Making the Most of High-Speed Rail in California

Lessons from France and Germany

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Executive Summary

As California plans for its growing population and mobility needs, many believe that high-speed rail (HSR) could be a cost-effective and environmentally friendly alternative to expanding highways and airport terminals.[1,2] Indeed, HSR experts agree that California has large enough cities spaced at appropriate distances from one another to make HSR viable. For example, the distance between San Francisco and Los Angeles along the planned HSR route is about 450 miles. This distance is too far to be quickly traveled by car or conventional rail.[3] At the same time, it is also what many transportation experts consider to be an inefficient distance to be covered by airplane if one accounts for the time spent getting to airports — typically located outside of cities — passing through security, and boarding planes.[4] People traveling from San Francisco to Los Angeles by plane will spend less than an hour in the air, but their door-to-door travel time may be closer to five hours. In spite of these inconveniences, the Los Angeles — San Francisco corridor is one of the busiest short-haul flight corridors in the world, and by far the busiest in the United States.[5] Given that HSR stations can be located in city centers and knit into densely populated urban districts — places that are closer to travelers' typical origins and destinations — HSR can offer quicker door-to-door travel times than airplanes for medium-distance trips, those in the 100- to 500-mile range. Since HSR can be brought into city centers and dense urban neighborhoods, HSR stations also tend to be better connected to urban public transit networks than airports. And where travelers' ultimate destinations are neither within a comfortable walking distance[6] nor easily reached by transit, so-called "last-mile" modes such as bicycling, bike share, and car share can play a meaningful role in bringing passengers to and from stations.

HSR is also an attractive option for California due to its anticipated effects on economic development. The state's economy, if compared to the economies of other countries in the world, would be the world's eighth largest, and the majority of this wealth is generated in communities that are along the HSR route, particularly in Greater Los Angeles and the San Francisco Bay Area. Eight of the ten most populous urban centers in the state are planned to have an HSR station. The Los Angeles — Long Beach — Santa Ana metropolitan area alone accounts for over one-third of California's gross domestic product (GDP).[7] By facilitating transportation between the state's major urban centers, HSR will make it easier to do business in both places and elsewhere along the corridor, which will have a beneficial effect on economic development. Finally, the high-speed rail project promises to offer a new, more environmentally friendly mode of intercity transportation[8] for the state that will help it achieve some of the aggressive greenhouse gas reduction goals that are required under California law.[9]

Though all of these factors seem to provide a solid basis for building high-speed rail in California, many are concerned that most of the

1 Egon Terplan. "Beyond the Tracks: The Potential of High-Speed Rail to Reshape California's Growth" (San Francisco Planning and Urban Research Association Policy Paper, January 2011), http://www.spur.org/publications/library/report/beyond-tracks.

2 For the purposes of this report, I employ the European Union's definition of HSR. According to the EU, high-speed lines include dedicated tracks that are specially built for speeds in excess of 250 kph (155 mph), as well as specially upgraded tracks that are designed for speeds of 200 kph (125 mph) or greater.

3 For the purposes of this report, trains that travel at speeds lower than 79 mph are considered "conventional." This is the maximum speed of most passenger rail vehicles that operate in the United States today.

4 The consensus among transportation economists is that HSR is best-suited to trips in the range of 100 to 500 miles (150-800 km). See http://www.fbbva.es/TLFU/dat/inf_web_economic_analysis.pdf, p. 73.

5 "Domestic Airline Consumer Airfare Report-2013, Table 1". U.S. Department of Transportation.

6 The maximum distance that transit riders are typically willing to walk to a transit station is a half mile, which represents a ten-minute walk. This is also the radius that is commonly used to define the limits of station areas for land use planning purposes in transit-oriented development efforts (for example, see the Metropolitan Transportation Commission's Transit-Oriented Development Policy: http://www.mtc.ca.gov/planning/smart_growth/tod/TOD_policy.pdf). HSR stations will draw passengers from a larger area, however, likely up to a mile. As such, a larger walking radius may be appropriate.

7 According to World Bank data. See http://www.ccsce.com/PDF/Numbers-July-2014-CA-Economy-Rankings-2013.pdf.

8 See http://www.fbbva.es/TLFU/dat/inf_web_economic_analysis.pdf, p. 30.

9 California Assembly Bill 32 and Senate Bill 375 are the most relevant on this point.

state's proposed station cities lack two ingredients that, for the reasons discussed above, make for the successful high-speed rail service in Europe and Asia: 1) dense activity centers within walking distance of future station sites; and 2) seamless connections between rail and local public transit networks. Therefore, the salient question for California is: How can HSR succeed in California without both promoting urban density around stations at levels that are currently uncommon in most of the station host communities and increasing typically expensive transit connections? Without convenient alternative connection options, most HSR passengers will drive to the stations. Expansive, costly parking structures will limit possibilities for denser land use around stations over the long term. This, in turn, will also reduce opportunities for the state to maximize return on its investment in HSR. Moreover, it will do little to decrease traffic congestion, greenhouse gas emissions, and increase transit ridership.[10]

In my role as liaison between the Federal Transit Administration and the California High-Speed Rail Authority (CAHSRA), the state agency responsible for implementing high-speed rail service in California, I grapple with the challenges that HSR will have in providing robust and convenient local transit connections in cities. France and Germany, the two European countries with the most HSR experience in Europe, have significant expertise to share with California on this topic. This is why, with support from the Urban and Regional Policy Program of The German Marshall Fund of the United States, I traveled to France and Germany to study these topics in the fall of 2013. Through my travels, I focused on three primary research questions:

- What are the primary differences between the French and German models of HSR development?
- How do French and German cities plan for and manage development within high-speed rail station neighborhoods as a means of stimulating economic development?
- What policies and practices have German and French cities employed to facilitate non-auto access to HSR stations?

In this report, I argue that in order for HSR to deliver on its promise to 38 million Californians and investors, the project must be designed as the backbone of a comprehensive system for sustainable passenger mobility in California. We are at a critical juncture in the timing and execution of one of the state's largest ever infrastructure projects, which will have an enormous impact on the state's future. HSR is a transportation technology that will link the state's major urban centers with a mode of intercity travel that is much more energy efficient and environmentally friendly than the car or airplane.[11]

However, in order for HSR to serve as the backbone of sustainable intercity transportation in California, the project's definition must extend beyond HSR route planning to include sustainable local transportation connections and careful station area planning. Cities across France and Germany demonstrate how HSR can be a powerful tool for strengthening cities and towns along HSR corridors in economic, social, and cultural terms. With careful planning, the same can be achieved in California. This is why the CAHSRA is funding planning efforts in most of the cities that will have HSR stations, to ensure that each station area is designed to maximize HSR-supportive development within station areas. A central focus of this report, therefore, is to highlight best practices from Europe that can help inform these CAHSRA-funded planning efforts.

10 CAHSRA policy calls for "[l]imits on the amount of parking for new development and a preference that parking be placed in structures," but local land use authorities will have decision-making authority over the amount and arrangement of parking within station areas, authorities that may not be naturally inclined to think about development opportunities and associated changes in travel behavior for stations over a long-term (50-year +) time horizon. See http://www.hsr.ca.gov/docs/programs/green_practices/station/HST%20Station%20Area%20Development%20-%20General%20Principals%20and%20Guidelines.pdf.

11 Frédéric Dobruszkes and Moshe Givoni (2013), "Competition, Integration, Substitution: Myths and Realities Concerning the Relationship between High-Speed Rail and Air Transport in Europe," in Lucy Budd, Steven Griggs, and David Howarth (ed.) *Sustainable Aviation Futures (Transport and Sustainability, Volume 4)* Emerald Group Publishing Limited, pp. 175-197.

Summary of Key Lessons

My research revealed a number of underlying key lessons, which are listed below. In the conclusion of this report, these key lessons are translated into actionable policy recommendations.

1. **There are trade-offs between achieving high operating speeds and maximizing connections.** In planning for HSR, there is always a tension between maximizing train operating speeds to reduce trip times and stopping trains frequently to maximize connections. France emphasizes the first approach, while Germany emphasizes the second. In assessing the advantages and disadvantages of both models, it is clear that high speeds should be prioritized in sparsely populated areas, while maximizing connections should be the primary consideration in densely populated areas.
2. **Central city stations maximize the economic development and mobility benefits of HSR.** Secondary sub-center stations in large urban areas can also bring HSR closer to many patrons without significantly slowing service. In contrast, stations located outside of densely urbanized areas usually remain park-and-ride stations and do little to attract economic development.
3. **HSR stations have inherent urban design advantages over other types of transportation facilities.** Unlike airports and roadway infrastructure, HSR stations can be inserted into dense urban contexts. California must recognize these comparative advantages and design HSR stations and tracks to make the most of them.
4. **HSR stations should celebrate their non-transportation functions.** Stations should serve not only as transportation facilities that process passengers efficiently, but also as important public places: places for people to gather, shop, and take care of everyday needs. Additionally, the stations themselves can serve as pieces of connective urban fabric that can link neighborhoods that would otherwise be physically divided by railroad tracks.
5. **High-density employment and commercial uses are best for HSR station districts.** High-density employment and commercial uses are best for tapping the economic development potential of HSR and for maximizing ridership for HSR. Residential and cultural uses can and should play a supporting role in ensuring round-the-clock activity within station districts and to avoid the creation of single-use office districts that are devoid of life outside of daytime business hours.
6. **Access to HSR stations via space-efficient modes of transportation should be prioritized.** Land within HSR station areas is a scarce and precious resource that will become more valuable over time. Bearing this in mind, planners should prioritize access to stations by space-efficient modes of transportation, including walking, transit, bicycling, taxi, and car share. If these modes are not pleasant and convenient, passengers will resort to the land-hungry default, the private automobile.
7. **Within HSR stations, first-rate intermodal physical connections between HSR and non-auto access modes are essential.** In order to encourage access to stations by space-efficient and environmentally sustainable modes, physical connections between those modes at HSR stations must be as simple, short, seamless, intuitive, and pleasant as possible.
8. **It should be easy to pay to use sustainable and space-efficient local access modes to HSR stations.** Another way to encourage access to HSR by space-efficient modes such as transit, bicycling, and car share is to make it easier to pay to use these modes in conjunction with rail travel. This can be accomplished through integrated fares and innovations in payment systems, both at the local and state-wide levels.
9. **It is essential to articulate and maintain bold long-term visions for HSR corridors and stations.** California's HSR system will not mature for many decades. We must be careful not to make decisions that we will regret in 50 years. In order to avoid this unfortunate possibility, Cali-

fornia must articulate a bold vision for HSR stations and the HSR system as a whole. It must also ensure that this vision is clearly publicized, understood, and maintained over the long-term.

10. **Each station area should establish a cross-cutting governance entity to lead station area planning efforts as early in the process as possible.** A distinguishing feature of the most successful HSR station design efforts, both in Europe and the United States, is that they began with a robust visioning process that was managed by a single entity whose purpose was to develop and implement that vision. This governance structure is essential to avoid the tendency toward piecemeal decision-making that can hamstring station area planning efforts.

Following from the examination of these topics, I propose the following policy recommendations for California and its HSR station cities. These recommendations are listed from the broadest to the most specific.

1. Develop, articulate, and hold bold long-term visions for HSR corridors and stations.
2. Wherever possible, California should site HSR stations in central city locations.
3. There are trade-offs to maximizing HSR travel speeds and maximizing connections by stopping trains. Emphasizing connections makes sense in dense urban areas, while speed should be prioritized in sparsely populated areas.
4. California must provide first-rate physical intermodal connections within HSR stations between non-auto access modes and HSR.
5. Make it easy to pay to use sustainable and space-efficient access modes and ensure seamless service coordination between local transit and intercity rail service.
6. Each station area should form a cross-cutting governance entity that will allow for the type of visionary, long-term, and integrated design for stations and station areas as described in P1 as early in the planning process as possible.
7. Prioritize land uses within station areas that will maximize ridership for HSR.
8. Recognize the inherent urban design advantages of HSR stations over other transportation facilities, and design them to make the most of these advantages.
9. Recognize, celebrate, and plan for train stations' non-transportation roles.
10. Encourage bicycle use as a space-efficient access mode that could serve an increasingly important role in bringing Californians to HSR stations.

Introduction

Background

As California plans for its growing population and mobility needs, many consider high-speed rail (HSR) to be a cost-effective and environmentally friendly alternative to expanding highways and airport terminals.[12,13] Indeed, HSR experts agree that California has large enough cities spaced at appropriate distances from one another to make HSR viable.[14] For example, the distance between San Francisco and Los Angeles along the planned HSR route is about 450 miles. This distance is too far to be quickly traveled by car or conventional rail.[15] At the same time, it is also what many transportation experts consider to be an inefficient distance to be covered by airplane if one accounts for the time spent getting to airports — typically located outside of cities — passing through security, and boarding planes.[16] People traveling from San Francisco to Los Angeles by plane will spend less than an hour in the air, but their door-to-door travel time may be closer to five hours.

Given that HSR stations can be located in city centers and knit into densely populated urban districts — places that are closer to travelers' typical origins and destinations — HSR can offer quicker door-to-door travel times than airplanes for medium-distance trips in the 100- to 500-mile range. Since HSR can be brought into city centers and dense urban neighborhoods, HSR stations tend to be better connected to urban public transit networks than airports. And where travelers' ultimate destinations are neither within a comfortable walking distance[17] nor easily reached by transit from HSR stations, so-called "last-mile" modes such as bicycling, bike share, car share, and taxi can play a meaningful role in bringing passengers to and from stations. These reasons, along with the fact that train travel produces far less air pollution and greenhouse gas emissions than plane or car travel, are behind a growing sentiment in transportation planning circles and the United States that airplanes are the wrong tool for medium-distance trips. Indeed, this is the logic behind the European Union's Transforum 2050 Initiative, which aims to triple the length of Europe's HSR network by 2030 and to ensure that a majority of medium-distance travel is done by rail by 2050.[18]

HSR experts agree that successful HSR corridors satisfy a number of preconditions, including:[19]

- Large urban centers located along the HSR corridor, spaced ideally between 100 to 500 miles apart. Distances below 100 miles are best covered by conventional rail or car, while distances above 500 miles are best traveled by airplane. The most successful HSR corridors have a number of large cities distributed along a corridor with a total length of 500 miles or less.
- High levels of economic activity along the corridor. HSR systems depend heavily on business travel to sustain ridership, and business travel is highest in places with more productive economies.
- Dense activity centers within walking distance of HSR stations.

12 Egon Terplan. "Beyond the Tracks: The Potential of High-Speed Rail to Reshape California's Growth" (San Francisco Planning and Urban Research Association Policy Paper, January 2011), http://www.spur.org/publications/library/report/beyond-tracks.

13 For the purposes of this report, I employ the European Union's definition of HSR. According to the EU, high speed lines include dedicated tracks that are specially built for speeds in excess of 250 kph (155 mph), as well as specially upgraded tracks that are designed for speeds of 200 kph (125 mph) or greater.

14 See Frédéric Dobruszkes and Moshe Givoni (2013).

15 For the purposes of this report, this trains that travel at speeds lower than 79 mph are considered "conventional." This is the maximum speed of most passenger rail vehicles that operate in the United States today.

16 See "In What Circumstances is Investment in HSR Worthwhile?" http://eprints.whiterose.ac.uk/2559/2/WP590_uploadable_protected.pdf.

17 The generally accepted maximum distance that transit riders are willing to walk to a transit station is a half mile, which represents a ten-minute walk. HSR passengers may be willing to walk farther than this, however, perhaps up to a mile.

18 http://www.transforum-project.eu/.

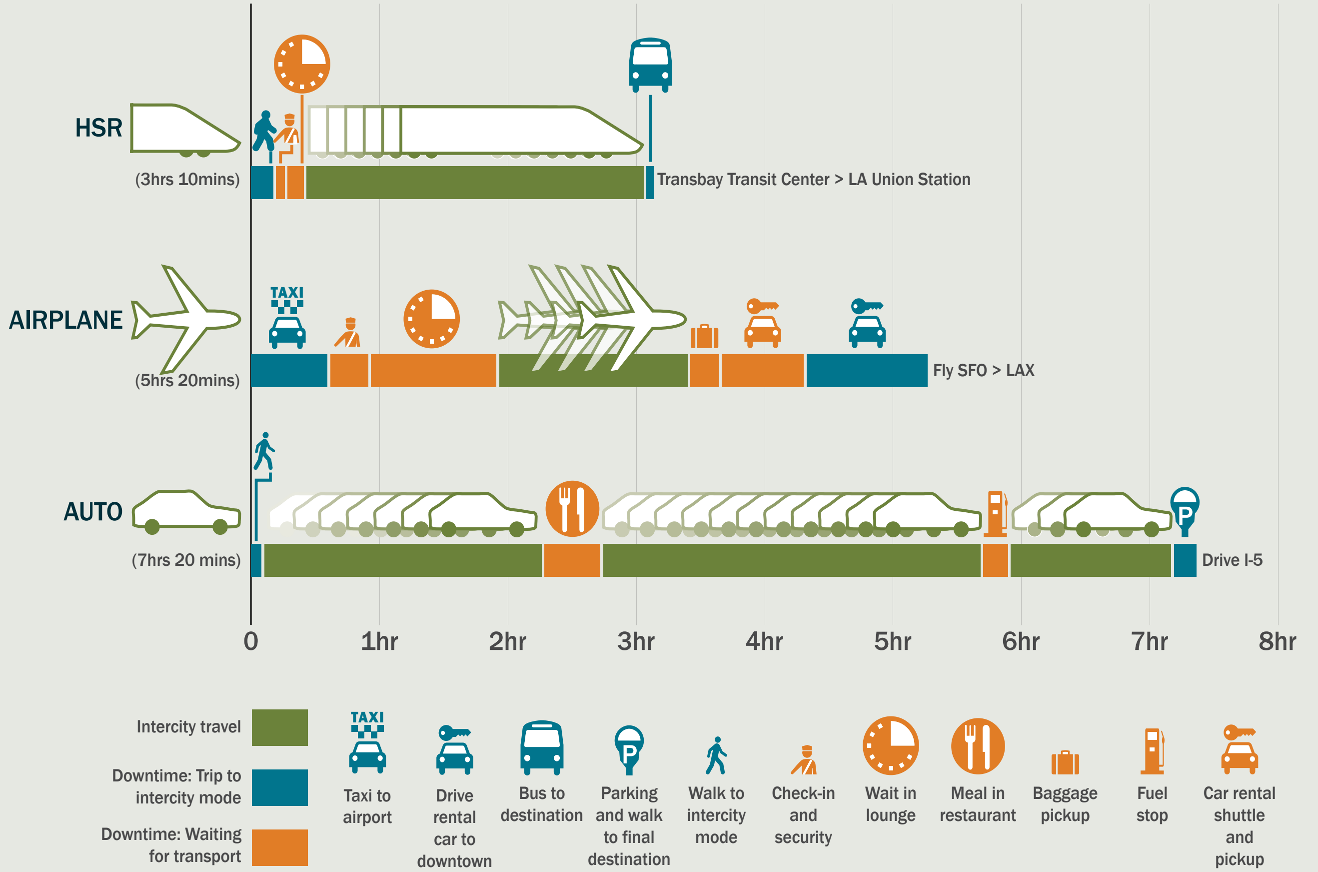
19 Adapted from Yoav Hagler and Petra Todorovich. "Where High-Speed Rail Works Best — America 2050," http://www.america2050.org/pdf/Where-HSR-Works-Best.pdf.

Figure 1

Door-to-door travel times between downtown San Francisco and downtown Los Angeles by mode.

Travel times calculated as follows:

- HSR — 3 hours 10 minutes: This graphic assumes a travel time of 2 hours and 40 minutes between the Transbay Transit Center (TTC) in San Francisco and Los Angeles Union Station, the travel time that is specified in California Proposition 1A of 2008, the ballot initiative that allocated funds to HSR. In this scenario, the traveler walks from the Ferry Building to the TTC, a 10-minute walk. The traveler arrives at TTC 15 minutes before the departure of the train.[1] Upon arrival at LA Union Station, the traveler takes a bus to Grand Central Market and arrives in five minutes.
- Fly SFO to LAX — 5 hours 20 minutes: Although a flight from SFO to LAX takes 1 hour and 15 minutes, the door-to-door travel time between TTC and LA Grand Central Market (GCM) can be over four times as long when factoring in travel to and from the airports and passing through security. This diagram assumes that the traveler takes a taxi from the Ferry Building to SFO, checks in luggage, passes through security, and waits for an hour in a lounge. Upon arriving in Los Angeles, the traveler picks up a rental car and drives to downtown LA. Once in downtown, the traveler spends 10 minutes searching for parking and walking from the parking garage to GCM.
- Drive I-5 — 7 hours 20 minutes: The uninterrupted travel time between the two points without traffic is 5 hours and 22 minutes according to Google Maps. The Interstate-5 corridor, however, is often highly congested. This diagram assumes just under an hour of traffic delay. Additionally, it assumes a meal break of 35 minutes and an additional 10-minute fuel stop. When leaving San Francisco, the traveler walks from the San Francisco Ferry building to a nearby garage, which takes five minutes. Upon arriving in Los Angeles, the traveler takes five minutes to park the car at a garage near Grand Central Market and walks five minutes to the market.



Source: Graphic by author, adapted from Brian Stokle

1 Access to HSR trains in Europe is not controlled by airport-style security checkpoints. However, if California chooses to implement such security measures, this, according to Stokle's estimates, could easily add 20 minutes to go through the checkpoint and 10-40 minutes waiting in a lounge.

- Robust public transit networks in HSR station cities, which would make it unnecessary for HSR passengers to drive to or from HSR stations, or use cars to get around in the city to which they are traveling, thus reducing the need for space-consuming parking and rental car facilities.

California's HSR project easily meets the first two of these criteria. In terms of the size of the cities that HSR would serve, Greater Los Angeles and the San Francisco Bay Area have a combined population of about 25 million people. Additionally, the California HSR line could be a boon for a number of smaller cities located in California's Central Valley with untapped economic development potential, including Fresno and Bakersfield. With careful economic development and land use planning in these Central Valley cities in anticipation of HSR, they stand to benefit greatly from being better connected to the state's major economic poles. Looking specifically at the length of the California corridor and the size of the cities along it, the project appears to be very compelling. The diagram below shows that the proposed California HSR route is of similar length to heavily traveled HSR corridors in France and Germany — the two European countries with the most experience with HSR that are the focus of this report. However, the cities located along California's HSR route are much larger than those along the French and German corridors.[20]

HSR is also an attractive option for California due to its anticipated effects on economic development. The state's economy, if compared to the economies of other countries in the world, would be the world's eighth largest, and the majority of this wealth is generated in communities along the HSR route, particularly in Greater Los Angeles and the San Francisco Bay Area. Over one-third of California's gross domestic product (GDP) is generated in the Los Angeles – Long Beach – Santa Ana metropolitan area alone.[21] By facilitating transportation between the state's major urban centers, HSR will make it easier to do business in both places.

Though all of these factors would seem to provide a solid basis for the HSR project in California, many are concerned that — with the exception of San Francisco and arguably Los Angeles — most of the state's proposed station cities lack the last two criteria: 1) dense activity centers within walking distance of future station sites; and 2) seamless connections between rail and local public transit networks. In other words, how can HSR succeed in California without both promoting urban density around stations at levels that are currently uncommon in most of the station host communities and increasing typically expensive transit connections? Without convenient alternative connection options, most HSR passengers will want to drive to stations. At the larger station sites, parking demand will not be accommodated with surface parking lots, and there will be pressure to develop large and costly parking structures. Large parking structures, in turn, will limit possibilities for denser land use around stations. This will reduce opportunities for the state to maximize return on its investment in HSR, and will do little to decrease traffic congestion, decrease greenhouse gas emissions, and increase transit ridership.

Addressing these questions is critical for a number of stakeholders, including:

- Employers seeking to take advantage of access benefits of co-locating job sites near HSR stations;
- Real estate developers and investors planning to develop in HSR station areas;
- State and federal taxpayers funding HSR capital and operating costs;
- Elected officials whose jurisdictions benefit from increased access and economic development potential from HSR; and
- Local transportation officials and transit agencies connecting HSR passengers to HSR stations.

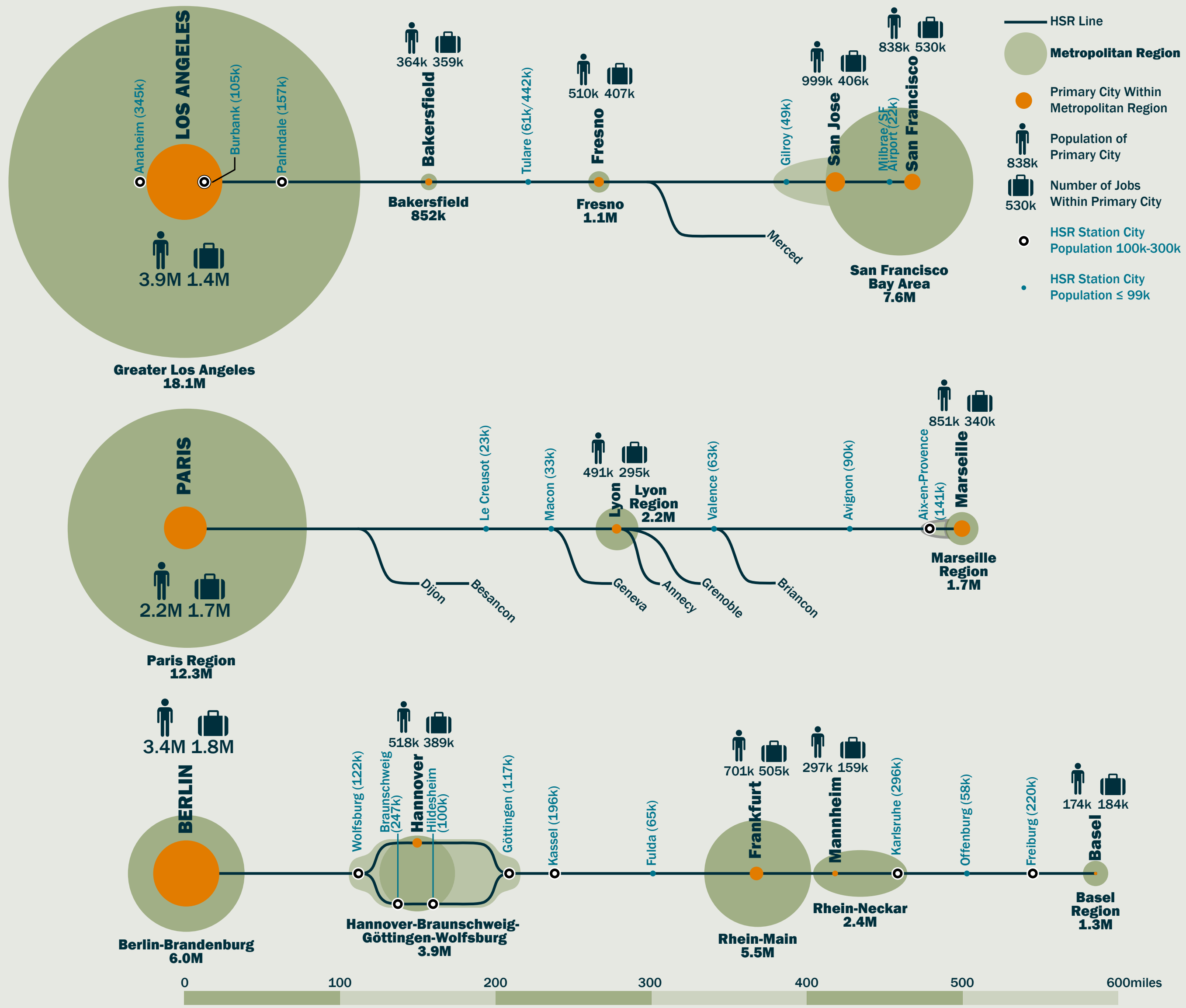
20 According to the California High-Speed Rail Authority's 2014 Business Plan, approximately 32 million riders are expected under the "medium ridership scenario" between Los Angeles and San Francisco in 2035.

