TEXAS ON THE FAST TRACK:

EXPLORING PASSENGER RAIL VIABILITY BETWEEN DALLAS AND HOUSTON

COMMUNITY AND REGIONAL PLANNING
TEXAS
The University of Texas at Austin

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Course Introduction

The Community and Regional Planning's master's program at the University of Texas at Austin's School of Architecture requires students to complete a Planning Practicum, as part of their core curriculum. The Planning Practicum, equivalent to a studio, is a project-based research course that allows the students to apply their acquired skills to real-world planning problems, often in collaboration with a client. The objective of this practicum is to explore practical solutions for infrastructure development using theories, methods, and techniques learned from other courses. Students are expected to deliver professional quality products on planning for passenger rail success through evaluating existing case studies, forecasting market demand, and evaluating policy and plan alternatives. This report is final outcome of this six-hour course spanning two semesters.

Titled 'Positioning the United States for Successful High Speed and Intercity Passenger Rail-Texas in Focus', the 2023-2024 practicum studied on the proposed high-speed rail connecting Dallas and Houston. Students in the practicum studied the history of Texas Central and its initial proposals. During Fall 2023, students studied and analyzed various case studies of high-speed rail across the globe, conducted a SWOT analysis of the proposal, and applied their initial findings to the local Texas context. Students focused on crafting a methodological framework, interviewing stakeholders, and developing a set of recommendations in the second semester of the project.

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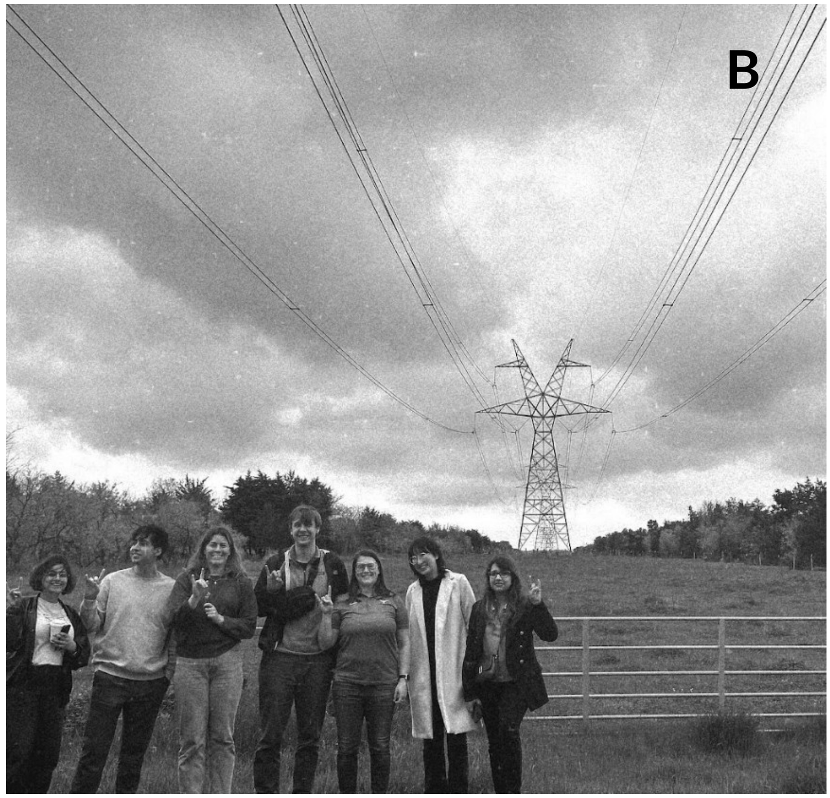
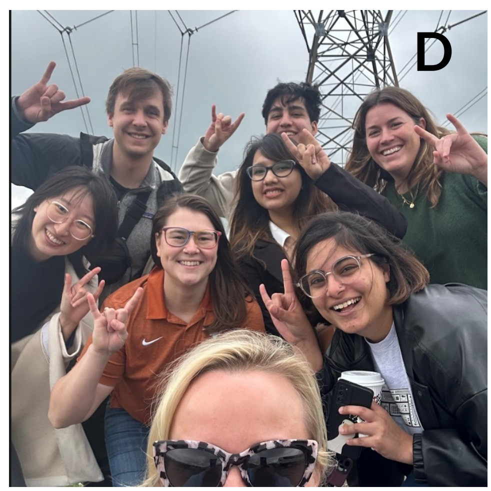




A: Meeting with Judge Brown

B & D: Field trip viewing possible rail corridors from Dallas to Houston

C: Final presentation day at Travis County office

Executive Summary

The Dallas and Houston metropolitan areas are two of the largest and fastest growing regions in the United States, with a combined population exceeding 15 million people. These two metropolitan areas are just 240 miles apart, and travel demand between them is substantial. Travelers are served primarily by IH 45 and short haul airline flights. However, increasing congestion will extend highway travel time between the two cities from 3.5-4 hours to 6.5 hours by 2035 if nothing is done.

To provide an additional intercity transportation option and support the continued population and economic growth of these megaregions, this report evaluates passenger rail alternatives between Dallas and Houston. The goal was to analyze the costs, benefits, and feasibility of different passenger rail options and develop an implementation strategy.

Three types of passenger rail were considered in the analysis for the report:

***High-Speed Rail (HSR)*, with top speeds of 160-200 mph, and is similar to the Japanese Shinkansen train sets.**

***High Performance Passenger Rail (HPPR)*, with top speeds of 90-125 mph. This is similar to Amtrak's Acela service in the North east Corridor or Brightline's Miami to Orlando service in Florida.**

***Conventional Passenger Rail*, with top speeds of 55-80 mph. This is similar to most existing Amtrak services outside the Northeast Corridor and runs on shared track with freight railroad service.**

For each rail type, the research team (the team) evaluated multiple alignment options. The team focused on leveraging existing freight rail corridors owned and operated by the Union Pacific (UP) and Burlington Northern Santa Fe (BNSF) railways, as well as a utility corridor. Altogether, a total of seven alternatives were analyzed in detail:

- One HSR option following a new "greenfield" alignment along an existing utility corridor, as proposed by Texas Central.
- Three HPPR greenfield options alongside freight corridors: one along UP tracks, one along BNSF tracks, and a "collaborative" option using UP tracks from Dallas to Corsicana and BNSF tracks from Corsicana to Houston.
- Three conventional rail options which share tracks on freight corridors: one on UP tracks, one on BNSF tracks, and the same collaborative option as before with track sharing from both companies.

To evaluate the feasibility and compare the relative merits of the seven alternatives, the team conducted a benefit-cost analysis (BCA) following federal guidelines. The BCA projected impacts over a 30-year time horizon from 2035 to 2065, assuming a common opening year of 2035 for all alternatives. The BCA considered factors including capital and operations and maintenance costs, travel time savings, emissions reductions, vehicle operating costs savings, and reduced crash costs. The HSR alternative BCA results are as follows:

- HSR had by far the highest projected 2035 ridership at 2.41 million annual riders, compared to 0.46-0.53 million for HPPR and 0.09-0.10 million for conventional rail.
- HSR generates $26.2 billion in raw benefits, 3.5 times more than HPPR ($7.1-$8.0B) and 25 times more than conventional rail ($1.1-$1.5B). Travel time and reliability savings account for the largest share of benefits across all alternatives.
- However, HSR is also the most costly alternative at $37.5B in lifecycle costs, compared to $17.8-$19.2B for HPPR and $1.4-$1.5B for conventional rail. For HSR and HPPR, the upfront capital costs dominate, while operating costs are more significant for conventional rail.
- The benefit-cost ratio was highest for conventional rail (0.71-1.09), followed by HSR (0.70) and HPPR (0.37-0.45). However, USDOT guidance on BCA inputs is subject to change with emerging data. Better quantifying benefits could better reveal the public good of HSR.

While conventional rail is most cost-effective from a BCA perspective, HSR's substantially higher ridership and overall benefits still make it an attractive option worthy of further consideration. HPPR is ultimately inferior and should not be pursued. If there is going to be a large infrastructure project that prioritizes the efficiency of movement, then there is much more potential value in building HSR over HPPR, especially considering the indirect benefits. Indirect benefits include economic agglomeration, labor market integration, future-proofing for growth, the ease of travel and comfort, and use for evacuation from natural disasters like hurricanes. While the BCA does not measure indirect benefits, HSR qualitatively does the best by far in this category.

Implementing any major passenger rail project in Texas will require establishing a new governing body. We propose a centralized entity with a (working) title of the Texas Railroad Authority (TRA). This new entity should be established before any of the other recommendations within this report can be implemented. The TRA would manage funding, ensure regulatory compliance, and balance freight and passenger rail needs. Additionally, the team recommends the TRA should have representation from key stakeholders like TxDOT, Amtrak, freight railroads, and local communities.

A mix of funding and financing from federal, state, local and private sources will likely be needed given the high costs of the project. The TRA will need to creatively package multiple funding streams and work closely with federal partners. Some potential funding sources include:

- Federal grants from programs like the Federal Rail Administration (FRA)'s Federal-State Partnership for Intercity Passenger Rail.
- Financing tools like TIFIA loans, RRIF, and private activity bonds to leverage public dollars.
- State and local contributions, potentially including general obligation bonds or revenue bonds and special taxes/fees.
- Private investment via public-private partnerships (P3s), especially for HSR projects that may be able to access private equity and financing.

Based on analysis performed for this report, an incremental approach to implementing passenger rail between Dallas and Houston is recommended:

1. Immediately establish a governing body that will coordinate funding and oversight of rail in Texas and build partnerships with the freight companies:
    a. Establish the proposed TRA governance structure to manage both passenger and freight rail.
    b. Continue to work with UP and BNSF to secure corridor sharing where necessary and safety improvements like grade-separated crossings.
    c. Begin to identify and pursue federal, state, and local funding.
2. Implement an initial conventional rail service along the collaborative UP/BNSF alignment:
    a. Conduct preliminary engineering and environmental clearance for the conventional rail service.
    b. Invest in targeted capacity improvements to enable reliable passenger service.
    c. Monitor performance and build ridership to demonstrate viability of passenger rail.
3. To prepare for future HSR, begin building capacity and making the political argument at a state level:
    a. Seek political allies and support through economic, freight efficiency, and safety arguments.
    b. Begin acquiring right-of-way (ROW) along the proposed utility corridor.

4. Build HSR along the utility corridor.

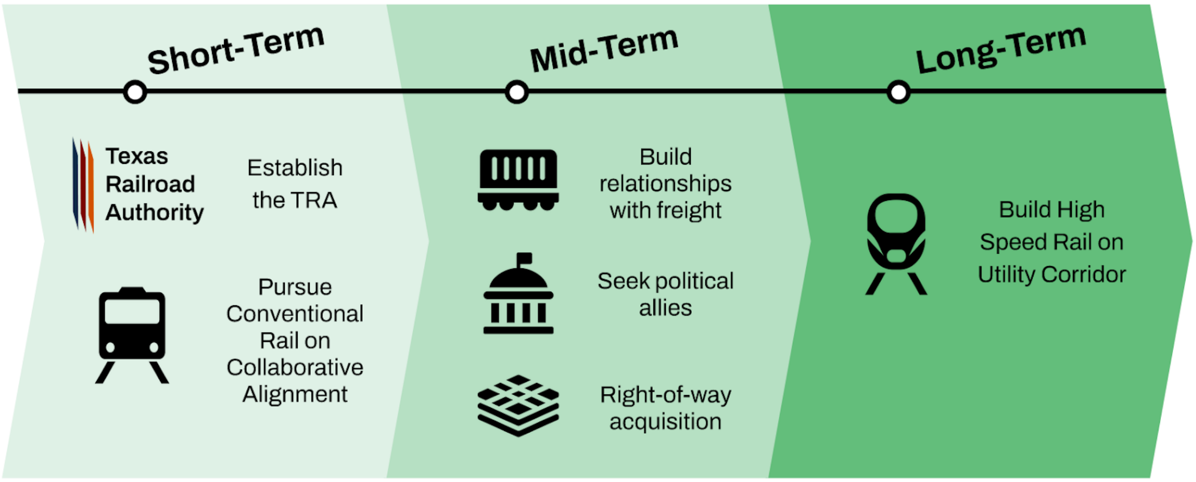


Figure I : Simplified roadmap for pursuing intercity rail in Texas.

Providing passenger rail between Dallas and Houston is critical to supporting the continued growth and connectivity of two of America's largest metropolitan regions. While challenging, it is a worthwhile pursuit to expand mobility options, reduce emissions, and long-term economic growth. With a strategic approach, strong governance model, and diverse funding plan, intercity passenger rail can become a reality in Texas. The time to start building that reality is now.

1 INTRODUCTION

Houston and Dallas are the 4th and 5th most populous cities in the US, respectively, with a combined metro population of over 15 million people. Travel between the two cities is regular. Commuters either take a short flight to their destination or use IH 45. Every year, an average of 16 million journeys are made between the mega cities, with an average travel time of three -and-a-half hours. However, with ever-increasing traffic, travel time can exceed five hours (Futurology, 2023). The situation is only worsening with the increasing population in the region. A 2010 study of intercity travel in Texas estimated that the average travel speeds of approximately 60 mph along the I-45 corridor would drop almost 35 percent to 40 mph—increasing driving time to 6.5-hours between North Texas and Houston (Texas Central, 2020). This increase in travel time includes all planned improvements and increased highway capacity. Additionally, increasing the number of rides will have a causal effect on the number of accidents occurring on the highway; 260 fatalities were recorded between 2016 and 2019 (Futurology, 2023). With increasing traffic, the number is expected to grow substantially.

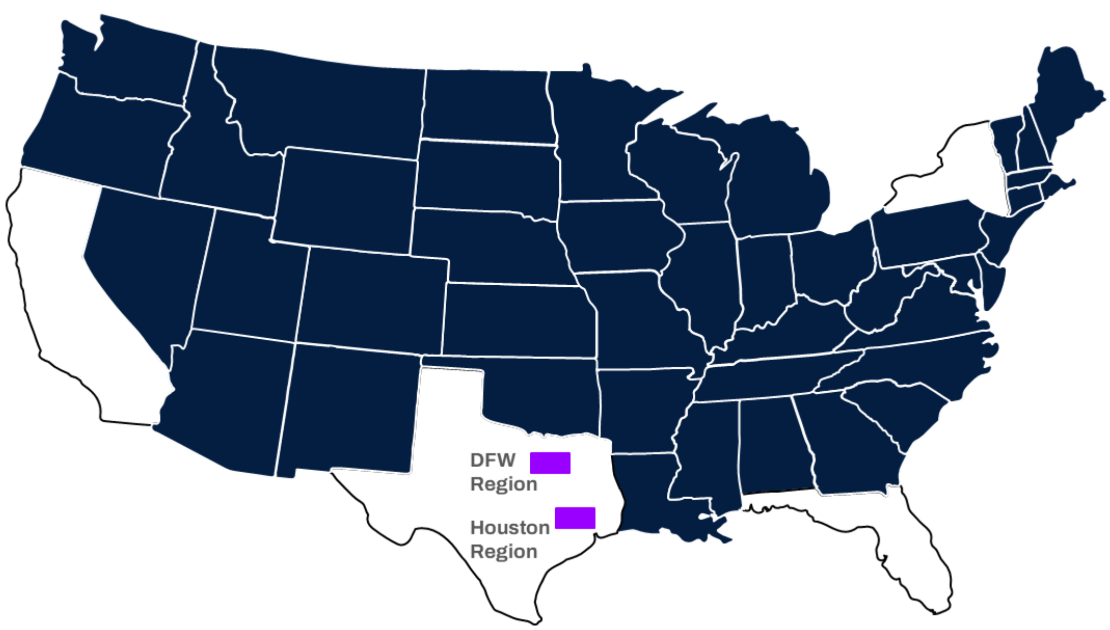


Figure 1-1: States with a smaller population than DFW and Houston MSA combined

To counter the problem, a private company, Texas Central established in 2012, announced their plan for a high-speed bullet train between the two cities, spanning 240 miles. The plan involved using Central Japan Railway's rolling stock (train) and ancillary technology. Japan Railways carries 100 million annual passengers. The Texas project was anticipated to:

- Move travelers between Dallas and Houston in 90 minutes
- Move an estimated at six million passengers by 2029 and more than 13 million by 2050
- Complement existing long-distance train service in the southern region
- Reduce greenhouse gas emissions by 100,000 tons per year and save 65 million gallons of fuel
- Remove 12,500 cars per day from IH-45
- Bring thousands of construction jobs and nearly 1,000 long-term skilled operations and maintenance positions to Texas.

