



**National University Rail Center - NURail**  
US DOT OST-R Tier 1 University Transportation Center

NURail Project ID: **NURail2017-MIT-R04**

**High-Speed Rail and Local Land Development:  
Case Studies in London and Las Vegas**

By

Daniel R. Mascoop  
Master in City Planning  
Department of Urban Studies and Planning  
Massachusetts Institute of Technology  
leinad12@mit.edu

Joseph M. Sussman  
JR East Professor, Emeritus  
Civil and Environmental Engineering and Engineering Systems  
Massachusetts Institute of Technology  
sussman@mit.edu

11-1-2017

Grant Number: DTRT13-G-UTC52 (Grant 2)

## **DISCLAIMER**

Funding for this research was provided by the NURail Center, University of Illinois at Urbana - Champaign under Grant No. DTRT13-G-UTC52 of the U.S. Department of Transportation, Office of the Assistant Secretary for Research & Technology (OST-R), University Transportation Centers Program. The contents of this report reflect the views of the authors, who are responsible for the facts and the accuracy of the information presented herein. This document is disseminated under the sponsorship of the U.S. Department of Transportation's University Transportation Centers Program, in the interest of information exchange. The U.S. Government assumes no liability for the contents or use thereof.



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US DOT OST-R Tier 1 University Transportation Center

## **TECHNICAL SUMMARY**

### **Title**

High-Speed Rail and Local Land Development: Case Studies in London and Las Vegas

### **Introduction**

The efficacy of a high-speed rail system depends, in part, upon locating rail stations close to urban centers and integrating them into broader transportation networks and the urban realm. In addition, through economies of agglomeration, successful high-speed rail systems can bring wider economic benefits to regions, cities and local areas. Transit-oriented development can be used as a strategy to realize and capture these local-level benefits by connecting the high-speed rail system with urban development. This research focuses on evaluating the relationships between high-speed rail development, local rail station development and land development.

### **Approach and Methodology**

The research is conducted by evaluating two case studies, each focusing on a major decision related to a high-speed rail development project. The first case study concerns the decision to use St. Pancras Station as the London terminus for the High-Speed 1 (HS1) project in the United Kingdom, which brought high-speed rail to the United Kingdom for the first time and connected England with high-speed rail systems in Continental Europe. With the decision to use the station as High-Speed 1's London terminus, the British government invested hundreds of millions of pounds into redeveloping the station, with new concourses, customs and immigration services, London Underground connections, hotels and shops.

The second case study is of the proposed high-speed rail line between Los Angeles and Las Vegas ("XpressWest"), which would be privately built and operated, along a major interstate highway right-of-way. The main purpose of the high-speed rail line would be to support and expand the entertainment- and leisure-based economy in Las Vegas.

The case studies are evaluated using stakeholder analyses and a benefit-cost analyses that highlight the relationship between local land development and the high-speed rail line.

### **Findings**

Appropriate placement and design of a high-speed rail station is essential to the efficacy of a high-speed rail system and its local impacts. A station's location can increase or decrease passengers' total travel time, it can impede or ease passengers' access to the high-speed rail system, and can be

separated from or integrated with the surrounding urban area. In both of the cases considered, the local-level benefits are dependent on the station's location and design.

In the St. Pancras Station case, the station is located in a central area of London, facilitates passengers' movements through different concourses and commercial areas within the station, and integrates well with the surrounding urban neighborhood. These are the characteristics that have earned it such a positive image and that have created the significant local benefits in and around the station.

The two proposed Las Vegas stations similarly are located near the city's entertainment district and are planned to integrate well with a variety of other modes of transportation. If built, the station should fit well with Las Vegas' urban structure and characteristics in order to facilitate the connections upon which local-level benefits depend.

The exact nature and type of local benefits that occur at or near high-speed rail stations vary and also depend on the urban, economic and political contexts. For example, the station itself might be a destination. In addition to providing transportation services, St. Pancras Station is a historic landmark with distinctive architectural beauty, which attracts cultural and political interest. The commercial district at St. Pancras Station and in King's Cross Central is defined by and builds upon the station. In that area, walking and public transit are common modes of transportation.

## **Conclusions**

High-speed rail's local-level benefits can be significant. The value of these benefits has the potential to make a project have socially net positive benefits and be even financially profitable. Many of these local-level benefits, however, are controversial, because they are difficult to estimate and they are difficult to connect directly to a high-speed rail project. In many cases, the benefits may be caused by a combination of the high-speed rail development and broader economic and social factors rather than by the infrastructure alone. Every stakeholder has its own principles and its own willingness to take risks on a project, and certain stakeholders may value certain benefits highly when others do not. With the understanding that many different local-level benefits are possible and with the motivation to explore how best to produce these benefits, stakeholders can take charge of a project or collaborate with each other in order to develop their desired high-speed rail system. The two case studies studied in this research demonstrate these processes and offer examples of certain opportunities for coupling high-speed rail development with goals for local benefits based on successful rail station and land development.

## **Recommendations**

In order to ensure that the most valuable local-level impacts of high-speed rail are realized, high-speed rail systems should address the opinions and values of the relevant stakeholders, especially those with the greatest saliency in the system and even more so the stakeholders that are funding the project. Many high-speed rail systems may not be profitable on revenue alone. These projects may not even provide sufficient financial benefits to justify their cost. Some stakeholders, however, also may value the provision of modern amenities, a more equitable distribution of or access to industry, or a city's or a nation's image. It is difficult to monetize these benefits, and it may be difficult to determine their wider impacts on economic growth. In certain cases, such as at St. Pancras Station, high-speed rail development in fact can provide these kinds of additional benefits and they likely had positive impacts on local economic growth. When stakeholders value profitability as a necessary outcome, then it

becomes more difficult to justify a project using these other benefits; however, there may be ways of quantifying and leveraging indirect benefits to support high-speed rail development.

In Las Vegas, connections to other sites across the city, such as hotels and casinos, rather than the station itself being a destination would be a more important quality for the high-speed rail station. In this way, it could support the most important local-level benefits of the XpressWest project. Visitors who use the XpressWest high-speed rail line and the station in Las Vegas likely wish to spend time beyond the station on longer visits. Even so, the station can be designed and built to provide for the local-level benefits appropriate for that situation.

### **Publications**

See attached thesis.

### **Primary Contact**

#### **Principal Investigator**

Daniel R. Mascoop  
Master in City Planning  
Department of Urban Studies and Planning  
Massachusetts Institute of Technology  
617-365-7399  
leinad12@mit.edu

### **Other Faculty and Students Involved**

Joseph M. Sussman  
JR East Professor, Emeritus  
Civil and Environmental Engineering and Engineering Systems  
Massachusetts Institute of Technology  
sussman@mit.edu

#### **NURail Center**

217-244-4999

[nurail@illinois.edu](mailto:nurail@illinois.edu)

<http://www.nurailcenter.org/>

# **High-Speed Rail and Local Land Development: Case Studies in London and Las Vegas**

By

**Daniel R. Mascoop**

SB in Civil Engineering  
SB in Planning  
Massachusetts Institute of Technology  
Cambridge, MA (2016)

Submitted to the Department of Urban Studies and Planning  
in partial fulfillment of the requirements for the degree of

**Master in City Planning**

at the

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

September 2017

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Author .....

Department of Urban Studies and Planning  
August 9, 2017

Certified by .....

Joseph M. Sussman  
JR East Professor of Civil and Environmental Engineering and Engineering Systems  
Thesis Supervisor

Accepted by .....

Associate Professor P. Christopher Zegras  
Chair, MCP Committee  
Department of Urban Studies and Planning



# **High-Speed Rail and Local Land Development: Case Studies in London and Las Vegas**

By

Daniel R. Mascoop

Submitted to the Department of Urban Studies and Planning  
on August 9, 2017, in partial fulfillment of the requirements  
for the degree of Master in City Planning

## **Abstract**

This thesis explores the relationship between high-speed rail development, local rail station development and land development. The efficacy of a high-speed rail system depends, in part, upon rail stations' locations close to urban centers and integration into the broader transportation networks and urban realm. Through economies of agglomeration, high-speed rail can bring wider economic benefits to regions, cities and local areas. Transit-oriented development can be used as a strategy to capture these local-level benefits and also bring urban development to the high-speed rail system. In order to evaluate these relationships, this thesis examines two case studies.

In the United Kingdom, the government chose St. Pancras Station as the London terminus for High-Speed 1, the first high-speed rail route in the UK. Although protected under historic landmark status, St. Pancras Station had been neglected for decades and required an £800 million refurbishment. This project also opened up new land, which currently is being developed as part of the £3 billion mixed-use project. Property values in the vicinity of the station have increased significantly, and this project has garnered wide acclaim for its architectural and place-making achievements.

XpressWest, a private high-speed rail developer founded in 2005, is proposing to build and operate a high-speed rail line between Victorville, California, and Las Vegas, Nevada. XpressWest plans to compete mainly with driving, since this is the most common mode of transportation on this corridor. A benefit-cost analysis shows that the project likely will have net negative impacts when considering only transportation benefits, such as time-savings. Wider economic benefits, however, could be on the order of billions of dollars, and have the potential to exceed the project's costs.

In conducting stakeholder analyses and in comparing these two case studies, this thesis determines that high-speed rail systems have the potential to generate a variety of local social and economic benefits, which are valued differently by different stakeholders. Through collaboration, these stakeholders may ensure that these local benefits are maximized. As long as these benefits hold value to the relevant stakeholders, there may be opportunities for local benefits to exceed the costs of infrastructure development.

Thesis Supervisor: Joseph M. Sussman

Title: JR East Professor of Civil and Environmental Engineering and Engineering Systems





## **Acknowledgements**

Conducting research for and writing this thesis have been challenging and rewarding processes that have extended from my undergraduate to graduate time at MIT. I would like to take this space to acknowledge the many people who have helped and encouraged me through this process and throughout my time at MIT leading up to this.

I first would like to thank my thesis advisor, Professor Joseph Sussman, for his guidance, interest, support and friendliness over the past years and throughout the entire process of writing this thesis. I especially appreciate his continued effort and support while—and despite—undergoing difficult medical treatment this past year. Being a part of the Regional Transportation Planning and High-Speed Rail Research Group has been a meaningful and educational experience, and Joe has inspired me with his work and guidance.

