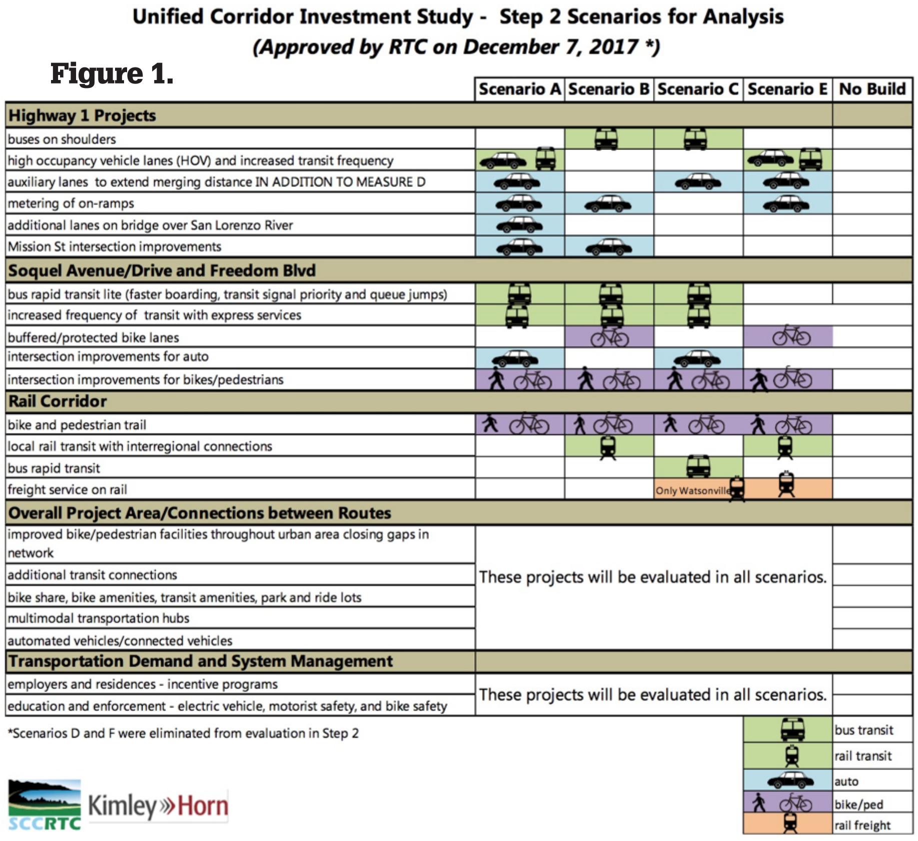
We also note that, as the population grows, rail transit can grow its capacity over time by running longer trains, allowing ridership to keep growing without major capital projects. Highway 1, on the other hand, cannot be widened beyond what’s proposed in Scenario A, unless inconceivable amounts of funding are made available.

A mockup of a battery-powered, possibly automated rail vehicle in fr

Most Cost-Effective Option: Rail Service

Local rail service under either Scenarios B or E is projected to cost $324 million or $14.7 million per mile. This figure includes a very generous allowance for Positive Train Control (PTC), conventional railway signaling and grade crossing upgrades totaling $76.8 million. Compared to the approximately $1.0 million per mile paid by SMART in Marin-Sonoma Counties, projected Santa Cruz costs for PTC and signaling is excessive. It also far exceeds PTC and signaling cost estimates in a number of recent rail passenger corridor studies.

Figure 1.