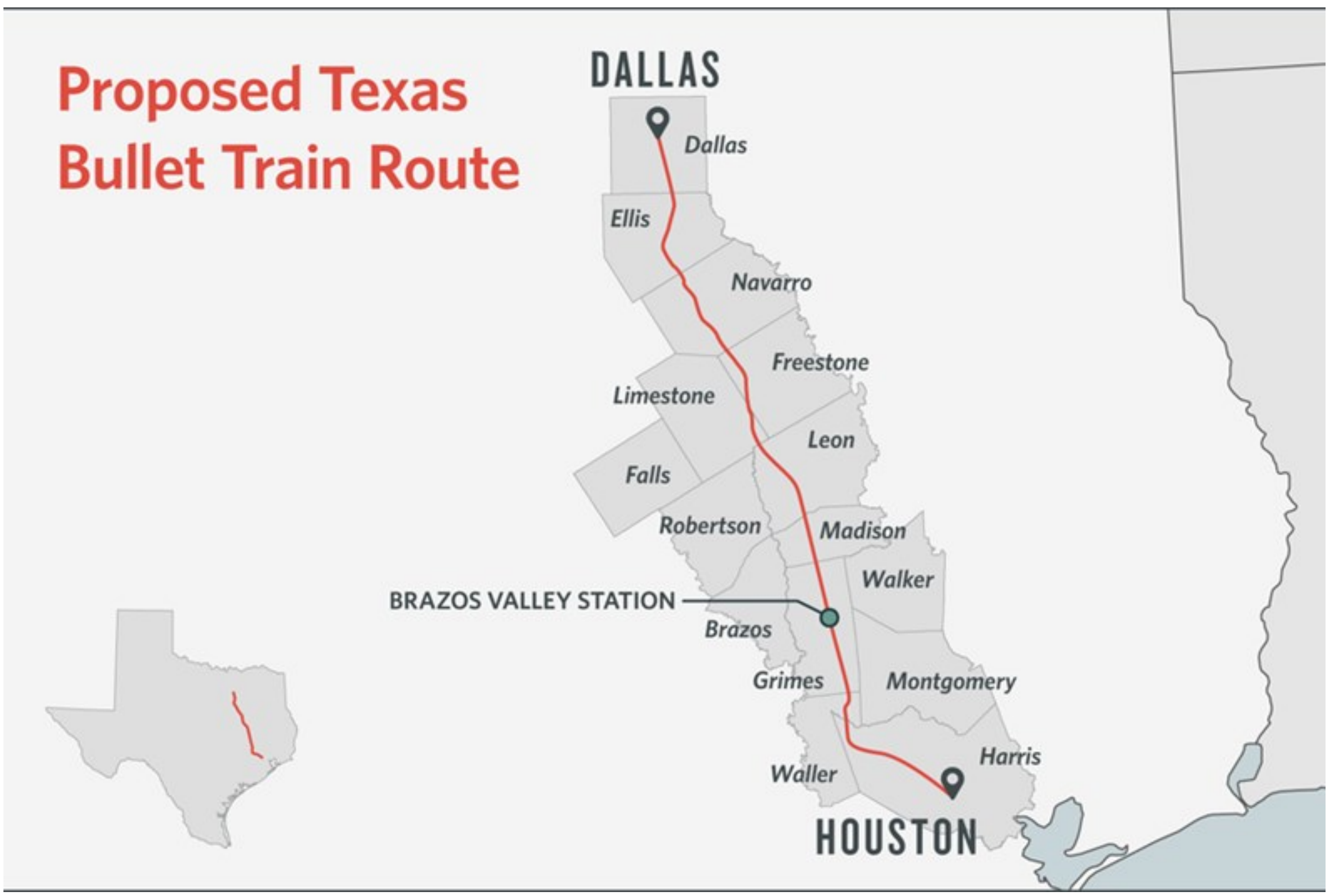


Figure 1-2: Proposed route for the Dallas-Houston bullet train

Source: Texas Tribune, 2020

The Texas Central project faced two major hurdles: land acquisition and ongoing, secured funding for the project. Advocates for private property ownership rights expressed deep concerns about the impact of the rail line on their properties, the local environment, and overall way of life (Melhado, 2022). This led to resistance and legal challenges from some local property owners. Secondly, the delay in beginning construction led to substantial cost increases for the project.

This report aims to take a step back and consider additional travel options for commuters between Dallas and Houston. Hence, our main problem statement is: the Dallas to Houston metro areas are experiencing increasing population, and people need more options for transportation between the two regions.

Currently, major railway corridors in Texas are owned and operated by freight, and passenger travel is treated as an afterthought. However, growing environmental concerns and an increasing population has renewed the possibility of passenger rail in Texas as a solution.

To combat any potential biases, this report proposes three types of rail transit: (a) HSR, (b) HPPR; and (c) Conventional Passenger Rail. These three options are evaluated against each other through a BCA. Conducting a BCA provides a benchmark for evaluation and comparison for investment decisions by monetizing and assigning a dollar value to each cost and benefit for each option. Details about the BCA and the list of assessed factors are described in detail in Chapter 2.

A successful rail project in this corridor depends on a public-private partnership containing multiple stakeholders. Thus, this report also lays out a funding and governance structure for rail transit in the Lone Star State. The conceptualization of a system-based approach helps establish a single point of accountability for each part of the complete process.

WHY

The Houston to Dallas metro areas are experiencing increasing population and people need more options for transportation between the two regions.

WHAT

What type of infrastructure is most appropriate to provide mode shift options in the corridor between?

High speed rail; High performance passenger rail; or Conventional passenger rail?

WHEN

For whichever strategy is chosen, when should the process begin and over what time scale?

WHERE

Which corridors are most well suited to house each type of infrastructure?

WHO

Who should own the infrastructure?

Who should operate the rail?

Who should develop the stations?

Although this project has covered extensive ground with the BCA, it does not offer detailed operational considerations, nor does it investigate specific alignments. Additionally, this report does not recommend precise locations for future stations, mainly due to the lack of time and expertise required for this additional analysis.

The second part of this chapter highlights the purpose and needs of passenger rail in Texas, specifically between Houston and Dallas, and why we consider it to be an urgent policy concern. Chapter 2 discusses details about the BCA, followed by funding opportunities and governance strategies in the subsequent chapters. The report ends with a set of recommendations, divided into short, medium, and long-term action plans.

1.1 PURPOSE AND NEEDS

1.1.1 WHY TEXAS

For years now, Texans have heard and complained about the meteoric population boom the state has been experiencing. Dallas and Houston have shared an incredible amount of growth. It is important to take a pause and put this population increase into context. Figure 1-1 illustrates this growth, where the states in blue are states with populations less than the combined population of Dallas and Houston Metropolitan Statistical Areas (MSAs).

These population trends are only expected to continue. Harris County, where Houston sits, is expected to grow by 1.5 million people by 2060. Dallas County is expected to see an increase of 0.5 million people by the same year. This does not include the surrounding counties of Denton, Collin, Tarrant, Fort Bend, and others, which are predicted to see transformative growth. A dramatic increase in the number of people in these regions accompanied by an increase in cars on the roads stresses the importance of considering additional transportation options.

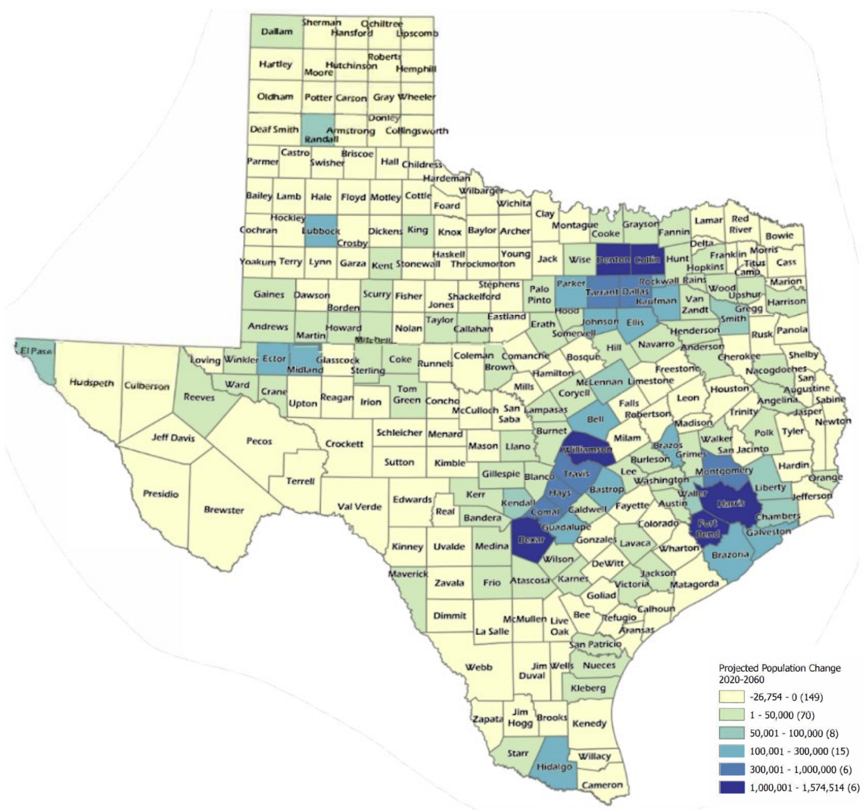


Figure 1-3: Projected Population Change, Texas Counties, 2020-2060

Source: Texas Demographics Center, 2022

The ideal HSR corridor must meet certain requirements. First, the corridor must be flat (or made to be flat in the case of mountainous regions) with minimal curves in order to safely achieve higher speeds. It should be between two similarly sized population centers with a middle-sized population center in the middle. The corridor should be within the “sweet spot” of under 500 miles or about six hours driving. There is no better city pairing in the United States for this than Dallas and Houston. This city pair naturally meets all of these criteria. The population of the DFW Metropolitan Statistical Area (MSA) is over 8.1 million people. Houston’s MSA is similarly sized, with 7.5 million people. The distance between the two cities is around 250 miles, making a HSR offering competitive with driving and flying. If HSR is possible in the United States, it is most possible in Texas.

Texas has another distinct advantage when it comes to a possible HSR offering. Geographically, Texas sits neatly in the middle of North America and is the center of trade between the United States, Mexico, and Canada. Forty-eight percent of all United States-Mexico-Canada trade agreement (USMCA) products are transported through Texas using the I-35 corridor (The Greater Austin-San Antonio Corridor Council, 2023). With an increase in demand for ecommerce post-covid, and as more factories move from Asia to Mexico through nearshoring, Texas will be at the economic center of trade in North America.

Figure 1-4: Trade flows between the U.S., Mexico, and Canada

Source: naftawebsite.weebly.com

1.1.2 WHY NOW

The United States' cargo capacity is maxed out. The New York Times reports that there are more near-miss airline collisions than we previously thought with about 300 occurring in the last 12 months. In 2023, a freight train carrying hazardous material derailed in Palestine, Ohio spilling toxic chemicals in nearby waterways. Most recently, the Baltimore Bridge crumbled following a collision with a cargo ship. Furthermore, there are about three derailments every day in the US. The US's freight infrastructure is at maximum capacity, and in order to ensure passengers can travel safely, alternative travel options are imperative.

Passenger travel is an afterthought when considering travel infrastructure in Texas. The state's population is rapidly increasing, and existing infrastructure is bursting at the seams. Demand for cargo capacity is only growing with more e-commerce and from nearshoring as US businesses move their manufacturing from overseas to Mexico.

Growing freight demand strains Texas highways. Meanwhile, ecommerce is driving unprecedented growth in freight transportation. According to the 2023 TRIP Freight Report, Texas ranked first in total value of freight shipped and value of freight shipped via trucks, specifically, threatening the movement of vehicle traffic on our roads. The same report noted that in 2022, Texas's freight system moved 3.4 billion tons of freight, valued at $3.1 trillion, the highest value of all states.

We expect to see a 91% increase in value and a 53% increase by weight of freight moved by trucks annually between 2022 and 2050 (TRIP, 2023). Expanding freight capacity on rail is imperative to avoid traffic strain on our highways.

Table 1-1: States freight by value ranking (Source: TRIP, 2023)

Rank	State	Freight by Value - All Modes ($2022 millions)	Rank	State	Freight by Value - Trucks ($2022 millions)
1	**Texas**	**3,132,697**	**1**	**Texas**	**2,053,701**
2	California	2,845,127	2	California	1,896,400
3	Illinois	1,571,888	3	Illinois	1,123,656

Intercity rail is equally important for passengers as it is for freight. It provides a safe, reliable alternative to driving. Passenger rail accessibility reduces the number of cars on roads. It also enhances the efficiency of both freight and passenger movement, and it supports economic growth.

At a time when climate change is gripping Texas, focus must turn toward environmental sustainability. According to the Environmental and Energy Study Institute, HSR is eight times more energy efficient than airplanes and 4 times more energy efficient than cars. This will lead to a reduction in greenhouse gas emissions (GHGs) by a factor of between 14-16, according to the FRA. Increased efficiency and reduced GHGs will reduce dependence of foreign oil – and fossil fuels in general – while improving air quality. Additionally, new research shows that car tires — a previously under-counted source of air pollutants — emit carcinogens that are dangerous to humans and wildlife (Emissions Analytics, 2020). Rail would help reduce the risk of exposure to these carcinogens produced by driving.

Intercity passenger rail and expanding freight capacity on rail will also induce benefits and trigger imperative indirect benefits. If Texas does not invest in rail expansion, it could forfeit a vast increase in tax revenue via increased economic activity, property development leading to increased property values and taxes, and job creation, which are some things that happened in Japan. We may also see massive benefits to per-capita GDP along high-speed rail routes, as evidenced in China. An increased opportunity for economic agglomeration along high-speed rail corridors is also a possible positive outcome of rail expansion. Finally, intercity passenger rail is associated with increases in quality of life including more accessibility to education, employment opportunities, and more, plus reduced stress resulting from more comfortable commutes, and more vibrant communities.

If Texas's state leaders and agencies continue to do nothing, we are looking at dire consequences. According to a TxDOT estimation, as previously mentioned, travel time between Dallas and Houston via car along IH-45 could double to 6.5 hours by 2035. Freight trucks will also suffer as a result of increased traffic on IH-45, since about 22% of the vehicles traveling along the corridor are freight trucks. This has implications for Texas's economy in terms of the cost and time to ship goods.

1.1.3 REASONS NOT TO PURSUE TEXAS HSR

This report examined HSR in Texas objectively, understanding that critics would provide numerous reasons for not pursuing this project. Three counter-arguments came up most frequently: infringement on private property rights, financial risk, and lack of government aptitude to deliver a project of this scale.

The first argument concerned private property rights infringement. Historically, Texas has a strong culture of private property rights in a country where such rights are stridently observed. For a project of this magnitude, eminent domain would be required in order to acquire portions of the right-of-way. Many Texans express concern over the taking of private property to construct passenger rail, even if the development will usher in tremendous economic opportunity. Despite the Texas Supreme Court win for Texas Central to use eminent domain to acquire land along the corridor, this is an expensive and time consuming process with almost guaranteed litigation.

The second argument frequently encountered is that this project would be financially unwise. Given the high capital costs required to construct it, many do not believe that the revenue and economic development generated from HSR will make up for these initial costs. Critics also point out other similar projects, such as California High-Speed Rail and Project Connect in Austin, whose costs have far surpassed their initial ask. This argument proves to be one of the most cited criticisms of the three arguments.

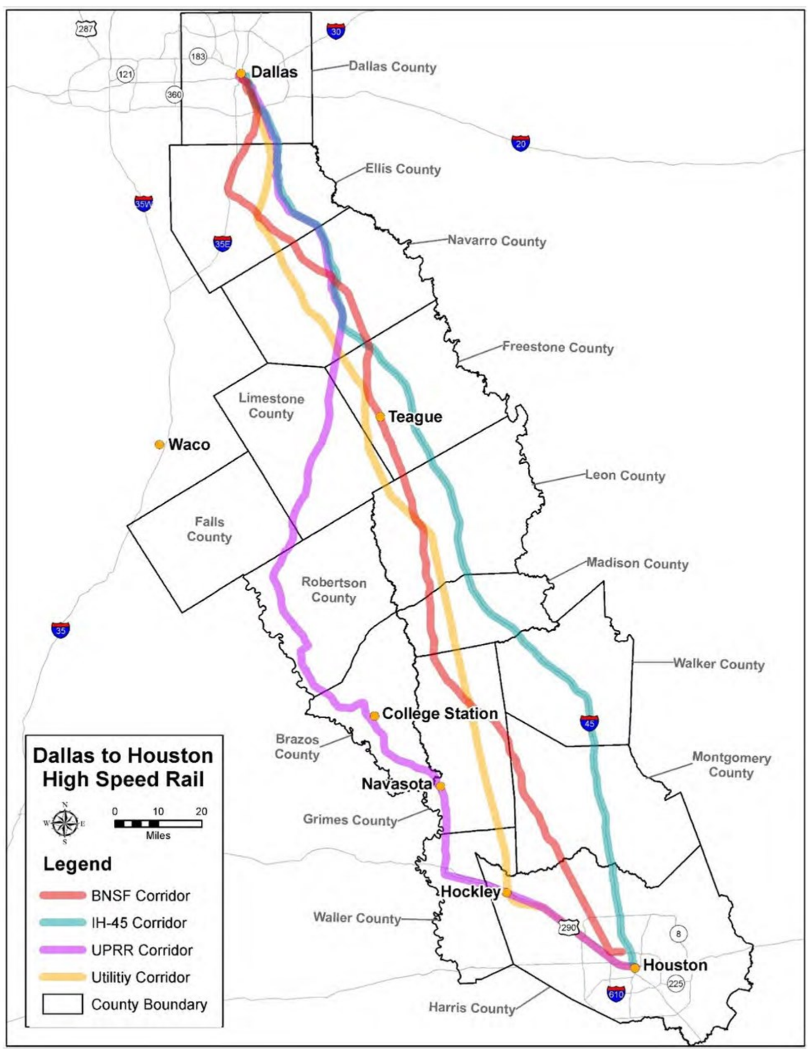
The final argument is that many believe that this is not the role of the government. Critics do not want to see the government at any level involved in the development and operations of HSR. Many believe that the government should not be involved in constructing a transportation service at all or one that could be done through a private company like Brightline.