21 http://www.lao.ca.gov/reports/2013/calfacts/calfacts_010213.aspx.

Figure 2

The length of HSR routes and the sizes of cities served in France and Germany in comparison to the proposed HSR route in California and the sizes of cities along it. As this graphic shows, California has very large urban regions that are spaced at appropriate distances from each other in order to be effectively served by high-speed rail.

Source: Graphic by author



Research Questions

In my role as liaison between the Federal Transit Administration and the California High-Speed Rail Authority (CAHSRA), the California state agency that is responsible for implementing HSR service, I grapple with the challenges that HSR will have in providing robust and convenient local transit connections in cities. France and Germany, the two European countries with the most HSR experience in Europe, have significant expertise to share with California on this topic. This is why, with support from the Urban and Regional Policy Program of the German Marshall Fund of the United States, I traveled to France and Germany to study these topics in the fall of 2013. Through my travels, I focused on three primary research questions:

- What are the primary differences between the French and German models of HSR development?
- How do French and German cities plan for and manage development within high-speed rail station neighborhoods as a means of stimulating economic development?
- What policies and practices have German and French cities employed to facilitate non-auto access to HSR stations?

The French and German HSR systems represent two very different models of HSR development, reflecting differences in governance, the national distribution of population throughout each country, and goals for HSR within each country's respective transportation system. France, which has a very strong central government located in Paris, uses a "segregated" HSR model, where trains (*trains à grande vitesse or "TGV"*) travel at very high speeds between the national capital and second-tier cities. Trains run along mostly dedicated track and make very few (if any) stops in smaller cities. By contrast, Germany, a federal country where power and population are distributed more evenly throughout the country, uses a "blended" or "integrated" model. In Germany, HSR trains (*Intercity Express or "ICE"*) usually run on track shared with conventional trains, do not travel as fast as the French trains, and make more stops in smaller cities. HSR corridors in Germany also tend to be less direct than in France, sometimes making significant detours to connect select cities, particularly state capitals. These differences, discussed later in this report, make both countries interesting case studies from which California can learn.

Methodology

- I reviewed HSR station access and development programs, both nationally and locally, and created an inventory of plans, policies, strategies, and approaches specific to each city's context and challenges. My focus was on the cities listed in Table 1, each of which is noteworthy from the standpoint of my research topic.
- I conducted more than 60 interviews in Europe with representatives from the French and German national railways, federal government officials, representatives from urban transit agencies and city planning offices, transportation consultants, architects and urban designers, academics, and a small number of HSR riders.
- I toured public transit systems in each city, focusing on key HSR connection points within each system.
- I did a significant amount of travel by HSR in both France and Germany in order to experience first-hand how HSR shortens both real and perceived travel distances and to observe differences in HSR infrastructure and connections to local transportation networks in both countries.

Table 1: Focus Cities

France	Germany
• Lyon	• Berlin
• Lille	• Leipzig
• Paris	• Dresden
• Strasbourg	• Erfurt
• Marseille	• Münster
• Aix-en-Provence	• Hannover
• Avignon	• Kassel
• Le Creusot	• Cologne*
• Haute-Picardie*	• Montabaur*
	• Limburg*
	• Freiburg*

* A city that I did not have the opportunity to visit during my travels.

In this report, I argue that in order for HSR to deliver on its promise to 38 million Californians and investors, the project must be designed as the backbone of a comprehensive system for sustainable passenger mobility in California. It is the mode of intercity travel that can do more than any other to reduce automobile dependence, a key consideration for California in light of state legislation that aims to reduce greenhouse gas emissions and improve air quality. Given that HSR is most efficient for medium-distance travel between city cores, that stations can fit more easily and harmoniously into existing urban neighborhoods, and that it is easier to connect HSR with local public transit networks and non-auto "last-mile" modes, it is a mode of intercity travel that can reduce dependence on less efficient and less sustainable forms of transportation such as cars and airplanes.

However, it is important to recognize that HSR will not be the most appropriate mode of intercity travel for all travelers and for all trips. It is best suited to trips in the 100 to 500-mile range between large cities for travelers to whom central-city-to-central-city travel times are most important. This segment of the state's travel is critically important, and increasingly so as many of California's proposed HSR cities see rapid population and job growth, much of which is concentrated in central cities.[22] With that growth, demand for intercity travel will also grow.

The Los Angeles-San Francisco corridor is already one of the busiest short-haul flight corridors in the world, and by far the busiest in the United States.[23] Airports in the San Francisco Bay Area and Greater Los Angeles already operate near peak capacity. Accommodating projected travel needs will require significant expansion of airport gates. As CAHSRA has pointed out, shifting some of the state's short-haul air travel to HSR will free up gate capacity at the airports, and allow the airports to allocate space to longer-haul planes that also typically carry more passengers per vehicle.

In order for HSR to serve as the backbone of sustainable mobility in California, the project's definition must extend beyond HSR route planning to include sustainable local transportation connections and careful station area planning. Cities across France and Germany demonstrate how HSR can be a powerful tool for strengthening cities and towns along HSR corridors in economic, social, and cultural terms. With careful planning, the same can be achieved in California.

Another social trend that favors HSR is the increased interest in urban living, both in California and nationally. The regions in California that are seeing the highest rates of population growth are located along the HSR route. This includes both coastal counties such as Alameda, Contra Costa, and Santa Clara counties in the north and Los Angeles and Riverside counties in the south, as well as Central Valley counties like Fresno and Kern.[24] As I will argue in this report, HSR has distinct urban design advantages over airports and roadways in that it can handle

Figure 3

Cover photo for May 2013 white paper entitled "Public Transit: Backbone and Engine of a Future-Oriented Coalition for Mobility." This paper was published by VDV, Germany's national public transit trade association. Just as VDV considers public transit the backbone for sustainable mobility at the city level in Germany, high-speed rail should be viewed as the backbone of national intercity transportation. Notably absent from this image is the bicycle, which plays an increasingly important role in urban transportation in Germany.

Source: GVH (Grossraum-Verkehr Hannover)

22 http://www.dof.ca.gov/research/demographic/reports/estimates/e-1/documents/E-1_2014_Press_Release.pdf.

23 "Domestic Airline Consumer Airfare Report-2013, Table 1." U.S. Department of Transportation.

24 State of California, Department of Finance, California County Population Estimates and Components of Change by Year, July 1, 2010-2014. Sacramento, California, December 2014, http://www.dof.ca.gov/research/demographic/reports/estimates/e-2/view.php.

much higher passenger volumes, and stations can either be inserted into densely developed urban contexts or integrated into existing stations and related infrastructure. Potential customers are most attracted to HSR when it is located in dense activity centers that are well served by public transit.

This report begins with a brief discussion of HSR, focusing on how it is defined and on its pros and cons. It then discusses the French and German HSR systems generally and then focuses on a number of train station master planning efforts in both countries. The reader will note that this report discusses a number of topics that may not seem directly related to HSR, including bicycling, bike share, infrastructure, car share, integrated fare payment systems, and others. This is based on the realization early in this project — and particularly based on insights from Germany — that HSR cannot be viewed in isolation from the larger transportation system. It must also be viewed in the context of larger systems such as physical infrastructure and technology including passenger information and integrated payment systems that facilitate access to stations. Because of this, there is significant attention on strategies that will increase the efficiency, attractiveness, and use of all non-auto modes that feed into HSR. The report ends with a set of actionable policy recommendations based on the French and German models that California should follow in order to maximize the state's investment in HSR.

What is High-Speed Rail?

First developed in Japan in the mid-1960s and later introduced in Europe and elsewhere in Asia, high-speed rail (HSR) is a type of rail transportation that operates at much higher speeds than conventional trains. HSR is defined in different ways in different parts of the world, but the European Union (EU) has perhaps put forth the most comprehensive definition of this travel technology. This definition focuses on three elements: 1) track infrastructure; 2) rolling stock, and; 3) the compatibility between track and rolling stock.[25] High speed lines include dedicated tracks that are specially built for speeds in excess of 155 mph as well as specially upgraded tracks that are designed for speeds of 125 mph or greater.[26] According to the EU, HSR vehicles must be designed to guarantee safe, uninterrupted travel at speeds of at least 155 mph on lines specially built for high speed, while enabling speeds of over 186 mph on tracks designed for those higher velocities.

The Proposed California High-Speed Rail Project

California high-speed rail will be the nation's first high-speed rail system. According to the California High-Speed Rail Authority

Figure 4

California high-speed rail route and phasing plan.

Source: Graphic by author

25 http://www.uic.org/spip.php?article971.

26 Exceptions are made to these definitions for track segments in which, due to topographical or other constraints, speeds of 200 km/h or greater cannot be maintained.

(CAHSRA), the project will connect the mega-regions of the state, contribute to economic development, create jobs, preserve agricultural and protected lands, and lead to a cleaner environment. In recognition of the project's potential for helping the state to meet aggressive greenhouse gas emissions reduction targets mandated by California laws, Assembly Bill 32 (AB 32)[27] and Senate Bill 375 (SB 375),[28] California lawmakers allocated 25 percent of future revenues from the state's "cap-and-trade" program — money raised from polluters to offset carbon emissions — to provide ongoing funding for construction of California's HSR project in June 2014.

By 2029, the system will run from San Francisco to the Los Angeles Basin in under three hours at speeds of up to 220 miles per hour. The system will eventually extend to Sacramento and San Diego, totaling 800 miles with up to 24 stations. In addition, the CAHSRA is working with regional partners to implement a state-wide rail modernization plan that will invest billions of dollars in local and regional rail lines to meet the state's 21st century transportation needs."[29]

Pros and Cons of HSR

Pros

HSR trains have several innate advantages over cars and planes. In comparison to cars, they do not get stuck in traffic and travel at much higher speeds. They also offer competitive door-to-door travel times in comparison to airplanes because train stations are closer to most people's origins and destinations. Also, since historic train stations are often central nodes within urban public transit networks, they tend to be easily accessible by public transit. In countries such as Germany and Japan, where many mid-sized cities are distributed along HSR routes linking major metropolitan agglomerations, HSR offers the advantage of direct city-to-city service along a chain of intermediate cities. In terms of urban development, HSR stations have the potential to catalyze economic development in station neighborhoods and cities if they are conceived as part of larger urban development and redevelopment plans. Also, from a passenger's standpoint, trains are often considered to be the most comfortable travel mode because they offer more legroom and space in general than either cars or planes. The superior comfort of trains makes it possible for passengers to be more productive while in transit, a factor that is especially important for business travelers.

Some of the main benefits of pursuing an HSR system include:[30]

- Shrinks the perceived distance between any two places on or near the line by making travel between them easier and faster.
- Improves mobility by saving travel time and reducing congestion for all travelers if more trips shift from air and auto to rail.
- Reduces pollution and helps meet ambitious state-wide climate change goals. With growing population and travel demand, the state cannot meet its greenhouse gas reduction goals without shifting more trips from automobiles and airplanes onto cleaner trains, siting destinations closer together to reduce distances, and reducing the need for motorized travel to satisfy short local trips. The rail system is estimated to prevent 3 million tons of carbon dioxide emissions annually and result in 4 billion fewer vehicle miles traveled on California highways in 2040. HSR could play an important role in reinvigorating the economies of the historic cores of many cities in California, particularly for economically depressed cities in the San Joaquin Valley.[31]
- Strengthens and improves commuter rail and regional intercity rail, increasing the viability of transit for intraregional

27 http://www.arb.ca.gov/cc/ab32/ab32.htm.

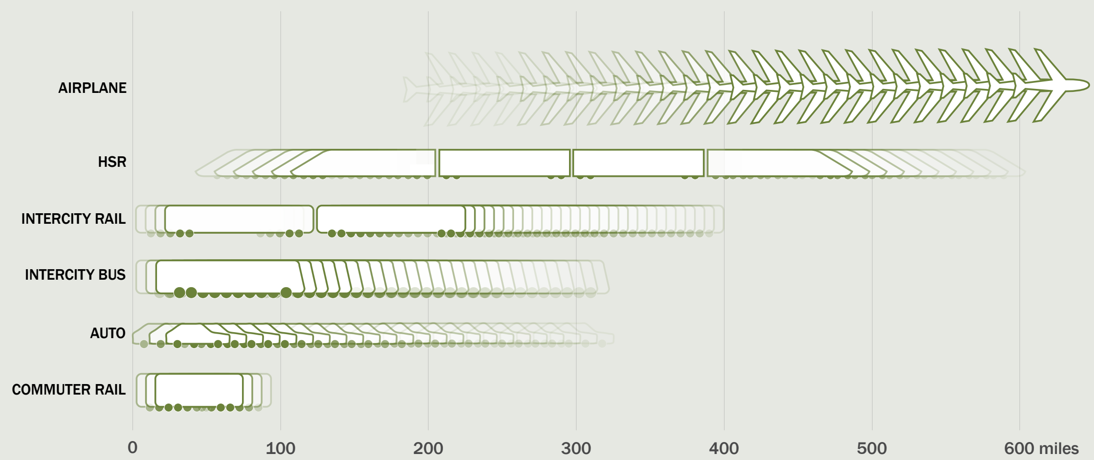
28 http://arb.ca.gov/cc/sb375/sb375.htm.

29 http://www.hsr.ca.gov/.

30 Adapted from Egon Terplan and Heng Gao, "Getting High-Speed Rail On Track" (2012), http://www.spur.org/publications/article/2012-07-10/getting-high-speed-rail-track.

31 Egon Terplan, "Beyond the Tracks: The Potential of High-Speed Rail to Reshape California's Growth" (San Francisco Planning and Urban Research Association Policy Paper, January 2011), http://www.spur.org/publications/library/report/beyond-tracks; Egon Terplan, "Beyond the Tracks: The Potential of High-Speed Rail to Reshape California's Growth" (San Francisco Planning and Urban Research Association Policy Paper, January 2011), http://www.spur.org/publications/library/report/beyond-tracks.

Figure 5



Introducing HSR spans a critical gap in the modal hierarchy of California's transportation system The optimal distance range for trips by high-speed-rail is between 100 and 500 miles, with the optimal distance being about 300 miles. Distances above 500 miles are best traveled by plane, while distances below 100 miles are best covered by traditional intercity rail, bus, or by private automobile.

Source: Graphic by author

commuting, together with the California State Rail Modernization Program.

- Reinforces the knowledge economy sector by supporting face-to-face interaction and improved productivity. Travel by train typically is more comfortable than by car or airplane because seats are generally larger and passengers are free to move about trains while in route. This makes it more feasible for passengers to use their travel time more productively.
- Can serve as a catalyst for future growth in the state — a necessary transportation option that will allow for the development of more compact and less auto-oriented growth in HSR station cities.
- Can also serve as the backbone for sustainable mobility in the state and can meet the intercity travel needs of significant numbers of travelers. If coordinated with public transit and other last-mile modes such as bicycles, car share, and bike share, HSR will allow many Californians to have less car-centric lifestyles.

Cons

Critics of the California high-speed rail project have argued that California lacks the geography, demographics, and cultural tradition that have made HSR service economically viable in densely populated countries like France, Germany, and Japan. This includes high population concentrations, closely spaced cities, high gasoline prices, and a public that is accustomed to traveling by train.[32] Specific criticisms of the California project include:[33]

- The project is too expensive, current forecasts underestimate the cost of the project and overestimate ridership, and the prospects for finding the money that will be required to build the project are not good.
- There is not enough political and popular support for the project, and such support is essential for such a large and costly undertaking.
- CAHSRA's decision to begin construction in California's Central Valley is misguided because the cities along that segment of the route are relatively small and unlikely to generate significant ridership. This has

32 See Ken Orski, "Will There Be a "Tipping Point" for High-Speed Rail in the U.S.?" in *Innovation Briefs*, Vol. 25, No. 13 (www.innobriefs.com).

33 See http://reason.org/studies/show/california-high-speed-rail-report and http://www.apta.com/resources/reportsandpublications/Documents/HSR-Defense.pdf.

led some critics to brand the project the "train to nowhere."

- HSR is an old technology and not transformational enough. Given California's position as a global center of technological innovation, the state should be looking into more groundbreaking modes such as magnetic levitation (MAGLEV) or even the highly publicized Hyperloop proposal put forward in 2013 by Tesla Motors founder Elon Musk.[34]
- California — like most of the United States — already has a well-developed network of regional air services that serve as an effective substitute for fast train service.
- Prevailing travel behavior and land use patterns in HSR station cities (the focus of this report) are not compatible with and supportive of HSR service.
- HSR would be a singularly attractive terrorist target.

The following section of this report discusses key topics related to HSR route planning, with a particular focus on the elements of station siting, station design, station access planning, and operational strategies that make for successful HSR service in France and Germany. In discussing each topic as it relates to these two European countries, I then consider the relevance of this information for California. This discussion will shed light, bearing in mind the pros and cons discussed above, on actions that the state should take now as construction on the HSR line has commenced and as station cities kick off planning efforts for their future HSR station districts.

34 See http://www.teslamotors.com/blog/hyperloop.

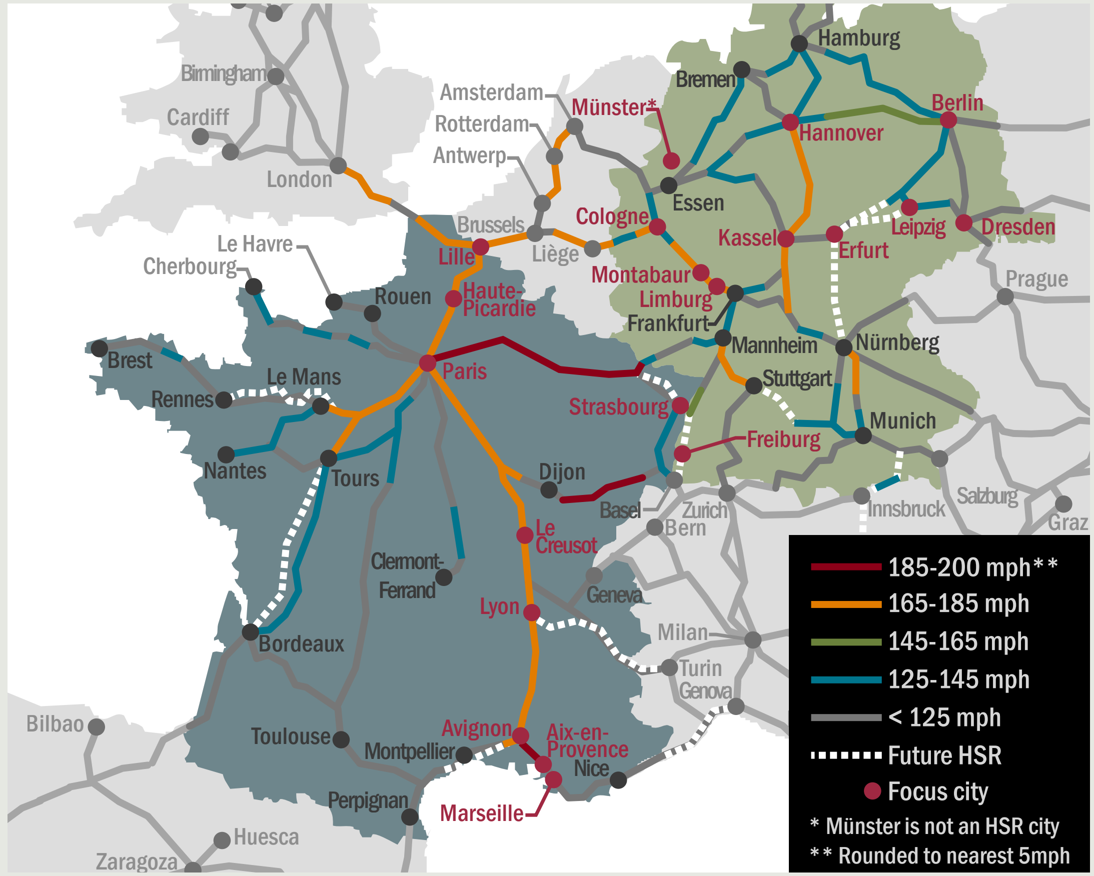
High-Speed Rail Development in France and Germany: Speed versus Connectivity

In planning for HSR, a tension exists between maximizing train operating speeds and providing as many connections and station stops as possible. France emphasizes the first approach, while Germany emphasizes the second. In assessing the advantages and disadvantages of both models, high speeds should be prioritized in sparsely populated places, while maximizing connections should be the primary consideration in densely populated places.

The French and German HSR systems represent two very different models of HSR development, models that reflect differences in governance, in the national distribution of population throughout each country, and in goals for HSR within each country's respective transportation system. France, which has a very strong central government located in Paris, uses a "segregated" HSR model, where trains (*trains à grande vitesse* or "TGV") travel at very high speeds between the national capital and second-tier cities. Trains run along mostly dedicated track and make very few (if any) stops in smaller cities.

By contrast, Germany, a federal country where power and population are distributed more evenly throughout the country, uses a

Figure 6



Differing approaches to high-speed rail in France and Germany. In France, virtually all HSR lines radiate from Paris to provide the shortest possible travel times to and from second-tier cities. Trains travel on dedicated tracks, often in excess of 180 mph. In Germany, the rail system is almost entirely blended and trains move more slowly. The national rail network is much more densely developed though, and smaller and mid-sized cities tend to be better connected.

Source: Graphic by author

"blended" or "integrated" model. In Germany, HSR trains, *Intercity Express* or "ICE," usually run on shared track with conventional trains, do not run as fast as the French trains, and make more stops in smaller cities. HSR corridors in Germany also tend to be less direct than in France, sometimes making significant deviations to connect select cities, particularly state capitals. For example, the decision to make Erfurt a stop along the future Berlin-Munich HSR line adds over 55 miles and 45 minutes to the trip over a more direct route that was briefly discussed early in the planning process.[35]

> "Service began on the first French TGV line in 1981, ten years earlier than the German ICE. The French system cost only half as much to build per kilometer and, to this day, is much faster than its German counterpart. However, the TGV is only half as useful as the ICE. Also, the interior design of French trains is — at least in the opinion of many German railcar engineers — not as good as German trains. As such, it can be more difficult in France than in Germany to make as good use of one's time while in transit."
>
> *— Markus Hoffman, Leader of Strategy and Marketing, Deutsche Bahn*[1]
>
> 1 Interview with Markus Hoffmann, November 8, 2013. When Hoffmannn said that the TGV only does half as much as the ICE, he was speaking primarily about the access benefits of HSR, particularly from the standpoint of door-to-door access and integration with local transportation networks. He was also alluding to the notion that German trains and track infrastructure is of a higher quality than French trains and rail infrastructure, and that German trains offer a superior ride quality.

Though the French model allows for much faster station-to-station travel times, one trade-off is that connections from HSR to public transit systems are not as seamless as in Germany, and the network does not serve smaller and mid-sized cities well. People who travel to smaller cities in France by TGV often need to drive to stations, a fact that has obvious downsides both in terms of the environment and sustainable land use. Additionally, it also means that lower-income French citizens who do not have easy access to cars may find it difficult to take HSR.

In Germany, HSR trains run on shared track and stop more frequently in smaller cities than their French counterparts, causing many HSR experts to liken the German system to an intercity subway.[36] More frequent stops extend service to larger portions of the country. Also, each stop increases opportunities for transfers to other modes, and also the possibility that people can reach their ultimate destinations by rail. The obvious cost of serving small and mid-sized cities is that travel times between Germany's largest cities are lengthened. The German Railway (Deutsche Bahn) seeks to balance the needs of its big city and smaller city passengers by offering a mix of local trains that stop in smaller intermediate cities and "sprinter" trains that do not. One of the best known of the sprinters is the Berlin-Frankfurt train, which completes the trip between Germany's political capital and its financial capital in 3.5 hours, shaving 45 minutes off the normal trip time.

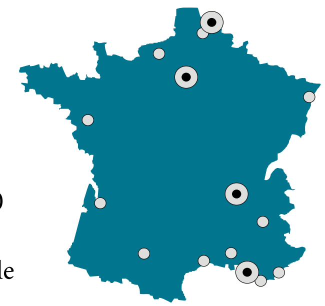
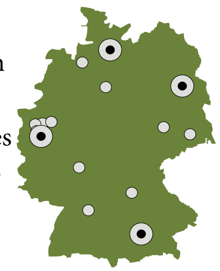
Differences in Population Density and the Distribution of Population in France and Germany

The two modes of HSR development in Germany and France do not stem purely from the strategic decision-making of the respective national railways. Indeed, existing settlement patterns are another important determining factor. First, Germany has about twice the overall population density as France. Second, Germany does not have a metropolitan area that is anywhere near as populous as Paris (Berlin, Germany's largest metropolitan region has about 5 million, while Paris has about 12). Also, Germany has far more mid-sized cities distributed much more evenly throughout the country than France. For example, the Ruhr Valley has five cities ranging from 400,000 to 600,000 inhabitants that essentially blend into each other, including Düsseldorf, Dortmund,

35 Christian Wüst, "Germany's Longest Subway: Billions Upon Billions for Berlin-Munich Bullet Train," Der Spiegel, October 27, 2011, http://www.spiegel.de/international/germany/germany-s-longest-subway-billions-upon-billions-for-berlin-munich-bullet-train-a-794125.html. According to several of the rail experts I interviewed, bypassing Erfurt was never really seriously considered during initial planning for the Berlin-Munich HSR line, even though the city is relatively small at just over 200,000 inhabitants. This is because Erfurt is the capital of the state of Thuringia and has an important history dating back over 1,300 years.