Unified Corridor Investment Study - Step 2 Scenarios for Analysis
*(Approved by RTC on December 7, 2017 *)*

	Scenario A	Scenario B	Scenario C	Scenario E	No Build
Highway 1 Projects					
buses on shoulders		🚌	🚌		
high occupancy vehicle lanes (HOV) and increased transit frequency	🚗 🚌			🚗 🚌	
auxiliary lanes to extend merging distance IN ADDITION TO MEASURE D	🚗		🚗	🚗	
metering of on-ramps	🚗	🚗		🚗	
additional lanes on bridge over San Lorenzo River	🚗				
Mission St intersection improvements	🚗	🚗			
Soquel Avenue/Drive and Freedom Blvd					
bus rapid transit lite (faster boarding, transit signal priority and queue jumps)	🚌	🚌	🚌		
increased frequency of transit with express services	🚌	🚌	🚌		
buffered/protected bike lanes		🚲		🚲	
intersection improvements for auto	🚗		🚗		
intersection improvements for bikes/pedestrians	🚶 🚲	🚶 🚲	🚶 🚲	🚶 🚲	
Rail Corridor					
bike and pedestrian trail	🚶 🚲	🚶 🚲	🚶 🚲	🚶 🚲	
local rail transit with interregional connections		🚆		🚆	
bus rapid transit			🚌		
freight service on rail			Only Watsonville 🚂	🚂	
Overall Project Area/Connections between Routes					
improved bike/pedestrian facilities throughout urban area closing gaps in network	These projects will be evaluated in all scenarios.				
additional transit connections					
bike share, bike amenities, transit amenities, park and ride lots					
multimodal transportation hubs					
automated vehicles/connected vehicles					
Transportation Demand and System Management					
employers and residences - incentive programs	These projects will be evaluated in all scenarios.				
education and enforcement - electric vehicle, motorist safety, and bike safety					

*Scenarios D and F were eliminated from evaluation in Step 2

🚌	bus transit
🚆	rail transit
🚗	auto
🚶 🚲	bike/ped
🚂	rail freight

SCCRTC Kimley»Horn

The Scenario C busway would be primarily single lane, with some passing lanes within the right-of-way and return bus traffic on parallel local streets where required. Busway capital costs are projected to be $265 million including contingencies and project management, or $32 million/mile.

Some rail critics have declared that local rail service in Santa Cruz County is “unaffordable.” However, the results of the UCS show that all of the scenarios evaluated are expensive. Each will require hundreds of millions in funding for capital costs. Scenario B is the most cost-effective, on a per-mile basis. For an HOV lane on Highway 1 between the Highway 17 interchange and Aptos under Scenarios A and E, projected capital costs are $440 million or $50 million+ per mile. For Highway 1 auxiliary lanes extended three miles from State Park Blvd. in Aptos to San Andreas Road, projected costs are $142 million or $40+ million/mile.

Converting proposed HOV lanes on Highway 1 for joint use as a busway to serve intermediate transit passengers at median busway stations at Morrissey Blvd., Soquel Ave., 41st Ave., Park Ave./Cabrillo College, Aptos Village, and Rio Del Mar Blvd. would be extremely expensive. Widening of the freeway median for safe out-of-traffic bus stops at median busway stations may add $200 million or more, pushing costs to $800 million+. Median stations would also need elaborate facilities for access for persons with disabilities, probably involving major overpass modifications.

Under Scenario B emphasizing local rail service and BRT Lite, train operating expenses are projected to be $14.0 million of the projected $43.9 million additional annual operating expenses. This total includes $12.1 million for additional bus service designed to feed rail stations. While the cost of added local bus service has been added only to the rail scenario, proposed enhancements to local bus service are desirable for all scenarios.

It also appears that operating dollars would go farther with rail. Scenario B local rail service is projected by the UCS to attract 6.0% of all p.m. peak period trips within the county. This may not appear to be a large difference, but the difference in ridership would be concentrated in the Highway 1 corridor, where the congestion is. Under Scenario B, in 2035 local rail service is projected to attract 3,133 p.m. peak period passengers

Rail Maximizes Ridership, Less Costly Than Road Expansion

ont of the Santa Cruz Beach Boardwalk. Source: Friends of the Rail and Trail

in both directions crossing the 17th Ave. screen-line in Live Oak.