Their arguments pose significant political challenges to HSR and are worth examining if a project of this size is to ever move forward.

2 COST V. BENEFITS

The Federal Railroad Administration (FRA) released the Final Environmental Impact Statement (EIS) for Dallas to Houston High-Speed Rail on May 29, 2020. The purpose of the Final EIS is to evaluate and document the reasonably foreseeable potential beneficial and adverse environmental impacts associated with the implementation of Texas Central's proposed HSR system. The Final EIS considered a No Build Alternative and six Build Alternatives for the HSR alignment between Dallas and Houston.

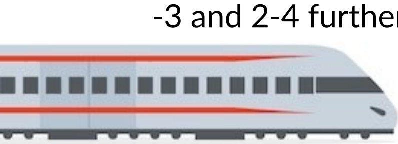
Among the six Build Alternatives, four distinct corridor options were evaluated in the EIS: the IH-45 corridor, the Union Pacific (UP) corridor, the BNSF corridor, and the utility corridor. However, for the purposes of our independent benefit-cost analysis, the IH-45 corridor was excluded from consideration due to several factors that make it less suitable for HSR development.



Source: AECOM 2016

Figure 2-1: Potential rail corridors between Dallas and Houston

One major fatal flaw with the IH-45 corridor is the presence of numerous curves and loops along the route, which are not ideal for the efficient operation of high-speed trains. HSR requires more linear alignments to maintain optimal speeds and performance. Additionally, the right-of-way available within the median of the IH-45 corridor is insufficient and inconsistent throughout the route, posing significant challenges for accommodating the necessary infrastructure for HSR. Figure 2-2, 2 -3 and 2-4 further illustrates this.



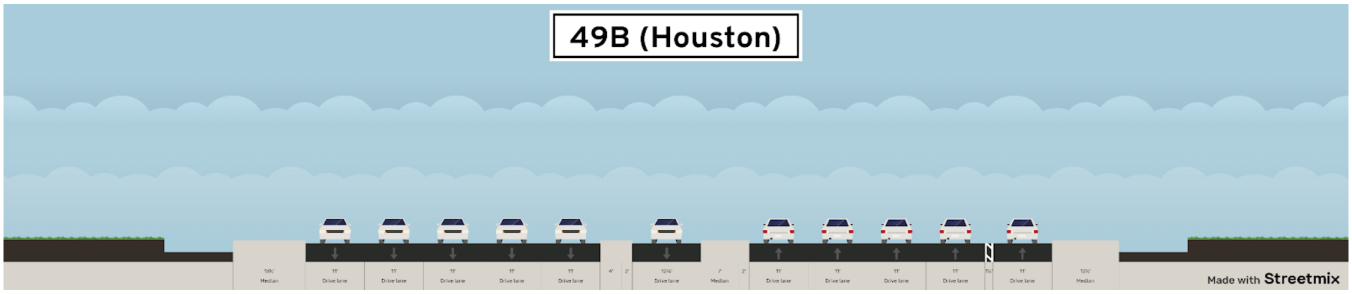


Figure 2-2: I-45 Corridor cross-section (HOV lane in median)

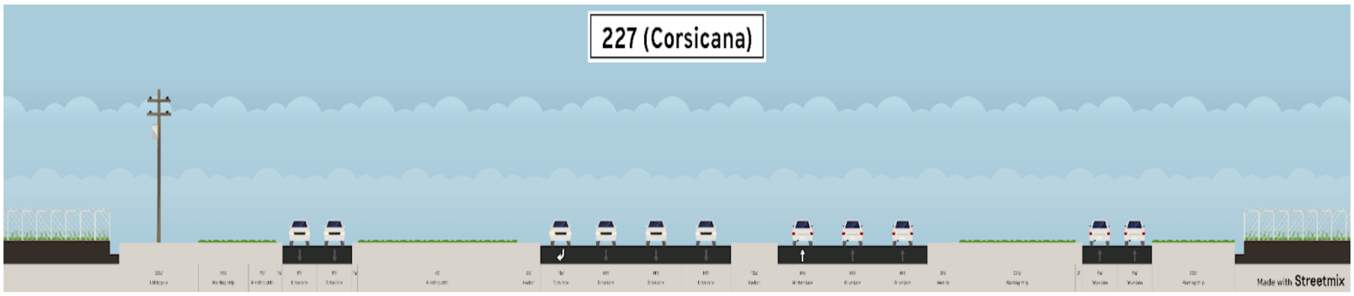


Figure 2-3: I-45 Corridor cross-section (median ~13’)

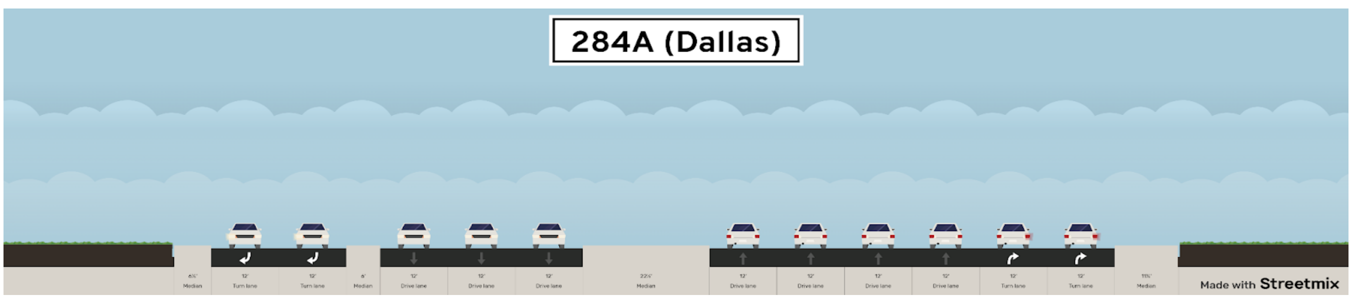


Figure 2-4: I-45 Corridor cross-section (median ~22.5’)

Moreover, if conventional rail is being considered as an alternative to HSR, there are other non-greenfield options available that may prove more feasible, such as sharing tracks with existing freight rail lines. These alternatives could potentially offer a more cost-effective and less disruptive solution compared to attempting to co-align conventional rail with the IH-45 corridor.

Considering these factors, the IH-45 corridor was not included in our alternative analysis through the BCA, as it presents notable challenges for both high-speed and conventional rail alignments. Instead, our analysis focused on the UP, BNSF, and utility corridors, which appear to offer more promising potential for the successful implementation of a rail project in the region.

2.1 OVERVIEW OF ALTERNATIVES

To plan for the intercity rail between Dallas and Houston, our team explored various options, including HSR, HPPR, similar to Amtrak Acela in the Northeast Corridor (NEC), and conventional passenger rail. We conducted a benefit-cost analysis (BCA) on seven alternatives to determine the most viable solution.

Table 2-1: Overview of the 3 rail mode types considered in the BCA

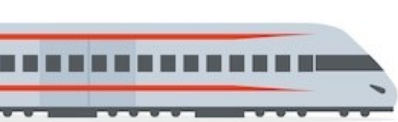
Mode	Most Like...	Maximum Speeds	Greenfield?	Build
High-Speed Rail	Japanese Shinkansen	160–200 mph (260–320 km/h)	Yes	On Texas Central's proposed utility corridor
High Performance Passenger Rail	Amtrak Northeast Corridor (Acela)	90–125 mph (145–200 km/h)	Mixed*	Alongside existing UP/BNSF track
Conventional Passenger Rail	Amtrak Long Distance Routes	55–80 mph (88–127 km/h)	No	Use existing UP/ BNSF track

The BCA takes into account factors such as construction costs, operating expenses, potential ridership, benefits in terms of travel time savings, reduced crash cost, reduced greenhouse gas emissions, and overall economic impact to determine the most promising alternative.

Table 2-2: The seven projects considered in the BCA

#	Projects Evaluated	Proposed by...
1	High Speed Rail	**Texas Central**
2	High Performance Passenger Rail - UP	Hypothetical
3	High Performance Passenger Rail - BNSF	Hypothetical
4	High Performance Passenger Rail - Collaborative	Hypothetical
5	Conventional Rail - UP	**TxDOT/Amtrak**
6	Conventional Rail - BNSF	Hypothetical
7	Conventional Rail - Collaborative	Hypothetical

*This selection is considered mixed because it would entail constructing new rail lines alongside existing lines. In order to conduct an accurate BCA accounting, the inputs assumed a completely new build, however, because there is existing infrastructure on this route, it does not technically qualify as greenfield.



High-Speed Rail (HSR)

The first option focused on the utility corridor, as proposed by Texas Central. This alternative would involve the construction of a dedicated HSR line, allowing for maximum operating speeds between 160 and 200 mph (260-320 km/h).

High-Performance Passenger Rail (HPPR)

Three proposals for HPPR were analyzed, which would utilize existing freight corridors or shared tracks. HPPR alternatives would have maximum operating speeds ranging from 90 to 125 mph (145-200 km/h).

- The second proposal considers building an HPPR line parallel to the UP corridor.
- The third proposal considers building an HPPR line parallel to the BNSF corridor.
- The fourth proposal considers building an HPPR line parallel to the corridors of both freight companies (UP and BNSF). The line would run alongside BNSF tracks from Houston to Corsicana, where they would switch to UP tracks until they reached Dallas.

PROPOSAL ALIGNMENTS

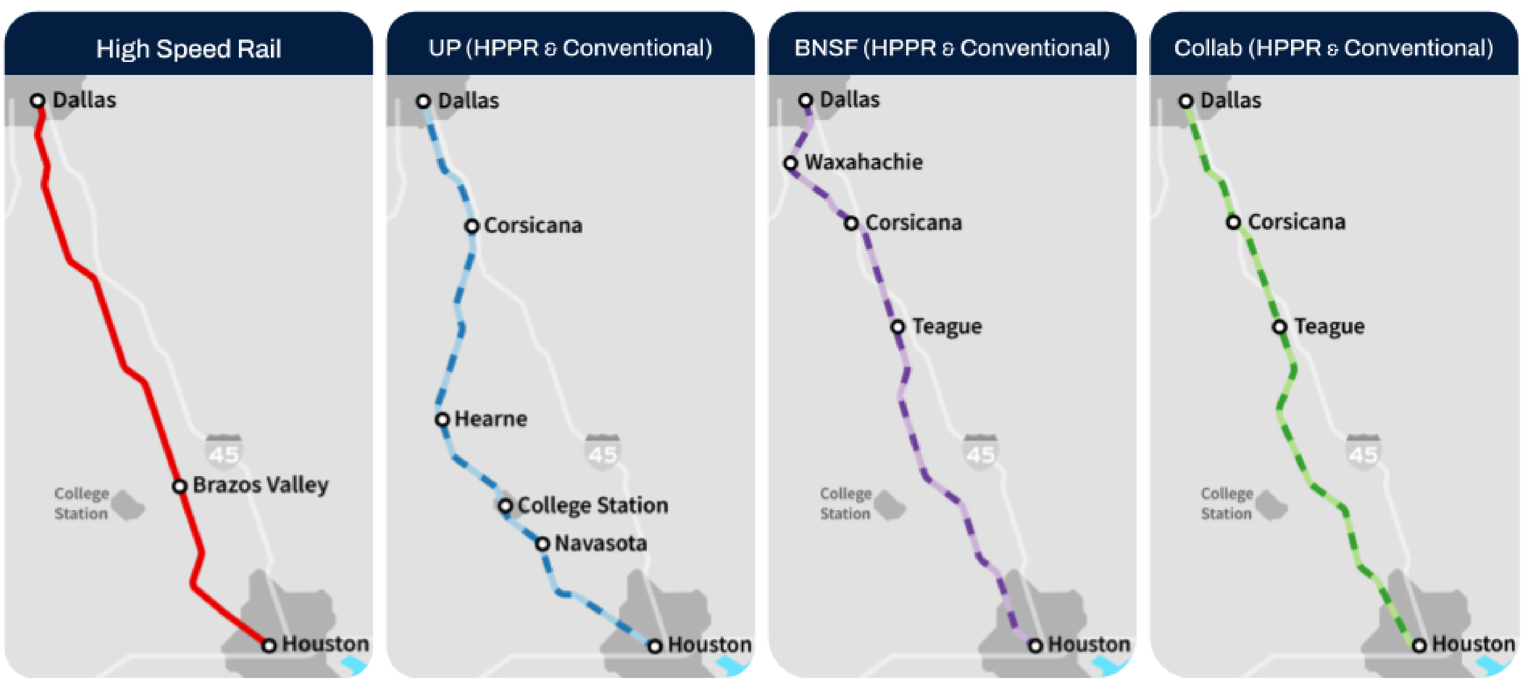


Figure 2-5: Rail alignments considered

Conventional Passenger Rail

We also evaluated three proposals for conventional passenger rail. Conventional passenger rail alternatives would have maximum operating speeds between 55 and 80 mph (88-127 km/h).

- The fifth proposal, which has already been put forward by Amtrak and TxDOT via their 2023 Corridor ID grant application, and uses the Amtrak Connects US plan for alignment and service details, considers a conventional rail line on the UP corridor.
- The sixth proposal examines establishing a conventional rail line on the BNSF corridor.
- The seventh examines establishing a conventional rail line on the tracks of both freight companies (UP and BNSF). The line would run on BNSF tracks from Houston to Corsicana, where they would switch to UP tracks until they reached Dallas.

Figure 2-5 shows the proposal alignments for each of the three types of rail. Note that this report does not seek to prescribe station locations, but rather to highlight the most relevant towns on the corridors. There is an exception: the two existing proposals that have outlined their proposed stops (HSR with three stations proposed by Texas Central and Conventional Rail on the UP tracks with six stations proposed by TxDOT/Amtrak).