36 Phone conversation with Yves Crozet, January 26, 2013.

Table 2: Basic Statistical Information about France, Germany, and California

France	Germany	California
 • Highly centralized politically and economically • Population: 66 million • Land area: 261,000 square miles • Density: 302 people per square mile • Paris by far largest metropolitan area (12 million); Lyon next (2 million) • Primary purpose of HSR is to speed travel between Paris and second-tier cities. HSR serves center city stations in these locations. • Stops between Paris and second-tier cities are rare, only in exurban unpopulated areas. • Mostly dedicated HSR track • HSR quicker and more popular than air between many French cities • The TGV commands 90 percent of the combined air-rail travel market for the Paris–Lyon route, which has a TGV travel time of less than two hours. TGV also has about 60 percent market share in corridors where the TGV travel time is around three hours[b] • Service initiated: 1981 • Track mileage (2013) = 1,265 mi; 470 mi currently under construction[c]	 • Federal country with relatively even distribution of population • Population: 82 million • Land area: 138,000 square miles • Density: 608 people per square mile • Decentralized Ruhr Valley region largest metropolitan area at 10 million; Berlin next largest at 6 million • Mostly blended HSR system • Many cities with 400,000 to 1 million inhabitants, so trains stop frequently • HSR trains serve historic city center stations • Little HSR-specific land use planning (i.e. cities serve central city stations that are located in neighborhoods that were built out centuries ago and are already the cultural and economic epicenters of urban regions) • HSR not fundamentally new, but rather the next evolution in an existing technology[d] • First rate highway system and well-developed network of airports compete with HSR • A "car country" • Heavy focus on intermodality • The German Railway (Deutsche Bahn) operates its own car share and bike share services • Service initiated: 1991 • Track mileage (2013) = 829 mi; 266 mi currently under construction[c]	 • Largest state by population within a large federal republic • Population: 38 million • Land area: 163,696 square mile • Density: 232 people per square mile • Los Angeles largest metropolitan area with 18 million (3.8 million in city limits);[a] next largest San Francisco Bay Region at 7.6 million (San Jose 999,000; San Francisco 838,000) • Plan is to build a blended system in the densely populated "bookends" of the system in the Los Angeles and San Francisco Bay regions, and dedicated track elsewhere • Primary justifications for project include: accommodating the large projected increase in travel between major population centers and reducing pressure on overcrowded airports and freeways; providing a backbone for focusing future population growth and land development; meeting greenhouse gas reduction targets • Planned track mileage (2029) = 530 miles (from San Francisco to Anaheim) • Service initiation date: 2029 (planned for Los Angeles to San Francisco service)

a 2010 U.S. Census
b http://reason.org/files/high_speed_rail_lessons.pdf.
c http://www.uic.org/IMG/pdf/20131101_high_speed_lines_in_the_world.pdf.
d Conversations with Philipp Latinak and Rainer Danielzik, November 2013.

Essen, Duisburg, and Bochum.[37] It is difficult to provide HSR service through cities of a half million people without stopping trains.[38]

The French scholars with whom I spoke all said that Germany's settlement patterns make it better suited to rail travel. But these settlement patterns also make it difficult for HSR trains to achieve very high speeds without bypassing important mid-sized cities. Given that the attractiveness of any mode of transportation is largely a function of how quickly it can transport passengers door-to-door in comparison to other modes, this creates a quandary for the Deutsche Bahn: is it possible to maintain fast enough travel times between stations located 100-500 miles apart, in order for HSR to be competitive both with airplanes and cars. This point is especially relevant in Germany because the playing field for HSR is more challenging there than in other European countries. Germany has a comparatively well-developed network of airports that offers many attractive options for traveling by plane, as well as an exceptionally well-built network of highways on which there are famously few or no speed limits.

37 These cities are part of Germany's industrial heartland. With a population of about 10 million people, many consider the Ruhr Valley to be a metropolitan area in and of itself. However, it is decentralized and polycentric, unlike other traditional metropolitan areas in Europe in this respect.

38 Interview with Bruno Faivre d'Arcier, October 21, 2013.

Paris and Berlin: Capital Cities Reflecting Different National Approaches to HSR

The different approaches in France and Germany toward HSR development are clear when comparing the arrangement of HSR stations and local transit connections to those stations in Paris and Berlin.

The French national railway system is premised on the assumption that Paris is the primary destination for most travelers. High-speed trains arriving from other parts of the country arrive at one of five terminal stations, depending on the direction from which they are coming. For example, passengers coming from Lyon or Marseille will arrive at Gare de Lyon in Paris, while passengers coming from London or Lille will arrive at Gare du Nord.

If an HSR traveler's ultimate destination is in Paris, the terminal station where they arrive may or may not be close to their ultimate destination. For example, an HSR passenger coming from Lyon may be able to make it to Paris Gare de Lyon in the central southeastern part of Paris in two hours. However, if their ultimate destination is in the northwest part of Paris, their door-to-door travel time will be significantly longer than that.

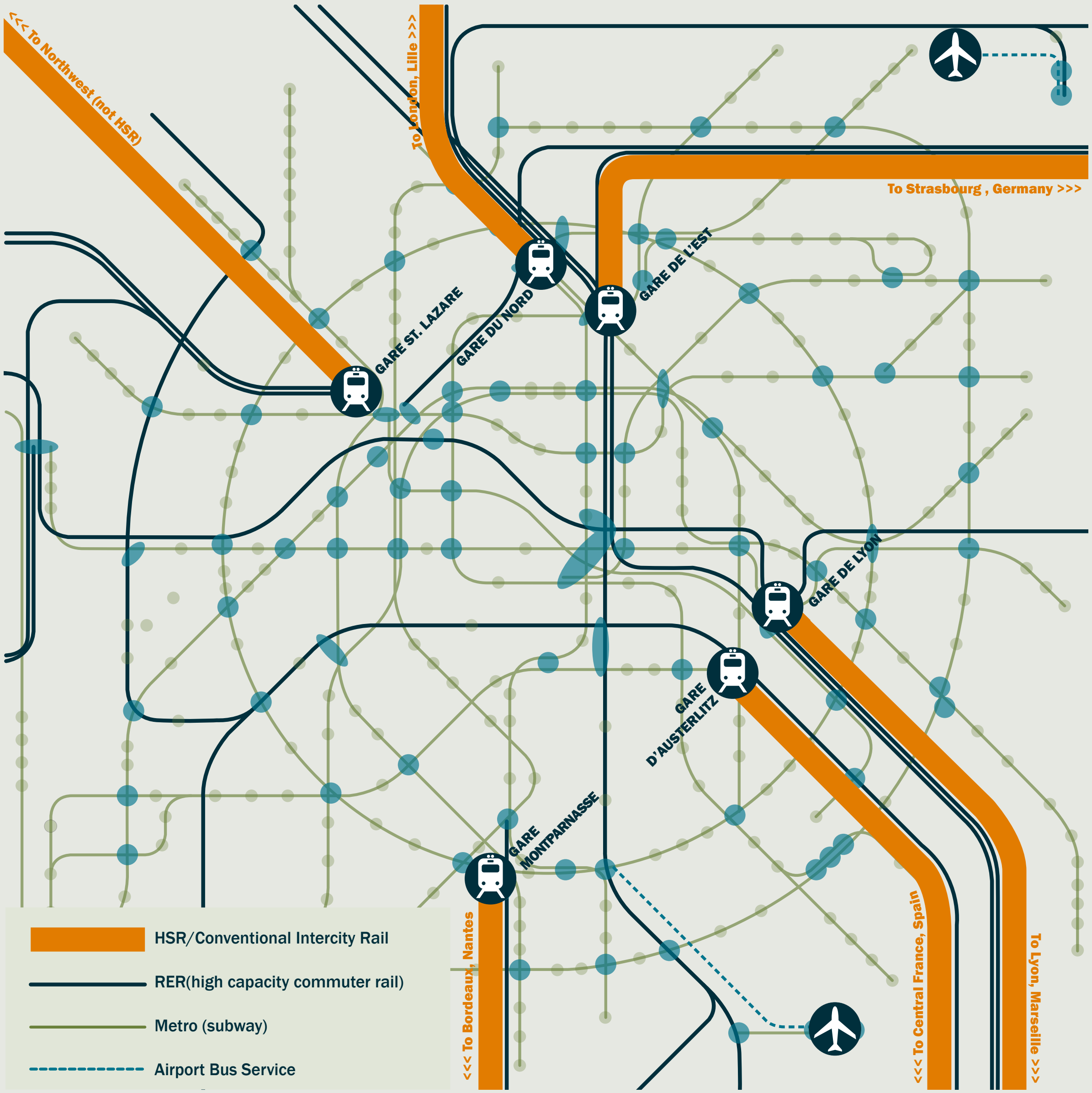
The arrangement of HSR stations in Paris is not efficient for passengers who are simply passing through Paris on their way to another city, such as passengers traveling from Lyon to London via Paris. Those passengers need to either make use of city's public transit system to get from one train station to another or take a taxi. And while Paris boasts one of the most extensive public transportation networks in the world, transfers by public transit can be very time-consuming because getting from HSR platforms to public transportation often involves long walks and many stairs. These transfers can also be awkward for HSR passengers who have physical disabilities, are traveling with children, or carrying luggage. This is because much of the Paris transit system — and particularly the subway, which carries most public transit passengers — is often crowded, and not well-equipped to handle passengers with special needs. For example, many stations still do not have elevators, and there is often insufficient capacity on escalators and moving walkways.[39]

In contrast, the high level of integration and coordination between intercity rail service and urban public transit in Germany makes it much easier and more efficient to use public transportation as an access mode to HSR.

First, HSR trains typically stop once before arriving at Berlin Main Station. For example, HSR trains traveling northward toward Berlin from the south stop first at Südkreuz before proceeding on to Berlin Main Station. At Südkreuz, travelers can transfer to one of several S-Bahn heavy rail lines, including two that run along the "Ringbahn," a track that encircles the central city. The Ringbahn

39 Accessibility, heralded with the passage of the Americans with Disabilities Act (ADA) is one especially note-worthy accomplishment in the United States that is recognized as a model in other places, including many European countries.

Figure 8



Six large terminal or "stub-end" train stations in Paris, which mark the end of the various HSR lines that serve different regions of France and Europe. For example, trains bound for London or Lille leave from Gare du Nord, while trains bound for Lyon or Marseille use Gare de Lyon. The arrangement of stations forces passengers who are simply passing through Paris on their way to other destinations to make often time-consuming transfers between stations by public transportation.

Source: Graphic by author, adapted from Jug Cerovic

Figure 9

The five HSR stations in the Berlin region, with Berlin's Main Station in the middle. In contrast to Paris, passengers accessing the HSR network in Berlin have a variety of stations to choose from, irrespective of the direction in which they are traveling. Also, stations are through-stations (as opposed to stub-end), so trains easily pass through Berlin on their way to another destination. Finally, HSR stations are well connected to the city's ring commuter railway, the "Ringbahn" and Stadtbahn, which bisects the ring from east to west. Passengers can easily transfer from HSR to the Ringbahn and quickly reach other parts of the city. The Ringbahn is exceptionally efficient at distributing passengers throughout Berlin since it intersects all of the city's subway lines except for the U-1.

Source: Graphic by author, adapted from Jug Cerovic intersects a large proportion of all of the city's rail transit offerings and, as such, allows for a large number of quick transfer opportunities. Similarly, passengers coming from the west, north, or east can get off at Spandau, Gesundbrunnen, or Ostbahnhof, respectively, and connect to Berlin's public transit network in those locations. These initial stops make it unnecessary for travelers to go to Berlin's Main Station to access HSR, which can significantly shorten door-to-door travel times for many passengers. Also, transfers between HSR and public transit are facilitated by well-designed "transfer path connections" within stations, a characteristic discussed in greater detail later in this report.

It is interesting to note that these additional "sub-center station" stops within large metropolitan areas do not significantly slow overall city to city travel times. This is in part because high-speed trains need to decelerate prior to reaching their ultimate destinations and because the high-speed trains need to share track with conventional trains when they enter urban rail networks. In contrast, stops in sparsely populated areas far from large urban areas, such as at Le Creusot station between Paris and Lyon, Haute-Picardie between Paris and Lille, or Montabaur and Limburg between Frankfurt and Cologne, do add significantly to travel times. The same could also be said of the proposed Hanford/Visalia station in California. In all of these places, trains must decelerate from peak cruising speeds and come to a full stop. As such, while stopping at a secondary station in a large city may add five minutes to city-to-city travel times, stopping at an exurban station can easily add 15 minutes.

Another beneficial feature of HSR stations in Berlin is that they are *through stations* as opposed to *terminal stations*. As such, and in contrast to Paris, passengers can travel all the way through Berlin on high-speed trains without needing to transfer to the city's urban public transportation system. This is a great benefit for passengers whose journey does not end in the German capital.

Key Takeaways: Speed versus Connectivity

High speeds should be prioritized in sparsely populated places, while maximizing connections should be the primary consideration in densely populated places. The HSR infrastructure should be designed to support multiple stations in densely populated areas. Not every train has to stop at every station, but if too few stations are built at the outset, the dearth of access points will make it hard for the HSR system to gain widespread acceptance.

There are trade-offs between maximizing HSR travel speeds and connecting the maximum number of origins and destinations. The French and German HSR systems represent very different philosophies and approaches on this topic, and can provide insights on when it makes most sense to focus on high speed and when it is wise to add stops in order to maximize connections. France offers faster travel times, which can enhance HSR's competitiveness over other modes. However, the French system does not always bring passengers as close to the places where they need to go as the German system, and connections to urban public transit networks are not as good as in Germany. Thus, while French trains may get people from one station to the next more quickly, people whose final destination is not within easy walking distance of the station need to connect to local public transit. This may be both logistically difficult for them and may render the faster station-to-station travel time advantages moot.

Under the German model, HSR lines entering the largest metropolitan areas make more than one stop. These stops are well connected to the local public transportation system. Embarking or disembarking at these stations to complete the intra-city segment of the journey via local transit can provide HSR passengers big time savings on their overall door-to-door travel times, savings that can make up for slower average speeds on the inter-city segments of their journey via HSR. In contrast, the clunkier connections between HSR and urban public transit in France can mean that HSR passengers may have door-to-door travel times that are barely faster than trips of similar distances in Germany, even though the HSR segment of the trip is much faster. On this point, it also bears mentioning that there are more stations in France than in Germany that are built in undeveloped areas without reliable public transit, which presents additional access challenges and concerns about equity.

Another consideration is that stopping trains in less populated areas between large cities along HSR lines significantly slows travel times.[40] This holds particular relevance for HSR route planning in California, where a number of stops in smaller cities in the San Joaquin Valley are planned and where ridership potential is limited.[41]

California Proposition 1A, passed by California voters in 2008, provides $9.95 billion in bond funding for the California HSR Project and stipulates that high-speed trains travelling between Los Angeles Union Station and the San Francisco Transbay Terminal must be designed to complete the journey in no more than two hours and forty minutes. This means that express trains would need to achieve an average speed of about 175 miles an hour for the entire trip, including any stops, between the two largest urban areas in the state.[42] Given plans to operate blended HSR/conventional rail service in the San Francisco and Los Angeles metropolitan "bookends" of the system, where speeds would be at or less than 110 miles per hour, this means that the trains will need to travel very quickly through the San Joaquin Valley.

40 For example, trains that stop at le Creusot TGV on their way between Paris and Lyon take 15 minutes more to complete the trip. This stop serves about 2,700 riders per day, which represents a very small proportion of the overall HSR ridership in the Paris-Lyon corridor.

41 An example of one such station is the proposed Kings/Hanford/Tulare stop, which would be located on an undeveloped site outside of Visalia.

42 The Prop 1A requirement is to design the system so that a non-stop train can meet this travel time. Multi-stop and local trains would travel slower.

Germany demonstrates that multiple stops in large and densely populated urban areas can make a lot of sense from a ridership perspective, as is clear from the case of Berlin. Stations located in sparsely populated places in between big cities, in contrast, are much more difficult to justify. Fresno, the fifth largest city in California with over a half million people (and almost 1 million in the metropolitan area), is clearly an important city to serve. Bakersfield is also a significant city with a population of 360,000. However, given that almost 80 percent of all passengers on the train will board either in the three San Francisco Bay Area stations (Transbay, Milbrae, or San Jose) or the three stations in the Los Angeles region (Palmdale, Burbank, or Union Station), it may be difficult to justify stopping many trains in smaller cities such as Visalia or Merced. This operational model is similar to the approach commonly followed by local transit agencies that operate "mixed service" on certain routes, such as express runs that serve only major stops and local runs that serve all stops along the route. This allows system operators to balance between optimizing point-to-point travel times to major nodes and providing system access to minor nodes to generate ridership.

Table 3: California HSR Projected Boardings by Station (2029)

Station	Boardings by Station[a]	Boardings Percentage
San Francisco (Transbay)	15,400	San Francisco Bay Area = 44% of total
Milbrae	6,900	
San Jose	8,200	
Gilroy	4,500	
Merced	3,400	San Joaquin Valley = 16% of total
Fresno	4,500	
Visalia	1,200	
Bakersfield	3,600	
Palmdale	3,900	Greater Los Angeles = 40% of total
Burbank[b]	8,800	
Los Angeles Union Station	19,700	
Total	80,100	

a The 2014 Business Plan assumes the following HSR levels of service for 2029: 1) 4 trains per hour (during peak and off-peak) between San Francisco and Los Angeles; 2 trains per hour during peak between San Jose and Los Angeles during peak; 2 trains per hour between Merced and Los Angeles during peak.

b The 2014 Business Plan lists a "San Fernando" station and not a "Burbank" station. However, according to CAHSRA staff, the most likely location for a station in the San Fernando Valley is Burbank. As such, I have substituted Burbank for San Fernando throughout this document.

Station Siting

Central city stations represent the best option for HSR; secondary sub-center stations in large urban areas can also bring HSR closer to many patrons without significantly slowing service; stations located outside of densely urbanized areas usually remain park-and-ride stations and do little to attract economic development.

HSR stations in Germany are mostly located in historic city centers that have long been important nodal points of urban transit networks. In France, the situation is more varied. Paris and most second-tier cities have historic central city stations — usually terminal stations — that are served by HSR. There are also a few second-tier cities such as Lyon and Lille that have built new stations in central city locations. Small and mid-sized cities generally do not have HSR stations. Where HSR stations do exist near those cities, they tend to be in far-flung peripheral locations that are far removed from most travelers' ultimate origins or destinations. These stations also tend to be poorly connected to public transit networks, so most people get to them by car and they are surrounded by large surface parking lots. The French refer to these as gares betteraves, meaning "beet field stations."

The stations that I visited cover the range of station types that exist in France and Germany. They can be grouped into the following station types:

- Historic Central City
- New Central City
- Sub-Center
- City Periphery
- Non-Metro Region/Exurban

Table 4 shows the European stations that I focus on in this report, as well as the proposed California HSR stations, categorized according to the above station types.[43]

43 Typology developed in collaboration with Anastasia Loukaitou-Sideris and Deike Peters.

Table 4: Station Types

Station Type	France	Germany	California
Historic Central City	Paris stations (Gare du Nord, Gare de l'Est, Gare de Lyon), Marseille St.-Charles	Erfurt, Cologne, Hannover, Strasbourg, Leipzig, Dresden, Münster	none
New or Rebuilt Central City	Lyon Part-Dieu, Lille Europe, Paris Gare de Montparnasse	Berlin Hauptbahnhof	San Francisco Transbay Terminal, Los Angeles Union Station, San Jose Diridon,[a] Fresno, (Gilroy, if central city location selected), (Bakersfield, if downtown location selected)
Sub-Center	Paris Charles de Gaule Airport, Marne-la-Vallée (Disneyland Paris)	Berlin Südkreuz, Cologne Deutz, Kassel Wilhelmshöhe	Milbrae/San Francisco Airport, Burbank, (Bakersfield, if Golden State and F St. location selected)
City Periphery	Avignon TGV	Montabaur, Limburg	Bakersfield (if non-downtown location selected), Palmdale, Gilroy (if non-downtown location selected)
Non-Metro Region/Exurban	Aix-en-Provence TGV, Le Creusot TGV, Haute-Picardie TGV, Lyon — Saint Exupéry	None	Kings/Tulare (Hanford), (Bakersfield, if "airport" location selected)[b]

a Although Los Angeles Union Station and San Jose Diridon, as envisioned as HSR stations, would include the historic downtown stations that exist today, each would be significantly expanded and their respective site plans significantly changed to accommodate HSR. As such, they are considered "rebuilt" central city stations rather than historic central city stations under this typology.

b As of this writing, the Bakersfield City Council had not decided on a location for the Bakersfield station. The location approved in the early 2000s was on a downtown site near the existing Amtrak station. In 2014, the possibility of building a station somewhere on the outskirts of the city was being discussed, but precise location of that alternative non-central city station was not public information.

Station Types and Definitions

Historic Central City

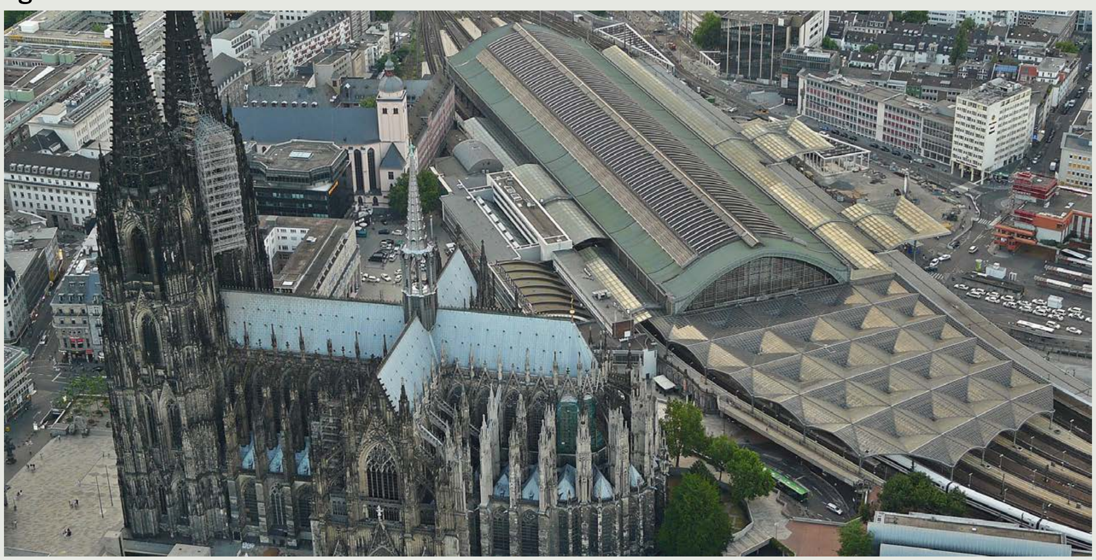
These stations are located within the historic cores of established cities. Historic stations were established before World War II, and have been modernized to accommodate HSR. In cities such as Paris or Cologne, which have always had thriving downtown cores, these stations are located in close proximity to the primary destinations in their respective cities and provide easy access to those destinations. From an economic development perspective,

Figure 10

Historic central city station: Gare de l'Est, one of the six large terminal stations in Paris.

Source: Wikimedia Commons, Gilbert Bochenek

Figure 11



Historic central city station: Cologne Main Station located in Cologne's historic core.

Source: Wikimedia Commons, user Neuwieser

the downside of these stations is that opportunities for new HSR-related development around them can be limited. This is because they are located in historic — often cherished — urban neighborhoods that have been built out for a long time and that the general public wants to see maintained as they are.

Examples: Paris stations (Gare du Nord, Gare de l'Est, Gare de Lyon), Marseille St.-Charles, Erfurt, Cologne, Hannover, Strasbourg, Leipzig, Dresden, Münster, Freiburg

New or Rebuilt Central City

New central city stations were built in the post-World War II period. They were typically built on vacant or underutilized sites within the central parts of cities, often on former military bases or industrial sites. These stations offer many advantages: their central city locations put them close to the main trip origins and destinations. At the same time, the fact that they are located on underutilized sites in districts where there are comparatively few constraints to new development (things such as historic buildings or opposition to new development from neighborhood or advocacy groups) gives these sites have much greater economic development potential than the historic central city stations.

Examples: Lyon Part-Dieu, Lille Europe, Paris Gare de Montparnasse, Berlin Hauptbahnhof[44]

44 Though built on the site of the now-demolished Lehrter Bahnhof, Berlin's Main Station is more like a new central city station than a historic central city station because Lehrter Bahnhof was not Berlin's primary rail station. The government decided that the new station should be built on the site in 1992 since, while it is close to the city center, the area was still not heavily populated.

Figure 12

New central city station: Lyon Part-Dieu was built on the site of a former military base.

Source: Groupe SERL

Figure 13

New central city station: Berlin Main Station, built on site of former Lehrter Bahnhof.

Source: Wikimedia Commons, user Dontworry

Figure 14

Sub-center station: Berlin Südkreuz.

Source: Wikimedia Commons, Denis Apel

Sub-Center

These stations are typically secondary stations located in established neighborhoods, primarily within first-tier cities, but also in a few select second-tier cities. Though significant in terms of the number of passengers who pass through them, these stations are not the primary access points to intercity rail in their respective cities. They may be located on the edges of central cities or in job centers outside of primary central business districts.

Examples: Südkreuz, Cologne Deutz, Kassel Wilhelmshöhe

Figure 15

Peripheral station: Avignon TGV Station, with Courtine Business Park in background.

Source: AREP

City Periphery

These stations are located on or near the edges of cities. They are typically connected to urban transit networks, although the quality of these services is often poor. Peripheral station locations are often selected by national railways in order to facilitate construction, lower construction costs, and, in many cases, to minimize deviations in HSR routes.

Examples: Avignon TGV, Montabaur, Limburg

Non-Metro Region/Exurban

Most common in France, these stations are located entirely outside of urbanized areas. In general, they are poorly connected to urban transit networks, if at all. The rationale for most of these stations is to build stations at the lowest cost possible and to avoid deviations in HSR routes to minimize travel times between major cities, while still providing access points to HSR — however remote — between the major cities. The trade-off is that short-term construction cost savings are basically externalized in the form of longer first-mile/last-mile travel times and expenses for travelers over the longer term. Most passengers who use these stations access them by car, and park their vehicles at the large park-and-ride facilities that surround them. Many of these stations have officially designated business development districts adjacent to them. In most cases, however, the amount of actual development has been very limited. Where development has occurred, it has been mostly auto-oriented in character.

Examples: Aix-en-Provence TGV, Le Creusot TGV, Haute-Picardie TGV, Lyon - Saint Exupéry

Figure 16

Exurban station: Aix-en-Provence TGV.

Source: AREP

Key Takeaways: Station Siting

While German HSR stations are typically historic downtown stations that were renovated to accommodate HSR, the situation in France is more varied. Stations in Paris and in second-tier French cities are generally in central locations, in mostly historic terminal stations. However, a few second-tier cities such as Lyon and Lille have built new central stations on underdeveloped sites to maximize HSR-related development. Such examples have the most to teach those station cities in California that are expecting significant population growth and that would like to capitalize on the potential development benefits of HSR.

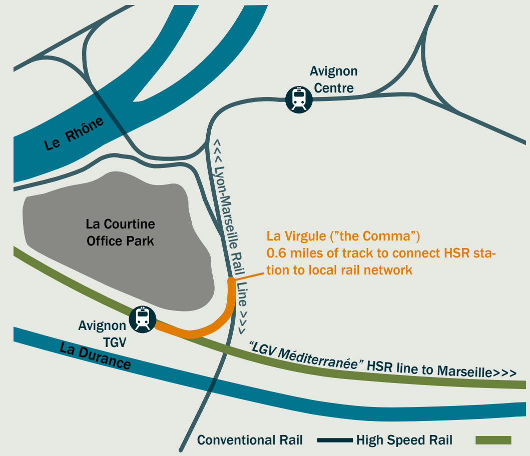
France also has a number of stations located in entirely undeveloped areas on urban peripheries. These stations tend to remain isolated and do not attract new development unless well-developed and credible land use plans to attract development are in place at the time of station construction. Similarly, such stations are not likely to become well-linked to urban public transit networks unless existing public transit infrastructure is either planned or already in place at the time of station construction to facilitate this. For example, the Avignon TGV station is finally connected with Avignon Centre, the city's historic main station, via the regional rail network more than 12 years after the station's opening. In order to achieve this connection, about three-quarter-mile of new rail track was laid to connect the HSR station to the existing regional rail network, as shown in Figure 16.