This compares to 1,797 p.m. peak period riders at 17th Ave. under Scenario C with a busway on the rail right-of-way. This translates to 11,000-12,000 daily riders in Scenario B by both bus and rail daily riders at this point, or 7,000-8,000 daily by buses only under Scenario C. This assumes that each peak period is about 25% of daily ridership. Under the Scenario C busway, only 4.8% of all p.m. peak period trips would be served compared to 6.0% under Scenario B. Under Scenario B, each additional passenger compared to Scenario C would cost about $5.00-6.00 based on amortization of somewhat higher capital and operating costs. This is significantly less than Metro's current operating and total capital cost per ride. The additional cost of enhanced local service is excluded, since this is also needed to feed Scenario C's proposed busway.

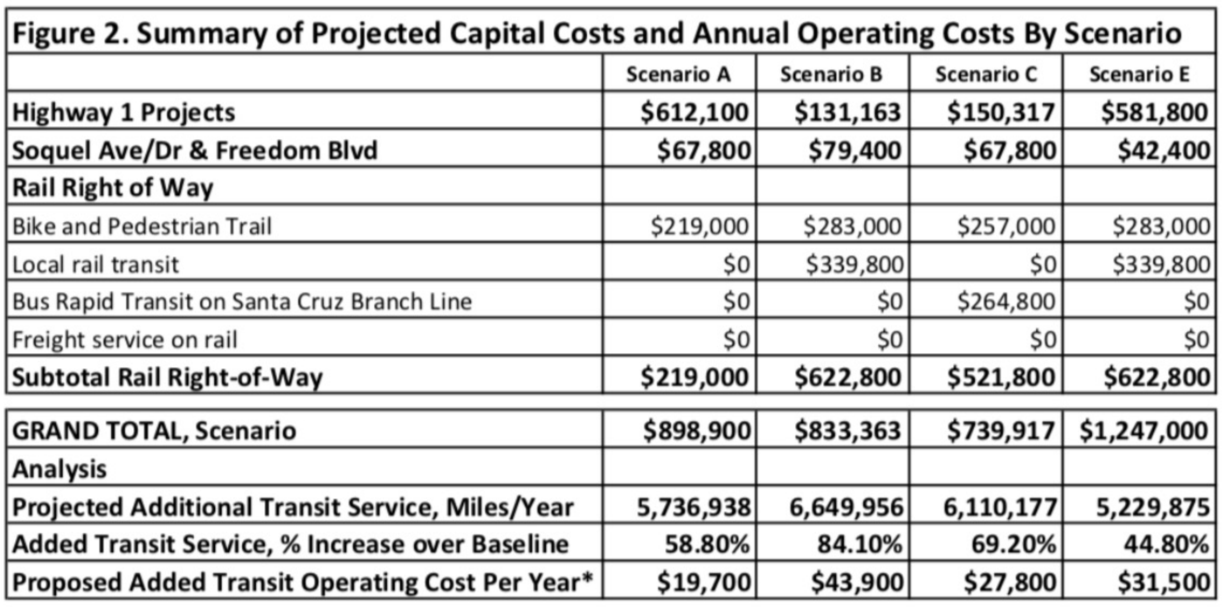


Figure 2. Summary of Projected Capital Costs and Annual Operating Costs By Scenario

	Scenario A	Scenario B	Scenario C	Scenario E
Highway 1 Projects	**$612,100**	**$131,163**	**$150,317**	**$581,800**
Soquel Ave/Dr & Freedom Blvd	**$67,800**	**$79,400**	**$67,800**	**$42,400**
Rail Right of Way				
Bike and Pedestrian Trail	$219,000	$283,000	$257,000	$283,000
Local rail transit	$0	$339,800	$0	$339,800
Bus Rapid Transit on Santa Cruz Branch Line	$0	$0	$264,800	$0
Freight service on rail	$0	$0	$0	$0
Subtotal Rail Right-of-Way	**$219,000**	**$622,800**	**$521,800**	**$622,800**
GRAND TOTAL, Scenario	**$898,900**	**$833,363**	**$739,917**	**$1,247,000**
Analysis				
Projected Additional Transit Service, Miles/Year	**5,736,938**	**6,649,956**	**6,110,177**	**5,229,875**
Added Transit Service, % Increase over Baseline	**58.80%**	**84.10%**	**69.20%**	**44.80%**
Proposed Added Transit Operating Cost Per Year*	**$19,700**	**$43,900**	**$27,800**	**$31,500**