With regard to the St. Pancras Station case, I would like to thank Rebecca Heywood, Professor Nigel Wilson, Nicola Shaw, and Rachel Starling for leading me to relevant and interesting sources and for providing generous and indispensable time, help and advice.

With regard to the Los Angeles-Las Vegas case, I would like to thank my colleagues in the Regional Transportation Planning and High-Speed Rail Research Group—especially Mark Mockett, Joanna Moody and Scott Middleton—for invaluable collaboration, support and comments on my work. I also would like to thank Professor Francesca Pagliara for providing useful material.

Finally, I would like to express my deepest gratitude to my family and friends, who have supported and encouraged me with enthusiasm and care. Without their support, love and friendship, especially through times of stress or slow progress, and without their insightful ideas, interesting conversation and entertaining company, I would not have been able accomplish this work. They demonstrate a sincere commitment to other people and to work that I aspire to match.



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# 1 Introduction

Proposals throughout the world for high-speed rail, which provides rapid intercity rail travel at speeds exceeding 150 miles per hour, remain both popular and controversial. In countries where high-speed rail lines have been built, these projects are cost-intensive to develop but provide rapid intercity connections, among other potential environmental, social and economic benefits.<sup>1</sup> As governments and private developers continue to propose new projects in order to address societal issues including road congestion, geographic economic and social inequality, excessive air pollution and greenhouse gas emissions, economic development and globalization, it remains important to understand in what ways high-speed rail technology actually impacts these societal issues. This thesis builds on previous research into all of these aspects and research into how stakeholders assert their interests in high-speed rail operations and right-of-way development, how high-speed rail transforms urban geographic scales and institutional relationships, and how rail operators and other stakeholders may experience acute difficulties at major rail stations that host high-speed rail lines. This thesis focuses on the role local-level benefits, such as local land development and infrastructure beautification at or near rail stations, may play in garnering support or opposition to high-speed rail development. In evaluating two case studies—one in the United Kingdom (UK) and one in the United States (US)—this thesis aims to inform research questions related to the impacts of high-speed rail development on local-scale issues.

## 1.1 High-Speed Rail

High-speed rail has expanded throughout Europe and East Asia since the 1960s. High-speed rail networks continue to expand throughout the world, with projects underway and proposed in the United States, Middle East, Eastern Europe, Morocco and South Africa, among other places.<sup>2</sup> In this century, China has undertaken the largest high-speed rail development in the world. Its first high-speed rail route opened in 2003, and in 2004 the government adopted the national “Mid-Term and Long-Term Railway Network Plan”.<sup>3</sup> Currently, the combined length

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<sup>1</sup> Elizabeth Deakin, “Background on High-Speed Rail,” in *High-Speed Rail and Sustainability*, ed. Blas Luis Pérez Henríquez and Elizabeth Deakin (New York: Routledge, 2017).

<sup>2</sup> Ibid.

<sup>3</sup> Haixiao Pan, Song Ye, and Minglei Chen, “The Influence of High-Speed Rail Station Site Selection on Travel Efficiency: The Case of the Shanghai Hongqiao Hub,” in *High-Speed Rail and Sustainability*, ed. Blas Luis Pérez Henríquez and Elizabeth Deakin (New York: Routledge, 2017).

of high-speed rail in China comprises two thirds of the total length of all high-speed rail in the world, and the Chinese government continues to undertake and plan rapid expansions.

Rail systems, including high-speed rail, are inherently tied to a region's economy as well as a region's urban structure. Rail infrastructure requires significant up-front investments, usually on the part of the government, as is common for other major infrastructure projects, such as highways or ports. Because of the large capital investments, these projects must produce significant benefits in order to justify the costs.<sup>4</sup> Like most other transportation infrastructure projects, these benefits are touted as economic, social, and, for rail specifically, as a solution to reducing greenhouse gas emissions in the transportation sector that contribute to global warming by taking passengers away from more polluting modes of transportation, such as air or car travel. While other technologies that could compete with high-speed rail have been proposed, such as Elon Musk's Hyperloop and magnetic levitation trains,<sup>5, 6</sup> and there exists potential for new technological innovations that displace high-speed rail's role in intercity travel, high-speed rail remains engrained in many regional and international transportation systems and garners much attention in this field.

## **1.2 Motivation and Research Background**

Continuing efforts to understand the impacts, both positive and negative, of high-speed rail as well as the difficulties in developing and operating high-speed rail systems motivates this thesis. Especially in the United States, high-speed rail remains an unrealized mode of transportation with great potential. The conditions in the United States, whether physical, technological, political, environmental, or social, among others, may contribute to this discrepancy. Previous research and intuition show that it is likely a combination of these factors that affect the development of high-speed rail and its success. Additionally, inefficiencies or misunderstandings among stakeholders impact high-speed rail development and operations. Stakeholders may not understand completely the potential costs or benefits of high-speed rail, and they may not assert their interests or cooperate effectively.

One motivation for high-speed rail development is the opportunity to increase the value of land in areas near rail stations and in cities connected to the rail system. While issues related

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<sup>4</sup> "High Speed Rail," US High Speed Rail Association.

<sup>5</sup> Elon Musk, "Hyperloop Alpha," 2013.

<sup>6</sup> Richard Polgreen Geoffrey, Magnetic system of transportation. US Patent 3158765 A, issued 1964.

to property development may present themselves at the local scale, the costs and benefits at this scale involve a wide array of stakeholders, including local governments, property owners and developers, and residents, and may impact whether or not a high-speed rail line is built. This thesis is motivated by the interest in these local-level issues, which have much broader implications in terms of geography, economy and society. Understanding these issues and relationship may help overcome the barriers to developing efficient and productive high-speed rail systems.

This motivation is inspired by the work of three master's theses, draws on their results and continues the line of research they establish. The following review provides an overview of the theses, which are discussed in more detail in Chapter 2. The research presented in these theses evaluates various technical and institutional aspects of high-speed rail infrastructure systems. Results from this previous work also have offered recommendations for improved institutional cooperation, especially related to high-speed rail planning, development and operations.

In a master's thesis, Samuel J. Levy evaluates the decision of the California High-Speed Rail Authority to adopt a so-called blended system instead of a dedicated high-speed line for the future California High-Speed Rail. In order to reduce costs, this blended system would require California High-Speed Rail to share tracks with freight lines and conventional passenger rail lines as opposed to building tracks dedicated to high-speed passenger rail.<sup>7</sup> In analyzing the impacts of this decision, Levy focuses on evaluating high-speed rail operations and stakeholder interests along the actual rail corridor, considering track construction and train operations. This blended system increases complexity in the rail line along its right-of-way with the need to construct tracks, stations and other infrastructure to accommodate multiple kinds of rail service and the need to coordinate multiple operators and additional stakeholders. According to Levy, issues arising from this complexity may undermine California High-Speed Rail's aims to provide frequent and regular service throughout the state.<sup>8</sup>

In a master's thesis, Naomi E.G. Stein uses case studies in Portugal and the United Kingdom to explore two themes related to high-speed rail systems: space and institutional relationships. Stein discusses how broad trends, such as globalization and an increasingly

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<sup>7</sup> Samuel J. Levy, "Capacity Challenges on the California High-Speed Rail Shared Corridors: How Local Decisions Have Statewide Impacts" (Master's Thesis, MIT, 2015).

<sup>8</sup> Ibid.

interconnected economy, strengthen interest in high-speed rail development.<sup>9</sup> In turn, high-speed rail lines transform the urban scale, “blurring the distinction between inter-city and intra-city travel, between urban and periphery, between global and local.”<sup>10</sup> The thesis then evaluates two case studies of secondary or intermediate cities, which are brought within a one-hour distance of a major metropolitan city by high-speed rail lines. Stein concludes that current public and social institutions are ill-suited for the transformations in urban structure caused by high-speed rail and recommends that further effort be placed on aligning various local and regional interests in order to produce the most effective transportation system.<sup>11</sup>

In a master’s thesis, Rebecca J. Heywood focuses on the significance of major, central rail stations to high-speed rail development and efficiency. Heywood uses Penn Station in Manhattan as the main case study. In this case, multiple physical constraints are present at the station, including lack of usable space for tracks and equipment storage, the presence of Madison Square Garden—a sports arena—above the train station and insufficient space for passenger movement. In addition, multiple institutional conflicts impede effective cooperation among stakeholders at the station, including two commuter rail operators and one intercity rail operator competing for platform and track priority.<sup>12</sup> The proposal to incorporate international-quality high-speed rail service at Penn Station further exacerbates these problems and conflicts, especially by bringing more stakeholders who transcend city, regional and state political boundaries to the station. Heywood makes recommendations for new governance structures to allow for better management and cooperation, highlighting the impacts of high-speed rail development in the extreme local setting at a train station.

In a condensed summary, these three theses use high-speed rail as the overarching motivation for their research and discuss the following themes (in the order in which they are presented above):

1. How best to accommodate various stakeholders’ needs in developing the infrastructure along a high-speed rail line.

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<sup>9</sup> Naomi E.G. Stein, “Spatial Dimensions of High-Speed Rail: Intermediate Cities, Inter-jurisdictional Planning, and the Implications for High-Speed Rail in Portugal” (Master’s Thesis, MIT, 2013).

<sup>10</sup> *Ibid.*, 15.

<sup>11</sup> *Ibid.*

<sup>12</sup> Rebecca J. Heywood, “Multi-Scale Regional Transportation Governance: Evaluating Cooperation and Decision-making at New York Penn Station” (Master’s Thesis, MIT, 2016).

2. How high-speed rail transforms regional urban fabric and how it impacts economic and institutional capacity at intermediate cities newly connected to larger metropolitan and economic areas.
3. How stakeholders function and interact in close-quarters, i.e. within constrained station infrastructure, and how stakeholder operations and interactions at individual rail stations impact the efficacy of the system.

This thesis builds upon these concepts of stakeholder interest and influence on infrastructure development, expanded and transformed urban scales impacting specific sites of rail stations, and using a local-level view of relevant issues to study how stakeholder interests and interactions affect the economic, physical and social impacts of high-speed rail on the local scale—at and immediately beyond the rail station. The benefits of local station revitalization and local land development may be significant parts of the total benefits of high-speed rail development. The prospect of station revitalization and local land development also may significantly impact stakeholders' support of or opposition to high-speed rail development. Evaluating how institutions and the public value these prospects and how rail station revitalization and land development are related to high-speed rail projects may offer insight into the true benefits and costs of high-speed rail. In all, this research will help inform how these issues relate and how best to coordinate these local physical issues within the broader infrastructure system and expanded urban scale.