It is unclear that a rail link between these two stations would ultimately have been built if a majority of the track needed to connect the two had not already been there to tap into.[45] The rail lines did intersect but not with the geometry required to move one train onto the other tracks. Also, the crossing was not at a location that would have made sense for a new transfer station.

California should carefully consider the economic development and access challenges that French cities such as Aix-en-Provence and Avignon have experienced with exurban and peripheral stations. Thankfully, California has made the wise decision of siting most HSR stations in central cities. However, one notable exception to this is the proposed Kings/Tulare station east of Hanford, which would be located in an exurban location. There is also debate over the location of two other stations, which could end up in more peripheral locations.[46] If non-central stations are selected, two preconditions should be met:

1. Robust, well-conceived urban design and land use plans should be in place for the station areas. Plans should address both short-term and long-term market feasibility, as well as development phasing. The plans that the CAHSRA is currently funding have the potential to satisfy this need.[47]
2. Multi-modal plans that prioritize non-auto access options to the stations must also be completed, ideally before

Figure 17



Avignon TGV station in relation to Avignon Centre, the historic downtown station. The short segment of track shown in red, dubbed "the comma," was completed in December 2013, allowing for passenger trains to travel between the two stations.

Source: Graphic by author, adapted from www.region-paca.fr

45 Guillaume Ziza, "La virgule d'Avignon : une erreur (enfin) réparée," *Urbanews.fr*, http://www.urbanews.fr/2014/01/10/38279-la-virgule-davignon-une-erreur-enfin-reparee.

46 As of this writing, the CAHSRA is planning for central city stations in all cases except for two airport stations, Milbrae and Burbank, as well as the Hanford station. Also, as discussed in this report, the Bakersfield City Council expressed a preference for a peripheral station location in 2014. Gilroy seemed to be favoring a central city location over a peripheral one, but has not yet ruled out the peripheral one.

47 As of this writing, only one of six cities that is slated to received station area planning funds from the CAHSRA had selected a consultant team. A large portion of the funds that will cover the costs of this grant program come from the American Recovery and Reinvestment Act of 2009 (the "Stimulus Bill"). According to this law, the funds must be spent by September 30, 2017. There is some concern that plans will not be completed in time to meet this deadline.

station construction begins. Local access plans should include an access hierarchy that is used to prioritize travel modes that provide the most mobility at the lowest cost, and require the least amount of space. And as suggested above for the urban design and land use plans, these plans should firmly address phasing issues with regard to station access, and not assume that HSR passengers will get to stations in 50 years in the same way that they do today. This is discussed in greater detail later in this report (Policy Options to be Considered).

Since many of California's existing stations are located in the historic centers of cities, those areas tend to be well-served by transit, at least by U.S. standards, and the potential for increasing service frequency to those areas is far less costly than building new service lines elsewhere. Where stations are not the epicenters of urban transit networks, and where new transit service must be established, well-conceived and credible plans must be in place prior to construction of the stations in order for transit improvements to become implemented at the beginning of HSR service. If not, the type of land use planning and transportation infrastructure that gets built within the station area is likely to be the auto-centric default characteristic of so many California cities. This, in turn, will make it difficult for the state to reap the full economic and environmental benefits of HSR: improved mobility, reduced greenhouse gas emissions, and economic development, particularly in central cities. The experience of France and Germany suggests that implementing transit connections after a HSR station service is up and running (and after people have become accustomed to driving to the stations) can be very difficult; it can be very difficult to achieve mode shift once automobile access is "hard-wired" in.

The experience of cities such as Avignon and Aix-en-Provence in France might be instructive for Bakersfield, a city in the southern Central Valley of California, as it considers the advantages and disadvantages of downtown and peripheral station locations. Until recently, Bakersfield supported a downtown HSR station site adjacent to the existing Bakersfield Amtrak station. In early 2014, however, citing concerns about property takings and noise impacts to existing residences and businesses along the tracks leading to the downtown site, the Bakersfield City Council reversed course and expressed support for considering sites outside of the downtown core instead.[48] In December 2014, the City of Bakersfield and the CAHSRA announced that they were studying a site in the general vicinity of F Street and Golden State Avenue, approximately 1.5-miles north of the downtown Amtrak Station.[49] Though not as ideal from the standpoints of pedestrian, bicycle, and transit access as the downtown Amtrak station, this location would still be preferable to the peripheral airport-adjacent location that is shown in the CAHSRA's 2005 Program-Level environmental document.[50]

One way of assessing the suitability of various station locations is to use Walkscore, a popular online tool that measures the "walkability" and "transit-accessibility" of given street addresses. Walkability and transit-accessibility, as I contend in this report, are key criteria that determine the suitability or "readiness" of sites to accommodate HSR stations. The Walkscore is based on an algorithm that measures the distance of various amenities to a specific street address. Relevant amenities for walkability include common destinations such as retail establishments, parks, and schools. The "transit accessibility" score measures the availability and frequency of public transportation.[51] Using this tool, the downtown Bakersfield station location gets a Walkscore of 77, which is considered "very good" and means that "most errands can be accomplished on foot." This same location gets a transit score of 50, which is considered "good" and means that there are "many nearby public transportation options." In contrast, the F Street/Golden State location receives a Walkscore of 62, which is "somewhat walkable" and a Transit Score of 45, which means that there are a few public transportation

48 http://www.bakersfieldcalifornian.com/business/x954481406/How-the-council-changed-course-on-bullet-train.

49 See http://www.fresnobee.com/2014/12/19/4294288_hsr-agency-announces-settlement.html?rh=1.

50 See *California High-Speed Train Final Program EIR/EIS*, http://www.hsr.ca.gov/docs/programs/eir-eis/statewide_final_EIR_vol1ch-6part1.pdf.

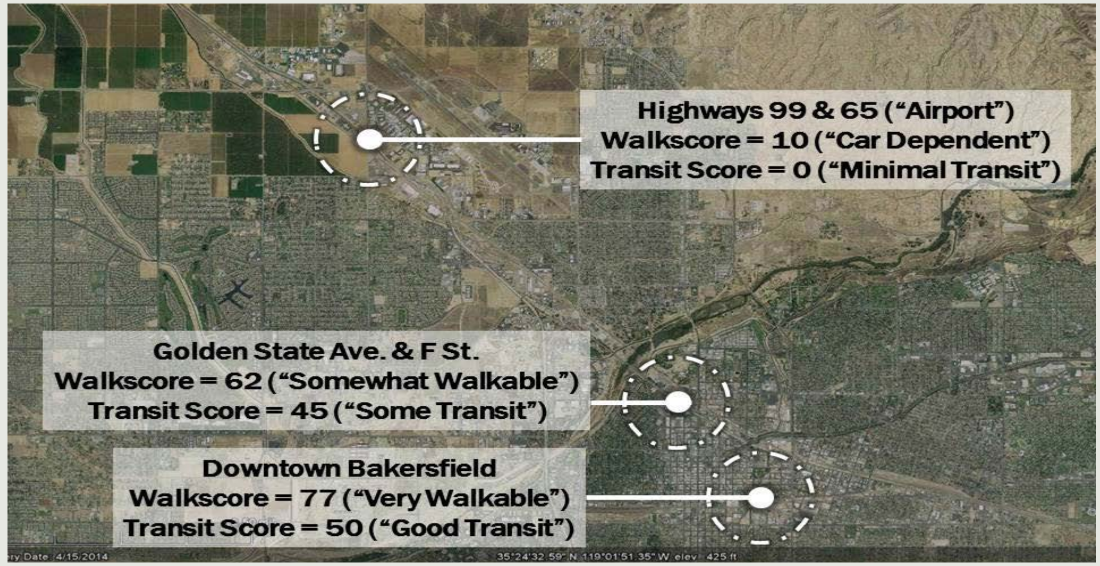
51 See www.walkscore.com.

options near the site. The conceptual airport station location, which sits roughly at the interchange of highways 99 and 65, gets a Walkscore of 10, which means that "almost all errands require a car" and a Transit Score of 0, meaning that there are no easily accessible public transportation options from the site.[52]

The downsides of the airport-adjacent location are significant: though perhaps less costly in the near-term, siting the HSR station outside of an existing urbanized area that is already served by transit creates has added expenses for passengers traveling to and from the station. The public sector must also bear the burden of extending new transit service into area previously not served.

The experience of France and Germany suggests that if a peripheral station location is selected for Bakersfield, an enormous amount of land use and transit planning work will need to be done before the station is completed if it is ever to become anything other than a park-and-ride facility. In terms of transportation, the cost of extending high-capacity transit connection into these locations can be prohibitive, and the experience of "beet field" stations such as Aix-en-Provence and Haute-Picardie in France suggests that once HSR passengers become accustomed to driving to a station, this travel behavior becomes difficult to reverse. From a development perspective, beet field stations also struggle to attract development to station areas where there is not already an existing cluster of economic activity. All of this is consistent with the common wisdom about transit-oriented development planning around transit stations in the United States: that the mere presence of a HSR station does not automatically generate economic growth and development in station areas. Moreover, it is very difficult to create something out of nothing. There must be a "there there" to begin with.[53,54]

Figure 18



Walkscore values for various Bakersfield HSR station alternatives: Proposed downtown location; conceptual Golden State Ave & F St. location; and hypothetical peripheral station near airport. Graphic shows half-mile radii (representing a 10-minute walk) surrounding each location.

Source: Graphic by author. Aerial imagery: Google

52 It is important to note that the interchange of highways 99 and 65 would need to be reconfigured in order to allow for an HSR station, and pedestrian, bicycle, and transit access would need to be improved. Currently, there are no residences or businesses that front directly onto the highways at this location. As such, there is no reason for a pedestrian to walk to the intersection of these two highways. Indeed, it would be dangerous to do so because there are no sidewalks.

53 Anastasia Loukaitou-Sideris and Tridib Banerjee, "The Blue Line Blues: Why the Vision of Transit Village may not Materialize Despite Impressive Growth in Transit Ridership," *Journal of Urban Design*, 5(2):101-125, 2000.

54 Moshe Givoni, "Development and Impact of the Modern High-Speed Train: A Review," p. 605.

Urban Design Advantages of HSR

HSR stations have inherent urban design advantages over airports and roadway infrastructure in that they can be inserted into dense urban contexts. Indeed, dense urban development can abut and even surround stations. California must recognize and capitalize on this in order to make the most of the state's investment in HSR.

HSR Stations versus Airports

High-speed rail stations are sometimes likened to airports. This comparison makes sense if one is focused on the fact that they offer similar levels of intercity mobility, at least for trips in the 100- to 500-mile range. However, such a comparison fails to account for the inherent urban design advantages of train stations over airports.

Though airports are sometimes located within heavily populated areas, they invariably have large footprints and include large swaths of undeveloped or sparsely developed land. Indeed, the size of airports is measured in thousands of acres, while the size of HSR stations is measured in tens of acres. While HSR stations can fit in dense city centers, even mid-sized airports are larger than most city centers in their entirety. Planes need vast amounts of space to take off and land safely, and federal aviation authorities therefore stipulate that airports be surrounded by runway protection zones. Airplanes are also very noisy, a reality that makes development around airports unfeasible without noise mitigation measures that constrain airport operations.[55] Finally, aviation authorities limit building heights along landing and take-off paths, a factor that significantly constrains development potential in places where commercial and residential properties abut airports such as in downtown San Jose and San Diego.

In contrast, HSR stations can be located in central city settings, directly adjacent to (or even below) development of all kinds. The comparative economic development benefits of HSR stations over airports are clearly evident when comparing Lyon's main station, Lyon Part-Dieu, with the city's airport, Lyon St.-Exupéry. Lyon Part-Dieu handles more than three times the number of passengers annually than the airport does, on a fraction of the land. As shown in Table 5, the entire Part-Dieu station district, which is 334 acres in size, includes almost 11 million square feet of office space, 3,500 housing units, and Europe's largest inner-city shopping center with 300 stores, all in addition to the train station. In comparison, the airport alone extends over 5,000 acres and has roughly

Table 5: Comparison of Lyon Part-Dieu and Lyon St. Exupéry

	Lyon Part-Dieu HSR Station District[a]	Lyon St. Exupéry Airport and HSR Station District[b]
Passengers/year	26 million	8 million
Land Area	332 acres	5,000 acres (approx.)
Office Space	10.8 million sq. ft. (97 percent occupancy) Additional 7 million sq. ft. of office space to be built by 2020	108,000 sq. ft. 320,000 sq. ft. of office space to be built in office park south of airport
Jobs	45,000	5,500
Hotel rooms	2,000	245
Other	Largest central city shopping mall in Europe, with 1.3 million sq ft of retail space and 269 shops	Convention and business center with 25,000 sq. ft. of space
Parking spaces	2,000 at train station; 3,000 at adjacent shopping mall	16,000[c]

a http://www.economie.grandlyon.com/immobilier-entreprise-commerce-lyon-part-dieu.166.0.html.
b http://www.economie.grandlyon.com/immobilier-entreprise-aeroport-lyon-saint-Exupéry.170.0.html.
c http://fr.wikipedia.org/wiki/A%C3%A9roport_de_Lyon-Saint-Exup%C3%A9ry#Acc.C3.A8s.

55 Noise impacts can be mitigated through residential noise insulation programs, under which airport authorities typically cover the cost of installing noise-shielding windows on homes that are located under airport flight paths, but such programs are costly. Alternatively, some airports, such as John Wayne Airport in Orange County, require pilots to limit the amount of throttle they use during takeoff to reduce noise impacts on airport-adjacent residential areas.

Figure 19

Lyon Part-Dieu, Lyon's main train station (top) shown at the same scale as city's airport, Lyon St.-Exupéry (below), which also includes an HSR station. While Part-Dieu station has a much smaller footprint than St.-Exupéry and is tightly knit into surrounding development, it accommodates over three times as many passengers per year (26 million vs. 8 million).

Source: Graphic by author

one-tenth the development and one-ninth the jobs of Part-Dieu.

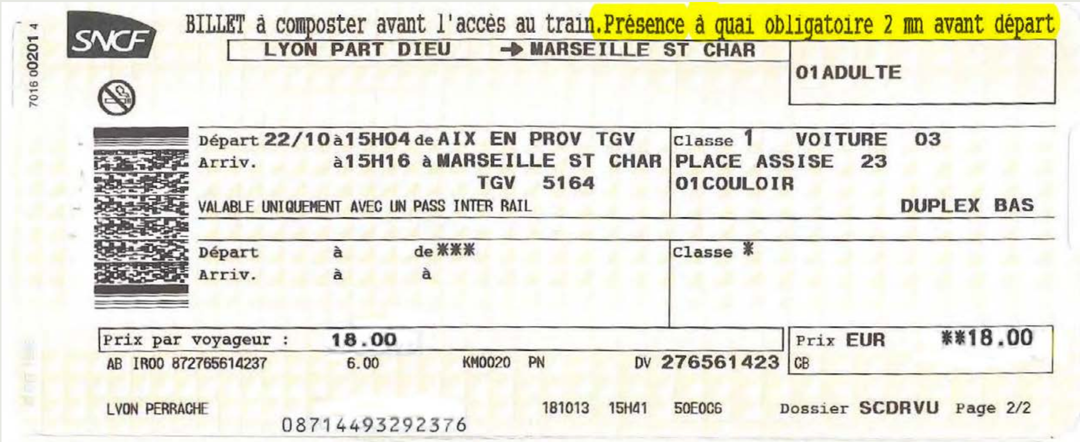
In terms of the customer travel experience, HSR is an easier and more *casual* mode of travel than airplanes in countries with existing HSR systems. This is in part due to the fact that stations are well-integrated into the urban fabric. However, in France and Germany, it is also because it is much easier to get on a train than a plane: neither advance reservations nor security checks are necessary in order to board. As evidence of this "casual" quality of HSR service in Europe, note the highlighted text at the top of the French Railway (*Société nationale des chemins de fer français* — SNCF) ticket that warns travelers to get to the train platform no less than two minutes prior to the departure of their train.[56]

The Compatibility of HSR with Dense Urban Environments: The Berlin Stadtbahn

The compatibility of HSR and cities extends beyond the physical qualities of HSR stations and the way in which those stations fit into urban neighborhoods. Indeed, the track infrastructure that brings trains into those stations can also have far less impact on urban neighborhoods than airports (with their expansive

56 Some believe that concerns about terrorism in the United States are greater than in Europe, particularly since September 11, 2001, and that CAHSR will need to implement airport-style security at HSR stations as a result. Although this may conceivably occur, boarding procedures on the Acela Express train in the northeastern United States are much closer to those of European train stations than airports. One could also argue that many existing buildings and pieces of transportation infrastructure would be higher-value terrorist targets than HSR stations and tracks.

Figure 20



Underscoring the convenient, efficient, and hassle-free quality of HSR travel, the highlighted text at the top of this ticket informs passengers that they must be present on the train platform no less than two minutes before the train's departure.

Source: Photo by author

terminals and runways) and highway facilities (with their sprawling interchanges and the roadways themselves). In Berlin, this is clearly demonstrated by a critical and long-established element of the city's urban rail network: the Stadtbahn.

Originally built in 1880, the Stadtbahn is an elevated five-mile long rail line that runs east-west across the center of Berlin. The Stadtbahn carries four tracks, in two pairs. The northern pair is reserved for use by the S-Bahn commuter rail, and is electrified using a third rail. The S-Bahn tracks have platforms at all 11 stations along the Stadtbahn. The southern pair of tracks is used by regional and intercity trains, including high-speed trains, and is electrified using overhead lines. Six of the Stadtbahn stations have platforms on these tracks. Some, but not all, regional and intercity trains stop at all stations, depending on the class and route of the train.[57]

The Stadtbahn is remarkable in that it accommodates significant rail traffic while creating surprisingly little disruption in the urban fabric. By U.S. standards, the rail right-of-way is quite narrow and the space underneath the tracks is occupied by active ground floor uses, such as restaurants and cafes. As such, the viaduct acts as a double-sided building at street level.

57 Eisenbahnatlas Deutschland [Railway Atlas for Germany] (in German). Verlag Schweers + Wall GmbH. 2009. pp. 128 — 29. ISBN 978-3-89494-139-0.

Key Takeaways: Urban Design Advantages of HSR

California must recognize the inherent urban design advantages of HSR over other types of transportation facilities and design tracks and stations to exploit these advantages. In order for California's HSR system to have the greatest chance of success, HSR station areas must be designed to capitalize on stations' inherent urban design advantages, and dense development must be allowed to come as close to stations as possible.

HSR Station Design and Land Use

HSR stations should serve not only as transportation facilities that process passengers efficiently, but also as important public places where people gather, shop, and take care of everyday needs. Additionally, the stations themselves can serve as pieces of connective urban fabric that can link neighborhoods that would otherwise be physically divided by railroad tracks.

Looking at both French and German stations, a few common land use patterns emerge. A feature of large German train stations is that they generally double as shopping centers. This is also an increasingly common feature of newly renovated stations in France. Additionally and as already discussed, since German train stations are typically located in the historic hearts of cities, they tend to be surrounded by long-established transit- and pedestrian-oriented neighborhoods.

Figure 21

The Berlin Stadtbahn at Hackescher Markt in central Berlin. Although only commuter trains stop at Hackescher Markt, the tracks that pass through the station carry all types of trains, including high-speed trains. The spaces underneath the tracks house businesses such as restaurants and cafes. This demonstrates a clear advantage of high-speed trains over airplanes: because they can run on relatively narrow rights-of-way and make little noise when traveling at moderate speeds,[1] it is possible to knit high-speed trains into densely built urban contexts.

Source: Photo by Christoph Büscher

1 Moshe Givoni, "Development and Impact of the Modern High-Speed Train: A Review," p. 606.

However, since these station districts were built out centuries ago, long before the advent of modern building technologies, they are not as dense as they might be if they were constructed today. This is where French cities such as Lyon and Lille provide models for development that are more relevant to the Californian context, where HSR station cities are seeking to maximize development potential within station areas.

The Multiple Roles of Train Stations: "The Tension between Place and Node"

A perennial challenge for designers of train stations is how to balance the conflicting roles that they play. The issue is how to design facilities that serve as places through which large numbers of travelers can move efficiently, while at the same time creating pleasant urban places where people want to spend their time. This is what is sometimes referred to as the "tension between place and node." Stations that successfully balance this complexity start with two intentions: the desire to bring together a mix of economic and social uses, and a commitment to planning and designing infrastructure at a human scale. The first requires market knowledge, public-private partnering, and political support. The second requires political leadership as well as close collaboration by design professionals (transportation planners, engineers, station area planners, and station designers) to ensure that trackway approaches to the station do not divide communities and that station access and layout celebrate transport as well as the station's "other" public purposes. A key factor is to ensure that stations and their various elements are designed to serve multiple public and private purposes. In the case of Lille, this integrated design approach was ensured by a single design team that was responsible for the station area plan, the design of the station, and the transportation infrastructure serving the station.

Station Design Considerations: Lyon Part-Dieu

François Decoster, chief architect and master planner for the Lyon Part-Dieu redevelopment effort, has grappled quite a bit with the tension between place and node as it relates to HSR stations. A key concept that that he has pursued in most of his station work, at Lyon Part-Dieu and elsewhere, is that of *la gare ouverte*, which we might translate as "the open station."

A significant shortcoming of the current design of Lyon Part-Dieu is the poor quality of pedestrian connections to and through the station. Designed in the auto-centric *trente glorieuses*[58] era that extended into the early 1980s, the site is sliced up by depressed roadways, parking garages, and the boxy and opaque Part-Dieu shopping center. Pedestrian circulation happens largely on elevated walkways that connect buildings above the street level (see Figure 22). A central focus of the plan is therefore to improve pedestrian circulation through the station and surrounding neighborhoods by bringing pedestrian paths down to grade level, and by increasing the size, number, safety, and ease of pedestrian

Figure 22

This view of Rue Servient is emblematic of the sol difficile ("pedestrian unfriendly conditions") surrounding Lyon Part-Dieu. Rue Servient is the primary east-west street linking Lyon's historic downtown to the Part-Dieu station and shopping center. The station area was built at the height of the auto-oriented trente glorieuses era, during which the efficiency of automobile circulation was the primary objective of investments in transportation infrastructure. In this location, the official pedestrian path is one level above the street. As shown in this image, however, many pedestrians opt instead to take a more direct and intuitive — albeit dangerous — route along the streetcar tracks, which run parallel to the auto travel lanes. Bicyclists also do this rather than take the more circuitous official bike route around the shopping center. Correcting these poor pedestrian and bicycle connections is one of the key objectives of the current station area redevelopment effort. Lyon Part-Dieu station is located on the far side of the underpass, seen here.

Source: Photo by author

58 Les Trente Glorieuses ("The Glorious Thirty") refers to the three decades after World War II, from 1945 to 1975. Roughly analogous to the Urban Renewal Era in the United States, this period is characterized by rapid economic growth, but also by efforts to retrofit older cities to accommodate automobile circulation, often at the expense of historic neighborhoods and structures.

crossings and sidewalk. The plan also aims to make pedestrian routes more intuitive.

In spite of the poor quality of the pedestrian environment surrounding Part-Dieu, an important realization of the master plan team was that the station itself plays an important role as a piece of connective urban tissue. Since the station sits at the center of Lyon and currently has 11 boarding platforms, the train tracks create a major chasm in the urban fabric. Pedestrians crossing from the east (Villeurbane) side to the Lyon side of the tracks use the station hall as a passageway to safely cross from one side to the other. According to TCL, Lyon's public transit agency, about 12-14 percent of people passing through the train station, or 20,000 per day, simply use it as a pedestrian connection and are neither intercity rail passengers nor public transit patrons.[59]

This potential of train stations to link neighborhoods that would otherwise be divided by railroads is what Decoster calls *la gare connectrice* ("the connecting station"). To illustrate his point, Figure 23 shows a station that his firm proposed for a station on the north side of Paris called Pleyel. A massive bridge structure would span a vast field of tracks that divides neighborhoods. The idea here was to provide a station that would also double as a link between neighborhoods that would otherwise be difficult to access from one another, at least from the perspective of a pedestrian or cyclist.[60]

Figure 23

Gare Pont/Gare Connectrice ("bridge station/connector station"): AUC proposal for Pleyel Station on the north side of Paris (proposal was not selected and will not be built). This bridge station would link neighborhoods that are separated by a large rail yard.

Source: AUC

Another critical factor for successful HSR station design is adequate sizing. A fundamental challenge that Part-Dieu faces in fulfilling the role of being a memorable and successful public place is that the station is so undersized. As mentioned above, Part-Dieu is a crossroads for many different modes: it is at

59 Interview with Philippe Bossuet, October 14, 2013.

60 Interview with Francois Decoster, October 26, 2013.

> "When it comes to megaprojects like Mission Part-Dieu that have the potential to change the way in which people experience an entire metropolitan region, it is essential that designers have the breathing room to develop and articulate a big and bold vision for their project. Once this vision has been adequately developed, only then should the constraints that might impede the realization of this vision be seriously considered. At that time, the designer should attempt to make the constraints conform to the vision, not the other way around. Starting the design process with the constraints as the focus will lead to suboptimal results: projects that end up as the sum of their constraints."
>
> *— Francois Decoster*

once the main nodal point in the Lyon region's public transit system and the busiest train station in France for connections. Designed for 35,000 passengers, the station routinely sees more than 120,000 on a typical day, and projections show that more than 220,000 passengers could pass through the station per day by 2030.

In light of the passenger volume forecasts, the proposal calls for thoroughly reconfiguring the station and making it much larger. The building and walkways will more than double in size, growing from 160,000 square feet currently to over 355,000 square feet.

Most retail spaces currently located in the hall that runs underneath and perpendicular to the tracks will be removed to facilitate foot traffic through the station. A much larger array of shops and restaurants will be located in galleries parallel to the tracks, as shown in the image below at left. Additionally, a new entrance at the southern end of the station will be added along Pompidou Avenue, which will help distribute foot traffic through the station.[61]

The master planning effort for which Decoster is the chief designer is inherently a constrained design exercise: the area is already mostly built out and the station must continue to accommodate passengers throughout redevelopment. Also, there are many mostly high-rise buildings in the Part-Dieu neighborhood that will be retained according to the master plan, not because they are great buildings, but because they are still structurally sound and mostly functional. However, Decoster feels strongly that in any design effort, no matter how constrained, it is essential for the design team to put forth a bold vision *first* and then *afterwards* to consider constraints that might hamper the implementation of that vision. According to Decoster, one should make the constraints bump up against the vision once the vision has been developed, refined, and articulated.

61 http://www.lyonpart-dieu.com.

Station as Shopping Center

The benefits of having stations that are important destinations in and of themselves are many, both in terms of economic development and transit ridership. As more destinations become accessible by transit, the greater the value of transit and the higher ridership will be, and the lower the costs of providing service become.

One notable German example of this is the Leipzig Main Station, which is the world's largest railway station measured by floor area. It has 24 platforms and a multi-level concourse with towering stone arches. The building's façade is 960 feet long. The station handles an average of 120,000 passengers per day and is the hub of the S-Bahn regional rail system in the Leipzig-Halle region. The station, which itself is a large shopping center with 143 shops and services, was thoroughly

Figure 24

Proposed new wing of Lyon Part-Dieu Station with shopping.

Source: AUC/Grand Lyon-Mission Part-Dieu, 2013 renovated and modernized after German reunification by the Deutsche Bahn. The area under the concourse floor was excavated to allow for two basement levels that are now occupied by the shopping center.