$1,000s of dollars Source: Adapted from Table 38, *Unified Corridor Investment Study - Step 2 Analysis Results,* September 2018

When express transit services are considered, an at-grade busway on the rail right-of-way would have lower expansion capability than local rail capacity and would be less cost-effective overall. An at-grade busway has limited capacity in both directions due to grade crossings. If there are too many buses, crossings would often be blocked, and buses would also regularly catch up ("bunch") with one another, slowing service.

In contrast, trains can be lengthened to serve about 500-600 riders each, so trains only every 15 minutes could carry 2,000 riders per hour each way.

Enhancing Local Rail Service in Santa Cruz County

TRAC proposes some modifications to Scenario B to increase potential rail ridership and improve cost-effectiveness. It would cost the same as Scenario B, but assumes that the estimated costs for PTC and signaling under Scenario B are very high. Using SMART's costs per mile, the savings could instead be used to extend the rail line to within 1/4 mile of downtown Santa Cruz's core, providing a direct connection to frequent bus service to the University of California, Santa Cruz.

The savings appear to also be adequate to purchase more rail cars and to construct a direct freeway overcrossing to Cabrillo College for bicycles, pedestrians and automated mini-buses, as suggested in TRAC's first Santa Cruz County position paper (linked here: **http://www.calrailnews.org/trac-position-papers/**).

Rail ridership estimates by the UCS are similar to those found in the 2015 rail feasibility study. In our first position paper, we estimated that extending service directly to downtown Santa Cruz, a connection to Cabrillo College and more frequent 15-minute peak period service westward from Rio Del Mar would increase potential ridership to 11,000–14,000 daily compared to the 5,000-6,000 daily predicted by the 2015 study under (then) current conditions.

As noted in another article in the Rail News, rapidly improving technology could dramatically reduce rail operating costs through automation, and offer zero-emissions battery-powered propulsion. If more frequent service can be provided due to lower rail operating costs, much higher patronage would be likely than even TRAC's estimates above.

Corridor Travel Volumes Matter

The Highway 1 corridor between Santa Cruz and Watsonville is quite similar to the Highway 78 corridor between Oceanside and Escondido in Northern San Diego County. Total travel volumes are similar in both corridors, but in addition, Oceanside–Escondido has "Sprinter" rail service. Currently, the Sprinter carries about 10,000 per day with 30-minute headways, which is more than projected for Watsonville-Santa Cruz rail in 2035.

The Santa Cruz-Watsonville corridor has numerous advantages for rail that the Highway 78 corridor does not:

1. Highway 1 is much more congested than Highway 78.
2. The Escondido Sprinter station is nearly a mile from the center of downtown. With relatively minor changes proposed by TRAC to Scenario B, trains can operate to within 1/4 mile of the core areas of both downtown Santa Cruz and Watsonville.
3. There are almost twice as many jobs along the Santa Cruz Branch Line within 1/2 mile of potential stations compared to the Sprinter between Oceanside and Escondido.
4. There are nearly twice as many residents living with 1/2 mile of potential rail stations along the Branch Line than along the Highway 78 corridor.
5. Compared to the rolling hills encountered by the Sprinter, the Santa Cruz Branch Line is relatively level, so service would be about 20% faster.
6. Local transit-riding culture is well-established compared to Northern San Diego County, even though Metro ridership has declined recently due to service cuts.