### **1.3 Research Questions**

Given the motivation of this thesis, this thesis aims to answer the following main question: *What role do local-level station development or revitalization and land development play in the broader context of high-speed rail planning and development?*

Additionally, other related questions arise including: How do stakeholders assert their interests in this local context? Do these efforts also influence how organizations work in this and other related capacities? Are there better ways to address conflicting interests to maximize the local-scale benefits of high-speed rail?

Given the kinds of travelers high-speed rail may attract, such as wealthier business travelers and tourists, the significant overall cost of a high-speed rail line, and the high-profile nature of such projects, if local-level stakeholders were to coordinate their interests and



cooperate with each other, they may leverage the wealth and political interest in the project for their own interests. In this way, these stakeholders may become strong proponents of high-speed rail development. In turn, local-level benefits at and immediately beyond rail stations may be used to garner further support for high-speed rail projects.

## **1.4 Thesis Research**

These research questions are addressed through evaluating two case studies, each focusing on a major decision related to a high-speed rail development project. The first case study concerns the decision to use St. Pancras Station as the London terminus for the High-Speed 1 (HS1) project in the United Kingdom, which brought high-speed rail to the United Kingdom for the first time and connected England with high-speed rail systems in Continental Europe. Before High-Speed 1, St. Pancras Station was a neglected and decaying station in northern London. With the decision to use the station as High-Speed 1's London terminus, the British government invested hundreds of millions of pounds into redeveloping the station, with new concourses, customs and immigration services, London Underground connections, hotels and shops. Currently, it is the most popular station in the London rail system in terms of passenger satisfaction and hosts many cultural and neighborhood amenities. This case study primarily is evaluated through a stakeholder analysis as well as review of the decision-making process.

The second case study is of the proposed high-speed rail line between Los Angeles and Las Vegas, which would be privately built and operated, along a major interstate highway right-of-way. The main purpose of the high-speed rail line would be to support and expand the entertainment- and leisure-based economy in Las Vegas. Currently, the project has had difficulty finding sufficient financing, and it is not clear if the project will be built. Sufficient information is available, however, to learn about the decision-making process and relevant factors that would impact the success of the project. This case study primarily is evaluated through a stakeholder analysis and a benefit-cost analysis that highlight the relationship between local land development in Las Vegas and the high-speed rail line.

## **1.5 Thesis Organization**

Following this chapter, "Introduction", this thesis is organized as follows:

Chapter 2 reviews literature relevant to this thesis. The first and second sections discuss high-speed rail development, focusing on the potential benefits and costs of high-speed rail. The

third section discusses the relationship between transportation and land development in general and specifically related to high-speed rail. The fourth section discusses how different stakeholders may influence infrastructure systems and how stakeholder interests in and influence on infrastructure development and operations may be evaluated and compared. The fifth section discusses the work and conclusions of the three master's theses introduced in this chapter.

Chapter 3 presents the case study related to the High-Speed 1 project in the United Kingdom. This case study focuses on the United Kingdom government decision to use St. Pancras Station as the London terminus for the UK's first high-speed rail route, which required significant financial investments and cooperation among a variety of stakeholders.

Chapter 4 presents the case study related to the high-speed rail link between Southern California and Las Vegas as proposed by XpressWest, a private infrastructure developer. This case study focuses on the viability of the project and the factors related to local land development that impact the decision to develop the project.

Chapter 5 evaluates, compares and contrasts the two case studies. Each section in the chapter focuses on a theme related to the research questions presented in this chapter and evaluates the case studies in the context of the theme.

Chapter 6 concludes the thesis by summarizing the previous chapters, offering general conclusions and discussing potential future research that could continue the work presented in this thesis.

The appendices provide detailed methodologies, information and calculations regarding the stakeholder analyses for both case studies and the benefit-cost analysis and financial analysis for the Los Angeles to Las Vegas high-speed rail link case.

We now proceed with Chapter 2, the literature review.



## 2 Literature Review

This literature review provides a broad overview of high-speed rail, benefits and related factors. The first and second sections discuss high-speed rail development, focusing on the potential benefits and costs of high-speed rail. The third section discusses the relationship between transportation and land development specifically related to high-speed rail. The fourth section discusses how different stakeholders may influence infrastructure systems and how stakeholder interests in and influence on infrastructure development and operations may be evaluated and compared. The fifth section discusses the work and conclusions of the three master's theses introduced in Chapter 1, the Introduction. The research discussed in this section combines all of the themes introduced and discussed in the rest of this chapter. The sixth section provides a summary of the discussions in this entire chapter.

### 2.1 The Relevance and Role of High-Speed Rail in Different Contexts

This section discusses high-speed rail's important as a competitive mode of transportation for intercity travel and its benefits and costs—theorized or realized. Currently, high-speed rail lines are in operation in Western Europe and Asia, with more lines under construction and planned throughout the world (Table 2-1.). While China continues to rapidly expand its high-speed rail network, other countries are reevaluating their commitments to these costly transportation projects. In 2009, Belgium decided to discontinue all high-speed rail investments, and the fates of long-proposed projects in Spain, France, Portugal, and the United Kingdom, among many other countries, are still unclear.<sup>13</sup> In the United States, federal and state governments as well as private developers have proposed upgrading conventional rail routes to high-speed rail and completely new high-speed rail lines. Currently, none are complete, and only one (California High-Speed Rail) is under construction.<sup>14</sup> Nevertheless, high-speed rail lines currently in operation play important roles in local, regional, national and international transportation systems as well as broader economic, social, political, geographic and urban systems. As the nature of these systems vary throughout the world, the roles that high-speed rail plays vary.

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<sup>13</sup> Yves Crozet, "Where High-Speed Rail is Relevant: The French Case Study," in *High-Speed Rail and Sustainability*, ed. Blas Luis Pérez Henríquez and Elizabeth Deakin (New York: Routledge, 2017).

<sup>14</sup> Robert Puentes, Adie Tomer, and Joseph Kane, "A New Alignment: Strengthening America's Commitment to Passenger Rail," *Brookings*, 2013.

| <b>KM OF HIGH SPEED LINES IN THE WORLD</b> |                     |                           |                |                      |
|--|---------------------|---------------------------|----------------|----------------------|
|  | <b>In operation</b> | <b>Under construction</b> | <b>Planned</b> | <b>Total country</b> |
| <b>Europe</b>                              |                     |                           |                |                      |
| Belgium                                    | 209                 | 0                         | 0              | 209                  |
| France                                     | 1896                | 210                       | 2616           | 4722                 |
| Germany                                    | 1285                | 378                       | 670            | 2333                 |
| Italy                                      | 923                 | 0                         | 395            | 1318                 |
| The Netherlands                            | 120                 | 0                         | 0              | 120                  |
| Poland                                     | 0                   | 0                         | 712            | 712                  |
| Portugal                                   | 0                   | 0                         | 1006           | 1006                 |
| Rusia                                      | 0                   | 0                         | 650            | 650                  |
| Spain                                      | 2056                | 1767                      | 1702           | 5525                 |
| Sweden                                     | 0                   | 0                         | 750            | 750                  |
| Switzerland                                | 35                  | 72                        | 0              | 107                  |
| United Kingdom                             | 113                 | 0                         | 204            | 317                  |
| <b>Total Europe</b>                        | <b>6637</b>         | <b>2427</b>               | <b>8705</b>    | <b>17769</b>         |
| <b>Asia</b>                                |                     |                           |                |                      |
| China                                      | 6299                | 4339                      | 2901           | 13539                |
| Taiwan-China                               | 345                 | 0                         | 0              | 345                  |
| India                                      | 0                   | 0                         | 495            | 495                  |
| Iran                                       | 0                   | 0                         | 475            | 475                  |
| Japan                                      | 2664                | 378                       | 583            | 3625                 |
| Saudi Arabia                               | 0                   | 550                       | 0              | 550                  |
| South Korea                                | 412                 | 186                       | 49             | 647                  |
| Turkey                                     | 447                 | 758                       | 1219           | 2424                 |
| <b>Total Asia</b>                          | <b>10167</b>        | <b>6211</b>               | <b>5722</b>    | <b>22100</b>         |
| <b>Other countries</b>                     |                     |                           |                |                      |
| Morocco                                    | 0                   | 200                       | 480            | 680                  |
| Brazil                                     | 0                   | 0                         | 511            | 511                  |
| USA  | 362                 | 0                         | 900            | 1262                 |
| <b>Total other countries</b>               | <b>362</b>          | <b>200</b>                | <b>1891</b>    | <b>2453</b>          |
| <b>Total World</b>                         | <b>17166</b>        | <b>8838</b>               | <b>16318</b>   | <b>42322</b>         |

**Table 2-1.** High-speed rail lines in the world in 2011. While included in this figure, the 362 kilometers of high-speed rail in the United States do not meet international standards. The combined values of the “In operation” and “Under construction” columns are equivalent to the length of high-speed rail lines in operation today. (ARA, 2012).