Though the station was already very large at the time of German reunification, it was still deemed important to create more space for the above-mentioned shopping mall. The mall, based on the mix of businesses that are located within it, has uses that go far beyond enterprises that one would consider typical for public transit. For example, Leipzig Main Station hosts not only restaurants, book stores, flower shops, and gift shops, but also such varied businesses as a pet store, a home furnishing store, and a full-sized supermarket.[62]

Figure 25

Leipzig Main Station.

Source: Photo by author

In France, an important example in the trend toward shopping center stations is Gare St. Lazare in Paris. Though not a high-speed rail station, Gare St. Lazare is one of six large terminus stations in Paris. It is the second busiest train station in Europe after Paris Gare du Nord, and sees an average of 450,000 passengers per day. It also represents a model of the French station of the future, according to SNCF.[63] Like Leipzig Main Station, St. Lazare is a shopping mall, with 80 shops distributed over a three-level arcade that runs perpendicular to the train tracks.

Key Takeaways: HSR Station Design and Land Use

Stations should be central to the neighborhoods that surround them. They need to be appropriately sized and designed well so that they can serve the multiple public purposes that successful train stations serve. They are not simply transportation facilities; they are valuable public places.

In terms of land use, California should take its cues from Germany and France on appropriate land uses within the train stations

62 http://www.promenaden-hauptbahnhof-leipzig.de/shopsuche/alle/.

63 Interview with Lionnel Grand, of the Stations and Connections Division of SNCF.

Figure 26

Gare St. Lazare, Paris. According to SNCF officials, Gare St. Lazare represents the French station of the future, a transportation hub that is also a destination.

Source: AREP

and build them as shopping malls.[64] A rich mix of retail establishments will give both train passengers and other neighborhood users a reason to spend time in stations and make them feel lively and inhabited rather than simply sterile transportation facilities.

Well-designed public spaces surrounding the stations can also solidify the role of train stations as neighborhood centers. However, such spaces need to be carefully programmed and appropriately sized. The greater risk is of public spaces that are too large and without amenities, qualities that will drive people away and can have a deadening effect on the station and surrounding areas. Public spaces that are too small can also compromise the proper function of train stations by failing to guarantee the smooth flow of pedestrians.

The CAHSRA should ensure that HSR stations are planned in concert with the neighborhoods that surround them. In most cases, separate teams will be responsible for designing the station and planning the station area. Where this is the case, the team that is doing the master plan for the station area should take the lead in defining the vision for the station and the station area, and the architect for the station itself should take cues from the master planner. Specifically, the master planner should get involved in the design of the station's interior public spaces, in sketching out how people — both rail passengers and also other neighborhood users — will move through the station and into surrounding streets. They should also work closely with the station architect to ensure the most direct possible connections between modes. If this does not occur, there is a danger that the stations will not be adequately integrated into the neighborhoods that surround them. There is also a danger that stations may not be designed to meet the multiple public purposes discussed in this report. As a result, the station may not meet its potential as a great public space, as a generator of economic development, and as a facilitator for movement and circulation.

All of these things need to be included as foundational elements of a robust vision for each station area and pursued doggedly. If they are not, this will erode the some of the

64 Though the market demand for retail space within station areas may currently be insufficient to support shopping malls, the hope is that HSR will stimulate demand for development within station areas and attract a significant portion of the state's future growth in the retail sector.

door-to-door travel time benefits of HSR over other modes, which will have a negative impact on ridership and on overall service.

Given the pressures in California to limit the cost of the HSR project and the political climate in which the project is currently being developed, it will be challenging for the California HSR station cities to envision how HSR can transform station neighborhoods and to put forward a robust vision in which stations are integral parts of the neighborhood in which they are built. The examples cited here demonstrate the potential.

HSR Station Neighborhood as Business District

High-density employment and commercial uses represent the highest and best use for HSR station districts; residential and cultural uses should play a supporting role in ensuring round-the-clock activity.

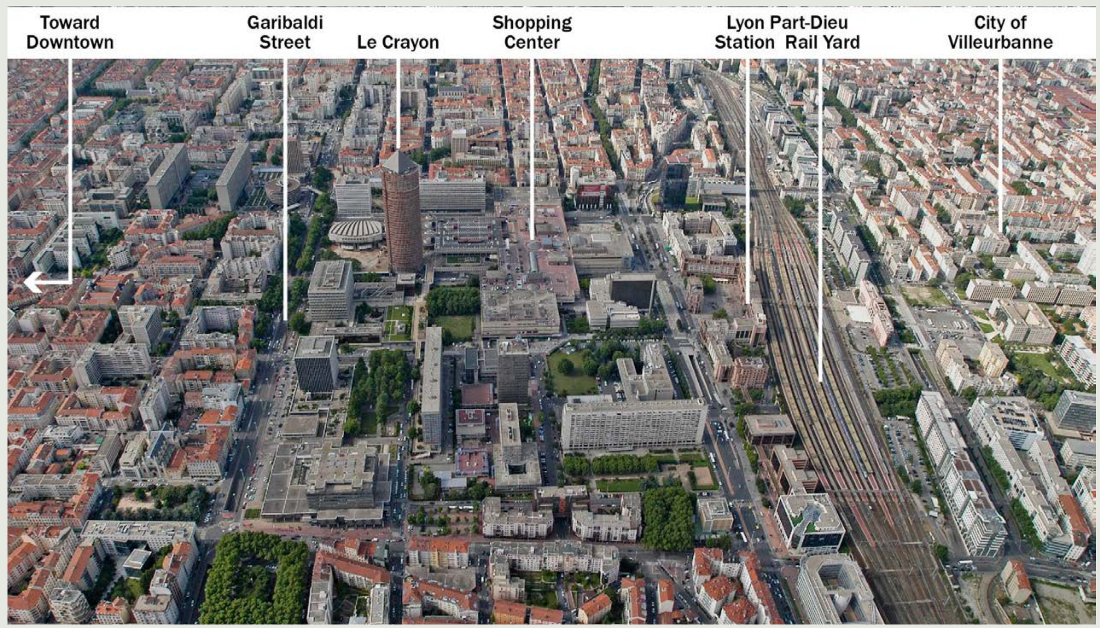
Lyon and Lille are noteworthy in the realm of HSR station area planning for fostering development to specifically capitalize on the access benefits of HSR. Lyon's main station and surrounding neighborhood, Lyon Part-Dieu, has become the second most important business district outside of Paris, whereas Lille's main station and the area surrounding it have become France's third most important business district. In addition to office space, both station areas include large shopping malls, entertainment venues, and housing.

In both Lyon and Lille, new stations were built on underutilized central city plots that had formerly been military bases. Moving the main station to underdeveloped sites allowed for surrounding dense HSR-oriented development. This development would not have been feasible in already built up areas.

Lyon

The initial plans for Lyon Part-Dieu in the early 1960s envisioned a new center with three primary elements to be built on the site of a former military base: 1) a cultural component, including a library and a concert hall; 2) an office district, including both offices for governmental entities and private companies; and 3) housing. It was not until later that decade that the planning agency for the Lyon metropolitan area proposed a train station on the site, a proposal that also shifted the focus of the master plan toward office and office-related uses. Planners intended for Part-Dieu to become a second center for Lyon, loosely modeled after la Défense in Paris, which would complement the historic core. The station was built in conjunction with the

Figure 27



Lyon Part-Dieu station district.

Source: Jacques Leone (aerial imagery)

Lyon Part-Dieu Station — Key Characteristics

- Opened in 1983
- Lyon pop. 2 million (in region)
- Center of new downtown district
- Central node in local transit and national rail networks
- Total of 2,060 parking spaces at station; 3,056 within adjacent shopping center
- Station has 11 tracks
- Station built for 35,000 people/day, but now sees 120,000 per day on average
- Busiest rail station in France for connections

Table 6: Key Numbers: Part-Dieu Development Program: Current and Future

	2013	2030
District acreage	334	Unchanged
Residents	5,000	7,150 (+2,150)
Housing units	3,500	5,000 (+1,500)
Parking spaces	7,500	Unchanged
Office space	10,763,910	17,760,452 (+6,996,542)
Jobs	45,000	70,000 (+35,000)

Figure 28

Master plan redevelopment proposal for the Part-Dieu neighborhood.

Source: AUC/Grand Lyon-Mission Part-Dieu, 2013

largest central city shopping center in Europe, which today features more than 300 shops in more than 1.4 million square feet of retail space. Today, the entire area boasts almost 11 million square feet of office space, 45,000 jobs, and 3,500 residences, figures that easily make Part-Dieu Lyon's primary business district and also France's most significant business district outside of Paris.

In the history of French and European HSR planning, Lyon was a pioneer. The city was not able to benefit from the experience of other cities in planning the station or station area, since the only precedents that existed at that time were in Japan. Also, it was unclear for the first 15 years of the planning process that a train station would be built on the site. As such, much of the planning for the station occurred in a context of great uncertainty and made it even more difficult to capitalize on the benefits of HSR.

Part-Dieu station and the Paris-Lyon HSR line have proven wildly popular, and in fact, much more popular travel mode than air travel in the Paris-Lyon corridor. The station was designed with conservative assumptions about passenger volumes based on a more auto-oriented character. As a result, Lyon quickly outgrew its station as HSR became the preeminent mode of intercity travel. The station area is also characterized by unsatisfying public spaces and awkward above-grade pedestrian walkways, the pedestrian-unfriendly hallmarks of the auto-oriented *trente glorieuses* era. These conditions are made worse by the fact that much of the office development in the neighborhood occurred before planning for the train station was underway, so the earliest development on the site faces away from the station, which is the neighborhood's primary focal point.

The station and surrounding area also suffers from a number of urban design shortcomings, which Frederic Duchêne, project director for Mission Part-Dieu, describes as the three "fractures" or dividing lines that separate the station from surrounding neighborhoods. These include 1) the 11-track-wide railway right-of-way that serves the station; 2) the Part-Dieu shopping center, which is adjacent to the station; and 3) Garibaldi Street, a high-speed arterial road that runs along the edge of the master plan site.

In light of the station and district's popularity, Part-Dieu is now the subject of a large redevelopment effort to improve the design of the station and the public spaces that surround it, improve non-auto access to the site, and increase the amount and diversity of development within the station area. The effort, called Mission Part-Dieu, will transform the area and further consolidate its position as France's preeminent business district outside of Paris. The master planners believe that the neighborhood, in order to be viable over the long term, must be livelier during non-business hours and on weekends. In particular, they believe that it needs to be a more "inhabited" place, and cultural and entertainment uses need to become more prevalent. Key to achieving this is introducing more cultural and arts-related uses, as well as some housing.[65]

What makes it challenging to redesign the Part-Dieu district is that the area is already a well-developed and important business district. For all of its problematic physical features — the boxy shopping mall, the wide arterial roads with fast-moving cars, the above-grade pedestrian walkways — the district enjoys a mostly positive public image. The challenge for Mission Part-Dieu, therefore, is to preserve what works well, strategically remove what does not, and try to make better use of a number of underdeveloped parcels.

In light of these complexities, the metropolitan government of Lyon ("Grand Lyon") decided to introduce a new form of government to oversee project development and implementation. *Mission Part-Dieu* (MPD) is a place-based "territorial mission" within Grand Lyon that is semi-autonomous. MPD has appointed a small team of cross-disciplinary urbanists who will represent the chief architect and master planner and the AUC architecture and planning firm, and who are responsible for championing AUC's overall urban concept and supporting its implementation. Among other things, the team plays a coordinating role between Grand Lyon and other entities that are affected by the project, including property owners, developers, private investors, neighborhood residents, and people who work in the district. This team also leads public outreach efforts and all the technical studies related to the project.[66,67]

Lille

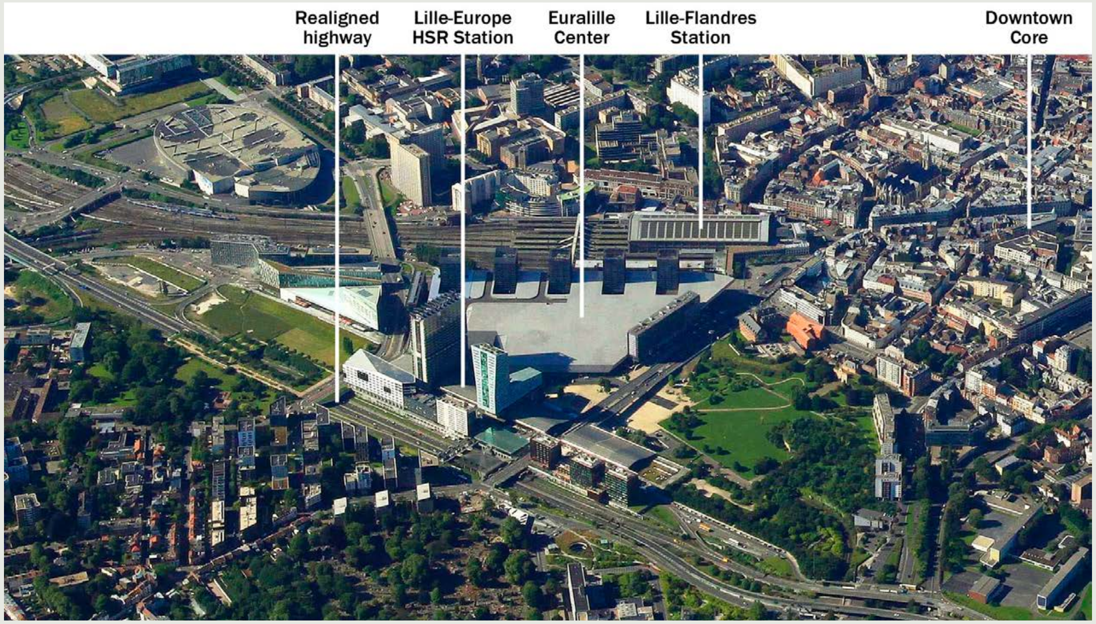
Initial planning for Lille's current main station, Lille Europe, as well as the district that surrounds it, began in the mid-1980s, at a time when Lille was a declining industrial city. The opportunity for Lille to become linked by HSR became a possibility when then-British Prime Minister Margaret Thatcher lent her support to the Channel tunnel project ("the Chunnel"), and SNCF began planning a rail between Paris and the mouth of the Chunnel. In the interest of building quickly and cheaply, SNCF had initially proposed to build a "beet

65 The land use mix proposed by the Mission Part-Dieu (MPD) team emphasizes primarily office and commercial uses because these uses reinforce the district's role as the Lyon Region's primary destination. However, the MPD team also proposes some cultural and housing development in order to attempt to enliven the district during evenings and weekends.

66 A key benefit of this governance structure is streamlined decision-making. See Maxime Bouly, Jean-Marc Valentin, and Roelof Verhage, "Part-Dieu Station Business District and Multi-Modal Hub," in *Railway Stations and Urban Dynamics: High Speed Issues*, pp. 68-85. Further information (in French) http://www.lyonpart-dieu.com/lexperience-lyon-part-dieu/la-gouvernance/lequipe-la-mission-part-dieu/#.U2ghtaywXbs.

67 In order to further streamline decision-making and facilitate project implementation, MPD will adopt a new governance structure that was first introduced by the French government in 2010 called *societe publique locale*. See (in French) http://www.collectivites-locales.gouv.fr/societes-publiques-locales-et-societes-publiques-locales-damenagement.

Figure 29



Aerial view of Lille "train station triangle" with Gare Lille-Europe in foreground and Gare Lille-Flandres in background. Both stations are connected by the Euralille shopping center.

Source: SPL Euralille (aerial imagery)

field" station west of Lille. However, Lille's powerful mayor, Pierre Mauroy, objected to this concept and fought SNCF to ensure that the station would be located in the heart of his city. Mauroy's deep involvement in all aspects of design and project implementation was uncommon for a mayor, but it was a critical factor in guaranteeing the success of the Lille station and station area development efforts.

Mauroy championed a master plan for the station and the 300 acres surrounding it that prioritized shopping, services, and tourist-related land uses. He involved himself in all aspects of design and implementation. At almost every other station in France, SNCF employs its own group of architects from the firm named AREP to design stations. In Lille, Mauroy insisted that the firm of the famous Dutch architect Rem Koolhaas, which won the competition for the master plan of the station area, also be responsible for designing the station, a rare arrangement in France.

Lille-Europe Station — Key Characteristics

- New through station, Gare Lille-Europe, built to supplement existing stub-end station, Lille-Flandres
- Euralille Shopping Center was built to connect both stations. Additionally, about 8 million square feet of floor space was built within the 300-acre station area
- Opened: 1994
- Crossroads between Paris, London, and Brussels
- Station currently accommodates 58,000 passengers per day (in 2012, includes ridership for both Lille Flandres and Lille Europe)
- HSR station credited for reorienting Lille's economy toward the service sector

Given the city's depressed economy, the redevelopment effort was funded through a public-private partnership. The city's main asset was in the form of land, which — as was the case for Lyon Part-Dieu — had previously been a military base. Today, the station area is the third-most important business district in France after La Defense in Paris and Lyon Part-Dieu. The area is exceptionally well connected to transportation infrastructure, in particular to Lille-Flandres Station and Lille-Europe Station, as well as a ring highway, a streetcar, and the world's longest automated metro system.

Today, the Euralille station area is thought of as the clear center of the Lille metropolitan area. This was not the case in the late 1980s when the project was first taking shape. The construction of the HSR station and the associated development within the station area that occurred have transformed the city from a sleepy and declining industrial outpost to a more dynamic metropolis that is much more international in its orientation. The station has seen steady growth in ridership since it opened in 1994. As HSR to Rotterdam, Amsterdam, and Cologne begins to increase, there is talk of the possibility that Lille may need to build a third station on the south side of town.

Key Takeaways: Station Area Land Use

Prioritize land uses within station areas that will maximize ridership for HSR. High-density employment and commercial uses represent the highest and best use for HSR station districts; residential and cultural uses should play a supporting role in ensuring round-the-clock activity

Lyon and Lille have both prospered since the initiation of HSR service, mostly by growing their service-sector economies. HSR is best at stimulating growth in the service sector, and it is most effective at bolstering the economies of cities with an existing economic base in the service sector, as shown most clearly by Lyon. However, a city without an existing strong economic base in the service sector may be able to foster service sector growth by steadfastly pursuing a clear economic development, land use, and urban design strategy that HSR can support, as Lille demonstrates.

The selection of the station location for the high-speed line is perhaps the most critical decision that a city can make. Both Lyon and Lille opted to construct new stations on underutilized, centrally located pieces of land. In both cities, the selection of new sites allowed for the construction of larger facilities that were better able to handle larger volumes of passengers than the historic main stations that they replaced. Also, the selection of new centrally located sites allowed for significant infill development immediately adjacent to the stations, which encouraged HSR-oriented development. Underutilized central city industrial or military sites are especially attractive for HSR stations and station area development, both because of their central locations and also because such sites can often accommodate dense infill development.

Stations should also be developed as part of master planned districts. The concept for these station districts needs to fit into each city's overall planning and economic development strategy for the city as a whole.

Finally, as is especially evident from the experience of Lille, strong and consistent political leadership is essential, especially as a primary champion for the project. The fact that Pierre Mauroy forcefully negotiated with SNCF to guarantee that the HSR station was located in the center of his city and that the master planner for the overall site, Rem Koolhaas, was also involved in the design of the station ensured that the station became a central focal point of the neighborhood. California mayors or even the governor could play a similar role in California.

Local Access to HSR Stations: The Importance of Prioritizing Space-Efficient Modes

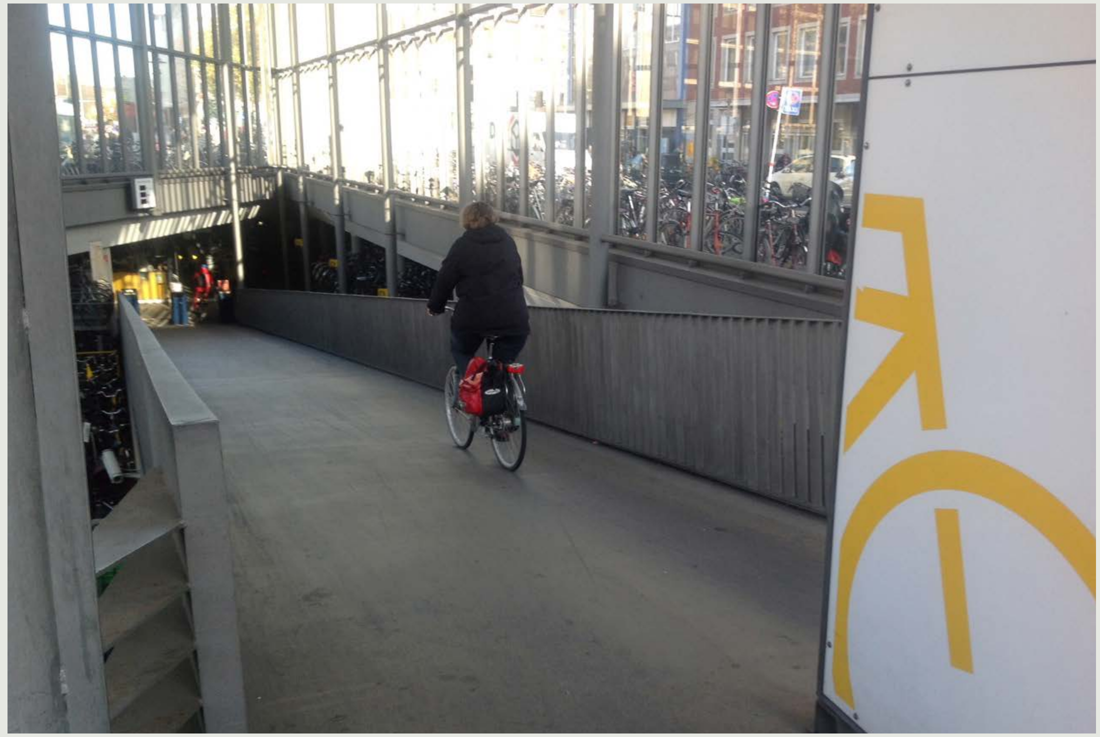
In order for both the transportation utility of HSR stations and the economic development potential of station areas to be maximized, access to HSR stations by space-efficient modes such as walking, transit, bicycling, taxi, and car share should be prioritized over auto access and made as convenient and pleasant as possible.

Land within HSR station areas is a scarce resource that will become more valuable over time. Bearing this in mind, it is important to prioritize access to stations via the modes of transportation that will deliver the greatest number of passengers to stations over the long term, while requiring the least amount of space. This includes walking, transit, bicycling, taxi, and car share.

The importance of walking as a transportation mode for places within close proximity (up to a mile) of HSR stations is obvious. Passengers who take transit or drive to stations must walk in order to get from transit or from a parking garage to HSR platforms. Also, the amount of dense development that is located within station areas can, in most cases, be viewed as an indication of the viability of walking as an access mode. This is because the more development that is put within walking distance of stations, the more that walking can be a viable means of accessing it.

For distances beyond a half-mile to a mile, walking will usually not be the most suitable mode. Many cities in Germany have found that the bicycle is an important piece of the HSR access mobility puzzle, one that could also play a much bigger role than it does currently in California, for four reasons: 1) origins and destinations that are too far to reach by foot, yet three (or more) miles from a train station can be easily accessed by bike; 2) bicycles, like cars and often unlike public transit, provide door-to-door access; 3) from a public finance perspective, the infrastructure for bicycles —lanes and parking facilities — is cheap in comparison to transit or auto infrastructure; and finally, and perhaps most importantly for this paper, 4) bicycles and bicycle infrastructure take up very little space — both in in terms of lanes and parking. Put another way, the bicycle is a space-efficient mode of transportation, delivering many passengers to HSR while requiring very little space.

Figure 30



Ramp from street level descending to 3,300-space underground bicycle parking facility at Münster Main Station, Germany's largest. Key to the popularity of this bike station is its location at the city's main train station, Münster's bike-friendly urban fabric, and design features within the station that expedite transfers from bike to rail or vice-versa.

Source: Photo by author

The Bicycle as Cost-Effective and Efficient Mobility Tool: The Case of Münster

Münster is the capital of cycling in Germany, where a staggering 38 percent of all trips are made by bike.[68] The city offers many lessons about the potential of the bicycle to serve the mobility needs of select cities and population groups and underscores the fact that sustainable modes of transportation can often be complementary and mutually reinforcing. Indeed, they often depend upon one another to meet the door-to-door travel needs of the people who use them. Understanding this is critical for cities that wish to reduce car use.

At Münster Main Station, train passengers who get to or from the station by bike enjoy convenient and secure bicycle parking at Germany's largest bike parking garage, a 3,300-space bike parking facility located just

68 Although Münster is not an HSR city, I have selected it here as a case study because it offers valuable lessons on bicycles as an access mode to intercity rail.

adjacent to the station. Bike access to the *Radstation* is afforded by ramps that descend to the underground parking level. The ramps are designed to allow cyclists to descend without needing to dismount (see Figure 30). This feature saves riders several minutes in each direction and enhances the attractiveness both of cycling as an access mode to the train, and also of the train as an alternative to the car.

According to surveys conducted by management of the Radstation, 60 percent of customers live outside of Münster and work near the city center. They leave their bikes at the Radstation for the entire week and only use them during the work week in order to get around the city during the workday. This means that the bike station owes its success to its proximity to the train station. The Radstation also demonstrates that bicycles should not always be viewed as an access mode *to* rail transportation, but that the opposite can also be the case: that trains can also serve as an access mode to bicycles.[69]

Using Bikeshare to Legitimize Cycling as a Mode of Transportation: The Case of Lyon

Unlike in Germany, bicycling has not traditionally been a significant mode of transportation in French cities. Indeed, for the cities profiled in this project, the average bicycle mode share for the French cities (not weighted for population) was 3 percent in 2008, while the average for the German cities that I studied for this project was 17 percent.

Figure 31

Dedicated bikeway in Lyon (left) and VeloV bike share station in Lyon (right).

Source: Photos by author

Lyon has historically been similar to other French cities in this regard. This changed in 2005 with the Launch of VeloV, Lyon's bike share system, the first bike share system to be launched in a large French city. Lyon's historic center is compact and was built out hundreds of years ago, long before the advent of the automobile. As such, bicycles are a far more efficient way of getting around the center's narrow streets than cars. And although walking remains the primary means of getting around the center of Lyon, bicycling allows people to get around more quickly.

Between 1995 and 2006, the bicycle mode share in metropolitan Lyon increased 124 percent. A study of bike share in the city suggested that VeloV users were 75 percent male, largely educated, and many were either students or academics.[70] However, the metropolitan government of Lyon (Grand Lyon) is seeking to broaden the appeal of cycling by aggressively expanding bicycle infrastructure in the city, including protected bike lanes, as shown in Figure 31. Grand Lyon's *Plan Modes Doux* (which we might translate as "active transportation plan") calls for almost tripling the city's bicycle lane mileage from 200 miles

69 This finding has also been borne out by recent research in the United States. See Bradley Flamm and Charles Rivasplata (2014), *Perceptions of Bicycle-Friendly Policy Impacts on Accessibility to Transit Services: The First and Last Mile Bridge*, http://transweb.sjsu.edu/PDFs/research/1104-bicycle-policy-transit-accessibility-first-last-mile.pdf.