2.2 BRIEF SUMMARY OF PROPOSAL ALTERNATIVES

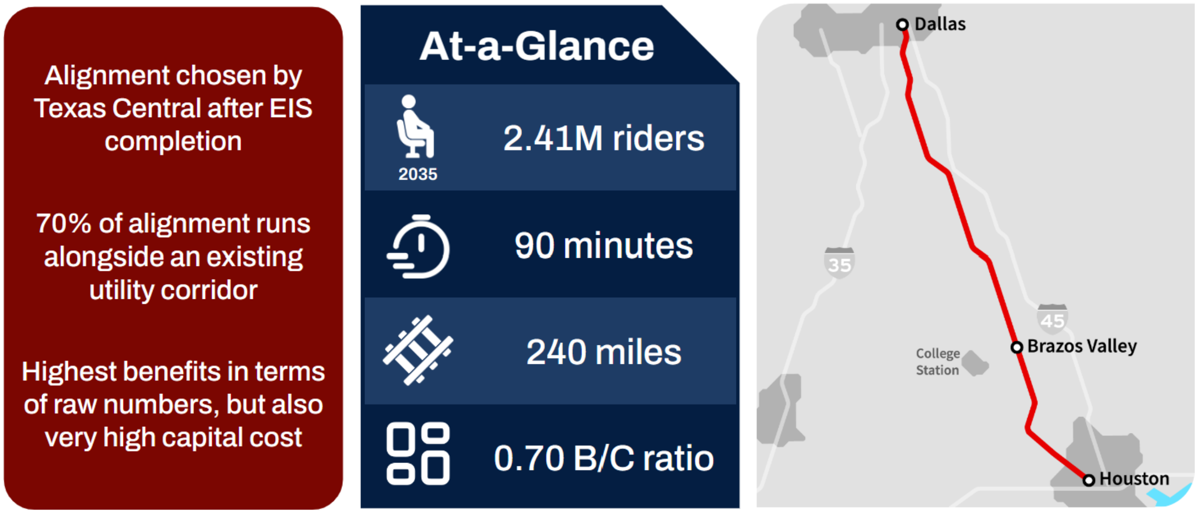


Figure 2-6: Utility corridor with HSR facts

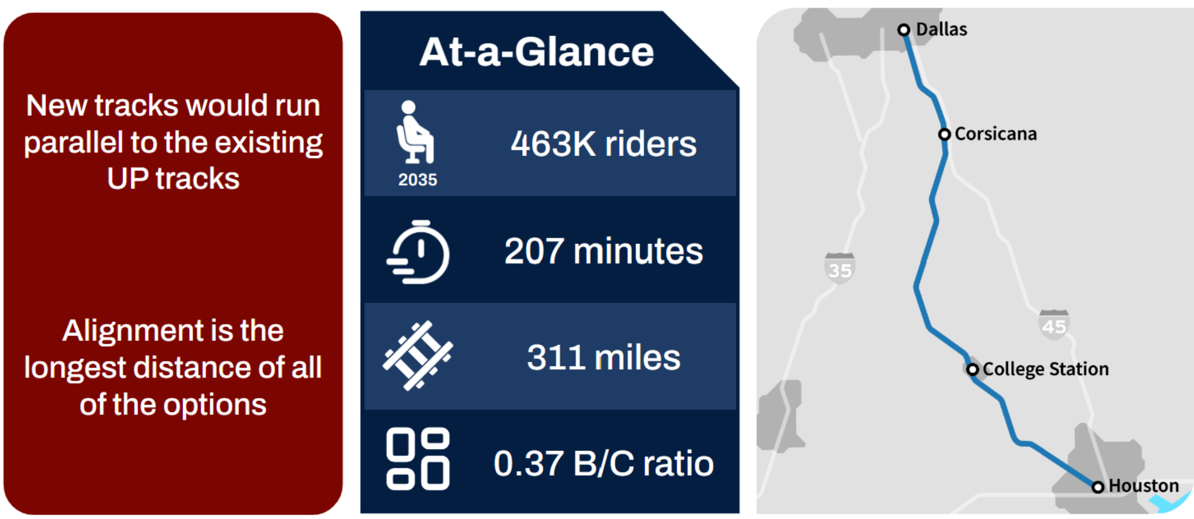


Figure 2-7: UP corridor with HPPR facts

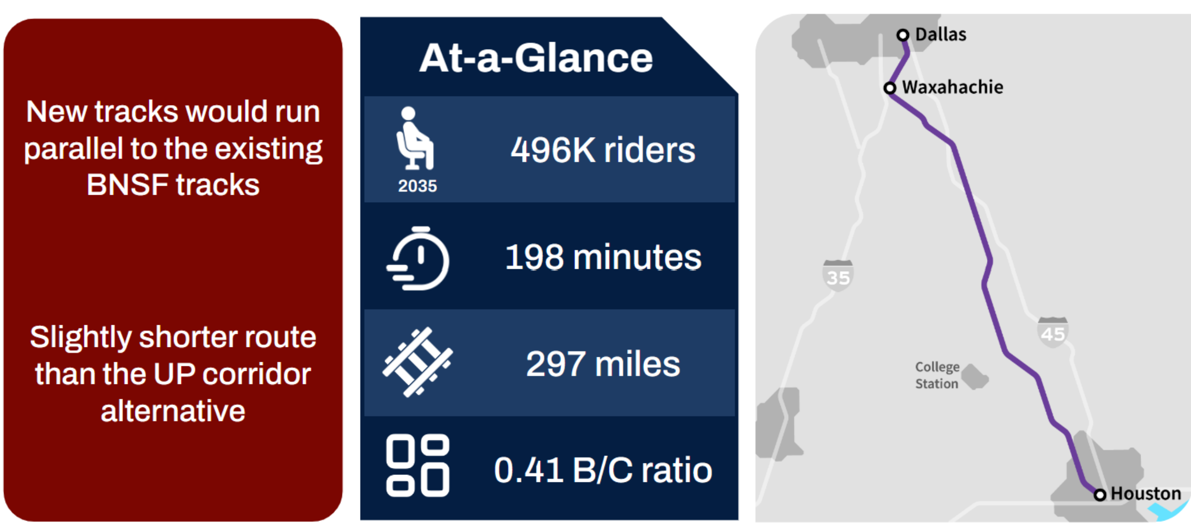
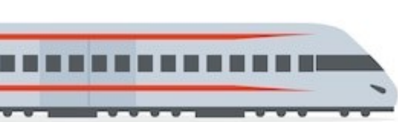


Figure 2-8: BNSF corridor with HPPR facts



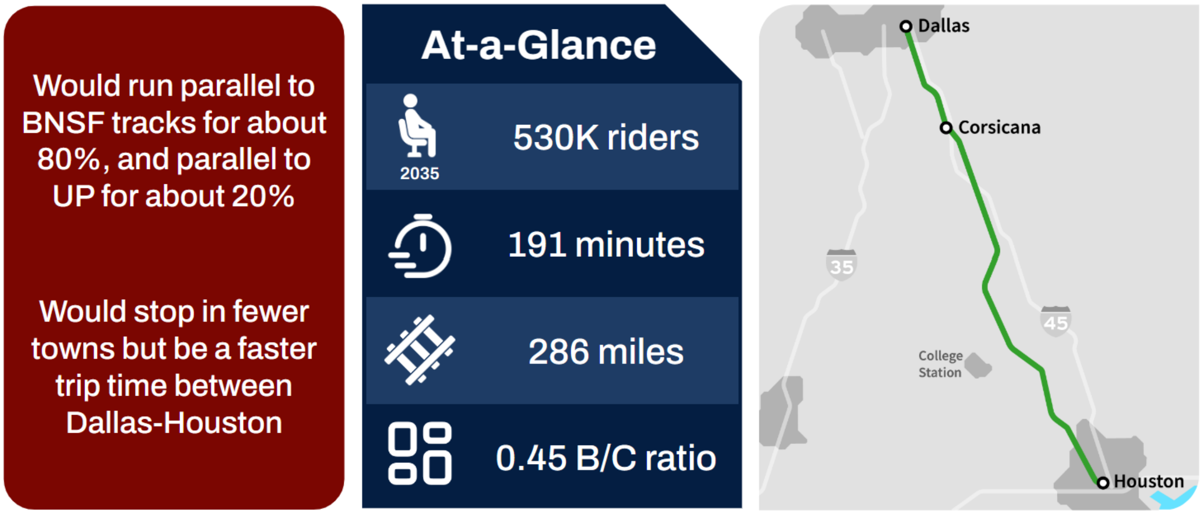


Figure 2-9: Collaborative corridor with HSR facts

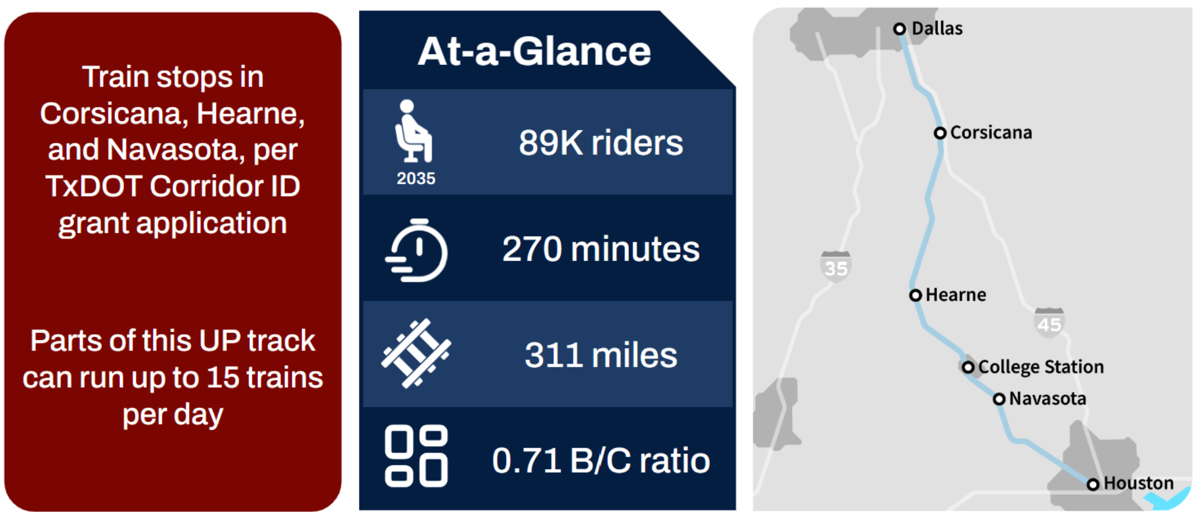


Figure 2-10: UP corridor with conventional rail facts

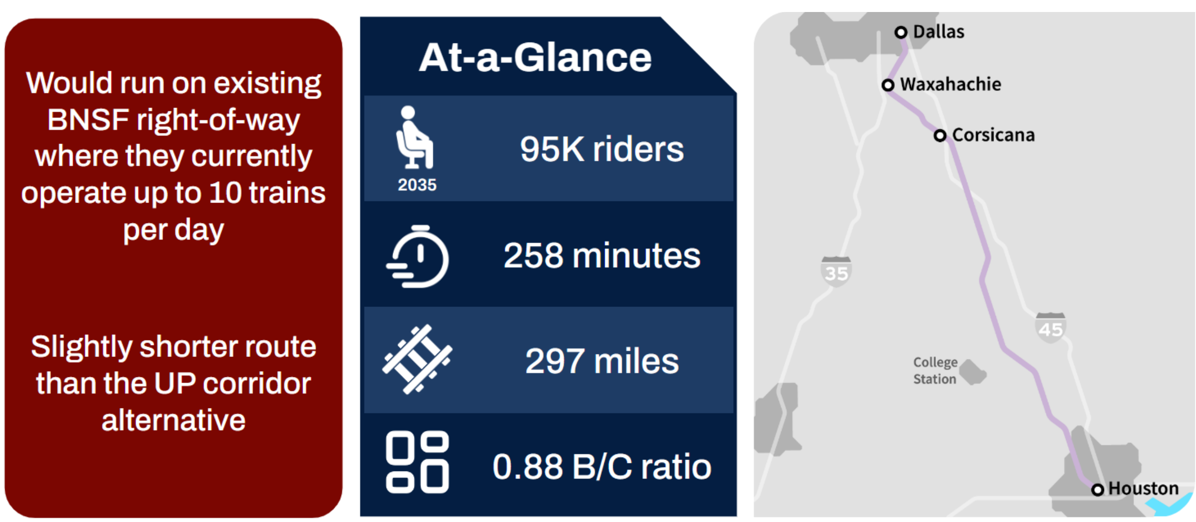
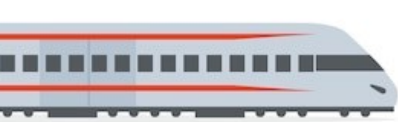


Figure 2-11: BNSF corridor with conventional rail facts



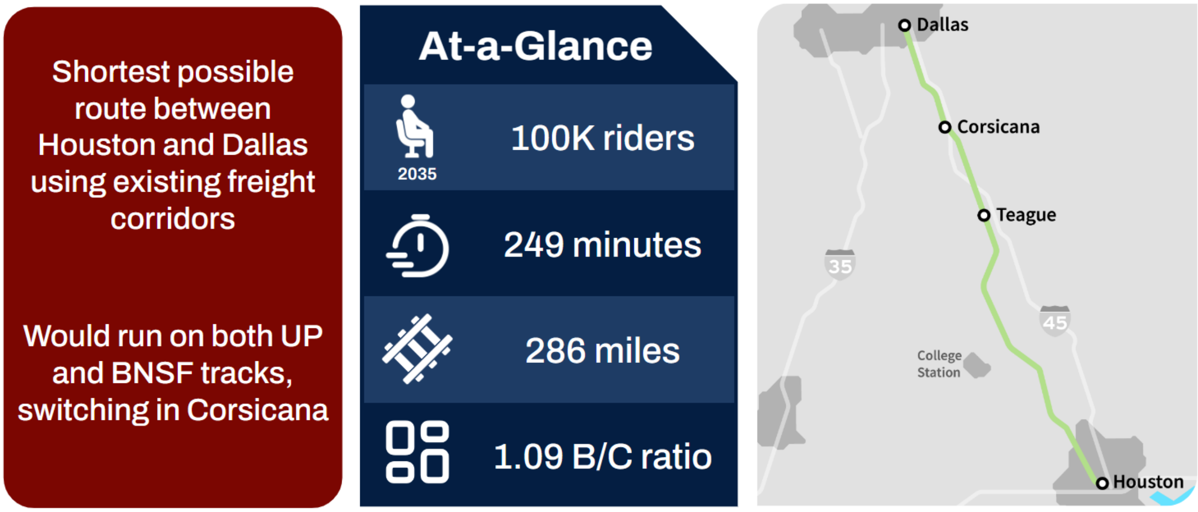


Figure 2-12: Collaborative corridor with conventional rail facts

2.3 COSTING

The team considered the capital costs for each rail alternative using the Federal Railroad Administration's Standard Cost Categories for Capital Projects (SCC) worksheet. This worksheet carries the standard costs by category and itemizes and aggregates the components according to the level of design, type of infrastructure, and activity and location. Costing for items not included in the SCC was considered using available resources from government agencies or comparable projects, allowing for the production of a preliminary cost sheet as shown in the Preliminary Capital Costing Table (Appendix A). The costs in the table were not used in the final BCA but were used to verify the costing methodology ultimately adopted. Through consultation with transportation professionals, the table was determined to not be specific enough due to the lack of any preliminary design for many of the alignments.

Thus, the costs that were used to perform the final BCA were established using a per-mile cost basis, shown in Table 2-3. These cost bases were determined using the most comparable examples in the United States. For the HSR proposal, we used costing estimates from California High Speed Rail per mile estimates, adjusted to 2022 dollars. The HPPR cost per mile was based on the total cost estimate for Brightline West, which has been estimated at $12 billion dollars. In addition to this cost basis for HPPR, we have also added right-of-way acquisition estimates from our Preliminary Capital Costing Table since Brightline West would mostly be built in the highway median whereas the HPPR proposals here would be built parallel to existing freight lines and have to acquire the right-of-way. The Conventional Rail cost per mile was based on TxDOT's Corridor ID Grant Application which stated that the estimated capital cost for re-establishing conventional rail on the UP corridor would be about $1.3 billion. These were all considered to be the most conservative estimates so we have used them here.

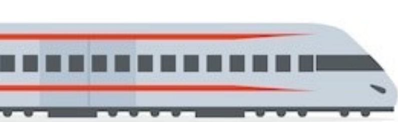


Table 2-3: Per mile cost basis for each project considered. (Source- HSR: California High Speed Rail 2024; HPPR: News 3, 2024;Converntional Rail: TxDOT 2022).

Mode Type	Cost Basis Per Mile
High-Speed Rail	$156.3M
High Performance Passenger Rail	$61.8M
Conventional Rail	$4.8M

2.4 BENEFITS

This study used guidelines set forth in the 2024 USDOT Benefit-Cost Analysis (BCA) Guidance to monetize benefits. In a BCA, only direct benefits to a project can be monetized, though unquantifiable benefits can still be described. Direct benefits are those that are (a) tangible, (b) have a causal relationship with the project, and (c) are not extrapolative to the point of speculation. While there are many indirect benefits, like wider economic impact, that such passenger rail projects will certainly have, their quantification is too speculative for a BCA following official guidance. Still, the qualitative argument is compelling and will be described in more detail in a forthcoming section.

The analysis period for this BCA was 30 years, which is a reasonable period for large rail infrastructure projects. The assumed opening date for all of the evaluated options was 2035, which means that the 30 year analysis period was from 2035 to 2065.

The direct benefits that were considered in this BCA are outlined in Figure 2-13. The benefits and how they were calculated are described in more detail in the following subsections.

Figure 2-13: Direct benefits considered in this BCA analysis for each option

2.4.1 TRAVEL TIME SAVINGS

Travel time savings refer to the reduction in time spent traveling due to the building of a project, which translates into economic value as people and goods move more efficiently. These savings are quantified by estimating the time saved and valuing it at their economic rates, per official BCA Guidance. This BCA considered different values for different modes, where commercial (freight) and high-speed travel (airplane) were valued higher than personal vehicle travel. Monetizations for these travel types are outlined in the BCA guidance.

There are two sides to travel time savings that were considered. Firstly, for the vehicles and trucks that remain on IH-45 even after the project is built, their time travel savings were calculated because it is assumed that their travel time on the highway would benefit from fewer vehicles on the road due to some vehicle users shifting to rail travel. Secondly, the travel time savings for those that permanently shift from vehicles and airplanes to rail were considered. Shift from airplane users was considered only in the HSR scenario because it was assumed that airplane users would only mode shift to an option that was time-competitive with air. The benefit was calculated by taking the difference between estimated vehicle hours traveled (VHT) between the no build and the build scenarios of each proposal.