In general, high-speed rail is competitive with other modes of transportation (automobile and air) for distances from 100 to 500 miles or approximately 150 to 800 kilometers (Table 2-2.). As discussed, however, the various contexts surrounding and characteristics of a high-speed rail system contribute to its competitiveness, viability and success. While high-speed rail must operate at speeds exceeding 150 miles per hour (250 km/h), other factors affect high-speed rail travel times. For example, a major component of the overall running time of a route is the frequency of stations and stops. The more stops there are along a route, the longer the route’s running time is because of dwell time at a station and the train’s deceleration from and acceleration to high speeds. In one analysis, each station could add up to ten minutes to running

time.<sup>15</sup> Additionally, other factors present at rail stations may contribute to the overall trip length. Depending on the organization of platforms, operations and passenger movement in a station, high-speed rail systems may need to coordinate with other conventional rail systems, which may have longer dwell times and different signaling technology that lead to slower operations.<sup>16</sup>

| <b>Distance</b> | <b>Travel Time</b> | <b>Function</b>                                 | <b>Competitive Mode</b>  |
|-----------------|--------------------|---|--|
| 70-150 km       | 35-45 minutes      | Suburban rail within a metropolitan area        | Overlaps with existing metropolitan transport systems.                     |
| 150-400 km      | 0.75-2 hours       | Commuting: opens new labor market opportunities | Competes with conventional rail and road and induces new mobility patterns |
| 400-600 km      | 2-3 hours          | Professional; one-day return travel             | Competes successfully with air (50-80% mode share)                         |
| 600-800 km      | 3-4 hours          | Professional, personal, and leisure             | Competes with air  |

**Table 2-2.** Categorization of high-speed rail usage patterns by scope and temporality. (adapted from Stein, 2013)

As the first country with high-speed rail, Japan serves a key example of high-speed rail’s importance and potential competitiveness with other transportation modes. In 1964, Japan built its first high-speed rail line between Tokyo and Osaka, establishing high-speed rail as a popular transportation mode before car ownership had become widespread and major highways were built. Even as automobile travel became increasingly popular, Japan expanded its high-speed rail network throughout most of the country, and ridership rapidly grew from 30.97 million annual passengers in 1965 to 160 million annual passengers in 1974. By 2014, Japanese high-speed rail served over 450 million passengers annually, and high-speed rail dominates most intercity travel markets, capturing over 70 percent of intercity trips under 900 km (560 miles).<sup>17</sup>

According to Yoshitsugu Hayashi et al. (2017), high-speed rail’s dominance in Japan is due to multiple factors. First, the system is based upon four distinguishing design features: high speeds<sup>18</sup>, frequent service<sup>19</sup>, reliability through separated rights-of-way and automatic train control<sup>20</sup>, and safety<sup>21</sup>.<sup>22</sup> Second, air travel between many intercity pairs is more difficult than

<sup>15</sup> Piers Connors, “Rules for High Speed Line Capacity.”

<sup>16</sup> Anastasia Loukaitou-Sideris and Deike Peters, “High-Speed Rail Stations as Transportation Nodes and Places: Lessons for California,” in *High-Speed Rail and Sustainability*, ed. Blas Luis Pérez Henríquez and Elizabeth Deakin (New York: Routledge, 2017).

<sup>17</sup> Yoshitsugu Hayashi, Aoto Mimuro, Ji Han, and Hirokazu Kato, “The Shinkansen and Its Impacts,” in *High-Speed Rail and Sustainability*, ed. Blas Luis Pérez Henríquez and Elizabeth Deakin (New York: Routledge, 2017).

<sup>18</sup> Speeds have increased from 210 km/h in 1964 up to 320 km/h on some routes in 2016.

<sup>19</sup> On the Tokyo to Osaka route, for example, there are over twelve trains per hour.

<sup>20</sup> In 2013, there was a system wide average delay of 30 seconds in 2013.

<sup>21</sup> Since the opening of high-speed rail, there has been only one fatal accident and only two derailments, both due to extreme natural events.

<sup>22</sup> Hayashi, Mimuro, Han, and Kato, “The Shinkansen and Its Impacts.”

travel by high-speed rail. Where frequency of flights is comparable to that of high-speed rail or access between an airport and a city's center is relatively convenient, however, air travel is more competitive. For example, air travel accounts for 84.6 percent of trips on the Tokyo-Fukuoka route where it takes 1.5 hours less than the 1,175 km-long high-speed rail route and the airport is a six-minute subway ride from the Fukuoka main rail station.<sup>23</sup>

In Europe, high-speed rail competitiveness is strongly related to travel times. Consistently, high-speed rail exceeds 50 percent market share on routes with travel times under 3 to 4 hours (Figure 2-1).<sup>24</sup> Depending on the country, however, high-speed rail systems hold somewhat different roles and uses. In France, which in 1981 opened the first high-speed rail line in Europe, faster speeds than air or auto travel and frequent service also are major factors in high-speed rail's popularity with more than four times the passenger-kilometers of domestic air travel. In addition, the French high-speed rail trains can run on conventional tracks, allowing these trains to access older train stations in city centers and to offer service to less-populated regions.<sup>25</sup> In evaluating passenger traffic forecasts, Yves Crozet (2017) determines that France's geography is especially accommodating to high-speed rail, since most major cities are between 400 and 800 km from each other. Following extreme enthusiasm for building new projects, however, the French high-speed rail network is overextended and recent proposals for extensions and new lines do not fall in this *relevancy zone* for high-speed rail in France.<sup>26</sup> Unlike the previous and successful lines, these new routes are fewer than 200 km in length and likely would be unsuccessful. Given these issues and the high costs of constructing new lines, the French government has abandoned or delayed all new high-speed rail proposals, except one, at least through 2030.

Spain and Germany's high-speed rail networks both operate with shorter distances between stations and more varied uses than France's network. Spain's first high-speed rail lines were built with the same characteristics as France's lines—2- to 3-hour one-way travel times, dedicated tracks and direct access to a city's center—and competed effectively with air, such as

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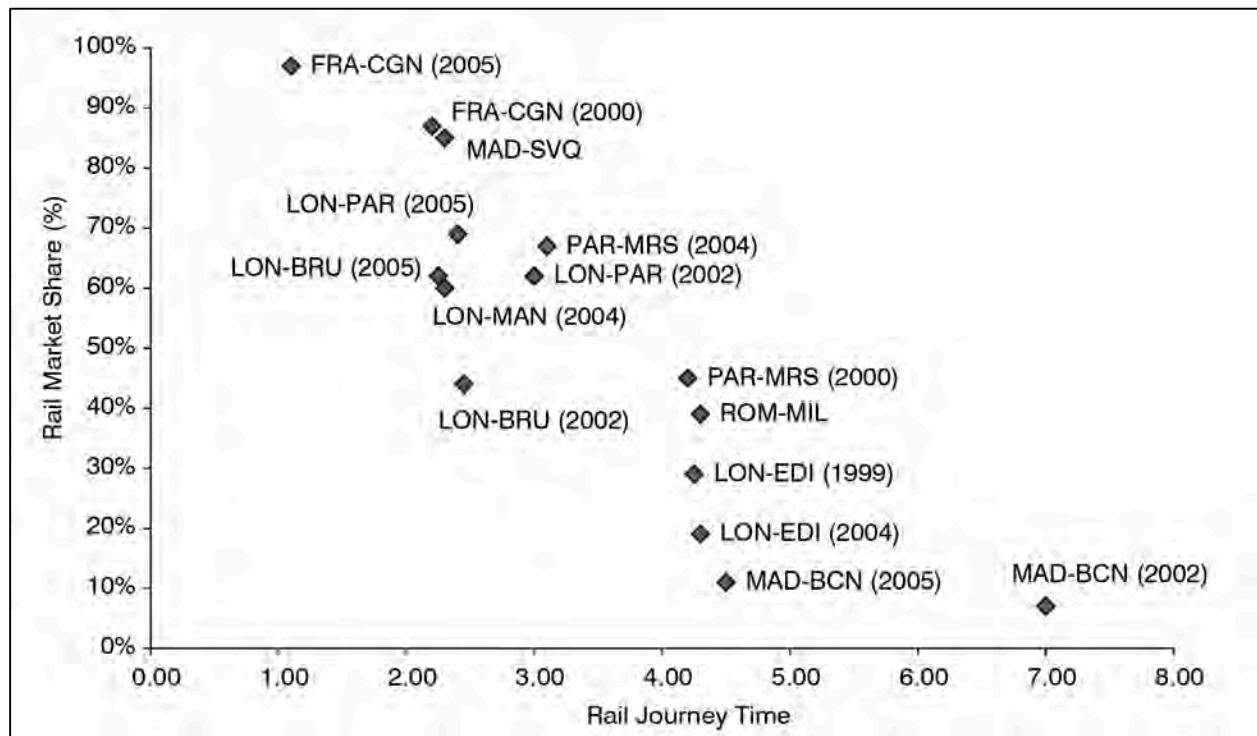
<sup>23</sup> Hayashi, Mimuro, Han, and Kato, "The Shinkansen and Its Impacts."

<sup>24</sup> Mikhail Chester, Megan Smirti Ryerson, and Arpad Horvath, "Uncertainties in the Life Cycle Assessment of High-Speed Rail's Energy and Environmental Impacts," in *High-Speed Rail and Sustainability*, ed. Blas Luis Pérez Henríquez and Elizabeth Deakin (New York: Routledge, 2017).

<sup>25</sup> Crozet, "Where High-Speed Rail is Relevant: The French Case Study."

<sup>26</sup> Ibid.

capturing 50-80 percent of business travel between Madrid and Seville.<sup>27</sup> In building newer lines, however, Spain began to experiment with shorter-distance routes—200 km to under 100 km—using tracks shared with conventional rail in order to connect smaller urban areas to the system. These trains are more frequent than conventional commuter lines and still run at faster speeds, albeit slower than longer-distance high-speed rail. In one case, the one-hour Madrid-Seville line captured 50-80 percent of commuters from conventional rail and auto.<sup>28</sup> The Spanish system, however, is only viable with significant public subsidies, especially from the European Union.<sup>29</sup>



**Figure 2-1.** Rail market share (compared with air) against rail travel time for select European intercity transportation corridors. (Chester et al., 2017)

In Germany, the high-speed rail system is designed to complement rather compete with air. Since major cities are situated around 50 km from each other, high-speed rail shares tracks with conventional rail and topography is hilly, frequent stops and slower service define the German network, and high-speed rail cannot compete as well with air.<sup>30</sup> Instead, the high-speed

<sup>27</sup> José M. de Ureña, Manuel Benegas, and Immaculada Mohino, “High-Speed Rail in Spain: Territorial Management and Sustainable Urban Development,” in *High-Speed Rail and Sustainability*, ed. Blas Luis Pérez Henríquez and Elizabeth Deakin (New York: Routledge, 2017).

<sup>28</sup> Ibid.

<sup>29</sup> Ibid.