70 E. Ravalet and Y. Bussiere, 2012. "Do bike sharing systems explain the renewal of urban cycling?" *Recherche Transports Sécurité* (Springer) 28, 1 (2012) 15-24. (French title: Les systèmes de vélos en libre-service expliquent-ils le retour du vélo en ville ? Article in French except for abstract)

in 2008 to 570 miles in 2020.[71] It also foresees a tripling of the bicycle mode share over this time period from an estimated 2.5 percent in 2008 to 7.5 percent in 2020. Lyon's active transportation plan is also noteworthy in that it recognizes not simply walking and bicycling as legitimate modes, but also push scooters and rollerblades.

Key Takeaways: Local Access to HSR

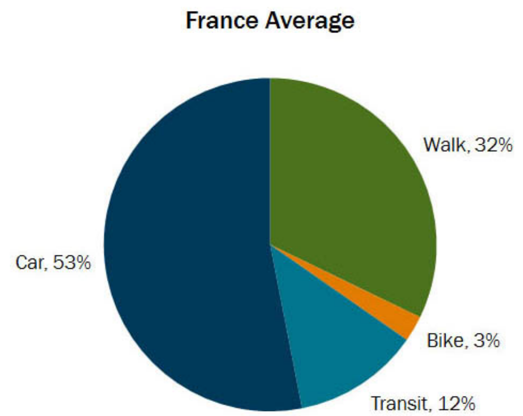
As the German example shows, bicycles can serve as a cost-effective and space-efficient means of meeting mobility needs, both for individuals and the funding agencies that pay for transportation infrastructure. These attributes indicate bicycling could be an important access mode to HSR for California station cities. According to Niels Hartwig, director of the division within the German Federal Transport Ministry that deals with bicycle transportation, investments in bicycle infrastructure can be especially worthwhile in mid-sized cities. In those places, there is not as much auto traffic on roadways, and cyclists have fewer aggressive drivers to contend with, which makes cycling less intimidating. Also, mid-sized cities typically have less money available to spend on large transportation projects, so smaller, much less costly investments in bicycle infrastructure can provide improved mobility at a low cost.[72] This may explain why cities like Münster and Freiburg, which have invested heavily in bicycle infrastructure, have such high rates of cycling.

71 http://www.grandlyon.com/Le-plan-Modes-doux.48.0.html.

72 Interview with Niels Hartwig, November 6, 2013.

Table 7: France[a]

City	Walk	Bike	Transit	Car
Aix	26%	1%	7%	66%
Amiens	33%	2%	7%	57%
Beaujolais	21%	1%	4%	74%
Lille	31%	2%	9%	58%
Lyon	32%	2%	15%	51%
Marseille	34%	1%	11%	54%
Paris	47%	3%	33%	17%
Strasbourg	33%	8%	12%	47%
France Average[b]	32%	3%	12%	53%

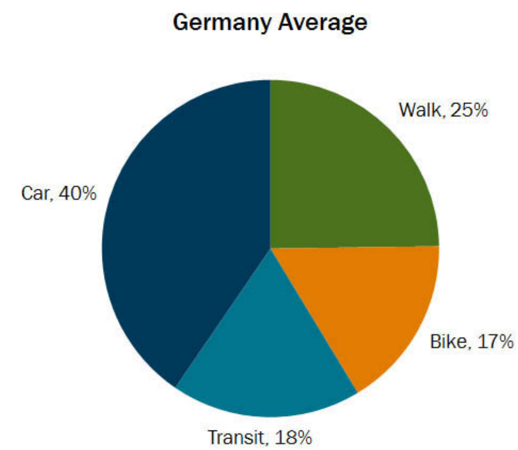


a TEMS - The EPOMM Modal Split Tool: http://www.epomm.eu/tems/index.phtml.

b Note: this is the average for all cities in this table, unweighted for population.

Table 8: Germany[a]

City	Walk	Bike	Transit	Car
Berlin	30%	13%	26%	31%
Dresden	22%	16%	21%	41%
Freiburg	24%	28%	18%	30%
Hannover	27%	13%	17%	43%
Kassel	29%	7%	22%	42%
Koblenz[b]	24%	8%	10%	58%
Cologne	24%	12%	21%	43%
Leipzig	27%	14%	19%	40%
Münster	16%	38%	10%	36%
Germany Average[c]	25%	17%	18%	40%



a TEMS - The EPOMM Modal Split Tool: http://www.epomm.eu/tems/index.phtml.

b City closest to Limburg and Montabaur for which mode split data was available via EPOM.

c Note: this is the average for all cities in this table, unweighted for population.

For its part, Lyon demonstrates how bicycling, if properly marketed, can address the mobility needs of a growing portion of the population and for more types of trips, including access to intercity rail stations. This can even occur in a place where bicycling has not historically been seen as a legitimate mode of transportation.

The examples of cycling in France and Germany as an important mode of transportation and as a mode of access to intercity rail may offer some food for thought to the mid-sized cities along the California high-speed rail route. Although cycling may not be the most appropriate mode of transportation for all segments of the population in every city and for every trip, targeted investment in HSR station cities may yield great long-term dividends. With advances in design and technology, including the development of cargo bicycles able to carry luggage and electric-assisted models, bicycles are poised to become more suitable as an access mode to HSR for ever greater numbers of trips and user groups. Indeed, since bicycles provide point-to-point access like cars, one could argue that bicycles may be a more suitable mode of accessing HSR stations than public transit in many of the lower-density cities along the California HSR route, at least for places located within three miles of stations. In order for bicycles to be a viable last-mile mode for HSR stations, adequate bicycle parking will be required at stations. Given that space on trains is limited, investments in bike stations, bicycle parking, and bike sharing facilities at HSR stations is doubly important.

The payoff in terms of bike ridership may also not be immediate, but may occur gradually over time if properly encouraged and planned for. From a financial and political perspective, it is also a low-risk and space-efficient strategy for providing the greatest improvement in passenger access to HSR stations, particularly for smaller and mid-sized cities where public transit is infrequent and significant investments in transit are difficult to justify.

There is growing recognition that higher quality bicycle facilities will need to be provided in order to significantly increase rates of cycling. In the United States, however, many of the types of facilities that have the greatest promise to encourage cycling, particularly among groups who feel less comfortable cycling in dense urban environments with speeding automobile traffic, are not currently allowed under many local and state roadway design guides. This includes facilities such as parking-protected bikeways.[73]

73 A relevant document here is the NACTO Urban Street Design Guide (USDG), produced by the National Association of City Transportation Officials (NACTO). The guide "demonstrates how streets of every size can be reimagined and reoriented as safe, sustainable public spaces for people walking, driving, biking, and taking transit." The premise of the guide is that public rights-of-way are cities' most valuable public resource, and that they must serve multiple purposes, from storefront or doorstep to throughway. As of this writing, 39 cities and 6 states, including California, had endorsed the USDG. See http://nacto.org/urban-street-design-guide-endorsement-campaign/. Some HSR station cities, including San Francisco, San Jose, and Los Angeles are considering some of the high-quality bicycle infrastructure treatments that are featured in the USDG, particularly buffered bike lanes.

Figure 32

This cargo bicycle, made by the Dutch firm Bakfiets, makes it possible to comfortably transport luggage by bicycle.

Source: Photo by Jeremy Nelson

Bikeshare might be one tool that large metropolitan regions in California may be able to use to legitimize cycling and increase cycling's importance as a mode of transportation. However, a key aspect of Lyon's VeloV system is that barriers to use are very low: a 24-hour pass, which allows for unlimited trips of up to 30 minutes each within that time period, costs about $2, while an annual subscription to VeloV costs about $28. Again, with this subscription, members can use VeloV for as many trips of 30 minutes or less as they want. In comparison, Bay Area Bikeshare costs $9 for 24 hours and $88 per year. (Although similar to VeloV, trips of less than 30 minutes are included.)

Table 9: Cost Comparison of Bike Share in Lyon and San Francisco[a]

Membership fees	Lyon VeloV	Bay Area Bike Share
Annual Membership	$28.00	$88.00
1 day membership	$1.70	$9.00
Usage fees in addition to membership fees		
Trips of 30 minutes or less	free	free
30-60 minutes	$1.10	$4.00
Each additional 30 minutes	$2.25	$7.00

a Assuming exchange rate of $1.13 per euro.

Finding a way to reduce the up-front costs of using bike share will be essential to broadening its use in the Bay Area and elsewhere in California, particularly among people who are unaccustomed to bicycling. This is also likely to be the case for visitors to the Bay Area, including future HSR passengers, who may also find the membership fees too high to try the service. And if bike share does not reach these groups, it is less likely to become a catalyst for popularizing and legitimizing bicycling as a mode of transportation in the way that occurred in Lyon.

Physical Connections Within HSR Stations Between Non-Auto Access Modes and HSR

California must provide first-rate physical connections between HSR and connecting non-auto modes at HSR stations. The state's decision to pursue blended HSR and conventional rail service within the San Francisco Bay Area and Greater Los Angeles can provide a basis for seamless connections among rail modes, but only if stations are designed with blended service as an underlying principle.

In order for transit and other sustainable access modes to be attractive means of getting to HSR stations, they all must be as quick and direct as possible and more convenient than the private automobile in order to be widely used. In terms of local transit connections at HSR stations, the situation in France is quite good by U.S. standards. However, it is generally much better in Germany. The quality of these connections is determined by a few factors, the primary of which are:

- The proximity of travel modes to one another;
- The quality of physical infrastructure that supports intermodal connections; and,
- User-friendly and integrated payment systems for all forms of public transportation (discussed in Section F).

Figure 33

Blended service at Berlin Main Station. High-speed train docked at platform (front) with regional train (middle) and S-Bahn commuter (rear).

Source: Deutsche Bahn

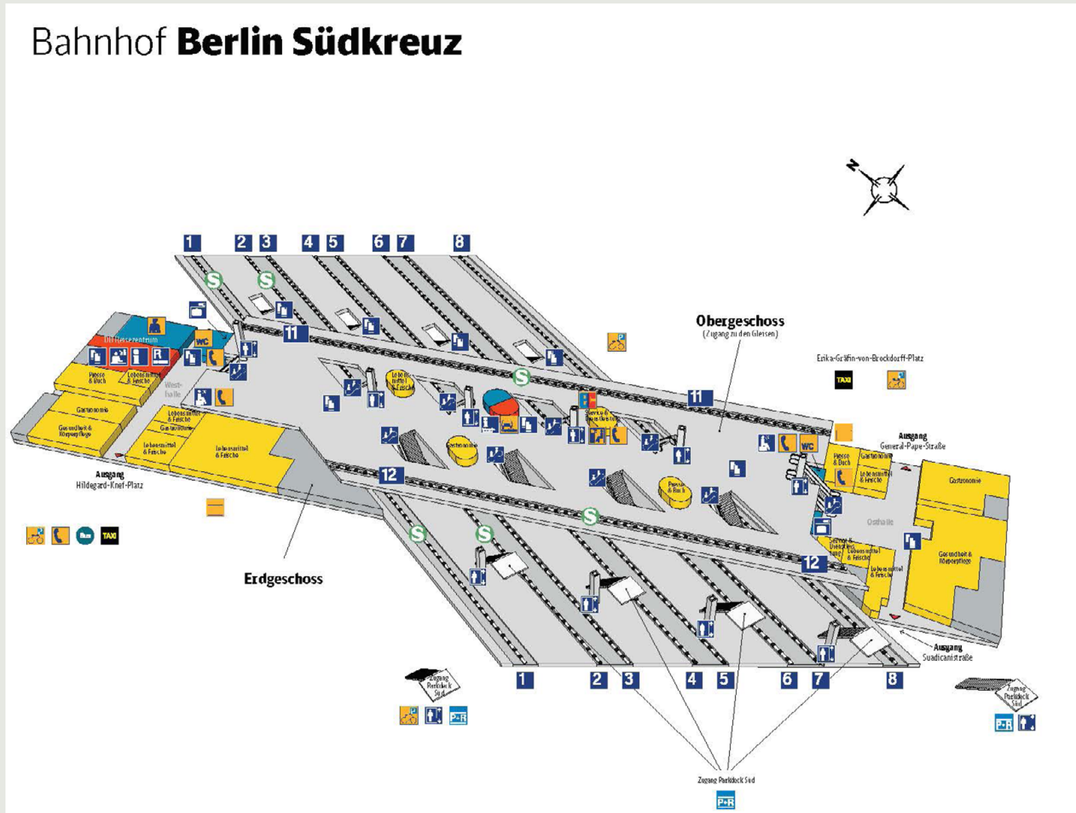
German Connectivity

The Proximity of Travel Modes from One Another

With very few exceptions, connections between intercity trains, including HSR and traditional intercity trains (IC), regional trains (Regionalbahn), and commuter rail systems (S-Bahn), are very good in Germany. This is in large part because the country's entire rail network is "blended," meaning that all types of trains run along the same tracks, and stations are built to accommodate these different types of trains at the same platforms. In addition to allowing for exceptional integration between different rail modes, this blended approach also allows for the efficient use of platform space. Fewer platforms mean lower construction costs and smaller station footprints, and so they have a less disruptive effect on the urban fabric of surrounding neighborhoods. From an economic development perspective, smaller footprints may also allow for greater private-sector development opportunities in the station vicinity. Figure 33 of Berlin's Main Station, which was completed in 2006, clearly demonstrates the close integration of rail modes, showing three distinct rail services running parallel in the same corridor with shared platforms.

Many intercity rail stations, including Berlin Main Station, have additional "stacked integration" features that facilitate intermodal connections. At Südkreuz Station, trains running along Berlin's Ring S-Bahn cross above the intercity rail platforms. Transferring between the two modes requires a simple escalator ride up or down, as shown in Figure 34. The commuter train lines are indicated with the "S" logo on the two top-level tracks and the two left-most tracks on the bottom level (tracks #1 and #2).

Figure 34



Berlin Südkreuz Station. This diagram shows the short and seamless transfer possibilities between S-Bahn commuter rail and intercity rail at the station, a condition that is common at most intercity rail stations in Germany. At Südkreuz, intercity trains use platforms 3 through 8, while S-Bahn trains use platforms 1 and 2 on the lower level and platforms 11 and 12 on the upper level.

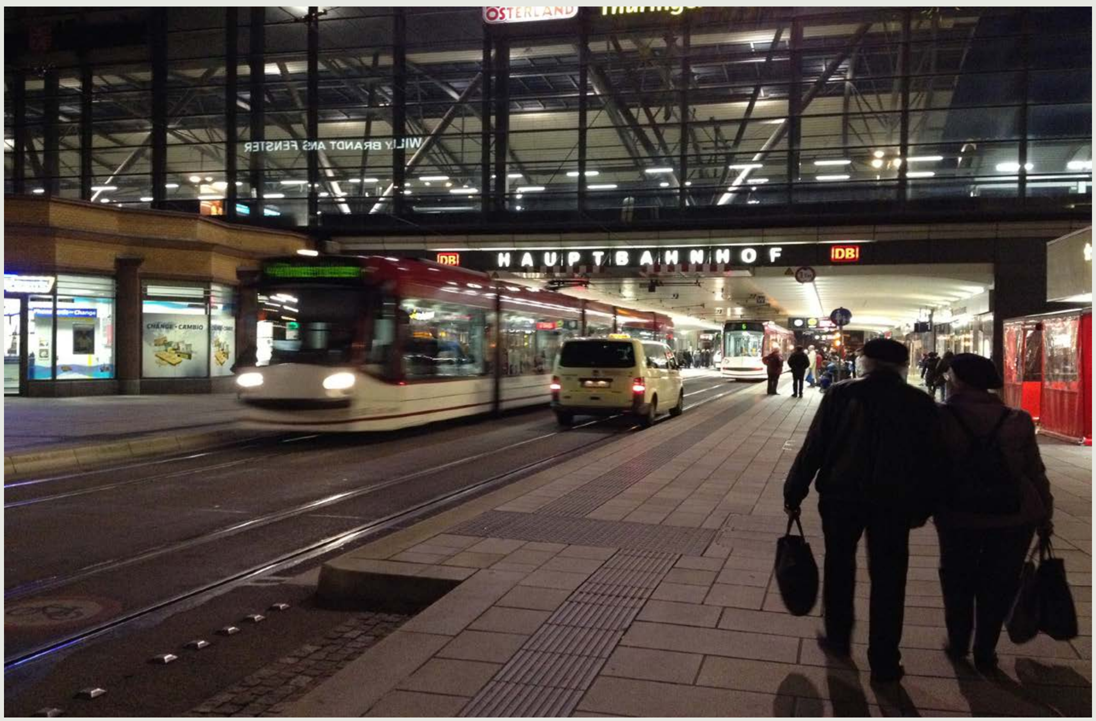
Source: Deutsche Bahn, www.bahnhof.de

Seamless Intermodal Connections at Stations: Erfurt as the German Prototype

Erfurt Main Station was rebuilt in 2006 with funds from the federal government's "Transportation Projects for German Unity" grant program, which addresses infrastructure deficits in the former East Germany. The station is a physical embodiment of at least two important tendencies of HSR development in Germany: 1) the emphasis on connecting mid-sized cities to the national HSR network; and 2) the preference for selecting central city station locations over peripheral ones.

At Erfurt Main Station, passengers enjoy the same integration between regional and intercity train service that exists at all other large stations in Germany such as Berlin's Main Station and Südkreuz. But where Erfurt stands out is its unparalleled integration between streetcar and intercity rail platforms. As shown in Figure 35, streetcars — the dominant mode of public transit in Erfurt — run directly underneath and perpendicular to the rail platforms. Streetcar passengers step off the streetcar onto the sidewalk and go up one level to the rail platforms via escalators. This transfer takes about 30 seconds. The directness of this connection makes streetcars a convenient means of getting to the station. The entire system also runs on ten-minute headways or better, so passengers never need to wait very long for their streetcar.

Figure 35



Seamless transfer between streetcar (below) and intercity rail (above) at Erfurt Main Station.

Source: Photo by author

Key Takeaways — Transit Connections at HSR Stations

German stations offer quick, direct, and intuitive connections between modes. Since HSR service in Germany is blended and runs of the same tracks as other trains, connections between intercity trains (ICE and IC), regional trains (Regionalbahn), and S-Bahn rapid commuter rail are quick and convenient nationwide. This enables very quick transfers, as short as just across the platform.

In 2012, the California High-Speed Rail Authority (CAHSRA) decided to pursue a blended approach to implement the HSR system. Whereas original plans for the project called for dedicated track for the entire length of the California HSR route, this decision will allow HSR trains to share track in the denser parts of the route, primarily in locations along the so-called "bookends" of the route near San Francisco and Los Angeles. The primary stated benefits of the blended system are that it will minimize impacts on surrounding communities, reduce the cost of the project, and expedite implementation.[74]

Much of the public debate on blended service in California has focused on the compromises that will need to be made in order for blended service to work: reduced speeds along the blended portions of the corridor, increased operating constraints as a result of needing to share track with non-HSR rail modes, and negotiating complicated trackage agreements with the other operators, including freight railways, who will use those blended portions of track. Far less attention has been paid to the benefits that can potentially result from blended service in terms of connections to other modes: shorter transfer distances between modes, and reduced impacts on the neighborhoods in which the stations and tracks are located.

As the German experience shows, when different rail services share the same tracks, they are — by default — close to each other. The main benefits of track sharing will occur at stations where conventional trains — both Amtrak and commuter trains — make stops. This situation exists at stops in the San Francisco Bay Area, including San Jose Diridon, Milbrae, and San Francisco, where HSR will share track with Caltrain. Opportunities also exist at stations in the vicinity of Los Angeles, including Burbank and Los Angeles Union Station. The benefits of adopting a blended service model at Los Angeles Union Station — both in terms of intermodal connections and urban form — would be especially significant.

The experience of French and German stations suggests that it is possible to accommodate high-speed trains at conventional rail platforms. For example, Lyon Part-Dieu, which, as mentioned above, is France's most important station for connections, accommodates 150 high-speed trains and over 400 conventional trains daily within a single-level rail yard and 11 parallel tracks. According to CAHRSA's 2014 Business Plan, 64 high-speed trains (HSTs) are expected to run daily between San Francisco and Los Angeles, fewer than half the number of HSTs that pass through Part-Dieu. In light of this, and given the numerous reasons related to cost and urban design for minimizing the footprints of rail yards, serious thought should be given to the possibility of integrating HSR platforms with conventional trains platforms wherever possible. Los Angeles Union Station, which currently has 14 tracks and 7 platforms, as well as San Jose Diridon, which has 9 tracks and 7 platforms, both seem like good candidates for this approach.[75, 76, 77]

However, the HSR platform configurations that have been publicly released for Diridon Station and LA Union Station all show HSR platforms separate from conventional tracks. Two factors seem to be driving this segregated approach toward rail yard design. First, much of the initial thinking about HSR station configurations occurred before the "blended system" concept was introduced in the CAHRSA's 2012 Business Plan and the CAHRSA assumed that HSR would be entirely separate from conventional rail services. Second, given the political and financial uncertainty surrounding HSR, it is easier for station planning efforts to assume that HSR will have its own separate station infrastructure.[78]

74 http://www.caltrain.com/projectsplans/CaltrainModernization/BlendedSystem.html.

75 Source: Appendix A, California 2014 Business Plan Ridership and Revenue Technical Memorandum. This shows that four trains per hour will run between Los Angeles and San Francisco for 16 hours per day in 2029. Hours of operation include six hours of peak period service and ten hours of off-peak service.

76 An important difference between Lyon Part-Dieu and LA Union station is that LA Union is a stub-end station as opposed to a through station. Even though both of these stations are roughly of the same size, trains could pass through Part-Dieu much more quickly than through LA Union States. As such, Lyon Part-Dieu can process far more trains with its 11 tracks than LA Union with its 12 tracks. As of this writing, however, LA Union was in the process of making three of its tracks through tracks.

77 According to CAHSRA officials, as construction work on the initial operating segment of the California HSR system gets underway, and as station area planning work funded by the CAHSRA progresses, opportunities for more integrated station designs will be explored. (Conversation with Michelle Boehm, July 1, 2014.)

78 Phone conversation with Michelle Boehm, Southern California Director of CAHSRA, July 1, 2014.

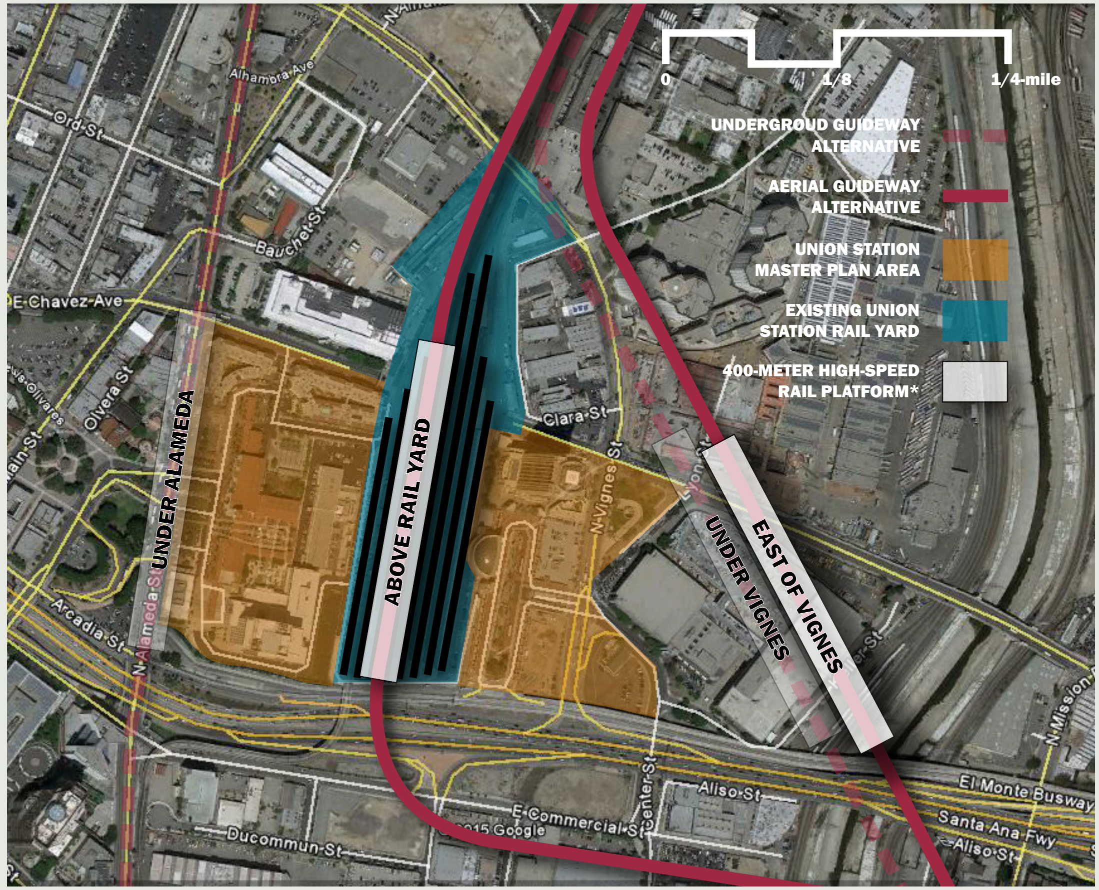
In the proposed configurations for HSR at Union Station in Los Angeles, none of the options show HSR being accommodated within the existing yard in spite of its large size.[79] The option that puts HSR closest to connecting rail modes, the "Above Rail Yard" alternative, places HSR on a separate level above the existing rail yard, an option that has drawn public criticism because it significantly increases the height and bulk of the station and thereby its visual impact. As of this writing, local entities in Los Angeles preferred the "East of Vignes" alternative, which puts HSR tracks nearly a half mile (a 10-minute walk) east of the entrance to Union Station, and almost one-quarter mile east of the center of the current rail yard.[80] Some are quick to point out that such distances are not uncommon in airports, where moving walkways are typically used to shorten these distances. This may be true, but maximizing the benefits of HSR depends on bringing it as close as possible to development and also in making connections between HSR and other modes as seamless as possible. If not, HSR begins to lose the advantages that it has over airplanes.

An important consideration of blended service in California as it relates to the integration of HSR and conventional rail service

79 The CAHSRA did look at single-level station at Los Angeles Union Station in 2010-11, prior to the development of the blended system proposal, but was rejected at that time because regional providers did not want to give up three platforms to exclusive HSR use.

80 The East of Vignes alternative is LA Metro's preferred option. The CAHSRA has not yet publicly endorsed any of the alternatives depicted here.

Figure 36



*All four station configuration alternatives proposed for high-speed rail at Los Angeles Union Station envision HSR trains docking at fully separate platforms from conventional trains. The top two options are above-grade, while the bottom two are tunnel options. Treating HSR separately in this way will lead to higher construction costs, larger station footprints, and less direct connections between modes. *The 400-meter HSR platform shown here is the length of two high-speed trains linked together, a common practice along heavily traveled HSR routes.*

Source: Graphic by author, Google aerial imagery

Figure 37

LYON PART-DIEU	SAN JOSE DIRIDON	LA UNION

LYON PART-DIEU	SAN JOSE DIRIDON	LA UNION
15 acres[1]	11 acres[1]	15 acres[1]
11 tracks	11 tracks[2]	12 tracks
150 HSTs/day	64 HSTs/day	64 HSTs/day
400 other trains	160 other trains[3]	241 other trains[3]

Comparison of land area and train volumes at Lyon Part-Dieu with Los Angeles Union Station and San Jose Diridon stations.