Table 2-4: Travel time savings for studied projects

Project	Travel Time Savings
High-Speed Rail	$7.9B
HPPR - UP	$1.6B
HPPR - BNSF	$1.9B
HPPR - Collaborative	$2.2B
Conventional - UP	$288M
Conventional - BNSF	$430M
Conventional - Collaborative	$602M

2.4.2 REDUCTION IN CRASHES

The reduction in crashes refers to the expected decrease in accidents that will occur in each of the build scenarios and assesses the financial savings from this. Per official BCA guidance, there are monetizable benefits associated with crashes at different severities using the KABCO classification scale. In Texas, the levels of injury, from most to least severe, are as follows: (1) Killed; (2) Incapacitating Injury; (3) Non-incapacitating Injury; (4) Possible Injury; (5) Not Injured; and (6) Unknown.

This BCA pulled crash statistics on IH-45 from TxDOT's Crash Records Information System (CRIS), which provides detailed crash information along Texas roadways. This BCA extracted crash statistics by severity for each of the last five years (2019-2023) to obtain a good sample size for an annual average crash rate by severity on IH-45. From here, the crash rate was adjusted (lowered) in two ways in order to better reflect crashes that could more reasonably be attributed to vehicles traveling between the two major cities. Firstly, the annual crash rate was adjusted for segment length, as we're only considering crashes on IH-45 from Houston's city center to Dallas's city center. Secondly, the annual crash rate was adjusted for the relative proportionality of AADT (annual average daily traffic) on IH-45 to more reasonably reflect the proportion of trips that are happening in between the two major cities—not trips that are irrelevant to intercity travel (for instance, trips on IH-45 between the suburbs and the city). This calculation was done by taking the proportion of average AADT on IH-45 between Huntsville and Corsicana (more representative of trips between Dallas and Houston on IH-45) over the average AADT on IH-45 between Dallas and Houston. AADT was pulled from TxDOT's Statewide Traffic Counts dataset using 2022 figures.

Table 2-5: Reduced crash cost savings for all proposals

Project	Reduced Crash Cost Savings
High-Speed Rail	$8.2B
HPPR - UP	$2.1B
HPPR - BNSF	$2.3B
HPPR - Collaborative	$2.4B
Conventional - UP	$423M
Conventional - BNSF	$450M
Conventional - Collaborative	$477M

2.4.3 RESIDUAL VALUE

The residual value refers to the estimated value of the physical asset following full depreciation. In this BCA, the useful life for all of the evaluated projects was assumed to be 100 years. Major infrastructure projects like rail are expected to have very long useful lives and, assuming proper maintenance, a useful life of 100 years is a reasonable assumption.

Table 2-6: Residual value for all proposals

Project	Residual Value
High-Speed Rail	$6.4B
HPPR - UP	$3.2B
HPPR - BNSF	$3.1B
HPPR - Collaborative	$3.0B
Conventional - UP	$231M
Conventional - BNSF	$220M
Conventional - Collaborative	$213M

2.4.4 OPERATING COSTS SAVINGS

Operating cost savings refers to the reduction in expenses for vehicle owners resulting from improvements to the infrastructure, in this case, the building of a new rail project. Operating costs can refer to a variety of elements including gasoline, repair and maintenance, tires, depreciation. However, this does not include fixed costs like insurance, license, registration, taxes, etc., per official guidance. Monetizations for the operating costs of light duty vehicles on a per mile basis is outlined in the BCA guidance.

The calculations include the operating cost savings for those drivers who permanently shift from driving a personal vehicle to an all-together mode-shift. That impact is significant and is calculated by taking the difference between estimated vehicle miles traveled (VMT) between the no build and the build scenarios of each proposal.

Table 2-7: Operating cost savings for all proposals

Project	Operating Cost Savings
High-Speed Rail	$4.0B
HPPR - UP	$1.0B
HPPR - BNSF	$1.1B
HPPR - Collaborative	$1.1B
Conventional - UP	$195M
Conventional - BNSF	$209M
Conventional - Collaborative	$221M

2.4.5 REDUCED EMISSIONS DAMAGE

The reduction in emissions damage quantified the environmental and health benefits of decreased air pollution due to the building of a project. The official guidance helps monetize the benefits of four specific pollutants, which include carbon dioxide, nitrogen oxides, particulate matter 2.5, and sulfur oxides. While recent research indicates the negative impacts from tire debris, this is not yet accounted for using the most up-to-date BCA guidance.

The BCA included two sides of emissions damage. Firstly, for the vehicles and trucks that remain on IH 45 even after the project is built, their emissions damage savings were calculated because it is assumed that they will be spending less time in traffic on the highway due to fewer vehicles on the road as some vehicle users would shift to rail travel. Secondly, the reduction in emissions damage was calculated for those that would permanently shift from vehicles and airplanes to rail. Shift from airplane users was considered only in the HSR scenario because it was assumed that airplane users would only mode shift to an option that was time-competitive with air. For vehicles on IH-45, the benefit was calculated by taking the difference of average speed between the no build and the build scenarios of each proposal.

Table 2-8: Reduced emissions damage for all proposals

Project	Reduced Emissions Damage
High-Speed Rail	$591M
HPPR - UP	$166M
HPPR - BNSF	$168M
HPPR - Collaborative	$168M
Conventional - UP	$34M
Conventional - BNSF	$28M
Conventional - Collaborative	$30M

2.5 OTHER BCA CONSIDERATIONS

The team made a number of assumptions in order to calculate many of the benefits. These include assumptions about ridership, existing VMT and VHT from vehicles traveling between Dallas and Houston, mode shift, and induced demand and the ramp-up effect. In addition, all costs and benefits had a discount rate applied to them, per official guidance. These are all outlined in the following subsections.

2.5.1 RIDERSHIP ESTIMATION

Since we did not have access to a complex model, we relied on existing sources on travel of people and vehicles between Houston and Dallas. The weighted average of three different sources for travel between Houston and Dallas was considered: Amtrak (from their 2021 Connect US Plan), TxDOT (from their 2011 Planning Documentation), and Texas Central (from their 2029 estimate of ridership in the EIS [USDOT 2020]). Each sources' date of estimate was scaled up to 2035 and 2065 using future population growth rate estimates in the two metros from the Texas Demographic Center's 2060 0.5 migration scenario (TXCIP 2022), which is intended for long-range planning uses. Then, each of the sources was weighted: Amtrak (0.6), TxDOT (0.3), and Texas Central (0.1). These weights are based on the source's proximity to the year of our analysis (2024), potential bias, and if the source was projecting out as was Texas Central. If the source was referring to vehicle trips, then their vehicle trips were multiplied by the average vehicle occupancy for all travel purposes, per BCA guidance, to get the total number of people. A mode shift from vehicle percent was applied to the final estimate to arrive at final ridership numbers. The vehicle mode shift percent was based on an existing study of the Northeast Corridor Intercity Rail Travel Study from 2015. While not perfect, mode shift percentages were applied to the seven proposals here based on this study, adjusting the percentage slightly to correspond to the type of mode.

The team also considered airplane travel between Houston and Dallas in ridership estimates. Numbers of passengers that flew between the cities in 2022 were used, pulled from the Federal Aviation Administration (FAA). Mode shift from airplane was only considered for the HSR option, where it was assumed people would only shift to rail if it was time-competitive with air. Mode shift was based on TxDOT's High-Speed Rail Study (2015).

2.5.2 INDUCED DEMAND AND RAMP-UP EFFECT

This BCA also took into account the effects of induced demand and the ramp-up effect for ridership estimates. Induced demand refers to ridership from passengers that would not have otherwise made the trip (ridership generated from improved level of service). The ramp-up effect describes the period after the project's completion during which usage gradually increases as the public becomes aware of and adjusts to the new infrastructure. The rates were adjusted based on the different proposal types set forth in our study. Induced demand rates were derived from Zhang et al. (2019). The benefits study used the High Desert Corridor Ridership Forecast Study (2017) to come up with appropriate ramp-up effect rates.

2.5.3 DISCOUNT RATE

Per 2024 USDOT BCA Guidance, all costs and benefits should be appropriately discounted. Discounting is the principle that benefits and costs that occur sooner in time are more highly valued than those that occur in the future. The discount rate for all costs and benefits is at a rate of 3.1%, with the exception of carbon dioxide, which is discounted at a rate of 2.0%.

2.6 INDIRECT BENEFITS

While the BCA can only measure the most direct benefits of a project, there are many identifiable indirect benefits that can only be described qualitatively. HSR would score most highly over the other options in terms of these indirect benefits, due to its efficiency and capacity. These indirect benefits include the economic agglomeration that would take place between the two megaregions, the ensuing labor market integration, HSR's ability to future-proof for population growth, the ease of travel and comfort, and its use as an evacuation route. As seen in Figure 2-14, the evacuation from Houston before Hurricane Rita in 2005, evacuation from hurricanes has proven to be an extreme stress on the roadway system's capacity.

Figure 2-14: Traffic during evacuations caused by Hurricane Rita (Source: Creative Commons)

2.7 BCA RESULTS

The BCA conducted for the Dallas to Houston intercity rail project has yielded significant findings that highlight the raw advantages of the HSR option over other alternatives. Table 5-9 summarizes the key results of the BCA, focusing on ridership estimates, projected benefits, costs, and benefit-cost ratios (BCRs) for each of the seven proposals evaluated.

Table 2-9: BCA summary

	Ridership (2035 est. millions)	Benefits ($2022 millions)	Costs ($2022 millions)	Benefit-Cost Ratio
High Speed Rail	2.41	$ 26,250	$ 37,500	0.70
HPPR - UP	0.46	$ 7,104	$ 19,200	0.37
HPPR - BNSF	0.50	$ 7,544	$ 18,400	0.41
HPPR - Collaborative	0.53	$ 8,010	$ 17,800	0.45
Conventional - UP	0.09	$ 1,065	$ 1,500	0.71
Conventional - BNSF	0.10	$ 1,320	$ 1,500	0.88
Conventional - Collaborative	0.10	$ 1,526	$ 1,400	1.09

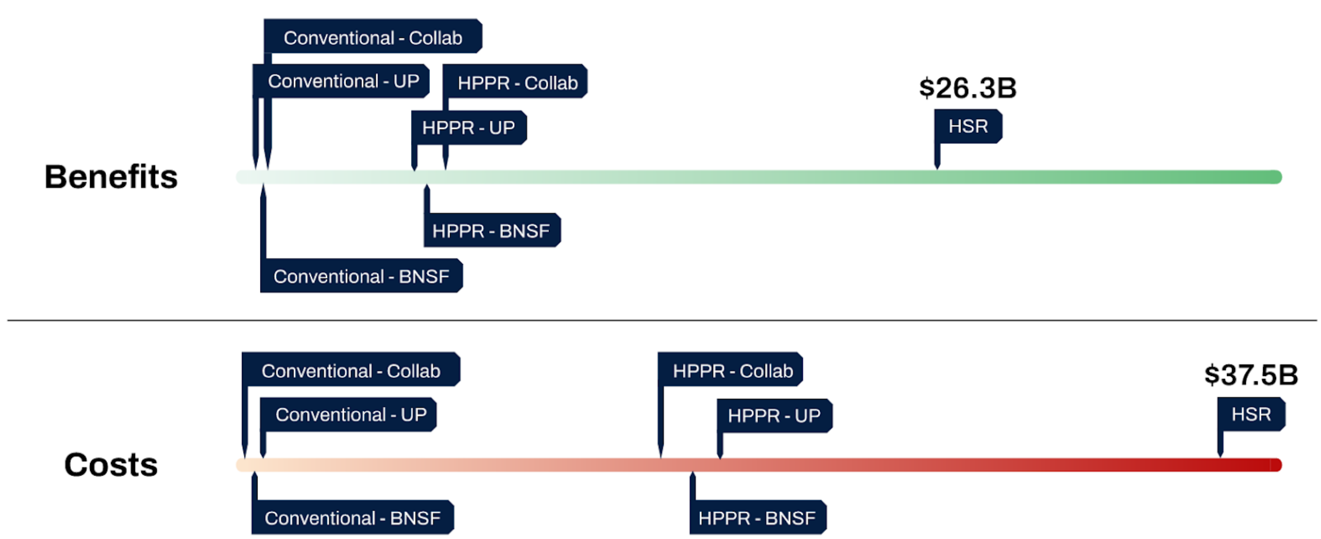
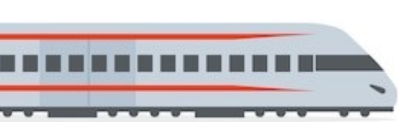


Figure 2-15: Scaled raw costs and benefits for each project type.



2.7.1 RIDERSHIP ESTIMATES

The HSR option, which uses the utility corridor proposed by Texas Central, demonstrates a substantial advantage in terms of ridership. The 2035 ridership estimate for the HSR alternative is 2.41 million, surpassing the estimates for conventional rail options by a factor of 24. Conventional rail ridership estimates range from 0.09 million to 0.10 million.

2.7.2 PROJECTED BENEFITS

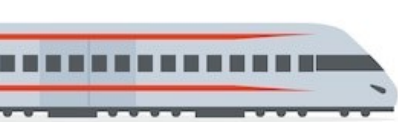
The HSR option is projected to generate $26,250 million in benefits by 2022, significantly outperforming the other alternatives. In comparison to HPPR options, the HSR benefits are approximately 3.5 times greater, with HPPR benefits ranging from $7,104 million to $8,010 million. When compared to conventional rail options, the HSR benefits are an impressive 25 times greater, as conventional rail benefits fall between $1,065 million and $1,526 million.

2.7.3 COSTS

The HSR option has the highest associated costs among the alternatives evaluated, amounting to $37,500 million. However, it is essential to consider these costs in the context of the substantial benefits offered by the HSR alternative. The cost of the HSR option is only twice that of HPPR options, which range from $17,800 million to $19,200 million. Conventional rail options have the lowest costs, ranging from $1,400 million to $1,500 million.

2.7.4 BENEFIT-COST RATIOS

The benefit-cost ratio (BCR) for the HSR option is 0.70, indicating that the projected benefits are 70% of the associated costs. While this BCR is lower than those of conventional rail options, which range from 0.71 to 1.09, it is important to consider the significantly higher ridership and benefits associated with the HSR alternative. The BCRs for HPPR options fall between 0.37 and 0.45, suggesting that the projected benefits are less than half of the associated costs for these alternatives.



3 FUNDING

With an understanding of the costs of such a project, processes and systems must be established in order to finance and construct it. The federal government has many infrastructure financing programs available, but the project first needs a governing body to accept, account for, and administer funds. Once this entity is established, the decisions as to which programs to participate in and which funding sources to apply for will be more straightforward. Considering the scale and expense of this project, our recommendation is that the governing body is established in a way that makes it eligible for both public funding and private investment.

3.1 FEDERAL FUNDING

The Bipartisan Infrastructure Law (BIL), also known as the Infrastructure Investment and Jobs Act, passed in 2021, approved what the White House calls “the largest investment in passenger rail since the creation of Amtrak” (The White House). The BIL allocated $66 billion through FY 2026 to rail projects throughout the U.S. (Figure 3-1). Approximately $8.25 billion is allocated for enhancements and safety improvements. Meanwhile, the remaining $58 billion is reserved for intercity passenger rail projects and Amtrak operations.

The funding most relevant to this project is the Federal-State Partnership for Intercity Passenger Rail program. This funds capital projects that repair railways, improve performance and expand or establish new intercity passenger rail services. This includes privately operated intercity passenger rail service if the applicant is an eligible entity. Eligible applicants include individuals or groups of states, public agencies or authorities established by a state, a political subdivision of a state, Amtrak, or any combination of these entities. The BIL also established the Corridor Identification Program (CID) which grants up to $500,000 for researching potential rail corridors. The Dallas to Houston corridor was awarded in December 2023 with Amtrak and TxDOT as the recipients who will conduct the study.

There is also always the possibility of future legislation that makes more funds available under the Federal-State Partnership for Intercity Passenger Rail program, as well as dedicated high-speed rail legislation and appropriations. Lawmakers continue to illustrate their interest in allocating resources to ramping up high-speed rail in the U.S. as well as bolstering passenger rail in general.