<sup>30</sup> Werner Rothengatter, “High-Speed Rail and Air Travel Complementary: The Case of Germany,” in *High-Speed Rail and Sustainability*, ed. Blas Luis Pérez Henríquez and Elizabeth Deakin (New York: Routledge, 2017).



rail network complements the air transportation network by providing feeder service to and from airports for medium- and long-distance flights, serving city pairs for which major airlines do not provide service, and offering redundancy in cases where flights are canceled for weather or other issues.<sup>31</sup> The Frankfurt/Main airport hosts a major rail station with connections throughout the country used by over 25,000 passengers a day. Lufthansa and Deutsche Bahn offer integrated air and rail ticketing for travel through the Frankfurt/Main airport.<sup>32</sup>

High-speed rail infrastructure in Italy differs from the previously discussed cases, because there are multiple rail operators. Italy introduced international-quality high-speed rail (at speeds exceeding 150 mph) in 2005 and has built its system on shorter distances between stations, mostly ranging from 100 to 250 km. The trains, however, run at higher speeds than in Spain or Germany—300 km/h with 360 km/h expected in the near future—on dedicated tracks that avoid urban areas. Because of the short distances and higher speeds, traveling by high-speed rail in Italy is more competitive with driving than with flying, which already has minimal service for these connections.<sup>33</sup> In 2012, Italy also became the first country to allow unsubsidized, competitive private high-speed rail services that operate on the same publicly-funded tracks and stations as Italy’s public high-speed rail service. To enable this arrangement, the Italy high-speed rail system is *vertically separated* in that one public agency is responsible for track infrastructure maintenance, traffic management, allocation of rail capacity and track safety. Other public or private rail operators pay charges to use tracks, stations and other infrastructure.<sup>34</sup> From 2009 to 2012, with this competitive structure imminent, the number of destinations increased, service frequency increased, fares decreased as pricing structures became more complex, and high-speed rail modal share increased from 27 to 31 percent.<sup>35</sup>

The United Kingdom is the most recent European country to introduce high-speed rail, connecting London to Paris and beyond. In an evaluation of transportation mode choice for international travelers between London and Paris, Eric Pels and Christiaan Behrens (2012) determine that from 2003 to 2009 the new high-speed rail line drew a large portion of the travel

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<sup>31</sup> Ibid.

<sup>32</sup> Ibid.

<sup>33</sup> Ennio Cascetta and Pierluigi Coppola, “Evidence from the Italian High-Speed Rail Market: Competition between Modes and between HSR Operators,” in *High-Speed Rail and Sustainability*, ed. Blas Luis Pérez Henríquez and Elizabeth Deakin (New York: Routledge, 2017).

<sup>34</sup> Ibid.

<sup>35</sup> Ibid.

demand from airlines, causing changes to total passenger travel and transportation mode choice between the two cities.<sup>36</sup> Pels and Behrens conclude that travel time and frequency—and not fare pricing—are the main factors in deciding a transportation mode on this route, with high-speed rail overtaking air in total trips and inducing further demand.<sup>37</sup> Additionally, the market pressures from high-speed rail created such competition that some low-cost air carriers left the market. With less competition in the air market and further pressure from high-speed rail, the remaining airlines reduced their schedules. In this way, high-speed rail, operated by a single private company under government concession, began to dominate the market. Pels and Behrens suggest that the solution to this potential problem of a monopoly on this route may include methods to create greater competition in the rail sector.<sup>38</sup>

While no international-quality high-speed rail system exists in the United States yet, many public agencies and private developers have proposed plans for lines throughout the country. To support these proposals, these agencies have conducted ridership forecasting, which offers indications as to the competitiveness high-speed rail in the US. A 2008 Federal Railroad Administration analysis of the benefits of high-speed rail on the *Northeast Corridor* between Boston and Washington, DC, compares two scenarios: (1) 3-hour service between Boston and New York and 2.5-hour service between New York and Washington and (2) a half hour shorter for each leg, meaning 2.5 hours and 2 hours for each leg, respectively.<sup>39</sup> Under the first scenario, air ridership would decrease by 10.6 percent and auto ridership would decrease by 0.3 percent. In the second scenario, these values would decrease by 20.3 percent and 0.6 percent respectively.<sup>40</sup> While auto does have a much greater capacity in the corridor than air or the potential high-speed rail, these values also suggest the competitiveness and similarity of high-speed rail with air in this corridor. The authors conclude that, in order to compensate for the lack of door-to-door service and private space offered by auto, high-speed rail must be even more competitive in other factors, such as speed or cost.<sup>41</sup>

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<sup>36</sup> Christiaan Behrens and Eric Pels, “Intermodal Competition in the London-Paris Passenger Market: High-Speed Rail and Air Transport,” 2012.

<sup>37</sup> Ibid.

<sup>38</sup> Ibid.

<sup>39</sup> US FRA, “Analysis of the Benefits of High-Speed Rail on the Northeast Corridor,” 2008.

<sup>40</sup> Ibid.

<sup>41</sup> Ibid.

In synthesizing 210 ridership forecasts from 43 intercity corridors for proposed high-speed rail routes in North America, Benjamin R. Sperry finds that the percentage of airline trips diverted to high-speed rail increases as the maximum speed of the system increases, using a simple linear regression model.<sup>42</sup> The percentage of induced trips and the percentage of diverted auto trips do not vary significantly (Table 2-3). In addition, connectivity between high-speed rail routes also is a major factor in ridership forecasts. Sperry emphasizes that each intercity corridor is unique with market-specific factors and needs.<sup>43</sup>

|                                    | <b>Emerging/<br/>Feeder Routes<br/>(≤ 90 mph)</b> | <b>Regional<br/>Corridors<br/>(≤ 125 mph)</b> | <b>Core Express<br/>(&gt; 125 mph)</b> | <b>MAGLEV<br/>(≈ 300 mph)</b> |
|------------------------------------|---|---|--|-------------------------------|
| Average HSR Mode Share             | 1.0%  | 2.5%  | 8.5%                                   | -- <sup>1</sup>               |
| Average Percent Induced Trips      | 7.4%  | 7.1%  | 7.1%                                   | 8.3%                          |
| Average Percent Auto Trips Shifted | 2.5%  | 3.1%  | 6.0%                                   | 4.1%                          |
| Average Percent Air Trips Shifted  | 11.4%   | 16.0%   | 23.9%                                  | 35.5%                         |

<sup>1</sup>One study, Calgary – Edmonton, reported a MAGLEV mode share of 6.7%

**Table 2-3.** Proposed North American high-speed rail ridership forecasts: 32 estimate of transportation system impacts. (Sperry, 2017)

In summary, the role and viability of high-speed rail depend on a variety of factors, all of which will continue to be discussed further in following sections. High-speed rail has the potential to provide significant service in intercity and even commuter corridors, diverting trips mainly from air but also from auto. Its ability to divert trips and induce trips depends on the length and ease of the journey, which is governed by speed and proximity of a station to a passenger’s origin and destination—temporal and spatial factors. The frequency of stops on a route, the technology used, and sharing tracks with conventional rail (sometimes a necessity for reaching central stations) impact the line’s speed. Institutional dynamics also impact other factors related to the ease of a journey. Service frequency attracts travelers to high-speed rail, and competition among operators may lead to increased frequency, as in Italy and suggested for the London-Paris route. Integrating high-speed rail with other transportation modes at major nodes and stations increases access to the system and its ease of use, as in Germany. Public subsidies may allow a system to connect to less populated regions and attract more diverse sets of passengers, as in Spain. In all, these characteristics define high-speed rail’s ability to attract

<sup>42</sup> Benjamin R. Sperry, “Synthesis of North American High-Speed Passenger Rail Ridership Forecasting” (paper presented at the Transportation Research Board Annual Meeting, Washington, DC, January 8-12, 2017).

<sup>43</sup> Ibid.

passengers, which in turn defines its ability to provide benefits. Without the ability to influence the broader transportation, geographic, social, and economic systems and hold an important societal role, high-speed rail would not serve a relevant purpose.

## 2.2 Benefits and Impacts of High-Speed Rail

This section discusses the benefits and costs of high-speed rail, whether supposed, theorized, expected, or realized. The espoused benefits of high-speed rail remain contested in the literature for various reasons, including the actual value of the benefits, how high-speed rail brings about these benefits in reality and the variation in the construction and operation among high-speed rail lines. Other than benefits during the construction of a project—jobs and other economic investment—high-speed rail must attract passengers, frequently diverting them from air and auto travel, in order to achieve other, longer-term and potentially significant benefits. As discussed in the previous section, high-speed rail’s ability to do so is intimately related to its spatial characteristics.

### 2.2.1 Overarching Themes when Considering Benefits and Costs

Given that high-speed rail projects are costly—on the order of billions to tens of billions of dollars—and frequently require public subsidies, understanding the true benefits of these projects and whether they outweigh their costs is of utmost importance and controversial.

Table 2-4 outlines the benefits and costs frequently considered in the literature.

| Benefits                     | Costs                        |
|------------------------------|------------------------------|
| - Time Savings               | - Construction               |
| - Revenue                    | - Rolling Stock              |
| - Reliability                | - Infrastructure Maintenance |
| - Capacity                   | - Rolling Stock Maintenance  |
| - Environmental Improvements | - Energy                     |
| - Wider Economic Benefits    | - Labor                      |

**Table 2-4.** Benefits and costs described in the literature.

While holding the value that “transport benefits should always be the main outcome of transport investment,”<sup>44</sup> David Banister and Moshe Givoni (2017) recognize that there are larger political issues at play.<sup>45</sup> Through evaluation of arguments for and against High-Speed 2, a high-speed rail extension in the United Kingdom from London to Birmingham and beyond, Banister

<sup>44</sup> David Banister and Mark Thurstain-Goodwin, “Quantification of the Non-Transport Benefits Resulting from Rail Investment,” *Journal of Transport Geography* 19 (2011): 213.

<sup>45</sup> David Banister and Moshe Givoni, “Realising the Potential of HSR: The United Kingdom Experience,” in *High-Speed Rail and Sustainability*, ed. Blas Luis Pérez Henríquez and Elizabeth Deakin (New York: Routledge, 2017).

and Givoni determine that “the era of rational decision making has now passed, and it could be argued that it never existed, as all major infrastructure decisions are essentially political.”<sup>46</sup> Even so, in previous cases stakeholders have attempted to argue based on rational decision-making, economic forecasts and benefit-cost analyses. Now, however, the debate over high-speed rail projects, such as HS2, increasingly are becoming overtly political. As Bent Flyvberg (2010) determines, forecasts for the benefits of infrastructure never embody a perfect science and frequently demonstrate biased optimism, especially on demand and cost estimates. These biases and uncertainties may lead to ineffective decision-making.<sup>47</sup> Concerning High-Speed 2, politicians and government officials have switched from supporting or opposing the project, depending on the opposition party’s stance and role in the review process and seemingly without regard to some of the business community’s opposition to the project. Many environmental groups at first supported the project for its potential to reduce greenhouse gas emissions; however, in learning that the route might interfere with unique natural habitats, their support turned from HS2 to more amorphous goals of policies for wider societal benefits.<sup>48</sup> For Banister and Givoni, the question remains as to whether new understanding of uncertain forecasts and political interests should qualify support of high-speed rail and limit current choices for action.<sup>49</sup>

Two opinion pieces highlight the controversy of evaluating these costs and benefits for proposed high-speed rail lines and systems in the United States. Kenneth Button (2012) advocates caution and realism about the overhyped benefits of high-speed rail. Button argues that defenses of high-speed rail are contradictory. For example, they either support wider economic benefits by more closely connecting major urban economic centers or by connecting remote communities, or they either claim that high-speed rail reduces highway and road congestion or competes best with air. Proponents emphasize the environmental benefits, while their magnitude is unclear, especially when considering the environmental costs related to accessing the high-speed rail system by driving or using other more polluting modes of transportation to reach rail stations.<sup>50</sup> Caution rather than complete abandonment of high-speed rail are key, however, as Button states: “Investments should be carefully targeted and tailored to circumstances. [...