Seventh but most significantly, the Santa Cruz Branch Line has direct access to most area beaches that collectively attract 8-9 million+ annual visits. TRAC's second position paper on Santa Cruz County rail service (linked here: **http://www.calrailnews.org/trac-position-papers/**) proposes excursion train service to Santa Cruz-area beaches in both directions from the Boardwalk, and to other attractions including downtown Capitola and Aptos Village. Providing visitors with non-auto access would not only improve traffic, it could help subsidize transit operations for residents. To do so, sufficient peak period capacity would be needed for weekday commutes, for weekend tourist peaks, and during midday and evenings over the summer beach season.

With all these factors combined, TRAC believes ridership potential is seriously understated.

Conclusion

While the Unified Corridor Investment Study offered projections for 2035, in the final analysis, the more important public policy question is "Will this investment continue to provide benefits for the next hundred years? Cities in Europe, for example, are still reaping the mobility benefits of projects completed a century ago. It is clear to TRAC that investing in local rail service with a strong feeder bus network, Scenario B, is the superior alternative for the near-term, and even more so for the longer-term.

A 21st Century Rail Renaissance: Automation & Batteries

By Michael D. Setty
Editor, California Rail News

By almost all accounts, Elon Musk is a genius. He has managed to take proven but heretofore very expensive technologies of rockets, electric cars and large-scale battery storage and dramatically reduce their cost. While Musk's SpaceX rockets still are very expensive to launch, they are much cheaper than rockets launched by NASA. Musk's Tesla electric cars are still very pricey, but much cheaper than past attempts at developing electric cars. Tesla batteries are still very expensive at about $20,000 for a 100-kilowatt hour Tesla Model S or X battery pack, but they are still far cheaper than traditional large-scale batteries.

But like any human being, Musk has had and continues to make his share of mistakes. Tesla is still learning how to efficiently manufacture automobiles and create attractive working environments, learning hard lessons that Detroit dealt with many decades ago. Musk's Nevada Gigafactory for mass production of batteries has not expanded nearly as quickly as Musk had earlier hyped. Musk has also generated some rather goofy and eccentric ideas, such as the unproven Hyperloop concept, a dubious proposal that suffers from the high costs of high-speed rail (HSR), but without the very high capacity.

Similarly, Musk's claims about fully-automated vehicles (AVs) have proven decades premature, and may never be feasible. The Boring Company might be helpful in reducing tunneling costs, but would be wasted on Musk's plans to operate very-low capacity, costly "sleds" for individual automobiles through his proposed urban tunnel networks.

Despite the shortcomings of some of Musk's ideas, in the near-future, rail advocates may be very thankful for those of Musk's initiatives that work. Tesla has dramatically reduced the price of large storage batteries, which make battery propulsion an increasingly feasible and economic alternative to electrifying railroads with overhead wires. Batteries are now sufficiently affordable and lightweight that rail passenger vehicles can travel many miles before needing recharging. For example, a 60-ton, 100-seat battery electric railcar with typical stations spacing can travel 25+ miles on one Tesla 100-kilowatt battery pack that would propel a Model S or X about 300 miles. When considering the energy cost of building rails vs. road construction, along with the potentially very high utilization of railcars, rail could be several times as efficient as electric cars.

A depiction of 20-passenger automated, battery-powered streetcars in Coventry, England.
Source: University of Warwick Very Light Rail (VLR) Innovation Centre, Warwick, UK

Using Automation More Effectively

While AVs "sort of" work under direct human supervision, most cannot adequately deal with the many variables of urban traffic, such as unpredictable pedestrians and bicyclists, erratic human drivers, as well as any weather that isn't clear, dry and sunny. While AVs may be able to adequately function when provided with electronic guideposts buried in the pavement, it is fanciful to believe that Caltrans and the other road bureaucracies are competent enough to keep such AV guidance devices properly-maintained and up to date.