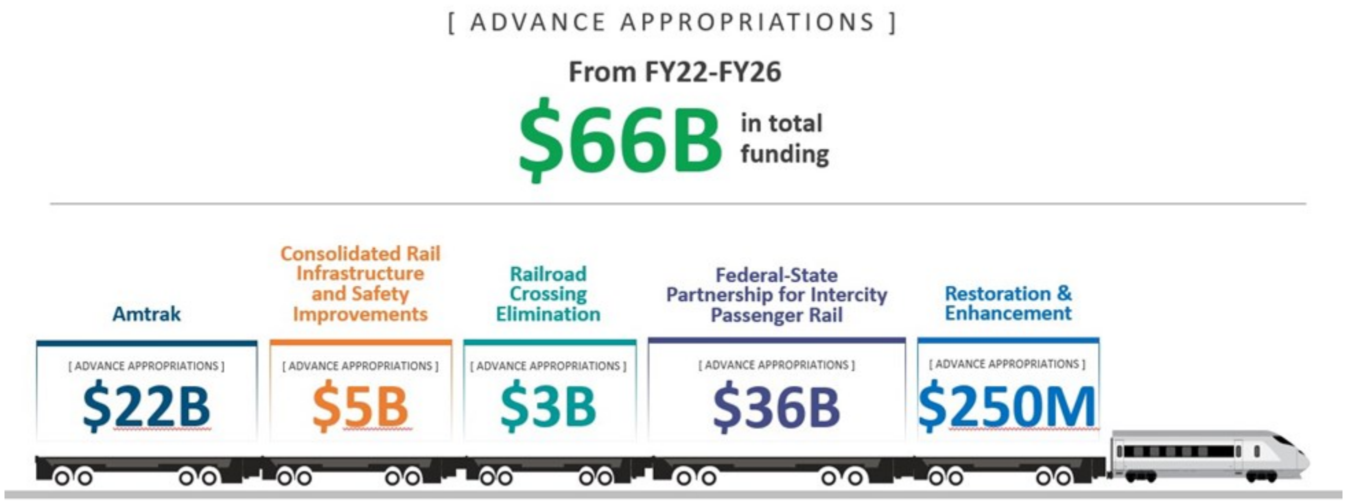


Figure 3-1: Bipartisan Infrastructure Law FRA funding.

Source: Bipartisan Infrastructure Law Information From FRA, 2021

In March 2024, the American High-Speed Rail Act was introduced in Congress; the bill does not yet have bipartisan support, nor has it been assigned to any committees. However, as interest in high-speed rail gains momentum in the U.S. and more projects are completed (for example, Brightline), Congress may see the value in investing in intercity passenger rail infrastructure.

Finally, as more legislation comes into the fold via clean energy and green jobs policies, we might also expect funding that could be allocated towards rail projects. Since rail is considered a greener mode of transportation – especially compared to airplanes – it could be reasonable to anticipate funding for capital projects that enhance or expand rail infrastructure. Additionally, as legislation related to green jobs is introduced at the federal and state levels (for example, the Inflation Reduction Act of 2022, which is projected to create more than 9 million climate and clean energy-related jobs in the next ten years), there is also reason to anticipate passenger rail projects will access these funds in order to design and build rail infrastructure and produce more “green collar” jobs in the process.

3.2 INNOVATIVE FINANCING TOOLS

The federal government offers several programs that lower the cost of borrowing for large-scale infrastructure projects. Eligible recipients are those who would also be eligible for FRA assistance, as mentioned previously. Intercity rail projects are considered to be of regional and national significance, which makes this pursuit eligible for federal financing.

3.2.1 TRANSPORTATION INFRASTRUCTURE FINANCE AND INNOVATION ACT (TIFIA LOANS)

TIFIA loans are available as low-cost financing for surface transportation projects of regional or national significance. The act was first authorized in 2005 and makes borrowing less expensive through direct loans, loan guarantees, and lines of credit for large-scale infrastructure projects. The TIFIA program also offers flexible amortization (up to 75 years for some projects, thanks to the BIL) and is available to projects led by creditworthy public and private entities.

3.2.2 RAILROAD REHABILITATION AND IMPROVEMENT FINANCING (RRIF)

RRIF offers direct loans or loan guarantees to public or private owners and operators of railroads. The program was established in 1998 under the Transportation Equity Act for the 21st Century and amended by three subsequent transportation bills, the most recent in 2015. Financing can be used to acquire, improve, or rehabilitate rail infrastructure, develop or establish new facilities, reimburse planning and design projects, refinance existing debt, and finance TODs. RRIF also carries a $35 billion lending capacity.

3.2.3 STATE INFRASTRUCTURE BANKS (SIB)

State Infrastructure Banks are rotating loans to local governments that are administered by state governments and capitalized by federal loans or grants as well as state funds. SIBs can offer loans and credit assistance to sponsors of Title 49 (subtitle V) railroad projects and help attract additional investment from private entities.

3.2.4 SECTION 129 LOANS

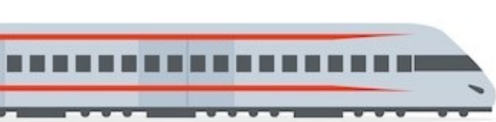
Section 129 loans are similar to State Infrastructure Banks, as they allow states to leverage federal assistance for local transportation projects that have a dedicated revenue stream. Once the loan is repaid, the state must recycle the funds into other projects.

3.2.5 GRANT ANTICIPATION REVENUE VEHICLES (GARVEES)

GARVEEs allow local and state governments to repay loans for transportation projects with federal grants. This debt instrument is helpful in opening up new capital markets, as well as allowing governments to diversify their debt portfolio and repayment streams. GARVEEs also allow projects to accelerate design and build timelines, as they offer upfront financing for long -term, expensive projects.

3.3 STATE & LOCAL FUNDS

State and local funding mechanisms are commonly used to finance large-scale infrastructure projects. Statewide and municipal bonds are very common and come in the form of general obligation (GO) bonds or revenue bonds. GO bonds are backed by the full faith and credit of the government, which includes its authority to levy taxes. GO bond repayment is often



generated by the project, such as revenues from tolls, airport fees, or utilities. States and municipalities can also levy additional use taxes and fees, such as sales tax on certain goods, the gasoline tax, carbon caps, and more that can contribute to infrastructure projects.

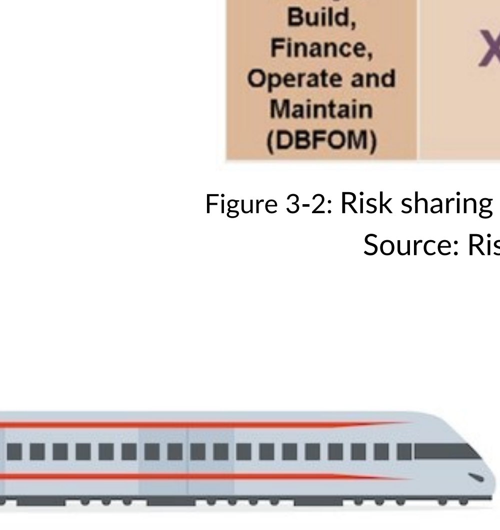
An example of state and local funding for rail projects is California High-Speed Rail. In 2008, California voters approved Proposition 1A, authorizing the state to levy $9.95 billion in general obligation bonds to build the infrastructure. California law required the CA High-Speed Rail Authority to supplement the project's funding with additional non-bond dollars. The state's carbon cap and trade program was utilized as matching funds, where 25% of the program's revenues are allocated to the HSR project. This infrastructure is also funded by federal grants (About California High-Speed Rail, n.d.).

3.4 PRIVATE FINANCING

Due to this project's potential substantial public benefit, private entities have access to the federal finance instruments. Public-Private Partnerships (P3s) benefit from lower capital costs, distributing risk, and greater flexibility in the private sector. Figure 3-2 illustrates that more involvement from the private sector reduces risk in the public sector.

P3 Structure	Design Risk	Constr. Risk	Financial Risk	O&M and Rehab Risk	Traffic Risk	Revenue Risk
Traditional Design-Bid-Build		X				
Design-Build (DB)	X	X				
Design-Build-Finance (DBF)	X	X	X			
Design, Build, Finance, Operate and Maintain (DBFOM)	X	X	X	X	Yes, if toll or traffic-based payment	Yes, if performance -based payment

Figure 3-2: Risk sharing between public and private sectors in large-scale infrastructure projects. Source: Risk Assessment for Public-Private Partnerships: A Primer, n.d.



3.4.1 PRIVATE ACTIVITY BONDS (PABS)

Also available to private firms working on projects for public benefit are PABs, which allow private entities to benefit from tax-exempt municipal bonds that are often repaid by revenue generated by the project. For example, the private equity behind Brightline accessed PABS to build its Florida line and they also received $2.5 Billion in PABs for the Brightline West project.

3.5 FINANCING AVENUES FOR PROPOSED ALTERNATIVES

Considering the alternatives presented in the previous section, this report will offer recommendations for financing the projects.

3.5.1 HIGH-SPEED RAIL FINANCING AVENUES

As noted, the high-speed rail infrastructure is newer technology and, therefore, more costly. This report is also informed by two different high-speed rail financing examples: the California High-Speed Rail project and Brightline. California's project is purely public funding, coming from bonds, fees, and federal grants. On the other hand, Brightline is funded by private equity. Because Brightline's projects offer substantial public benefit, they are eligible to receive private activity bonds and have also received $3 billion in federal funding from the BIL.

While California and Brightline offer two seemingly opposite models for financing high-speed rail projects, these approaches are not mutually exclusive. A "blended approach" to financing large-scale infrastructure projects should be considered, as there are many tools available, from direct assistance in the form of federal grants to financing instruments aimed at making borrowing less expensive and making a project more attractive to private investors. Such a large project requires creativity and resourcefulness to match.

3.5.2 CONVENTIONAL RAIL FINANCING AVENUES

In considering how a conventional rail project might be funded, the examples are more common and the funding straightforward. Funding for this project could also be "blended" and would mostly originate from federal grants, including the BIL's dedicated funding to Amtrak. Additional appropriations would come from the Department of Transportation as they are appropriated by Congress and the federal financial instruments available. To supplement this funding, the project might solicit subsidies from the State of Texas and local governments. As mentioned above, future legislation could also benefit this project.

The conventional rail alternative could also receive support from the private sector, though this would likely not be to the same degree as high-speed rail, considering the lower price tag, Amtrak involvement, as well as lower ridership estimates.

4 GOVERNANCE

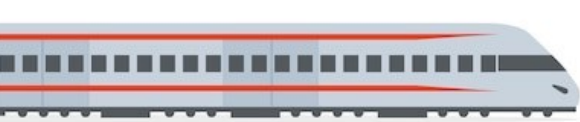
The governance structure of a passenger rail system is a critical factor in its planning, implementation, and overall success. As this project considers having a passenger rail link between Dallas and Houston, conventional or high-speed rail, it is imperative that we first examine the existing rail governance models to determine the most suitable approach for this project. Understanding the pros and cons of different governance structures can guide us to create an effective framework that ensures not only the system's efficient operation and financial sustainability but also consumer and community satisfaction. Two models exist that should be considered in the context of this project: the Integration Model and the Separation Model.

Under the Integration Model, a single entity undertakes unified operations and infrastructure development. This approach involves nationalized rail development and operations, as seen in countries like France, Switzerland, and the State of California. In contrast, the Separation Model divides responsibilities between separate entities. One entity receives funding and manages subsidiaries responsible for operations and development. Examples of this model can be found in Spain, Japan, and the United Kingdom. This model allows for specialized focus on each aspect of the rail system while maintaining government oversight and control.

4.1 CONVENTIONAL US PASSENGER RAIL GOVERNANCE

Figure 4-1 presents a generalized organized structure for conventional rail governance within the United States. At the highest level, oversight is provided by funding bodies such as the United States Department of Transportation (USDOT), Federal Railroad Administration (FRA), Federal Transit Administration (FTA), various investors, etc. Additionally, entities, including state and local transportation authorities like the Texas Department of Transportation (TxDOT), the Environmental Protection Agency (EPA), and the FRA, etc. provide regulatory oversight.

Subordinate to the oversight level are Amtrak, the national passenger rail service provider and major freight railroad corporations such as BNSF, Union Pacific, CSX, Norfolk Southern etc. These companies own and operate a significant portion of the rail infrastructure in the country. These entities are a mix of both managing body and acting divisions.



Under the purview of Amtrak and the freight railroads, there are several subdivisions under the Operations Division and the Development Division. Those divisions are:

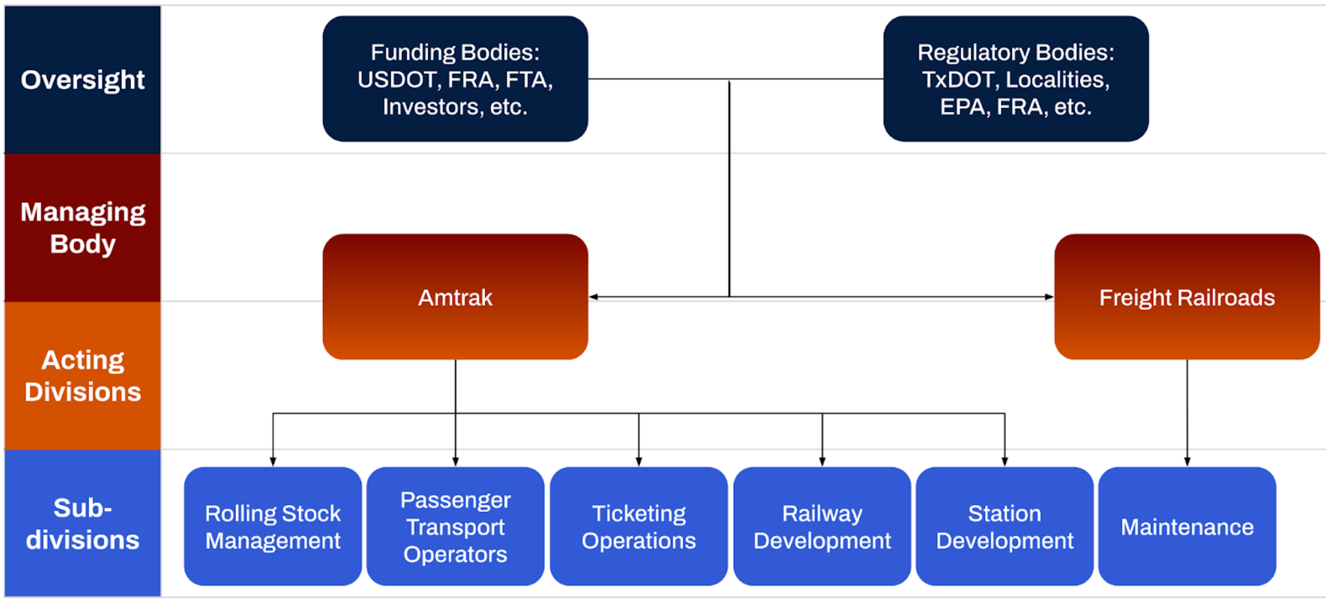


Figure 4-1: Current conventional rail model in the United States.

Operations

- Rolling Stock Management: Manages rail vehicles, associated equipment, and logistics
- Passenger Transport Operators: Provides service to passengers
- Ticketing Operations: Handles ticket sales, reservations, and marketing

Development

- Railway Development: Plans and constructs new rail lines and infrastructure
- Station Development: Plans and constructs rail stations
- Maintenance: Conducts repairs and maintenance on rail assets

In the current, Amtrak-centric model operational across the US, Amtrak has overseen rolling stock management, passenger transport operators, ticketing operations, railway development, and station development. Amtrak generally uses lines controlled by freight entities and in these locations, where freight companies own the infrastructure, they maintain these lines.

4.2 HIGH-SPEED RAIL GOVERNANCE

4.2.1 HIGH-SPEED RAIL GOVERNANCE IN SPAIN

Figure 4-2 illustrates Spain's Separation Model for HSR Governance. At the highest level, the Spanish Government provides oversight by maintaining funding mechanisms and regulatory standards for development. On the development side of the Managing Body, ADIF (Administrador de Infraestructuras Ferroviarias) serves as the state-owned company responsible for railway infrastructure development and is managed by the Spanish Ministry of Transport, Mobility, and the Urban Agenda. ADIF oversees railway and station development and maintains the tracks. On the operations side, Renfe, the state-owned passenger rail operator, manages the rolling stock, passenger transport, and ticketing.