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<sup>46</sup> Ibid., 30.

<sup>47</sup> Bent Flyvberg, *Megaprojects and Risk: An Anatomy of Ambition*, 2010.

<sup>48</sup> Banister and Givoni, “Realising the Potential of HSR.”

<sup>49</sup> Ibid.

<sup>50</sup> Kenneth Button, “Is There Any Economic Justification for High-Speed Rail Railways in the United States?” *Journal of Transport Geography* 22 (2012).

T]hrowing away some arbitrarily determined aggregate sum of money at a hodgepodge of projects is unlikely to produce any major social return.”<sup>51</sup>

In an opinion piece on the value of high-speed rail for the United States, Andrew Ryder (2012) recognizes the high costs and unprofitability of most lines across the world. Additionally, population density is lower and there is no culture of train travel in the United States.<sup>52</sup>

Disagreeing with previously discussed guidance of transportation development for the purpose of transportation benefits, Ryder argues that nevertheless there are still greater benefits to building high-speed rail. While high-speed rail proponents in the US use simplistic, moral and refutable claims of energy savings, auto traffic reduction and job creation to defend proposed projects, Ryder argues for a longer-term perspective that high-speed rail development should be integrated into a broader economic and political program. High-speed rail could influence the foundational structure of urban development in the next decades. Ryder, inspired by the outcomes of the US highway system and the Toronto subway, states: “Just as sugar crystallises [*sic*] on a piece of string in a concentrated solution, in fast growing states, high-speed lines could create an armature around which town, cities and regions could grow.”<sup>53</sup>

Since there are straightforward reasons to consider construction, operation, labor and energy as major costs of high-speed rail systems, the remainder of this section focuses on high-speed rail’s potential benefits and whether they outweigh the significant costs.

### **2.2.2 Time Savings**

Passengers’ time savings compared to their journey time using a different mode of transportation is the foremost direct benefit considered in developing high-speed rail.<sup>54, 55</sup> First, access times to the high-speed rail must be considered as part of the total journey time for door-to-door service.<sup>56</sup> Second and as discussed in previous sections, other factors, including the frequency of stops and the frequency, reliability and speed of service, determine the expected wait times (especially for connecting service) and the length of the journey. Third, it is difficult

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<sup>51</sup> Ibid., 302.

<sup>52</sup> Andrew Ryder, “High Speed Rail,” *Journal of Transport Geography* 22 (2012).

<sup>53</sup> Ibid., 305.

<sup>54</sup> Crozet, “Where High-Speed Rail is Relevant: The French Case Study.”

<sup>55</sup> Chris Nash, “Enhancing the Cost-Benefit Analysis of High-Speed Rail,” in *High-Speed Rail and Sustainability*, ed. Blas Luis Pérez Henríquez and Elizabeth Deakin (New York: Routledge, 2017).

<sup>56</sup> Nash, “Enhancing the Cost-Benefit Analysis of High-Speed Rail.”

to determine to what degree passengers value time, whether stated as a monetary value or as a preference for spending time in certain ways.<sup>57</sup>

In evaluating public transportation values of time, Mark Wardman (2004) explains that a traveler's value of time is the ratio of the marginal utilities of time and money and that the marginal utility of time is comprised of the opportunity cost of time spent traveling and the disutility of this same time spent traveling.<sup>58</sup> The *user type* variation, determined by income, trip purpose and other factors, impacts the marginal utility of money for all time spent traveling, and the *mode valued* variation impacts this value depending on the mode of transportation used.<sup>59</sup> Analyzing empirical evidence, Wardman finds that time spent walking and waiting is valued much more highly than time spent in-vehicle, that time for commuter travel is valued less than time for leisure travel, which is valued less than time for business travel, and that time spent in delays is valued much more than scheduled travel time.<sup>60</sup> In addition, as many passengers spend time working on a train or a plane, the value of time is greater on these transportation modes.<sup>61</sup> Ultimately for applied methods, such as benefit-cost analysis, government and economics agencies provide usable guidelines and values to aid in determining monetary values of time for different passengers and transportation modes.<sup>62</sup>

While determining the inputs to obtain time savings values may be controversial in itself, more difficulties arise when using these values with economic and travel forecasts to determine the time savings a high-speed rail route may produce. The optimism bias and other uncertainties in forecasting described by Flyvberg (2010) play major roles in these results.<sup>63</sup> Analysts may employ more flexible objectives, such as reasonable travel time and travel time reliability, to push back against the positivist commodification of time. Doing so would help account for different personal, cultural and social factors that also impact passengers' experience of time, including differing values of the quality of a transportation service or its ease of use. As Banister and Givoni argue, "The concern with time savings needs to be balanced with a richer interpretation of the many different constructs of time that might begin to increase our

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<sup>57</sup> Ibid.

<sup>58</sup> Mark Wardman, "Public Transport Values of Time," *Transport Policy* 11 (2004).

<sup>59</sup> Ibid.

<sup>60</sup> Ibid.

<sup>61</sup> Nash, "Enhancing the Cost-Benefit Analysis of High-Speed Rail."

<sup>62</sup> Robert Belenky, "Revised Departmental Guidance on Valuation of Travel Time in Economic Analysis," 2011.

<sup>63</sup> Flyvberg, *Megaprojects and Risk: An Anatomy of Ambition*.

understanding of travel decisions, the quality of time and the benefits of slower not faster movement.”<sup>64</sup>

### 2.2.3 Capacity

High-speed rail can provide additional capacity for overcrowded transportation networks. In addition, many lines have been shown to induce demand along intercity routes, increasing economic drivers, such as business meetings and tourism.<sup>65</sup> This reasoning led the investments for the Japanese and French high-speed rail routes.<sup>66</sup> Scholars disagree on whether these benefits to system capacity are sufficient to impact the larger transportation network or are worth the investment. First, other investments into improving conventional rail reliability, comfort, safety and frequency may be less costly and increase access for all travelers more equitably. Additionally, if the funds used to develop high-speed rail lines would have been invested in other infrastructure instead, these investments may negatively impact service and capacity on conventional rail, freight rail and other transportation services.<sup>67</sup> In cases of investing in high-speed rail extensions to add incremental portions to the system and connect it with other lines—conventional or high-speed—the benefits may be significant compared to the incremental cost of the extension. Doing so may add passengers to the existing line, increasing revenues and benefits on the entire route.<sup>68</sup> In cases where a line extension connects to a populous city center and other urban transportation systems, the extension may significantly increase access to the high-speed rail system, a major factor in determining the competitiveness and value of high-speed rail.<sup>69</sup>

Concerning the United Kingdom, Banister and Givoni argue that the proposed High-Speed 2 line would have to run at full capacity upon opening in an ideal, but unlikely, scenario in order to provide sufficient additional capacity to the overall system.<sup>70</sup> This is similar to the issue presented in forecasting the quantity of trips diverted from air and auto due to high-speed rail on the *Northeast Corridor* and discussed in Section 2.1, where only up to 0.6 percent of auto trips

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<sup>64</sup> Banister and Givoni, “Realising the Potential of HSR,” 23.

<sup>65</sup> Roger Vickerman, “High-Speed Rail in Europe: Experience and Issues for Future Development,” *The Annals of Regional Science* 31 (1997).

<sup>66</sup> Banister and Givoni, “Realising the Potential of HSR.”

<sup>67</sup> Nash, “Enhancing the Cost-Benefit Analysis of High-Speed Rail.”

<sup>68</sup> Ibid.

<sup>69</sup> Andrés Monzón, Emilio Ortega, and Elena López, “Efficiency and Spatial Equity Impacts of High-Speed Rail Extensions in Urban Areas,” *Cities* 30 (2013).

<sup>70</sup> Banister and Givoni, “Realising the Potential of HSR”.



would be diverted in part due to the sheer number of auto trips.<sup>71</sup> Running a high-speed rail system at full capacity also negatively impacts system reliability and comfort on board the train, creating negative feedback to the benefits of adding capacity.

#### **2.2.4 Environmental Benefits**

High-speed rail's main environmental costs are noise, land appropriation, visual degradation, and energy consumption from potentially polluting sources.<sup>72</sup> Table 2-5 outlines the energy used for traction for various modes of transportation, depending on a specified load factor. At a 70 percent load factor, high-speed rail uses more energy per passenger-kilometer than an intercity train but less than air or diesel car. Additionally, significant amounts of energy are used during construction, potentially adding 15 percent to the values in Table 2-5 given the same load factors.<sup>73</sup> The greenhouse gas emissions reductions that high-speed rail achieves depend on factors related to the rail system itself and other transportation systems, as Elizabeth Deakin (2017) summarizes clearly in an assessment of high-speed rail's environmental impacts:

“[I]mpacts, such as air pollution reduction and [greenhouse gas] emissions avoidance, will depend on a combination of design, equipment, and operations, choices, how many passengers are attracted to [high-speed rail], and what share of total passengers would otherwise have travelled by car or air. For the latter set of impact calculation, the future performance of cars, highways, aircraft and airports will also determine the comparative performance, and hence the net environmental benefits, of HSR.”<sup>74</sup>

In addition, high-speed rail may attract passengers away from conventional rail, likely a less polluting mode of transportation. High-speed rail, however, may be uniquely effective compared to auto and air travel, because it already runs on electricity. To obtain lower greenhouse gas emissions, the power sources need only to be switched to renewable energy.<sup>75</sup> (This easier transition to renewable energy would be one of the advantages of replacing combustion engines in cars and other vehicles with electric power sources.) Because of the many uncertain factors involved with quantifying environmental benefits for benefit-cost analyses, Chris Nash (2017) concludes: “Environmental benefits are unlikely to be a significant part of the case for high-

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<sup>71</sup> US FRA, “Analysis of the Benefits of High-Speed Rail on the Northeast Corridor.”