Source: Graphic by author, Google aerial imagery

1 Approximate land area calculated using Google Earth Pro. Area measured is for the rail yards only.
2 This total includes nine tracks for intercity trains and two for VTA light rail. The VTA tracks are included here because they are part of the rail yard.
3 HST train volumes for Diridon and LA Union stations from the CAHSRA 2014 Business Plan. Number of high-speed trains (HSTs) are for opening year of Phase 1 in 2029. Non HST volumes are for 2025 and come from the California State Rail Plan. Train counts are shown as one-way trips — revenue trains only. Number of trains by operator as follows:
San Jose Diridon: a total of 160 trains, including 114 Caltrain; 22 Capitol Corridor; 20 Altamont Commuter Express (ACE); and 4 Amtrak long distance.
Los Angeles Union Station: a total of 241 trains, including 201 Metrolink/Coaster; 36 Pacific Surfliner; and 4 Amtrak Long Distance.

at stations is the need for the state to come to agreement on uniform platform heights for HSR and conventional rail vehicles. This has been a thorny issue in California, which is discussed in Box 1.

The less-than-perfect integration between modes that is evident in the Los Angeles Union Station master plan alternatives is not unique to Los Angeles Union Station or even to Los Angeles. Indeed, poor coordination among modes is the rule rather than the exception in most intermodal facilities in U.S. cities.[81] Coordination is especially poor in urban areas where many different operators provide transit service.[82]

Integrated Fares and Schedules, Innovations in Payment Systems

It should be easy to transfer from space-efficient and sustainable access modes to HSR. This means that it should also be easy to pay to use those services. In the case of fixed-route transit, schedules should be coordinated to

81 The Transbay Transit Center in San Francisco is a notable exception to this rule. There, thanks to the formation of a Joint Powers Authority (JPA) to oversee project design and development, one single entity oversees the design and development of a thoroughly integrated intermodal facility, one that will bring together high-speed rail, Caltrain, and commuter bus service into a single facility that is designed comprehensively and holistically for all modes. The Transbay project includes three interconnected elements: 1) replacing the former Transbay Terminal at First and Mission streets; 2) extending Caltrain and California High-Speed Rail underground from Caltrain's current terminus at 4th and King streets into the new downtown Transit Center; and 3) creating a new neighborhood with residences, offices, parks, and shops surrounding the new Transit Center.

82 http://www.spur.org/sites/default/files/publications_pdfs/SPUR_A_Better_Future_for_Bay_Area_Transit.pdf.

Box 1: Uniform Platform Heights — Challenges and Benefits of Making Efficient Use of Railyard Real Estate

At stations along the integrated "bookend" portions of the HSR project, inconsistent train and platform heights present a significant obstacle to optimal service integration: the standard floor height for HSR vehicles is approximately 50 inches above the track, while the floor of Caltrain commuter trains is 25 inches above. The 50" height that the CAHSRA is pursuing is a standard for most of the world's HSR systems and is consistent with Amtrak's plans in the Northeast Corridor. This height is largely driven by the fact that modern HSR trains are electric multiple units (EMUs), and the heavy drivetrain equipment in EMUs is best placed as low as possible to ensure a low center of gravity and ensures optimal performance, particularly while cornering at high speeds.

In order to accommodate growing passenger demand in the Caltrain Corridor, Caltrain needs to procure vehicles that are *both* bi-level and EMU. While using dual-level cars will allow Caltrain to carry more passengers on a train of a given length, having self-powered EMU cars will allow Caltrain achieve faster acceleration, a key consideration in Caltrain's quest to offer quicker and more robust service in the San Jose-San Francisco corridor. At the same time, virtually all bi-level EMU vehicles in the United States have been built to date have a 25" boarding height. Although a vehicle could be built for a different boarding height, it would not be available "off-the-shelf." Caltrain has been reluctant to consider this because designing custom vehicles is generally more costly, and production of such vehicles is usually slower.

If Caltrain were to remain at a 25" height and HSR initiates service with 50" platforms, the platforms for the two systems would need to be separate, which would reduce the operating flexibility. This may be feasible at some stations, but in places like the Transbay Terminal in downtown San Francisco, where Caltrain and HSR will need to share a total of six platforms, this will prove to be a serious constraint that would significantly hamstring operations. The problem at Transbay will be especially severe given downtown San Francisco's importance as a destination, the fact that Transbay will be San Francisco's main train station, and also that Transbay will be a stub-end station.[1]

As of this writing, significant progress was being made to come to an agreement on a uniform platform height, prompted both by the fact that a majority of the funding that Caltrain needs for modernization will come from California High Speed Rail, and also that HSR will use the existing Caltrain right-of-way.[2]

1 See comment letter by California High-Speed Rail Peer Review Group on 2014 Business Plan at http://www.cahsrprg.com/files/comments_on_2014_bp.pdf.

2 It should be noted that the Americans with Disabilities Act (ADA) in the United States imposes more stringent requirements related to level-boarding than is the case in European countries. In Germany, for example, there are stations where different trains with different boarding heights share the same platforms. This would not be allowed in the United States under the ADA. At those German stations, passengers must use stairs to ascend or descend from the station platform to the train floor. Kassel-Wilhelmshöhe is one example of this. There, "RegioTram" trains (light rail vehicles) share the same platforms as intercity trains. Given that RegioTrams have a lower boarding height than the intercity trains, passengers must descend two steps inside of the train in order to reach the train floor.

minimize wait times for passengers when they transfer between services.

In addition to better passenger transfers and connections from HSR to local and regional transit systems, another way in which the German system is more user-friendly than the French is the use of integrated ticketing and fare media. In France, intercity rail travelers who transfer to transit need to pay the transit fare separately. In Germany, most inter-city train tickets allow the ticketholder to ride urban public transportation at both ends of their trip for no additional charge.

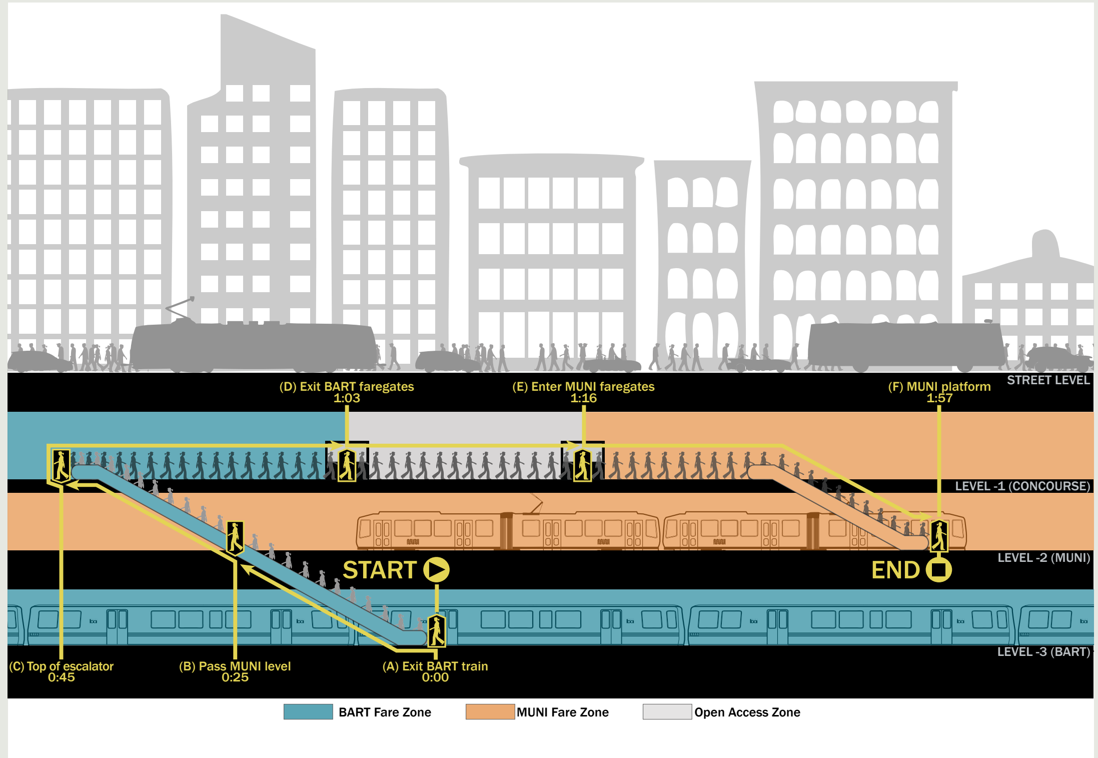
Important Features of Public Transportation in Germany

Proof-of-Payment

One of the first things that visitors to Germany will notice when they ride public transit is that there are no fare gates that control access to subway or commuter rail platforms. This is because public transit systems in Germany operate under the "proof-of-payment" (POP) fare collection method, whereby passengers must carry a ticket or pass proving that they have paid the fare. Ticket controllers or conductors do periodic checks to deter fare evasion. From the rider's perspective, POP makes it quicker and more convenient to connect between modes at stations. In contrast, the need to funnel passengers through faregates in systems that do not use POP forces passengers to walk often circuitous paths through transfer stations in order to connect from one mode to another. For example, transit passengers in San Francisco wishing to transfer from the BART commuter rail system to the San Francisco LRT system at one of the downtown stations need to ascend two levels to the concourse in order to exit the BART faregates and then subsequently enter the San Francisco MUNI faregates, then descend one level back down to the LRT platform; in Germany, they would only need to go up one level. The extra time that it takes passengers to make this transfer adds time to transit trips, especially if the extra transfer time causes passengers to miss a connection and forces them to wait for the next train or bus.[83] Finally, faregates can also make it awkward for disabled passengers, parents with young children and strollers, passengers carrying luggage, and bike/transit passengers to ride transit.

The absence of faregates can also be beneficial from an operator's perspective. On one hand, faregates create pinch points in transit systems that can impede the efficient passage of passengers through a station, and can create backups at peak travel times or during emergency evacuations. Second, the often circuitous paths that passengers must take through busy transfer stations simply because they need to pass through faregates when trans-

Figure 38



When going from A to B means going all the way to F

This diagram of Embarcadero station in downtown San Francisco shows how passengers who wish to transfer between the Bay Area Rapid Transit (BART) system to the San Francisco light rail (MUNI) or vice-versa must first ascend to the concourse level of the station to pass through fare gates before redescending to the other operator's platform. The transfer here between BART and MUNI that would take only 25 seconds if it were possible to go directly from the BART level to the MUNI level takes almost two minutes under ideal conditions, and often longer during peak travel times or during special events such as baseball games when passengers end up queuing at the faregates. This station layout, which would be inconceivable in places where service and fares are coordinated at the regional level, demonstrates how poor connections between modes are the product of fragmented governance in transit.

Source: Graphic by author

83 Many studies that have looked at the way in which transit travelers perceive the burdens of walking, waiting, and transferring have found that transit travelers view time spent outside of vehicles as roughly three times as onerous as time spent in vehicles. See Allison Yoh et al., see "Hate to Wait: Effects of Wait Time on Public Transit Travelers' Perceptions" in *Journal Transportation Research Record*, Volume 2216 / 2011 Transit 2011, Vol. 1 (https://trb.metapress.com/content/e50h468453721476/resource-secured/?target=fulltext.pdf)

ferring from one line to another can lead to inefficient pedestrian flows. These can in turn overburden critical station infrastructure such as escalators and the faregates themselves. Eliminating faregates can enable more direct transfers and improve pedestrian flows at these stations.

While the recent experience of transit operators in the United States suggests that POP may not be broadly adopted as a fare collection method in the United States, at least on urban public transit systems,[84] it seems that advances in fare collection methods using technologies such as near-field communication (NFC) technology will soon allow for a more passive method of fare collection, one that does not require faregates. Therefore, stations could be designed to allow for quicker and more convenient transfers.

Verkehrsverbünde (Transport Alliances)

A defining governance feature of public transportation systems in Germany is that service is coordinated and funded at a regional level through *Verkehrsverbünde* — or "transport alliances." Virtually all German metropolitan areas and cities are now integrated into one of the nation's 75+ Verkehrsverbünde. Transport alliances were first developed in the mid-1960s in Hamburg as an approach to addressing that metropolitan area's disorienting public transit network, its redundant routes, conflicting schedules, and confusing fares.

The two main responsibilities of a Verkehrsverbund are to: 1) develop a uniform fare structure, independent from transit providers; and 2) coordinate timetables and routes to reduce redundancy, service gaps, and wait times. Additionally, the Verkehrsverbund typically acts as the central administrator of fare collection and distributor of public subsidies from local and state governments. Finally, each Verkehrsverbund also plays the role of transit advocate and planner for the region that it serves, and plans for future needs. It produces a comprehensive local marketing strategy, and lobbies state and federal governments for funding. By enabling transit patrons to make a journey involving multiple providers with just one ticket, German transit providers have been able to provide a more seamless travel experience for customers. In turn, they have achieved both increased revenue and ridership for transit agencies.

France has not been as successful as Germany in implementing coordinated regional pricing

Figure 39

A) Array of separate ticket machines for local, regional and intercity travel at Gare St. Lazare, Paris; B) Single ticket machine at a Berlin S-Bahn station for all urban public transit and intercity travel in Germany.

Source: Photos by author

84 Portland, Oregon, is one community in the United States that has operated on the POP system on its light-rail system for nearly three decades and is now reversing course. According to a recent news report, "Even on one of America's most celebrated transit systems, there's a hard-to-shake belief that Portland's trains would be safer and cleaner if it were more difficult for fare jumpers to ride." See http://www.oregonlive.com/commuting/index.ssf/2015/03/trimet_turnstiles_orange_line.html. As for payment on intercity rail, payment on all California intercity and regional/commuter rail routes is now done by proof-of-payment, as discussed in the "key takeaways" part of this section.

for transit. Travelers arriving at train stations in France will encounter an array of different ticket vending machines, as shown in Figure 39. The difficulty stems from the fact that SNCF sets fares according to distance traveled, while public transit agencies in France set a flat fee for each ride taken, a fee that varies only somewhat by distance traveled. The unions representing SNCF and local urban transit agencies have fought for over 15 years about how to share fare revenues and have not been able to come to an agreement.[85]

Universal Mobility Services

Many German public transportation providers have also ventured into the business of providing universal mobility through comprehensive mobility services that include other (non-transit) ways to get to and from HSR stations. First pioneered in Hannover, mobility services seek to blur the line between public transportation and the private automobile. The premise behind mobility services is that urban transit systems are limited in their reach and appeal. In order to entice people to ride transit more and drive less, transit operators need to make transit a more viable option for more people, especially for people who live or work in places where traditional transit service is limited. HannoverMOBIL does this in part by bridging so-called "last-mile barriers," which is to say by providing transportation options to people who do not live within easy walking distance of transit stations. Under the HannoverMOBIL program, urban transit is considered the backbone for urban transportation. Where needed, transit is supplemented by other modes, including car share, bike share, and taxi, that can bridge these last-mile barriers. By including these options as part of a comprehensive program, mobility services give people only *as much car as they need*.[86] Mobility services, in turn, may allow some people to live without owning a car, or they may allow some households with a car to make do without a second one.

A second part of the HannoverMOBIL program is to make information regarding all travel options available through a single platform: "Instead of spending time on choosing the right solution and signing up with a multitude of providers, the customer has instant access to a comprehensive 'mobility menu' from which he or she can choose the right service for the given needs at any time by using an 'all-in-one' access-card."[87] A third important aspect of the service is that payment is coordinated and simplified: customers receive a comprehensive mobility bill for all travel that they do with the card. By simplifying payment, HannoverMOBIL reduces the difficulty of transferring between modes, thereby making trips that involve multiple transfers seem more convenient — a little more like driving a car.

85 Interview with Bruno Faivre d'Arcier, October 21, 2013.

86 Interview with Andreas Knie, Founder of the Innovation Centre for Mobility and Societal Change, November 18, 2013.

87 http://www.uestra.de/hannovermobil.html?&MP=26-1224&L=1.

Figure 40

HannoverMOBIL Mobility Menu.

Source: Üstra

Mobility services such as HannoverMOBIL may include the following offerings:

- Public transit pass
- Car share membership
- Discounted car share rental rates
- Car rental discounts
- Discount on taxis, cashless payment
- Bikeshare membership
- Limited use of bike share for free; additional hours at discounted rate
- German Rail discount card for intercity rail trips

Figure 41

DB Navigator app homescreen.

Source: Deutsche Bahn

- Discounted parking at park-and-ride facilities, cashless payment
- Integrated mobility bill for all basic costs, car share, and taxi trips

Like the Hannover region, the Deutsche Bahn has also endeavored to make its offerings more useful and user-friendly with the help of mobile applications, while also taking advantage of the fact that transit systems operate under the "proof-of-payment" model nationally.

The mobile app that most customers of DB are most familiar with is the Deutsche Bahn Navigator, a GPS-enabled app that allows customers to get door-to-door directions to wherever they would like to go in Germany, and to purchase and receive electronic tickets directly from their mobile devices. Intercity train tickets automatically include public transit on both ends of the train journey. Features include:

- Travel planning, including S-Bahn commuter trains, subway, streetcars, and bus
- Real-time departure and arrival information
- GPS-enabled door-to-door route planner, including public transit and walk directions
- Ticket booking from this single app
- Optional alarms for updated information on train delays
- Ability to save and manage all bookings through the app
- Ability to download electronic ticket directly to mobile device

More recently, DB has developed another app called "Touch and Travel" that builds off of the Navigator, but takes advantage of the fact that public transportation within Germany is done according to the proof-of-payment model in order to allow people to travel through Germany without purchasing a ticket in advance. With Touch and Travel, patrons use their GPS-enabled smartphones to record their journeys by rail and public transit. The patron's travel is billed at the end of the month via a comprehensive mobility bill.

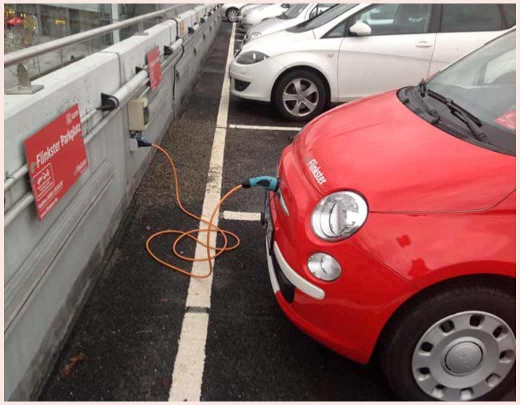
These advances demonstrate efforts to try to make train travel easier. The Navigator is the one-stop shop for all travel directions and needs. Touch and Travel builds on this convenience by doing away with the need to buy tickets in advance of travel, all of which reduces the difficulty of train travel. This makes train travel a little more like driving a car in that it greatly reduces the need to plan ahead of time. And with the Navigator to help with directions, the train traveler, in contrast to the car driver, does not need to worry as much about getting lost.

Key Takeaways: Integrated Fares, Innovations in Payment Systems

Make it easy to pay to use and to transfer between sustainable and space-efficient access modes.

It is much cheaper to develop technology than to build infrastructure, and tech can be used to drastically improve the passenger experience. German-style mobility services could be pursued in California, especially since California is the center of the tech world and is therefore well positioned to innovate in this sector. Integrated fare payment cards such

Box 2: Last Mile Solutions — Deutsche Bahn's Venture into Car share and Bikeshare



Deutsche Bahn has reached the same conclusion as public transit operators in cities like Hannover: they need to expand into the realm of universal mobility in order to make its offerings more attractive to people who live in places that are not well-served by public transportation and who therefore tend to lead more auto-centric lifestyles. Although Germany has an extensive intercity rail network by world standards, only about one-third of Germans ride the train. According to Andreas Knie, founder of the Deutsche Bahn-affiliated Innovation Centre for Mobility and Societal Change, about two-thirds of the German population live in less densely populated parts of the country and do not intuitively think of going places by train. In light of this, Deutsche Bahn has concluded that it needs to branch out beyond traditional public transportation to make its services more attractive to more people. One way in which Deutsche Bahn has done this is to establish its own car sharing and bike sharing businesses: Flinkster and Call-a-Bike. Since Deutsche Bahn owns and operates these services, many train stations in Germany have car sharing and bike sharing stations, and reservations for these cars and bikes can be made easily as part of booking a Deutsche Bahn train ticket.

Source: Photos by author

"The Deutsche Bahn (DB) has a steep hill to climb in increasing its market share in Germany because so many people live very car-centric lives. DB really isn't even on the radar of two-thirds of the German population. This is why DB needs to branch out beyond traditional rail offerings. The problem is that once people own a car and have made that high up-front investment in a vehicle, they structure their lives around it. There are of course many trips for which cars are simply the best option, like for going to housewares stores like IKEA. But we really are best off as a society if we only give people as much car as they need... This is the principle behind car share, and it is why DB has gotten involved in the car share business."

— Andreas Knie, Founder, Innovation Centre for Mobility and Societal Change

as the Clipper card in the San Francisco Bay Area and the Transit Access Pass (TAP) card in the Greater Los Angeles region are already a step in this direction.[88] However, although some urban regions in California have succeeded in developing single fare cards to pay for travel on multiple providers, passengers still need to pay a new fare each time they transfer between providers. Achieving truly integrated regional transit fares like those that exist in Germany will likely require more drastic organizational change.[89]

In Germany, much of the difficult coordination work that is necessary to achieve integrated fares is already taken care of by the organization of the transit system at the federal and metropolitan levels. As discussed, the country is divided up into

88 Los Angeles subway and light rail previously operated under the proof-of-payment method, but recently switched to fare gates because of concerns about fare evasion. See http://graphics.latimes.com/los-angeles-metro-riders/.

89 For a detailed discussion of this and related issues, see SPUR report: *Seamless Transit: How to make Bay Area public transit function like one rational, easy-to-use system*, http://www.spur.org/publications/spur-report/2015-03-31/seamless-transit.

regions managed by separate Verkehrsverbünde, which are responsible for distributing transportation funding, just like metropolitan planning organizations in the United States, but which are also charged with setting a coordinated regional fare structure for transit and coordinating transit schedules.

Mobility services can be a powerful tool for inciting mode switch because they make a whole suite of transportation options available through a single platform. There are no mobility services that are quite as comprehensive as HannoverMOBIL in the United States. California — like most of the United States — is more like France than Germany when it comes to the organization and management of transit at the metropolitan scale: transit is provided by many separate operators whose service is often poorly coordinated. In regions with many providers, small agencies are often funded with money that is raised locally by cities or counties that feel they are underserved by major regional providers. Those agencies pride themselves on providing service with a distinctively local feel. This desire to differentiate runs counter to efforts to consolidate service.[90] The San Francisco Bay Area is one place with an especially fragmented management structure for transit: the region is served by 27 separate transit agencies.[91]

Absent agency consolidation, integrated fare payment technologies such as the Clipper Card in the San Francisco Bay Area are one innovation that has the potential to create a more seamless transit experience without requiring agencies to merge. The Clipper Card, which is now the payment method for about half of Bay Area transit trips,[92] is "the all-in-one transit card that keeps track of any passes, discount tickets, ride books and cash value that you load onto it, while applying all applicable fares, discounts and transfer rules."[93] In contrast to the German mobility services, Clipper does not offer unified fare structure, only unified payment. It is a debit card for transit. Each agency sets its own fares and transfer discounts. No region-wide passes are available under Clipper.

Nevertheless, Clipper does allow for a more seamless experience for transit trips that require using more than one provider. Additionally, a relatively new feature is that cardholders can use the card to pay for parking in a limited but growing number of park-and-ride lots. This can make Clipper a way to expose drivers to other more modes of transportation, and potentially to make fewer trips by car. Additional ideas that are currently being discussed to increase the appeal of Clipper are to move toward a "fare accumulator" system, whereby cardholders would eventually reach a daily, weekly, or monthly maximum charge, after which riding transit would be free. Also, there has been discussion of making it possible to pay for last-mile modes such as bike parking, car sharing, and bike sharing with the card.[94,95]

At the state level, the CAHSRA is currently working with rail providers around the state on integrated service planning, and there are a few encouraging precedents on fare integration in California that could help pave the way for seamless ticketing between HSR and more local transportation providers in the future. For example, ticketed passengers on the San Jose-Sacramento Capitol Corridor passenger rail service may transfer to local transit services along the corridor route at no additional charge. Also, payment on all California intercity and regional/commuter rail routes is now done by proof-of-payment. These precedents show that some of the elements that make for seamless ticketing and travel in Germany can be achieved in California.

90 Interview with Carol Kuester, July 1, 2014.

91 http://www.spur.org/sites/default/files/publications_pdfs/SPUR_A_Better_Future_for_Bay_Area_Transit.pdf.

92 Metropolitan Transportation Commission Press Release, May 9, 2014: "Clipper Card Program Attains 20-Million-Monthly Transaction Mark," http://www.mtc.ca.gov/news/press_releases/rel642.htm.

93 https://www.clippercard.com/ClipperWeb/whatsTranslink.do.

94 Interview with Carol Kuester, July 1, 2014.

95 http://sf.streetsblog.org/2014/05/13/clipper-card-upgrade-could-miss-big-regional-transit-improvements/.

Policy Recommendations

This section contains ten recommendations related to visioning, route planning and station siting, station and station district design, land use, and access to stations that will help California make the most of its significant investment in HSR. These recommendations rest on the idea that HSR should serve as the backbone of a comprehensive system for sustainable passenger mobility in California — a missing link in California's modal hierarchy that will allow Californians to live less auto-dependent lives.

1. *Develop, articulate, and hold bold long-term visions for HSR corridors and stations.*

Responsible partners: CAHSRA, HSR station cities, political leaders at all levels of government

Most relevant to: All HSR station cities

There are two prerequisites for the development and implementation of bold long-term visions for HSR corridors and stations: 1) compelling long-range planning documents that include credible phasing plans; and 2) powerful political champions who will advocate for these documents and build public support for them.

California's HSR project will have far-reaching implications for how people move around the state for decades to come. As such, we should also take a very long view in thinking about the future of HSR station areas, and proactively plan for a less auto-oriented future. We must also consider the incremental improvements that are necessary to arrive at this long-term vision. Recognizing HSR's transformational potential for station cities and California's economy in general, the CAHSRA has offered planning grants to most of California's HSR station cities. The purpose of these grants is to provide an opportunity for station cities to think about the long-term potential of their stations and station areas in terms of urban and economic development. This effort is commendable, however, there is a risk that these planning efforts may fail to live up to their potential because they risk getting watered down by local political dynamics.

The typical time horizon for a station area planning effort is about 20 years. But California's HSR system may not mature for perhaps 50 years. With a growing population and increasing pressures on highways and airport infrastructure, the HSR system's usefulness is likely to increase over time. From an economic development perspective, some of the most significant development opportunities within station areas may not materialize for several decades. Thus, California HSR station cities should adopt and adhere to plans that emphasize HSR-related development opportunities over the long term. For example, there may be a temptation in the early years of HSR service to build parking garages on the best and most valuable parcels of land, those located directly across from HSR station platforms. Similarly, developers may approach HSR station cities with proposals to build low or mid-rise housing in the early years of HSR service, even though those cities may have embraced denser mixed use, commercial, and office development in long-range planning documents. In anticipation of this dynamic, station area plans must include carefully conceived phasing plans that will foresee how station areas will evolve over time into more urban, compact, and economically dynamic places.[96] This will be of greatest importance for stations in the most auto-oriented cities of the state where access to the HSR station in the early years of the system's operation will be mostly by car, but where, over the long term, there will be opportunities for more compact development. Fulfilling those opportunities will be critical for the HSR system to generate a good return on investment.