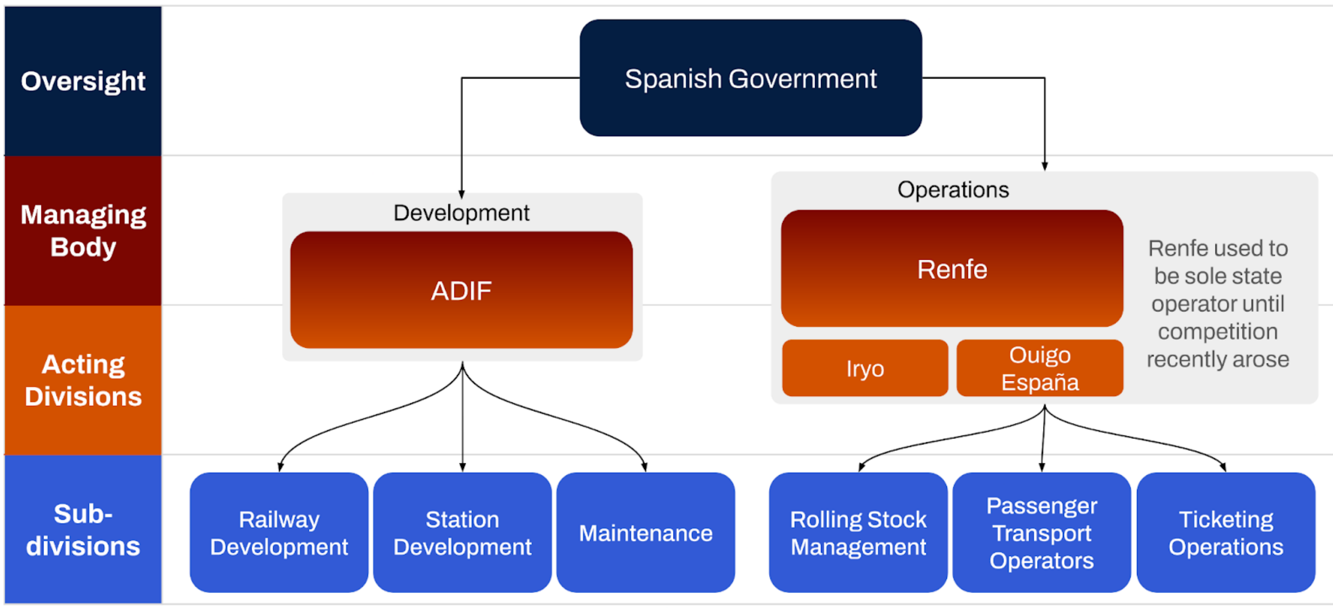
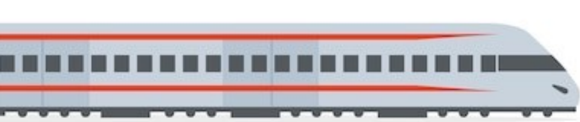


Figure 4-2: Spain's separation model for HSR governance

In Spain, Renfe held a monopoly on passenger rail operations in Spain until recently. However, due to European Union regulations promoting competition in the rail sector, the Spanish rail market has been opened to other operators, such as Ouigo and Iryo, which now compete with Renfe on certain routes.

4.2.2 HIGH-SPEED RAIL GOVERNANCE IN JAPAN

A process flow diagram representative of Japan's model for high-speed rail governance is shown in Figure 4-3. Under this structure, the Japanese Government serves as the primary entity for oversight. Further nuances arise between the prominence of the Japan Railway Construction, Transport, and Technology Agency (JRTT) and the Japanese Railways Group. JRTT develops the tracks and stations for passenger rail in Japan and additionally oversees two of the regional rail lines, Shikoku and Hokkaido. The Japanese Railways Group is a state-owned rail operator that oversees the majority of the passenger rail line operations in the country.



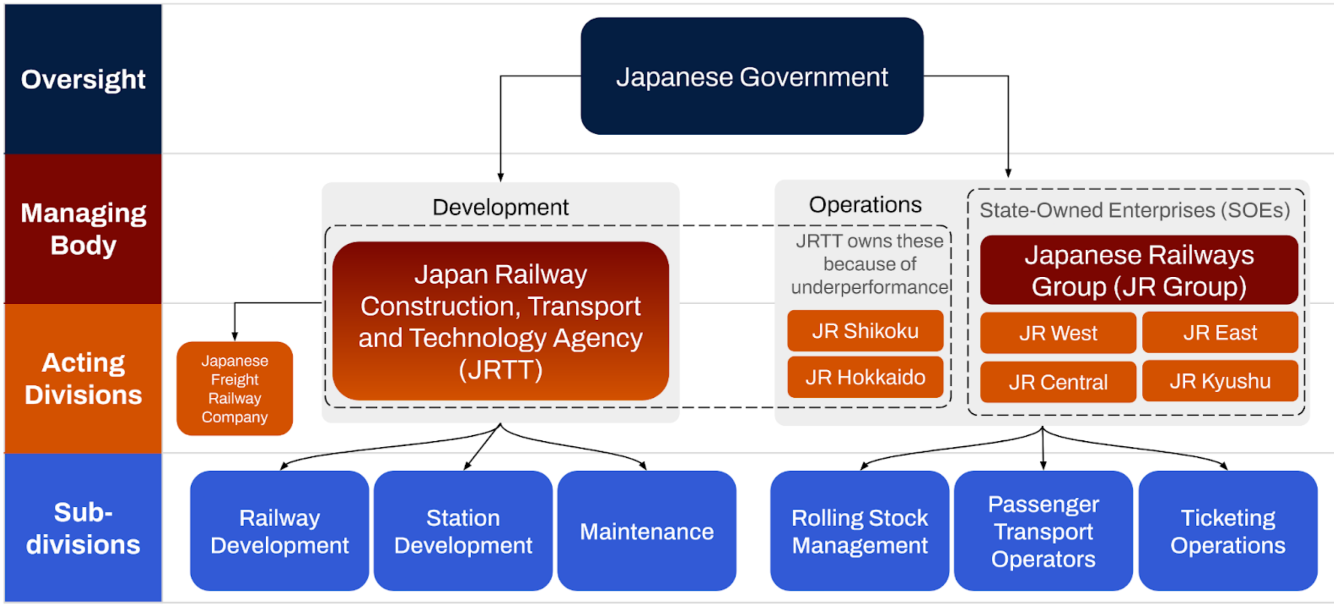


Figure 4-3: Japan's separation model for HSR governance

4.2.3 PROPOSED GOVERNANCE STRUCTURE

We propose that the governance structure for the implementation of enhanced rail in Texas be prioritized through the creation of a new entity, the Texas Railroad Authority (TRA). The TRA will seek and manage funding from wherever is available and will ensure compliance with federal, state, and local rules and standards. The TRA should be robust but not constricted by definition as to how it should achieve its goal: enhancing rail networks in Texas. The TRA should work with both freight and passenger rail and should be more adept at balancing each of these groups' needs to ensure proper service is delivered. Being a liaison between freight and passenger interests allows these groups to be co-beneficial. The TRA could help broker and maintain shared use agreements or oversee co-funding of expansion of rail projects, such as double-tracking or sharing right of way to enhance both forms of rail service. There are six easily definable requirements of the TRA. The TRA should:

- Plan and fund programs
- Adapt to changing demands and conditions
- Contract development and operations to subsidiaries
- Manage growth and public relations
- Be State-supported, regionally led

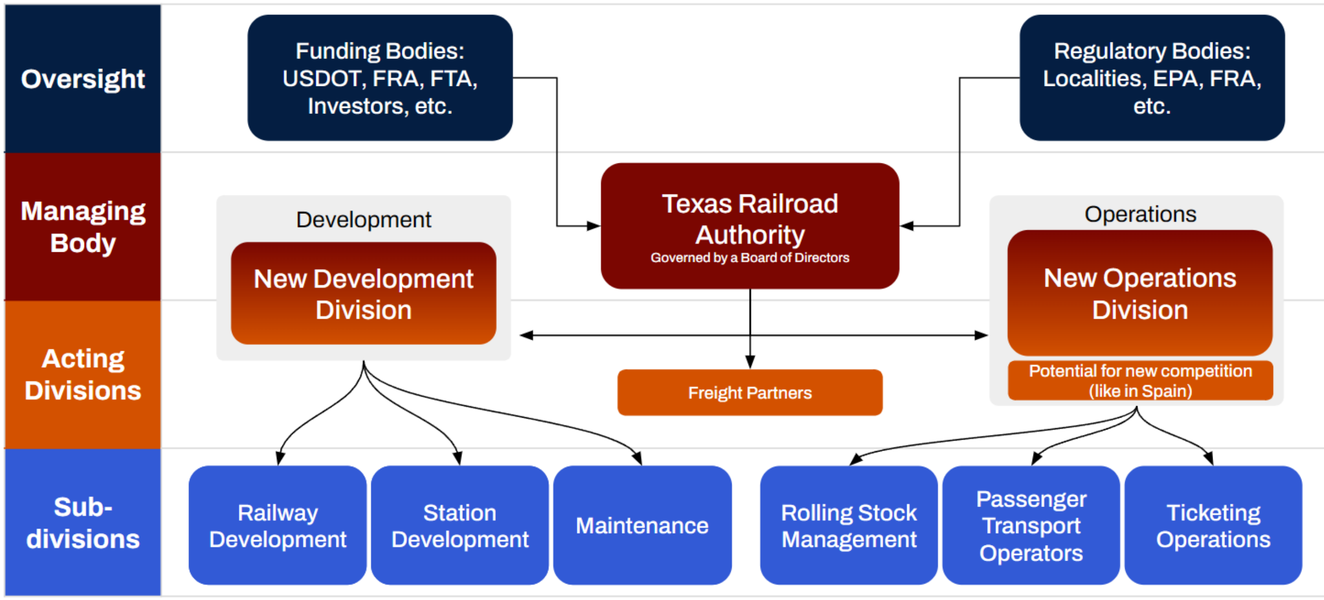


Figure 4-4: Proposed governance model for passenger and freight rail in Texas

The TRA must be adaptable. In ensuring flexibility in a constantly changing political, social, and environmental climate, the TRA should also be able to contract out services in its Development or Operations Sector as its directors see fit. Especially in the Operations Sector, there should be an opportunity for competitors to emerge. The presence of this opportunity will allow for an essential goal to be met: the development and operation of rail needs to be sensitive to the context in which it lies. The flexibility wrought from having an entity like the TRA allows such a body to partner and create as is befitting of the conditions wherever they are ripe.

4.2.3.1 Texas Railroad Authority Make-Up

The TRA should be overseen by a board of directors and advisors (the Board). This Board should be occupied by people from partner agencies throughout the state and on both the freight and passenger sides of the industry. These partners should help to maintain accountability between involved agencies and entities and should ensure that the developments occurring in rail are efficient and representative of market demands. Possible partner agencies include:

- Texas Department of Transportation (TxDOT)
- Freight Railroad Partners
- Amtrak
- Representatives from high-demand localities

These are just a few of the many interested parties, but the TRA would ultimately need to establish who is involved in governing the Entity and in what capacity. It is essential that the TRA has close ties with other related agencies.

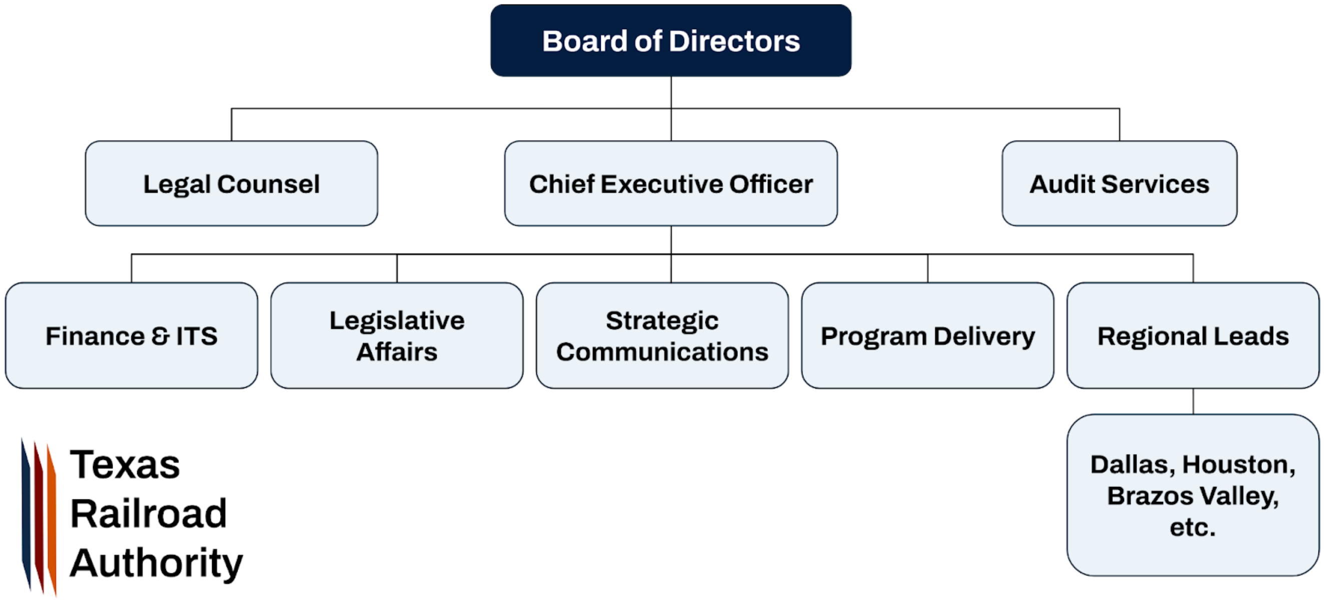


Figure 4-5: Proposed internal structure of the Texas Railroad Authority

The Board of Directors advises and oversees a Chief Executive Officer (CEO). To develop the structure of the TRA like a business is the most appropriate for the Texan environment, a strong voice encouraging free market politics. This structure also allows the TRA to maintain the necessary flexibility and adaptability. Through the advice of lawyers and financial auditors, the TRA would have the above-listed divisions to ensure effective internal accountability and tasking. One of the most key parts of this structure are the Regional Leads. To ensure that the development of rail is by Texans and for Texans, local voices who know community needs and preferences will need to be involved in development processes on top of other necessitated activities, such as the National Environmental Policy Act (NEPA).

Through the actions of a CEO at the behest of a comprehensive Board of Directors, the TRA should allocate its development and operations as it sees fit and be willing to change over time. A simplified model of the TRA's responsibilities is shown in Figure 4-6.

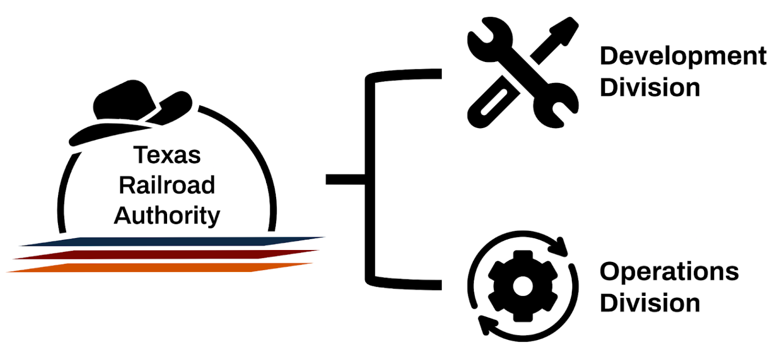
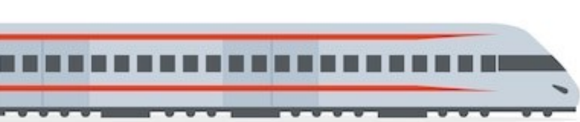


Figure 4-6: Simplified model for the Texas Railroad Authority



4.3 PREFERRED JOB QUALIFICATIONS

As the proposed governance model chart above outlines, there are numerous roles to fill within the overarching structure. Each of these roles and sub-roles would entail specific sets of tasks and responsibilities to fulfill as part of bringing inter-city passenger rail to fruition, managing said system, and assisting the TRA in accomplishing the tasks described in detail above. As such, there are a few qualifications that potential candidates for each position ought to possess in order to get the necessary tasks accomplished.

4.3.1 TEXAS RAILROAD AUTHORITY

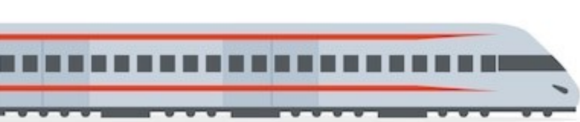
The TRA, as the Managing Body of the governance structure, ought to be able to maintain a holistic view of the entire process in order to guide the entire project. Ideally, this body should have a proven track record of forming and upholding relationships with various state and federal government agencies and would be able to process and make decisions regarding various types of funders and financing mechanisms. The candidate would also need to possess a thorough understanding of rail operations and development, as well as the ability to build relationships with Texans and develop an understanding of their desires, needs, and concerns in regard to passenger rail.

4.3.2 DEVELOPMENT DIVISION

Similarly, there are a few requirements that an ideal developer should be able to fulfill. The ideal candidate should have a proven track record of working with developmental processes, particularly NEPA, and as such, should be able to maintain a holistic understanding of impacts to and caused by passenger rail development, particularly in regard to equity, environmental, and economic impacts. The development division should also be able to adapt to unforeseen changes and obstacles and possess demonstrated experience in partnering with other entities to accomplish tasks.

4.3.3 OPERATIONS DIVISION

Likewise, there are a few requirements that an ideal operator would be able to fulfill. The ideal candidate should have demonstrated experience in rail route and service planning operations, as well as ticketing and fare services for rail. Safety is also of paramount importance, so the ideal candidate should also possess a clean safety record. This relates to both roadway and railway safety. In regards to the latter, this could be key to forming partnerships with freight companies in order to make the process of operating the system more efficient and perhaps even help bring the project into existence.