<sup>72</sup> Nash, “Enhancing the Cost-Benefit Analysis of High-Speed Rail.”

<sup>73</sup> Ibid.

<sup>74</sup> Elizabeth Deakin, “Environmental Impact of High-Speed Rail California,” in *High-Speed Rail and Sustainability*, ed. Blas Luis Pérez Henríquez and Elizabeth Deakin (New York: Routledge, 2017), p. 275.

<sup>75</sup> Nash, “Enhancing the Cost-Benefit Analysis of High-Speed Rail.”

speed rail when all relevant factors are considered, but nor are they a strong argument against it provided that high load factors can be achieved [...]”<sup>76</sup>

|                                 | <i>Intercity train</i> | <i>High-speed train</i> | <i>Air (500km)</i> | <i>Diesel car on motorway</i> |
|---------------------------------|------------------------|-------------------------|--------------------|-------------------------------|
| Seating capacity                | 434                    | 377                     | 99                 | 5                             |
| Load factor                     | 44%                    | 49%                     | 70%                | 0.36                          |
| Primary energy (MJ per seat km) | 0.22                   | 0.53                    | 1.8                | 0.34                          |
| (MJ per passenger km)           | 0.5                    | 1.08<br>(0.76*)         | 2.57               | 0.94                          |
| Source: CE Delft (2003)         |                        |                         |                    |                               |
| *At 70% load factor             |                        |                         |                    |                               |

**Table 2-5.** Energy consumption used for traction only by mode 2010. (CE Delft, 2003)

In undertaking a more detailed life cycle assessment for high-speed rail, Mikhail Chester et al. (2017) determine that high-speed rail should begin to realize net greenhouse gas emissions reductions in the third decade after the commencement of construction.<sup>77</sup> In California, for example, net emissions reductions may occur earlier in the timeline of the project since the California High-Speed Rail project has committed to zero net greenhouse gas emissions during construction and 100 percent renewable energy during operations. As part of broader, statewide initiatives for greenhouse gas reduction, suppliers’ materials and practices also should minimize their carbon footprint.<sup>78</sup>

In Spain, simulations concluded that passengers traveling by high-speed rail had avoided 6.5-15 percent of their greenhouse gas emissions even accounting for induced demand. Already in 2009, the RENFE, the Spanish railway operator, used an energy mix for traction rolling stock with 29 percent renewable sources.<sup>79</sup> Many of these forecasts and simulations, however, do not consider how passengers access the high-speed rail system. In discussing the faults of shelved high-speed rail proposals in France, Crozet (2017) adds:

“12 years of [high-speed rail] traffic would be necessary to offset the emissions produced during construction alone; additional years of traffic would be necessary to offset the emissions produced in the manufacture of construction materials such as concrete and steel. Some of the proposals had train stations

<sup>76</sup> Ibid., 180.

<sup>77</sup> Chester et al., “Uncertainties in the Life Cycle Assessment.”

<sup>78</sup> Deakin, “Environmental Impact of High-Speed Rail California.”

<sup>79</sup> Ureña et al., “High-Speed Rail in Spain.”

built in suburban areas; access to the stations could actually promote driving.”<sup>80</sup>

(Further discussion on the importance of rail stations as part of a high-speed rail infrastructure system follows in Section 2.3.2.)

### **2.2.5 Spatial Impacts of High-Speed Rail, Agglomeration and Wider Economic Benefits**

It has become increasingly common for high-speed rail proponents to emphasize the general economic benefits—employment, regeneration, connected economic systems and regional distribution of economic growth—in defense of these projects.<sup>81</sup> For example, one of the main motivations for the High-Speed 2 between London and Birmingham is to improve productivity in key economies through the more direct connection to the economic strength of the London area.<sup>82</sup> These expected *wider economic benefits* and their geographic distribution are especially controversial and are of special relevance to this thesis, and these benefits and their equitable distribution rely on two foundational concepts: agglomeration and connected, polycentric urban development.

Agglomeration benefits concern evidence for accessible locations enabling higher levels of labor productivity than less accessible locations because of the geographic proximity of firms to each other.<sup>83</sup> A variety of possible circumstances may lead to economies of agglomeration, including better allocation of workers to positions appropriate to their skills, economies of scale in specialized services, such as legal or financial services, and increased opportunities of individuals meeting, whether planned or by chance, and then sharing and expanding knowledge.<sup>84</sup> The ability of high-speed rail to support the economies of agglomeration is based on its ability to increase capacity and connectivity to generate net increases in employment and productivity, not just a redistribution of employment from one location to another. Some theorists argue that in the already perfectly competitive economy (unlikely to exist in reality), where there is no involuntary unemployment, there would be no agglomeration benefits from increased movement due to a new high-speed rail line; however, there still may be benefits from knowledge-sharing.<sup>85</sup>

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<sup>80</sup> Crozet, “Where High-Speed Rail is Relevant: The French Case Study,” pp. 62-63.

<sup>81</sup> Banister and Givoni, “Realising the Potential of HSR”.

<sup>82</sup> Button, “Is There Any Economic Justification for High-Speed Rail Railways in the United States?”

<sup>83</sup> Nash, “Enhancing the Cost-Benefit Analysis of High-Speed Rail.”

<sup>84</sup> Ibid.

<sup>85</sup> Ibid.

High-speed rail may promote benefits of agglomeration in that it may radically impact urban development at different physical and temporal scales. U. Blum, K.E. Haynes and C. Karlsson (1997) discuss two different accessibility problems high-speed rail may address at the regional scale. First, high-speed rail may serve as a point-to-point link, equivalent to an air connection between two cities. The high-speed rail networks in Japan and France, as discussed in Section 2.1, express this relationship between high-speed rail and an urban spatial structure that is polycentric on the regional level.<sup>86</sup> Second, high-speed rail may link together many more closely situated cities or business districts, creating a regional band or corridor of cities with high accessibility. The high-speed rail networks in Germany and Spain, which facilitate shorter trips and serve more commuters as discussed in Section 2.1, express this relationship between high-speed rail and an urban spatial structure that is polycentric within regions, centered around the rail stations themselves.<sup>87</sup> In these ways, high-speed rail connects towns, cities and regions into larger urban agglomerations, which in turn provides greater economic integration and free market competition upon which economies of agglomeration are based.

David Banister and Mark Thurstain-Goodwin (2011) recognize that, while agglomeration benefits are secondary outcomes to the benefits of time savings, transportation capacity and connectivity, they are frequently necessary to quantify and consider in benefit-cost analyses in order to obtain positive net present values, accounting for optimism bias. In doing so, Banister and Thurstain-Goodwin separate these benefits into three spatial levels. Macro-economic effects refer to the link between infrastructure investment and economic growth, measured by gross domestic product (GDP).<sup>88</sup> At this level, public investment in infrastructure may increase private capital returns, thereby encouraging more private investment. Much research and modeling has been conducted on this hypothesis with limited conclusive results. It is difficult to determine causality—whether investment leads to GDP growth or vice versa—and it is apparent that many other factors contribute to GDP growth or decline.<sup>89</sup> Meso-economic effects refer to agglomeration effects at the city scale and are frequently quantified. These agglomeration benefits may be quantified by the urbanization effects—increase in population associated with a

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<sup>86</sup> U. Blum, K.E. Haynes, and C. Karlsson, “The Regional and Urban Effects of High-Speed Trains,” *The Annals of Regional Science* 31 (1997).

<sup>87</sup> Ibid.

<sup>88</sup> Banister and Thurstain-Goodwin, “Quantification of the Non-Transport Benefits.”

<sup>89</sup> Ibid.

disproportionate increase in productivity—and the localization effects—increase in employment density.<sup>90</sup> Micro-economic effects refer the link between infrastructure development and a rise in values of properties within a short distance, such as a half-mile, of a rail station. These effects are discussed in greater detail in Section 2.3.

Daniel J. Graham (2007) develops a model of agglomeration benefits—a relationship between the density of economic activity and productivity—in the UK economy in order to determine whether there are deficiencies in standard transportation evaluations. Graham summarizes the work of Anthony J. Venables (2004), which demonstrates that the elasticity of productivity with respect to agglomeration can signal the extent of agglomeration benefits, shown as an outline in Figure 2-2. In Figure 2-2, “Figure 1a” shows urban equilibrium where the size of the city occurs at  $X$ . In this model, wages are consumed completely by a combination of rent and commuting cost, dependent on the distance of the worker’s home to the central business district. “Figure 1b” shows the benefits from a transportation improvement that lowers the commuting costs, expanding the size of the city to being at point  $X^*$ . There is a change in commuting costs of  $\eta - \alpha$ , and the total value of all wages increase by  $\beta + \eta$ , leaving a net benefit of  $\alpha + \beta$ , equal to  $(\beta + \eta) - (\eta - \alpha)$ . In “Figure 1c”, it is assumed that larger cities have greater productivity due to agglomeration benefits; therefore, the wage gap is modeled by a (concave) curve rather than a constant. In this case, the real income gain from the transportation improvement is  $\alpha + \beta + \partial$ , since  $\partial$  includes the increase in wages for the workers due to agglomeration benefits.<sup>91</sup>

Graham aims to measure  $\partial$  for sectors of the economy in the UK, which is correlates with the elasticity of productivity with respect to city size. Across these industries, Graham determines that there consistently are increasing returns to agglomeration. (Only the rubber and medical equipment have significant but negative elasticities.) The service industries have the highest elasticities—higher than manufacturing—with respect to agglomeration, with a weighted average of 0.197 (weighted by proportion of service jobs in each industry).<sup>92</sup> Graham questions whether the magnitude of these benefits from transportation investment would be significant compared to other benefits, such as time savings. He judges that they are likely not trivial, but