Phasing plans for some of the smaller stations could include interim land use strategies, economic activities requiring little up-front

96 As suggested in this report, HSR stations outside of dense and compact urban districts should be considered with caution; greenfield sites where no future development is planned and that are not likely to be well-connected to regional and local transit networks are not good candidates for HSR stations because they fail to capitalize on the competitive advantages that are discussed in this report.

investment that would be viable in the early years of HSR service. This might include food trucks, open air farmers markets, parks, and surface parking lots. As the station area matures and as the value of HSR access grows, the station could mature into the bold longer-term vision that was originally articulated.

Many European cities faced similar dynamics to those currently present in California when HSR was first proposed in those countries. Cities such as Lille demonstrate that in order for any city to make the most of the construction of an HSR station, there is no substitute for the involvement of powerful political champions who tirelessly advocate for the project and who get involved in various details of the design and planning of the station and station district. With the pieces for HSR in California now beginning to fall into place, including a stable revenue source, a string of favorable judicial rulings, and an official groundbreaking in January 2015, the time is ripe for these powerful political players to step forward and play a bigger role in advocacy and in the important details of station area planning work or even rail operations. Examples of this might include the integration of stations with the neighborhoods that surround them (as demonstrated by Lille) or agreement on operational issues such as level boarding for commuter rail, Amtrak, and HSR.

Inadequate vision leads to projects that fail to offer key benefits, including travel time savings, economic development, reduced air pollution, or improved urban design. Without these benefits, these projects become less compelling as public investments and more susceptible to being further compromised when evaluated under state and/or federal environmental law because there is no strong overarching vision to communicate to the resource agencies about how their single issue fits into a larger picture. Why, for example, should a historic preservation group accept alterations to a locally significant building to make way for a train station? Why should a regulatory agency that is responsible for preserving freshwater animal and plant species agree to the construction of a bridge that will cast shadows on a creek that runs alongside the proposed train station? Unless the train station offers the types of significant benefits mentioned above, it is hard to make the case that the project is worth approving.

Finally, based on my interviews with transportation professionals in France, Germany, and California, I would argue that Californians (and Americans generally) may simply have lower hopes and expectations for public transportation systems than the French and the Germans. Californians may also have a higher tolerance for congestion on roadways. As this relates to HSR in particular, the fact that so few Californians have experienced HSR, and few are familiar with places like Lyon and Lille where HSR has been used as a tool for economic development, makes it difficult to sell this it as a viable alternative transportation option. More public education about these examples will likely be helpful in developing bold visions about what HSR stations and station districts have the potential to become.

2. *Wherever possible, California should site HSR stations in central city locations.*

   Responsible parties: CAHSRA, CAHSRA station cities, all entities funding HSR and local connections to it, local political leaders

   Most relevant to: Bakersfield, Gilroy, Kings/Tulare (Hanford)

HSR is most useful for travelers for whom central-city-to-central-city travel times are most important. This is why central cities are the most logical locations for HSR stations. For California, the experiences of station siting in Lyon and Lille are the most relevant since both moved their main stations to underutilized downtown sites with significant potential for new development when HSR service was first introduced. Many of the cities along the California HSR route have downtowns that are struggling economically. Nevertheless, these downtowns provide an established urban fabric that can provide a solid foundation for future HSR-oriented development. At the same time, cities like Fresno have significant development potential near their proposed downtown stations, both on surface parking lots, vacant parcels, and parcels with outdated or underperforming buildings.

If the experience of small and mid-sized cities in Europe is any guide, HSR, in and of itself, is not enough to turn around a struggling local economy.[97] Ideally, planning for HSR station areas should connect to other planning efforts for the neighborhoods surrounding HSR stations. Thankfully, this is the case in many HSR cities like Fresno, where HSR station planning work will build on significant redevelopment efforts focused on the city's main street, Fulton Mall, and the larger downtown area.[98] The success of Fresno's HSR station will be closely intertwined with the success of those other planning efforts. In contrast, the French and German experience suggests that prospects for HSR-related access and economic development benefits in exurban station locations such as the proposed location for the Kings/Tulare station near Hanford are highly uncertain.

97 Many scholars who have looked at the economic development impacts of HSR on local economies have found that HSR benefits the largest cities along HSR corridors most, often at the expense of smaller cities. See Anastasia Loukaitou-Sideris et. al, *Planning for Complementarity: An Examination of the Role and Opportunities of First-Tier and Second-Tier Cities Along the High-Speed Rail Network in California*. Mineta Transportation Institute Research Report 11-17 (2012).

98 See http://www.fresno.gov/Government/MayorsOffice/DowntownRevitalization/FresnoDowntownPlans/default.htm.

3. *There are trade-offs to maximizing HSR travel speeds and maximizing connections by stopping trains. Emphasizing connections makes sense in dense urban areas, while travel speeds should be prioritized in sparsely populated areas.*

   Responsible partners: CAHSRA, as well as state and local political leaders

   Most relevant to: HSR station cities, entire HSR corridor

The French and German HSR systems represent very different philosophies and approaches to resolving this trade-off, and can provide insights on when it makes most sense to focus on high speed and when it is wise to add stops in order to maximize connections.

France emphasizes speed, while Germany emphasizes connections. For California, this suggests an approach that prioritizes connections in large metropolitan regions, and speed in sparsely populated areas. Another consideration is that secondary stops in large metropolitan regions with more integrated HSR systems like Germany's do not add much time to the length of trips between cities, since trains need to slow down when approaching the main station in the large urban areas anyway. In contrast, stopping trains in less populated areas between large cities along HSR lines significantly slows travel times. This is particularly relevant for HSR route planning in California, where a number of stops in smaller cities in the San Joaquin Valley are planned and where ridership potential at those stops is limited.

Even though HSR cannot directly meet everyone's intercity travel needs, the German example shows that it will benefit all by reducing strain on the state's roadway and airport infrastructure, and by helping to achieve environmental goals. Germany's airports and roadways would be much more crowded without rail service, and its transportation system would generally function much less efficiently. The same thinking should apply to California and its HSR project. In an era when the state is seeking to reduce air pollution and greenhouse gas emissions, HSR — as the most environmentally friendly means of intercity travel available — will help the state meet these goals. Finally, HSR will provide critically needed diversity and redundancy in the transportation system that will allow the state to maintain mobility when other modes of transportation fail due to unexpected catastrophic events. Though disasters can affect HSR like other modes of travel, Japan's experience in re-establishing HSR service after the historic earthquake and tsunami of 2011 demonstrates that HSR can be designed to be resistant to earthquakes and other natural disasters.[99]

99 Frances L. Edwards, Daniel C. Goodrich, Margaret Hellweg, Jennifer Strauss, Martin L. Eskijian, And Omar Jaradat, "Great East Japan Earthquake, JR East Mitigation Successes, and Lessons for California High-Speed Rail," Mineta Transportation Institute, April 2015, http://transweb.sjsu.edu/project/1225.html.

4. *California must provide first-rate physical intermodal connections within HSR stations between non-auto access modes and HSR.*

Responsible partners: CAHSRA, HSR station cities, transit agencies in HSR station cities

Most relevant to: HSR station cities, entire HSR corridor

Convenient local and regional transit connections to HSR stations are critical for maximizing station catchment areas, and thereby ridership for HSR and local transit services. Provisions for private shuttles, as well as convenient access for carpools and kiss-and-ride passengers, are also important. In terms of station access, both Lyon and Lille emphasize walking within the station neighborhood by maximizing development in the station district and the quality of pedestrian connections to the station. Both stations also serve as the primary nodes within their respective public transit systems, which facilitates transit connections between HSR and the local/regional systems. In making Lyon Part-Dieu Station the central node in Lyon's public transit network when that station was built in the early 1980s, the city also realized the importance of local transit connections to intercity rail stations.

As Germany's example of running HSR trains on the same tracks as conventional trains shows, CAHSRA's decision to pursue a blended approach to HSR service creates distinct advantages for connecting HSR and rail transit modes, particularly when it comes to offering seamless connections between HSR and urban public transportation at HSR stations. However, in order for this proximity to be a benefit for passengers, the stations must also be designed with blended service as an underlying principle. This is especially relevant for train stations where conventional rail services will intersect with HSR, such as at San Jose Diridon Station and Los Angeles Union Station, each of which is located within the "blended" portions of the HSR project.

Though most of the current station design proposals assume that HSR tracks will need to be built separately from the existing rail yards at these stations, each of the rail yards' rights-of-way is already quite large. With proper platform management, it is conceivable that HSR could be accommodated within existing rail yards. As Lyon Part-Dieu demonstrates, it is possible to handle 150 HSR trains and upwards of 400 conventional trains on just 11 tracks. The benefits of this integration would be two-fold: 1) The transfer distance between HSR and conventional rail modes could be shortened, which would reduce transfer times; and 2) the size of rail yards at stations could be minimized, which would reduce the amount of station land and potentially free up more land for development. Finally, the cost of stations could be reduced, especially in places like San Jose where land values are high.

5. *Ensure seamless service coordination between local transit and intercity rail service and make it easy to pay to transfer between multiple sustainable and space-efficient access modes.*

Responsible partners: CAHSRA, State of California public transit agency, metropolitan planning organizations

Most relevant to: the state's larger metropolitan regions

A critical issue for California to consider is how best to integrate local transit service schedules with HSR. California's urban areas should coordinate transit schedules for entire metropolitan regions and establish coordinated regional fares for public transit in order to enhance the attractiveness of transit as an access mode to HSR.

The German Verkehrsverbund provides a good model for California to emulate in this regard. California should explore expanding the roles and responsibilities of its metropolitan planning organizations (MPOs) to include the responsibility for setting regional fares and coordinating transit schedules. This will admittedly be a tough sell in many California communities where transportation projects are often funded with local tax dollars, and where politicians want local control over service provision as a result. However, regional coordination in public transportation is vital, arguably more so than in any other realm of public investment, because the value of any individual transit link depends on its connection to a larger network. In a large urban area, a small bus service that offers infrequent service and poor or no connections to a regional rail network will be far less useful than one that offers these connections. This point must be emphasized in public debates on regional service integration.

Even in U.S. urban areas that are relatively well served by transit, connections between modes are often very poor in comparison to Europe. The fact that physical connections are poor often stems from the fact that there are too many transportation agencies in metropolitan regions, and that they plan and implement their projects without adequate coordination. We notice this poor coordination first-hand at many locations where modes operated by different agencies meet.[100]

The CAHSRA should also actively pursue innovations in payment systems for public transportation and last-mile modes that could be used to bring passengers to and from HSR stations. Many U.S. metropolitan areas have developed region-wide integrated payment systems that make it easy to pay for transit on multiple modes supplied by various providers with a single card. These cards make it easier to transfer between modes, thus making entire transit systems more user-friendly. It is for these very reasons that integrated payment systems, if extended beyond urban transit systems to intercity rail, would facilitate using intercity trains and might boost ridership for them too. This is why the Deutsche Bahn and public urban public transit providers alike have gotten into the business of developing software and mobile apps to facilitate both navigation and payment across public transportation modes and also for last-mile modes such as car share and bike share. Given the increasingly important role that private taxi and ride sharing services are playing in U.S. cities, we should also focus on developing integrated payment systems that will work on those new emerging services as well as on traditional public transportation.

As implementation of the California HSR project advances and the date of initial operations nears, California could and should think about developing navigation and payment systems that are similar to those available in Germany, including the DB Navigator and Touch and Travel. Similarly, California HSR could consider branching out into providing access to HSR stations via first-mile/last-mile modes, perhaps by establishing its own car share and bike share services or, at a minimum, by ensuring that the CAHSRA has a role in the design and provision of car share and bike share services at HSR stations.

6. *Each station area should form a cross-cutting governance entity that will allow for visionary, long-term, and integrated station and station area design as early in the planning process as possible.*

   Responsible partners: Station cities

   Most relevant to: San Jose, Fresno, Bakersfield, smaller cities along HSR route

The fragmented governance structure that characterizes public transportation in the United States also makes it difficult to develop bold visions for transit stations. This fragmentation has far-reaching implications, both in terms of public transportation operations and infrastructure design. Service operated by different agencies is often poorly coordinated and facilities where multiple services come together are often designed in awkward ways that are not conducive to easy transfer between the multiple services. In addition to making transfers less convenient for travelers, this also results in duplicative and costly infrastructure. An antidote to this siloed decision-making is to ensure that a clear leadership structure for HSR stations and station areas is in place *early* in the design process. The governance structure should also allow for streamlined decision-making.[101] Absent the formation of a joint powers

100 Examples of this discussed in this report include 1) the connection between BART and Muni at downtown San Francisco stations, where passengers need to make three grade changes when they only want to go up or down one level; and 2) plans for accommodating high-speed rail at Los Angeles Union Station, where current proposals assume that the HSR platforms need to be built separately from the existing railyard, and separately from conventional intercity and commuter rail platforms.

101 Governance structures employed in France to great success on large neighborhood redevelopment projects include the "sociéte d'économie mixte" and the "sociéte publique locale," both of which allow for streamlined decision-making and environmental review.

authority or other overarching entity *early* in the planning process to lead the visioning and conceptual design work, it is unlikely that the various stakeholders who have a say in the future of station areas will work together in a concerted fashion to propose visions that are bold enough and that will ensure maximum opportunities for synergies.

A model that is commonly used in the United States is the joint powers authority (JPA). The Transbay Joint Powers Authority (TJPA) is the project sponsor for San Francisco's future HSR station and station area redevelopment efforts. It has succeeded in creating an integrated design for the Transbay Transit Center (TTC), a design that houses numerous different transportation providers within the same structure. Also, since the TJPA, in collaboration with the city of San Francisco, was also responsible for the master plan for the neighborhood surrounding the TTC, the approved master plan is perfectly compatible with it. The TTC itself also meets many of the criteria of great stations discussed earlier: in addition to operating as an efficient transportation facility, it will be a great public building where people will like to spend their time.

7. *Prioritize land uses within station areas that will maximize ridership for HSR.*

   Responsible parties: CAHSRA, CAHSRA station cities, Strategic Growth Council, local political leaders

   Most relevant to: all HSR station cities

The experiences of Lyon and Lille demonstrate that high-density employment and commercial uses are best for tapping the economic development potential of HSR and for maximizing ridership for HSR. Residential and cultural uses can and should play a supporting role in ensuring round-the-clock activity within station districts. Single-use office districts that are devoid of life outside of daytime business hours should be avoided. As for which land uses should be closest to HSR stations, what is true for transit[102] is doubly true for HSR: riders are more concerned that their ultimate destinations be easy to reach by foot or transit from their destination HSR station than that their origin HSR station be easy to reach by foot or transit. Also, travelers' destinations are also generally much more focused on city centers than origins. With this in mind, destination-type uses such as employment and shopping should be located closest to HSR stations, while residential uses can be located farther away.

102 See *Making the Most of Transit: Density, Employment Growth, and Ridership around New Stations* http://www.ppic.org/content/pubs/report/R_211JKR.pdf

8. *Recognize the inherent urban design advantages of HSR stations over other transportation facilities and design them to make the most of these advantages.*

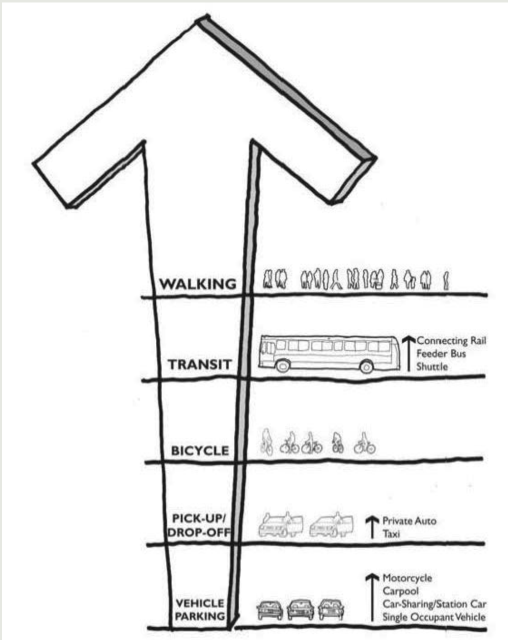
   Responsible parties: CAHSRA, CAHSRA station cities, local political leaders

   Most relevant to: all future HSR stations that have not yet been designed (all except for San Francisco, Anaheim)

In order for California's HSR system to have the greatest chance of success, HSR station areas must be designed to capitalize on the fact that they can fit into dense urban contexts, and can serve to connect neighborhoods that are otherwise divided by railroad tracks or other transportation infrastructure**.**

A determining factor of whether or not California takes full advantage of investments in HSR will be whether the state adopts *space-efficiency* as an underlying tenet of all aspects of HSR station area design. Simply put, station area plans should promote compact development and land uses that will benefit the most from proximity to HSR stations. Dense development must be allowed to come as close to stations as possible. Space-efficiency should also be a guiding principle in developing multimodal access plans for stations. Modes that produce the highest ridership and revenue benefits for HSR at the lowest cost and by using the least amount of valuable land within the station area over the long-term should be prioritized. Space-efficient modes

Figure 42



BART station access hierarchy.

Source: BART Station Access Guidelines, http://www.bart.gov/sites/default/files/docs/access_guidelines.pdf

include walking, transit, bicycling, taxi, rideshare, private shuttle, vanpool, and car share. While cars will undeniably play an important role in providing access to most California HSR stations in the short-term and even medium-term, prioritizing car-related infrastructure in station areas would be a poor use of scarce station area land over the long term.

As a means of prioritizing space-efficient modes, each HSR station needs to develop a multimodal access plan that includes a station access hierarchy. The Bay Area Rapid Transit District's Access Guidelines provide some clues about how to structure such a hierarchy.[103] Their stated purpose is to help resolve competing demands for funding and for physical space necessary to meet station access needs by emphasizing the modes that produce the highest ridership and revenue benefits for BART at the lowest cost.[104] BART's access hierarchy is depicted visually in Figure 42.

9. *Recognize, celebrate, and plan for train stations' non-transportation roles.*

Responsible parties: CAHSRA, local political leaders in HSR station cities, local planning authorities

Most relevant to: all HSR station cities

While train stations must be designed to process large numbers of passengers quickly and efficiently, many European examples show that they can also be important public places where people enjoy spending their time. As discussed above, resolving these conflicting functions of stations is sometimes referred to as the "tension between place and node."

With a few notable exceptions such as New York's Grand Central Station, Washington's Union Station, and Denver's newly renovated Union Station, most U.S. train stations are viewed as little more than places to buy tickets and wait for trains. In contrast, European examples such as Lyon Part-Dieu and Lille Europe are more complex. They are 24/7 activity centers that include a rich mix of shops, services, and public spaces that serve important public functions, and can serve as pieces of connective urban tissue that link neighborhoods that are divided by train tracks ("gare connectrice"), as public gathering spaces ("gare ouverte"), or places where people go to take care of everyday errands.

Stations that successfully achieve this complexity start with two intentions: the desire to bring together a mix of economic and social uses, and a commitment to planning and designing infrastructure at a human scale. The first requires market knowledge, public-private partnerships, and political support. The second requires political leadership as well as close collaboration by design professionals (transportation planners, engineers, station area planners, and station designers) to ensure that trackway approaches to the station do not divide communities and that station access and layout celebrate transport and a station's role as public space. Key to all of this is ensuring that stations and their various elements are designed to serve the multiple public and private purposes discussed in this report.

From a financing perspective, restrictions on the use of public funds can make it more diffi-

103 BART Station Access Guidelines. Bay Area Rapid Transit District document, published April 2003, http://www.bart.gov/sites/default/files/docs/access_guidelines.pdf.

104 Though this type of thinking clearly underlies much of the station access planning for central city stations in Europe, automobile travel (the least space-efficient mode) in those places also is not as dominant, and so there is not as much of a need to come up with a hierarchy such as the model developed by BART.

cult to build publicly funded transportation facilities that include commercial uses such as shops, restaurants, and office buildings that may improve opportunities for value capture (i.e. the public sector's return on investment) and improve the performance of the transportation facility though higher ridership. In the fall of 2014, the Federal Transit Administration (FTA) published a revised joint development circular that clarifies the rules for joint development for FTA-funded projects[105] with the ultimate goal of making such projects easier to undertake. For its part, the Federal Railroad Administration (FRA), the federal arm of the U.S. Department of Transportation that funds intercity rail, has no such guidance document. As such, in the short term, joint development proposals for FRA-funded projects will be reviewed without the same standardized framework that has been developed for FTA projects. This may make joint development with FRA-funded properties more difficult.[106]

105 See http://www.fta.dot.gov/about_FTA_11009.html.

106 Although the FRA does not have a joint development circular, the agency has published a guidebook on station area development for high-speed and intercity rail terminals, which provides guidance on how to best integrate train stations into their surrounding contexts and to maximize ridership, economic development, and environmental benefits.

10. *Encourage the use of bicycles as a space-efficient access mode that could serve an increasingly important role in bringing Californians to HSR stations.*

Responsible partners: CAHSRA, HSR station cities, transit agencies in HSR station cities, bicycle advocacy organizations

Most relevant to: All HSR station cities, but particularly San Jose, Fresno, Bakersfield, and Palmdale

The bicycle is one mode in particular that could serve an increasingly important role as a cost-effective and space-efficient means of transportation for California's HSR station cities. Bicycles can be especially well-suited to medium-density mid-sized HSR cities that are neither populous nor dense enough to support extensive high-capacity transit networks. This is best illustrated by select mid-sized German cities such as Münster and Freiburg. California HSR station cities should recognize this and take steps to facilitate and encourage bicycle use, particularly as a means to get to HSR stations, and to provide adequate bicycle infrastructure, including high quality bike paths, cycle tracks, or bicycle boulevards, designed with elements to make cycling easy, comfortable, and safe. As suggested by Federal Transit Administration policy guidance,[107] these investments should especially be focused within a three-mile radius of transit stations. Examples of such elements might include shade trees, a raised bed for the bicycle path, and barrier-separation from car traffic. Additionally, the importance of adequate and secure bicycle parking cannot be understated as a prerequisite for encouraging bicycle riding as a way of getting to stations.

107 https://www.federalregister.gov/articles/2011/08/19/2011-21273/final-policy-statement-on-the-eligibility-of-pedestrian-and-bicycle-improvements-under-federal.

Though bicycle trips account for a small proportion of overall travel in the United States,[108] there has been significant growth in this mode in the past decade. California has seen a 60 percent growth in cycling between 2005 and 2012 alone.[109] The experience of Lyon also suggests that bicycling can start to catch on even in communities that have not historically had high rates of bicycling.

Along the California HSR route, San Jose, Fresno, and Merced seem particularly well-positioned for growth in cycling. Each is characterized by low-density, auto-oriented development patterns that make these cities difficult to serve in their entirety with high-capacity transit service. The topography in each of these cities is flat, a characteristic that cities with high rates of cycling tend to share. The weather in these cities is actually much more conducive to cycling than that of the European cities where residents bike the

108 According to the 2009 National Household Travel Survey (NHTS), walking trips accounted for 10.9 percent of all trips reported, while 1 percent of all trips reported were taken by bike, http://katana.hsrc.unc.edu/cms/downloads/15-year_report.pdf.

109 "Where We Ride: Analysis of Bicycling in American Cities," p. 6, http://bikeleague.org/sites/default/files/ACS_report_final_forweb_2.pdf.

most. Finally, these three cities have universities within biking distance of the proposed HSR stations, a characteristic that, in Europe, appears to be correlated with high rates of cycling and use of bicycles to access intercity rail stations.

Conclusion

California's HSR project promises to offer a new, more environmentally sustainable mode of intercity transportation for the state. It also has the potential to bring about significant opportunities for economic development, particularly in cities along the HSR route, but throughout the state generally.

However, the experience of the two European countries with the most experience with HSR development, France and Germany, suggests that simply building HSR will not ensure that any of these benefits materialize automatically as service comes online. Based on my research and analysis of the French and German cases, I propose ten policy recommendations in order to maximize the state's investment in HSR:

1. Develop, articulate, and hold bold long-term visions for HSR corridors and stations.
2. Wherever possible, California should site HSR stations in central city locations.
3. There are trade-offs to maximizing HSR travel speeds and maximizing connections by stopping trains. Connections should be emphasized in dense urban areas, while speed should be prioritized in sparsely populated areas.
4. Provide first-rate physical intermodal connections within HSR stations between non-auto access modes and HSR.
5. Make it easy to pay to use sustainable and space-efficient access modes and ensure seamless service coordination between local transit and intercity rail service.
6. Each station area should form a cross-cutting governance entity that will allow for the type of visionary, long-term, and integrated design for stations and station areas as described in P1 as early in the planning process as possible.
7. Prioritize land uses within station areas that will maximize ridership for HSR.
8. Recognize the inherent urban design advantages of HSR stations over other transportation facilities and design them to make the most of these advantages.
9. Recognize, celebrate, and plan for train stations' non-transportation roles.
10. Encourage use of bicycles as a space-efficient access mode that could serve an increasingly important role in bringing Californians to HSR stations.

The planning grants that CAHSRA is offering to select cities that are located along the San Francisco-Los Angeles portion of the system present an opportunity to incorporate these recommendations. Specifically, these plans are intended to 1) encourage and steer HSR-supportive development to station areas; and 2) to ensure the establishment of robust transit connections between the new HSR station and existing central business districts (in cases where the HSR station is not located in the economic center of the city). Cities that are slated to receive funds include Palmdale, Bakersfield, Fresno, Merced, Gilroy, and San Jose. The CAHSRA has also invited cities near the Kings/Tulare station to apply for these funds. These grants offer an ideal opportunity for cities to develop bold visions for their stations and consider how transatlantic lessons from this research could influence or inspire critical choices for making the most of the state's monumental investment in HSR.

The CAHSRA has made the wise decision to site most stations in historic city centers, both in order to strengthen those central cities by drawing more economic activity to them, and also to put the stations in places that are currently best served by urban public transportation. All of this makes sense and is supported by best practices from France and Germany.

There are a few significant differences between most of California's HSR station cities and the European cities discussed in this report, which may limit the usefulness of the European experience for California. Chief among these are the comparatively better physical and economic health of European central cities, the amount of available land for redevelopment, and different levels of automobile dependency. These differences particularly limit the relevance of the European experience in the areas of development phasing and parking management. With the exception of San Francisco, the downtowns of the California cities are, proportionally speaking, not nearly as important to the metropolitan regions of which they are part as the centers of European cities to their regions. Also, many — including Fresno, Bakersfield, and Merced — have downtowns that are downright depressed. Fortunately, there is a silver lining to this: in comparison to the cities of Germany and France, whose quaint and compact downtowns were built out several centuries ago, California can build new downtown stations in central locations with relative ease. California is also fortunate in that the state is expecting significant population and employment growth, especially in the cities along the California high-speed rail line. If the CAHSRA-funded station area plans are successful, the HSR stations and station areas will capture a large portion of this growth and become thriving centers anchored by HSR.

California's HSR project is often referred to as the single largest infrastructure project in the history of the state. It is precisely because of the project's monumental scale that it has the potential to be transformational for the state as a whole, and particularly for communities that will have stations. But it must be done right to achieve that potential. This report provides insights on how California can make the most of high-speed rail for generations to come.

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