A depiction of a 60-passenger very light rail vehicle for lower volume branch line services.
Source: University of Warwick Very Light Rail (VLR) Innovation Centre, Warwick, UK

Many observers are concerned that the press-led AV hype is fundamentally misguided. These hagiographies for AVs are oblivious to their potentially very large negative impacts, including potentially generating many more daily vehicle miles. AV implementation could result in average occupancies of 0.5 persons or less, counting all mileage for taxi-like "deadheading" to pick people up and idle times between riders.

However, several companies in Europe and the U.S. have demonstrated that automated transit vehicles are technically feasible on surface roadways, without separate fixed guideways. Examples include demonstration projects in the Netherlands, France, Sweden, Germany and Switzerland and the U.S. There is also the nearly 50 years of automation experience with BART and the 1970's era "personal rapid transit" system in Morgantown, West Virginia (though the size and cost of the Morgantown guideways made the technology too expensive for widespread application to the U.S. transit industry).

Automated transit technology is rapidly improving. The operating environment in which automated buses—-or automated streetcars—-would run is relatively simple compared to the much more complicated urban road environment faced by automated

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automobiles. Already, major rail vehicle manufacturers have had significant success with automated light rail cars. In Potsdam, Germany, automated streetcar experiments are going especially well. The fact that tracks are fixed and railcars are thus self-steering–whether in exclusive right-of-way or embedded in streets–means that automated railcars would not have to steer, so rail service would be even simpler to operate than automated buses.

A few academic studies have predicted that shared ride AVs such as automated taxis and minibuses could attract many auto drivers, since the high cost of owning automobiles in urban areas could be eliminated or greatly reduced. However, because such studies emerge from the dominant auto-mobility mindset, they tend not to offer a comparison to an equally advanced transit technology. They never consider the fact that automated fixed-route buses or streetcars running every few minutes, particularly if operated in dedicated lanes, would be much more convenient to use.

Automated taxi enthusiasts forget that walking a few minutes to a fixed route stop with frequent service will usually be quicker than waiting 5-10 minutes for the automated taxi to arrive, deviate to the next customer(s) requiring another 5-10 minutes, and only then traveling to your destination.

After the hype dies down and the challenges of autonomous driving prove to be more difficult to solve than previously understood, it may just turn out that rail advocates have the last laugh. The author believes that very soon, automated streetcars and light rail vehicles in dedicated lanes, and automated commuter rail trains on exclusive rights-of-way will be technologically and economically feasible.

Researchers in England are currently developing automated, battery powered 20-seat streetcars and 60-seat railcars for lower-volume suburban and rural rail routes expected to be ready for deployment within the next 3-5 years.

Eventually, such services could be supplemented by automated fixed-route buses on local roads, operated both as local service and as rail feeders, particularly where potential ridership cannot justify upgrading an existing rail line or new construction. In North America, automated rail vehicles might make branch line rail services in rural areas and smaller urban areas economically feasible, and potentially profitable in situations such as tourist areas.

Tuning SMART for Success

By Michael D. Setty
Editor, California Rail News

Long-time SMART-hater Mike Arnold's "Marin Voice" on SMART in the September 2, 2018 edition of the *Marin Independent Journal* had little to offer the reader, other than a mega-dose of sour grapes. It would be far more constructive to discuss how SMART can be optimized by applying rail best practices from Europe.

The current, increasingly crowded conditions on Golden Gate Transit's San Francisco–Larkspur ferries show that there is strong and growing demand for express transit in the Highway 101 corridor. Once SMART has its full complement of operations personnel and vehicles, it could be serving many more passengers. Plugging gaps in the schedule and increasing peak period capacity will make a big difference in ridership. Moving from commute service to all-day service typically increases ridership significantly, as many more people find the train fitting their travel needs.

SMART needs to apply best practices from Europe to the Highway 101 corridor. For example, in Switzerland and other European countries, trains and buses run on "clockface headways," e.g., service arrives and leaves at the same time every hour on the hour 7 days per week, regardless of whether service runs every 15 minutes, every 30 minutes, or hourly. Even service as infrequent as every two hours or only a few times per day in remote rural areas are scheduled at the same times past the hour.