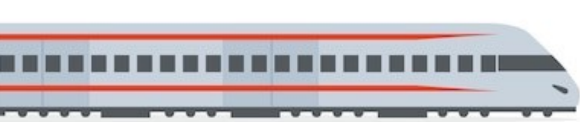


4.4 RECOMMENDATIONS FOR ORGANIZING

As highlighted throughout this report, it is imperative for policymakers to begin taking steps now toward future organizing and creating an appropriate and capable governance structure. Some of the immediate steps that ought to be taken include entering shared-use agreements, safety compacts, and network upgrades with freight companies, building bipartisan support in the Texas government, and building relationships with relevant stakeholders. With regards to building relationships, the focus here should be on forging relationships with local community leaders in order to ensure to them that this project would be for Texans and would benefit them. This is a necessary step in order to lay the foundations for any future project.

4.4.1 MAKING THE ARGUMENT AT A STATE LEVEL

Building a bipartisan support network for the foundation of a successful governance model is likely to be difficult, considering the partisan nature of rail politics. As such, there are numerous arguments that would need to be made in order to build bipartisan support at the state level. Arguments and facts centering on the economics of passenger rail and the economic benefits associated with it could be the most compelling for those on the fence about such projects. These arguments include pointing to results from other passenger rail systems that have resulted in strong business models, led to a large return on investment, created jobs, brought tourists, and granted access to jobs previously not available to different sectors of the workforce. Likewise, considering the state of freight transport in the United States, the ability of passenger rail to free room for 18-wheelers by taking some vehicles off the road could be quite compelling. And ultimately, shared-use tracks are not ideal for freight rail, so those on the fence may be inclined towards pursuing separate tracks for passenger and freight rail to maximize the benefits of each. Likewise, as we've highlighted so far, safety is of key importance to any potential project and should be focused on at a statewide level. Concerns over safety could be a great way to build necessary relationships with freight companies.



5 RECOMMENDATIONS

5.1 BUILD CAPACITY NOW

If passenger rail is going to be brought to fruition, immediate steps should be taken to build the capacity needed for the service to begin operating. This starts with purchasing land for future alignments and building relationships with freight companies along the corridor. Pursuing the highest-performing option (the collaborative UP and BNSF alignment between Dallas and Houston, as identified in our BCA analysis) would demonstrate that ridership is viable for service along this corridor to succeed. Likewise, coordination over the steps necessary to acquire federal funding for the project should begin immediately.

5.2 INCREMENTAL APPROACH

We recommend a step-by-step or incremental approach to building up passenger rail capacity and operations. Prioritizing conventional rail over HSR right now makes the most sense to get the project running, and the collaborative alignment (UP + BNSF) between Dallas and Houston should be targeted to enhance passenger rail use. Likewise, preliminary studies on the feasibility of cost-effectiveness should be undertaken, with cooperation from freight companies. Entering shared-use agreements with UP and BNSF is another immediate step that should be taken in order to get the project running.

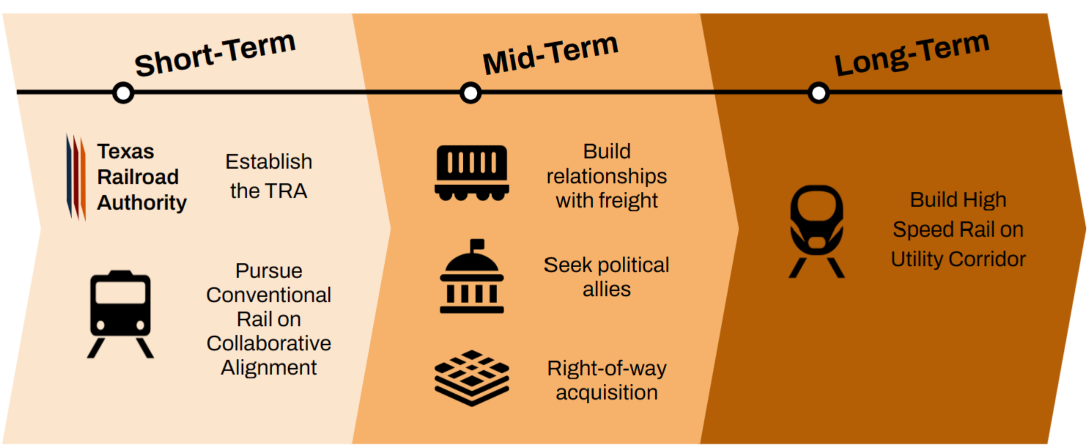
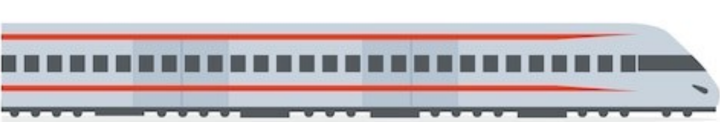


Figure 5-1: Phased development proposal



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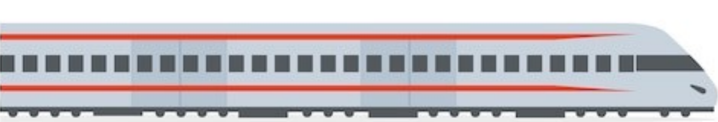

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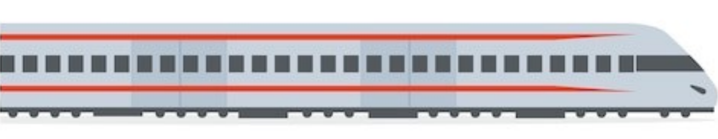

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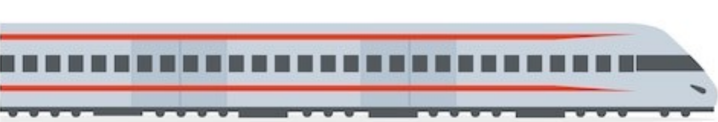


GLOSSARY

AADT Annual average daily traffic

ADIF Administrador de Infraestructuras Ferroviarias

BCA Benefit cost analysis

BNSF Burlington Northern Santa Fe

BIL The Bipartisan Infrastructure Law

CID Corridor Identification Program

CRIS Crash Records Information System

EIS Environmental Impact Statement

EPA Environmental Protection Agency

FAA Federal Aviation Administration

FRA Federal Rail Administration

FTA Federal Transit Administration

GARVEE *Grant Anticipation Revenue Vehicles*

GHG Greenhouse gas emissions

HPPR High Performance Passenger Rail

HSR High Speed Rail

JRTT Japan Railway Construction, Transport, and Technology Agency

MSA Dallas and Houston Metropolitan Statistical Areas

NEC Northeast Corridor

NEPA National Environmental Policy Act

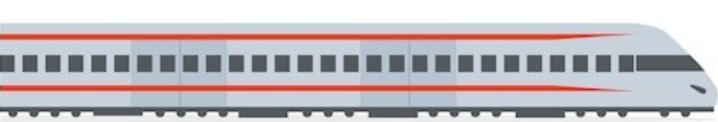
PAB Private Activity Bonds

RRIF Railroad Rehabilitation & Improvement Financing

ROW Right-of-way

SCC Standard Cost Categories

TIFIA Transportation Infrastructure Finance and Innovation Act



GLOSSARY

TRA Texas Railroad Authority

TxDOT Texas Department of Transportation

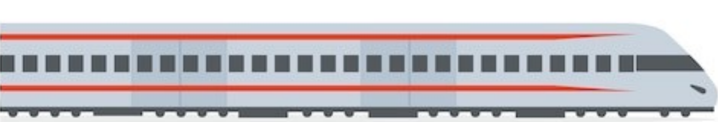
UP Union Pacific

USDOT United States Department of Transportation

USMCA United States-Mexico-Canada trade agreement

VHT Vehicle hours traveled

VMT Vehicle miles traveled



Appendix A: Preliminary Cost Table

Label	HSR (Utility Corridor)	HPPR UP	HPPR BNSF	HPPR Collaborative	Conventional UP	Conventional BNSF	Conventional Collaborative	Source
Miles	240.0	310.9	297.0	286.6	310.9	297.0	286.6	TxDOT. Open Source Roadway Database. https://gis-txdot.opendata.arcgis.com/.
Cost per Mile of Track	$71,497,210.00	$7,509,139.50	$7,509,139.50	$7,509,139.50	$7,509,139.50	$7,509,139.50	$7,509,139.50	CAHSR Cost per mile (guideway & track + HSR upgrades) applied to TX miles & FTA Capital Cost Database.
Total Cost of Track	$17,159,330,400.00	$2,334,456,306.04	$2,230,312,050.31	$2,152,382,200.58	$2,334,456,306.04	$2,230,312,050.31	$2,152,382,200.58	
Cost per Mile of ROW	$0	$15,169,553	$15,169,553	$15,169,553	$15,169,553	$15,169,553	$15,169,553	FTA Capital Cost Database
Total Cost of ROW	$0	$4,715,940,976	$4,505,554,445	$4,348,124,824	$4,715,940,976	$4,505,554,445	$4,348,124,824	
Number of Trains	6	6	6	6	6	6	6	
Cost per Train	$5,403,942.00	$5,403,942.00	$5,403,942.00	$5,403,942.00	$5,403,942.00	$5,403,942.00	$5,403,942.00	FTA Capital Cost Database
Total Cost of Train Cars	$32,423,652.00	$32,423,652.00	$32,423,652.00	$32,423,652.00	$32,423,652.00	$32,423,652.00	$32,423,652.00	
Track, Train, and ROW Cost per Mile	$17,191,754,052.00	$7,082,820,933.79	$6,768,290,147.50	$6,532,930,676.74	$7,082,820,933.79	$6,768,290,147.50	$6,532,930,676.74	
Total Intersections	229	338	300	296	338	300	296	TxDOT. Open Source Roadway Database. https://gis-txdot.opendata.arcgis.com/.
Intersections Requiring Grade Separation (AADT > 30,000)	170	31	33	36	31	33	36	FHWA. Chapter 3: Treatment Selection Guidance. Available: https://highways.dot.

Label	HSR (Utility Corridor)	HPPR UP	HPPR BNSF	HPPR Collaborative	Conventional UP	Conventional BNSF	Conventional Collaborative	Source
								gov/safety/hsip/xings/highway-rail-crossing-handbook-third-edition/chapter-3-treatment-selection
Aerial Structure Miles	5.80	1.06	1.13	1.23	1.06	1.13	1.23	
Aerial Structure Cost per Mile	$161,782,551.00	$161,782,551.00	$161,782,551.00	$161,782,551.00	$161,782,551.00	$161,782,551.00	$161,782,551.00	FTA Capital Cost Database
Aerial Structure Total Cost	$937,603,420.57	$170,974,741.40	$182,005,369.88	$198,551,312.59	$170,974,741.40	$182,005,369.88	$198,551,312.59	
Build-Up Fill Miles	85	15.5	16.5	18	15.5	16.5	18.0	Calculation based on CAHSR and other existing tracks
Build-Up Fill Cost per Mile	$25,022,364.00	$25,022,364.00	$25,022,364.00	$25,022,364.00	$25,022,364.00	$25,022,364.00	$25,022,364.00	FTA Capital Cost Database
Total Build-Up Fill Cost	$2,126,900,940.00	$387,846,642.00	$412,869,006.00	$450,402,552.00	$387,846,642.00	$412,869,006.00	$450,402,552.00	
Average Grade Separation Cost	$18,026,496.24	$18,026,496.24	$18,026,496.24	$18,026,496.24	$18,026,496.24	$18,026,496.24	$18,026,496.24	FHWA. Appendix D: Costs and Benefits of Various Crossing Improvements. https://highways.dot.gov/safety/hsip/xings/highway-railway-grade-crossing-action-plan-and-project-prioritization-7
Total Grade Separation Cost	$3,064,504,360.57	$558,821,383.40	$594,874,375.88	$648,953,864.59	$558,821,383.40	$594,874,375.88	$648,953,864.59	
Number of Other Crossings	59	307	267	260	307	267	260	
Active Crossings	0	102	80	82	102	80	82	FHWA. Chapter 3:

Label	HSR (Utility Corridor)	HPPR UP	HPPR BNSF	HPPR Collaborative	Conventional UP	Conventional BNSF	Conventional Collaborative	Source
Needed								Treatment Selection Guidance. Available: https://highways.dot.gov/safety/hsip/xings/highway-rail-crossing-handbook-third-edition/chapter-3-treatment-selection
Active Crossings Cost per Unit	$388,945.04	$388,945.04	$388,945.04	$388,945.04	$388,945.04	$388,945.04	$388,945.04	FHWA. Appendix D: Costs and Benefits of Various Crossing Improvements. https://highways.dot.gov/safety/hsip/xings/highway-railway-grade-crossing-action-plan-and-project-prioritization-7
Active Crossings Total Cost	$0.00	$39,672,394.08	$31,115,603.20	$31,893,493.28	$39,672,394.08	$31,115,603.20	$31,893,493.28	
Closures Needed	59	68	80	77	68	80	77	FHWA. Chapter 3: Treatment Selection Guidance. Available: https://highways.dot.gov/safety/hsip/xings/highway-rail-crossing-handbook-third-edition/chapter-3-treatment-selection
Closure Cost per Unit	$123,474.62	$123,474.62	$123,474.62	$123,474.62	$123,474.62	$123,474.62	$123,474.62	FHWA. Appendix D: Costs and Benefits of Various Crossing Improvements. https://highways.dot.gov/safety/hsip/xings

Label	HSR (Utility Corridor)	HPPR UP	HPPR BNSF	HPPR Collaborative	Conventional UP	Conventional BNSF	Conventional Collaborative	Source
								/highway-railway-grade-crossing-action-plan-and-project-prioritization-7
Closure of Crossings Total Cost	$7,285,002.58	$8,396,274.16	$9,877,969.60	$9,507,545.74	$8,396,274.16	$9,877,969.60	$9,507,545.74	
Passive Crossings Needed	0	137	107	101	137	107	101	FHWA. Chapter 3: Treatment Selection Guidance. Available: https://highways.dot.gov/safety/hsip/xings/highway-rail-crossing-handbook-third-edition/chapter-3-treatment-selection
Passive Crossings Cost per Unit	$1,852.12	$1,852.12	$1,852.12	$1,852.12	$1,852.12	$1,852.12	$1,852.12	FHWA. Appendix D: Costs and Benefits of Various Crossing Improvements. https://highways.dot.gov/safety/hsip/xings/highway-railway-grade-crossing-action-plan-and-project-prioritization-7
Passive Crossings Total Cost	$0.00	$253,740.44	$198,176.84	$187,064.12	$253,740.44	$198,176.84	$187,064.12	
Total Safety Crossing Costs	$7,285,002.58	$48,322,408.68	$41,191,749.64	$41,588,103.14	$48,322,408.68	$41,191,749.64	$41,588,103.14	
Stations	3	4	4	4	6	6	6	NCRRP and TRB. 2016 .https://nap.nationalacademies.org/read/23535/chapter/7

Label	HSR (Utility Corridor)	HPPR UP	HPPR BNSF	HPPR Collaborative	Conventional UP	Conventional BNSF	Conventional Collaborative	Source
Cost per Station	$20,580,000	$20,580,000	$20,580,000	$20,580,000	$20,580,000	$20,580,000	$20,580,000	FTA Capital Cost Database
Total Station Cost	$61,740,000	$82,320,000	$82,320,000	$82,320,000	$123,480,000	$123,480,000	$123,480,000	
TOTAL COST	$20,325,283,415	$7,772,284,726	$7,486,676,273	$7,305,792,644	$7,813,444,726	$7,527,836,273	$7,346,952,644	
TOTAL COST + CONTINGENCY	$21,341,547,586	$8,160,898,962	$7,861,010,087	$7,671,082,277	$8,204,116,962	$7,904,228,087	$7,714,300,277	
TOTAL - ROW		$3,056,343,750	$2,981,121,828	$2,957,667,820	$3,097,503,750	$3,022,281,828	$2,998,827,820	
TOTAL - ROW + CONTINGENCY		$3,209,160,938	$3,130,177,919	$3,105,551,211	$3,252,378,938	$3,173,395,919	$3,148,769,211	
Notes	Assuming 0.5 miles of fill to each aerial structure				TxDOT estimates 1.3B	TxDOT estimates 1.3B	TxDOT estimates 1.3B	

Appendix B: Intersections Based on Average Annual Daily Traffic (AADT) Value

Corridor	Intersections Based on AADT Value			
	AADT >=30000	AADT<=1000	30000>AADT>=2000	All Roads
Utility	19	59	67	229
BNSF	33	80	80	300
UP	31	68	102	338
Collaborative	36	77	82	296