Clock headways are very easy for passengers to remember. They also make it easy to organize regional networks. One can travel hundreds of miles across Switzerland with minimal delays, even if several connections are required.

The Swiss National Railways, along with its rail and bus partners, have perfected the concept of "timed transfers" based on clock headways. They provide cross-platform connections at key stations where trains and buses connect, usually with less than 5 minutes of delay at each transfer point. Train and bus travel times in Switzerland between these timed transfer points have been optimized to allow connections at the same times past each hour, facilitating transfers and minimizing connecting time delays.

While the San Rafael Transit Center offers timed transfers between buses, SMART's schedule frustrates bus-train and train-bus transfers. SMART has chosen to not match the hourly and half-hourly departures of the buses. Instead, its departures are a minute earlier, causing some transferees to miss the train. Preliminary research by TRAC has uncovered an apparent system design error by SMART. We call for studying a fix that would enable simultaneous SMART and bus departures, with arrivals 5 minutes earlier, to allow adequate transfer time.

A well-integrated feeder bus network is essential in maximizing the convenience of the transit alternative. Improved bus facilities are needed at a number of SMART stations to allow cross-platform connections as close as possible, where such facilities either do not exist or are an unreasonable walking distance from train platforms.

In some cases, new stations may be needed. For example, a SMART station at River Road in Fulton including a bus loop adjacent to the train platform could dramatically reduce transit travel times to/from Russian River communities, with new timed connections with SMART trains.

Similarly, a ¼ mile elevated extension of SMART from its station in Larkspur to an elevated platform above Golden Gate Transit's ferry dock would provide an attractive ferry feeder service. While potentially very expensive, it would appeal to ferry riders who generally shun buses, greatly relieving the current severe parking shortage.

A new ferry-SMART direct connection potentially could attract several hundred thousand new trips per year from San Francisco, with its new uncongested, non-highway access to the 101 corridor's Wine Country. This tourism revenue could support additional service, stretching current operating subsidies much further.

In conclusion, with sufficient investment over the long run, SMART ridership could increase by an order of magnitude, becoming a heavily-used, key transit service in the Highway 101 corridor, as originally envisioned.

Michael D. Setty is Editor of California Rail News. He has 40 years of transit industry experience, including as a member of the team that developed the successful Vallejo Ferry.

Hydrogen-Powered Rail Has Arrived

The first full-size hydrogen train is now carrying passengers in Germany. Source: Alstom

By David Schonbrunn
TRAC Vice President for Policy

The Age of Hydrogen Rail arrived in September 2018 (The Age has been delayed slightly. See Coast Observations). Alstom's Coradia iLint hydrogen fuel cell-powered trains began operating in revenue service then, in the Bremerhaven area of Germany. The two prototypes are able to travel over 600 miles between refuelings, making a top speed of 87 mph. Fourteen more trains have been ordered for this German regional transport authority, which has over 120 diesel DMU trainsets that will also require replacement soon. Renewable electricity to generate hydrogen will eventually come from wind, making these truly zero-emission trains.

Significantly, operators are starting to select hydrogen trains instead of catenary electrification in efforts to reduce diesel emissions. Stadler will produce 5 hydrogen trainsets for Austrian operator ZVB, which decided to go with hydrogen after opposition emerged to its electrification plans.

Toronto, Canada, has completed a study finding hydrogen-powered trains to be a technically feasible alternative to electrification for GO Transit.

With all these developments, it's time to squarely address the safety concerns that have dogged hydrogen ever since a catastrophic fire destroyed the Hindenburg zeppelin airship.

The safety of a hydrogen-powered system can best be understood by analyzing each of its sub-systems separately:

The tank. The tank for storing hydrogen is seemingly the most vulnerable part. However, today's storage technology has nothing in common with the Hindenburg's rubberized gas bag. Modern tanks are made of carbon fiber wrapping an inner liner normally made of aluminum or high-density polymer. Tanks for railroad use are designed to be operated at pressures 350 times the standard atmospheric pressure. (For fuel cell automobiles, the tanks operate at 700 times atmospheric pressure.) These tanks are literally bulletproof. They are designed to survive crashes without being breached. If a tank should become too hot, perhaps because of exposure to a fire, a thermally activated pressure relief valve will dump hydrogen fast enough to prevent the tank structure from being breached by high pressures, after being weakened by high temperatures--yet slow enough to avoid serious damage.

The piping. Another worry about hydrogen trains is the potential for a derailment to damage the piping system that connects the tank to the fuel cell. Hydrogen systems are designed with a valve that shuts off the tank if it senses the pressure has dropped in the connecting piping, or sensors detect a hydrogen leak. The gas left in the piping will disperse quickly, Even if it should be ignited, there will not be enough of it to cause any damage.

The fuel cell. The fuel cell is the power source for the vehicle's electric traction motors. It converts hydrogen from the tank and oxygen from the surrounding air into electricity. The only exhaust is pure water. The fuel cell stack is a compact unit which can withstand significant impacts and – like the piping – contains only a minimal amount of hydrogen.

Refueling. The refueling equipment, including seals and the nozzle that connects the refueling station to the train, is designed as a hermetically sealed system. It does a self-check regarding leaks before each refueling process, minimizing the risk of a leak. As no hydrogen is released into the environment, it is actually safer to refuel with hydrogen than with gasoline. Typically, gasoline vapor is released during refueling, which can be ignited by the use of a cell phone!

Passengers are the First Priority of European Rail Service

By David Schonbrunn
TRAC Vice President for Policy

The most striking thing about the German and French transit I sampled, besides the sheer amount of it available, is the amount of care and resources that have gone into providing an excellent passenger experience. Buses, trams and trains all work together as an integrated system. I hypothesize that these societies see transit use as an essential part of life, and devote resources accordingly. In the States, transit is only an afterthought, since "most people drive."

This caring is most evident in their passenger information systems. Where American transit riders are pretty much left on their own, Europeans provide passengers with arrival information at bus stops, train stations, and on board transit vehicles. While older systems have automated Next Stop announcements, newer vehicles have graphic displays that show not only upcoming stops, but the connections available at each. Some systems are even able to provide real-time arrival information for connecting lines!

Unlike BART or Amtrak, the public address announcements are made in a pleasant human voice. They are natural sounding, and not machine-like, despite being obviously automated.

Germany has adopted the "clock face" approach to scheduling. Trains and buses tend to be scheduled at the same number of minutes past the hour, all day long. If there are 3 buses per hour on a line, one will arrive at the stop pretty much every 20 minutes. Not only does the regular spacing make it easy for local residents to catch buses, trams and trains, it makes scheduling connections relatively easy.

Major train lines are all electrified. Combined with excellent right-of-way maintenance practices, this produces an unusually smooth and quiet ride, unlike anything available in the U.S. It was eye-opening to see definitive proof that there's no excuse for noisy systems like BART.

One quite different European practice is that doors are opened individually by passengers. The button lights up green when the door can be opened. They close by themselves after a moment, if no one is blocking closure. The American practice, opening all doors at every stop, uses more energy, and imposes higher heating/cooling loads.

HSR Meets HV

TRAC's newest Board member has been digging up extraordinary information about the planning failures of California's HSR project. Susan MacAdams is perfectly positioned to do so, having worked for LA Metro as its HSR planning manager.

In her comment letter on the 2018 HSR Business Plan, Susan pointed out mission-critical information that had been left out of the Business Plan: the very high cost and long planning processes required to provide safe clearances between HSR catenary wires and overhead high-voltage (HV) power lines crossing the proposed right-of-way. By ignoring (or burying) this information, the HSR project is sure to experience yet more delays and cost overruns.

The letter, along with many other of her comment letters on HSR and Metro projects, is online at **CalRailNews.org/Southland.**