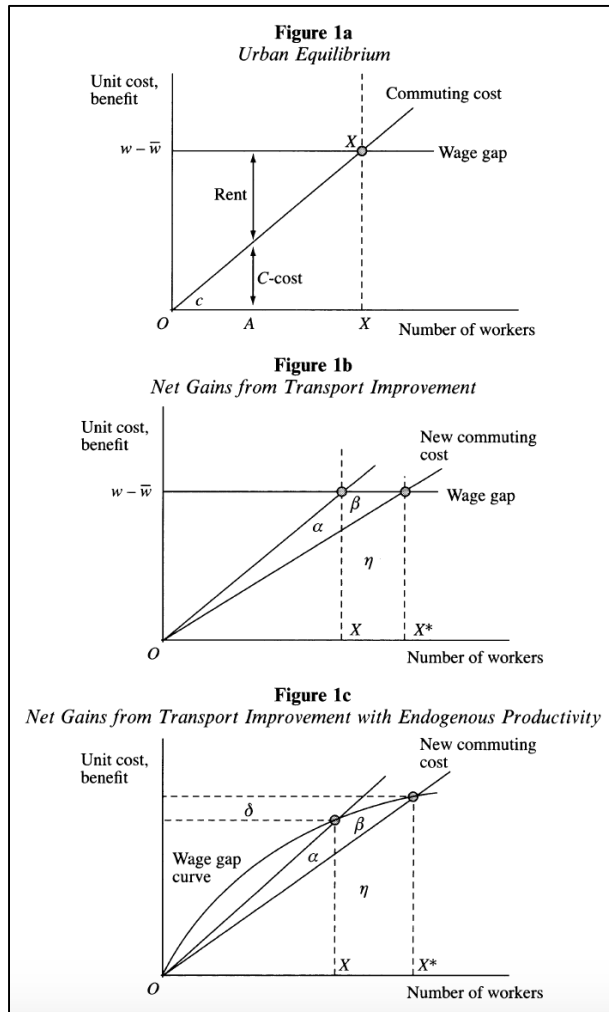
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<sup>90</sup> Ibid.

<sup>91</sup> Daniel J. Graham, “Agglomeration, Productivity and Transport Investment,” *Journal of Transport Economics and Policy* 41 (2007).

<sup>92</sup> Ibid.

the nature of these benefits, depends on the nature of the transportation investment. Agglomeration benefits are most likely to occur where transportation investment increases the density of industry, employers and employees within a certain travel time of each other.<sup>93</sup>



**Figure 2-2.** Graham’s outline of Venable’s agglomeration benefits model. (Graham 2007)

In considering agglomeration benefits at the inter-regional scale rather than intra-regional scale, Daniel J. Graham and Patricia C. Melo (2011) investigate how a polycentric urban system in the UK promoted by high-speed rail may bring about these benefits. With the understanding that the “geographical scope of agglomeration economies will depend on the rate at which these flows decrease with distance,”<sup>94</sup> Graham and Melo expect that “in the case of interurban connections, most of the arguments linking transport to agglomeration could hold in the sense

<sup>93</sup> Ibid.

<sup>94</sup> Daniel J. Graham, and Patricia C. Melo, “Assessment of Wider Economic Impacts of High-Speed Rail for Great Britain,” *Journal of the Transportation Research Board* 2261 (2011): 16.

that if spatial interactions between economic agents are made more efficient then increasing returns can be expected.”<sup>95</sup> The authors, however, also recognize the phenomenon developed in empirical research where agglomeration economies decay with distance. Contemporaneous methodology employed by the UK Department for Transport assumed that the decay effect for these benefits was constant.<sup>96</sup> Unlike with intraregional agglomeration benefits, Graham and Melo determine that the magnitude of inter-regional agglomeration benefits in the UK to be small—0.02-0.19 percent of the UK’s GDP.<sup>97</sup>

Chia-Lin Chen and Peter Hall (2011), however, develop different conclusions when comparing changes in economic growth in cities that were brought within one or two hours of London by the InterCity 125/225 train, which ran at relatively high speeds, with cities that were not served by this new high-speed line. According to Chen and Hall, high-speed train services seem to have reinforced cities brought closer to London and its knowledge economy. Substantial and demonstrable effects occurred in a significant majority of cities within a two-hour travel distance of London, with population increasing, unemployment rates decreasing and the wealth of residential populations increasing compared to the national average. In contrast, cities that were left unconnected to the new high-speed system experienced weaker than average economic performance and reversed trends.<sup>98</sup> Additionally, Chen and Hall find a trend in reverse commuting from London to cities within a one- or two-hour distance by higher-speed train from London. This implies a need for “finer-grained and deeper-probing analysis at an intra-regional level of the potential for rail improvement as an agent of change in city-region development.”<sup>99</sup>

As Chen’s and Hall’s conclusions suggest, the distribution of agglomeration impacts and benefits, may not be as intended or expected and may not be equitable among central and intermediate cities. In an influential paper, Roger Vickerman (1997) discusses how this redistribution of economic growth and power to intermediate cities may not occur in reality. In fact, further benefits generated by high-speed rail are siphoned off from intermediate cities to the larger and already more influential cities that anchor the metropolitan areas. Vickerman proposes that the term *tunnel* rather than *corridor* more appropriately describes the regional connections

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<sup>95</sup> Ibid., 18.

<sup>96</sup> Ibid.

<sup>97</sup> Ibid.

<sup>98</sup> Chia-Lin Chen and Peter Hall, “The Impacts of High-Speed Trains on British Economic Geography: A Study of the UK’s InterCity 125/225 and Its Effects,” *Journal of Transport Geography* 19 (2011).

<sup>99</sup> Ibid., 704.

high-speed rail develops: “The regional development effects are therefore likely to be concentrated, airport style, around stations. Some of these may involve transfers from other locations along the corridor which suffer a reduction in overall accessibility.”<sup>100</sup> Better regional planning is necessary to mitigate these potential negative impacts. When considering these inequitable effects on the urban scale within a city, Nash (2017) discusses the example of the Channel Tunnel Rail Link in the UK. In this case, the area in greatest need of regeneration was in a central location, close to the high-speed rail station. In other cases, however, if the “depressed areas are at the periphery [of a city], the effect may be for the peripheral areas to further lose activity to the central ones, the opposite of what is desired.”<sup>101</sup> Even in cases where agglomeration benefits are distributed among cities or business districts more fully, agglomeration economies may become too strong and detrimental to a city. Blum et al. (1997) warn against the prospect of too much specialization for each business area connected in a high-speed rail system. With a loss in economic service diversity, each urban area exposes itself to greater risk in cases where an industry falters.<sup>102</sup>

Jin Murakami and Robert Cervero (2017) analyze the regional distribution of agglomeration impacts in Japan in order to inform predictions of such impacts on the *Northeast Corridor* and California where high-speed rail lines are proposed in the United States. Murakami and Cervero determine that the magnitude and nature of agglomeration impacts along the Tokaido Shinkansen line in Japan depend on the economic and business environment already around (within 5 km of) the high-speed rail station. Economic development impacts were concentrated in large, globally-connected business centers and regional service centers, while edge and other intermediate cities, such as Odawara and Shizuoka, did not experience economic development benefits, because of their manufacturing economic bases. As these stops were less attractive to business travelers, JR Central, the Tokaido line’s operator, introduced service that skipped these stops to replace service that made every stop.<sup>103</sup> Murakami and Cervero expect similar outcomes in the United States, because there are similar geographic and economic conditions as those in Japan.<sup>104</sup>

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<sup>100</sup> Vickerman, “High-Speed Rail in Europe: Experience and Issues for Future Development,” 35.

<sup>101</sup> Nash, “Enhancing the Cost-Benefit Analysis of High-Speed Rail,” 175.

<sup>102</sup> Blum, Haynes, and Karlsson, “The Regional and Urban Effects of High-Speed Trains.”

<sup>103</sup> Jin Murakami and Robert Cervero, “High-Speed Rail and Economic Development,” in *High-Speed Rail and Sustainability*, ed. Blas Luis Pérez Henríquez and Elizabeth Deakin (New York: Routledge, 2017).

<sup>104</sup> Ibid.



While these risks to intermediate cities connected to high-speed rail networks are significant, these cities may be able to convert these same issues to their favor. José M. de Ureña, Philippe Menerault and Maddi Garmendia (2009) analyze big intermediate cities between metropolitan areas in Spain and France through a multilevel perspective, accounting for the national, regional and local scopes (equivalent to the macro-, meso- and micro-economic levels discussed by Banister and Thurstain-Goodwin (2011)). Ureña et al. determine that, on a regional level, a big intermediate city may increase in importance and centrality in relation to smaller cities within the region.<sup>105</sup> This is especially true with development of regional, short-distance high-speed or improved conventional rail between the larger intermediate city and other regional cities. In France and Spain, such integrated systems have reduced travel times within these regions by 50 percent. In France, high-speed and conventional trains are able to run on the same tracks and are priced at equivalent levels. In Spain, high-speed trains must have dedicated tracks, so fares are more expensive but service is more frequent than in France.<sup>106</sup> These opportunities for intermediate or peripheral cities also may exist even on the urban or local scale. José M. de Ureña et al. (2010) analyze economic development near high-speed rail stations within 100 km of Madrid and London. These areas already well-integrated into the metropolitan area; however, with these new high-speed rail stations, they became special sub-centers within the metropolitan region, facilitating a disproportionate level of office activities than surrounding urban areas.<sup>107</sup> One issue that arises from these conclusions considers the fact that, even if these intermediate cities or peripheral urban areas become central economic areas for smaller or less integrated cities and urban area, they might simply be pushing the inequitable distribution of agglomeration economies further into the urban periphery.

In order to reconcile the issues of economic growth through agglomeration economies and the equitable distribution of such growth, Andrés Monzón, Emilio Ortega and Elena López (2013) propose a methodology to assess both the efficiency and equity implications of high-speed rail projects. First, an accessibility metric is calculated under both a no-action scenario and a high-speed rail development scenario. The accessibility value for a location is the sum of the

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<sup>105</sup> José M. de Ureña, Philippe Menerault, and Maddi Garmendia, “The High-Speed Rail Challenge for Big Intermediate Cities: A National, Regional and Local Perspective,” *Cities* 26 (2009).

<sup>106</sup> Ibid.

<sup>107</sup> J. M. de Ureña, M. Garmendia, J.M. Coronado, R.W. Vickerman, and V. Romero. “New Metropolitan Processes Encouraged by High-Speed Rail: The Cases of London and Madrid” (paper presented at WCTR, Lisbon, July 11-15, 2010).

size of a destination (either population or GDP) divided by the generalized travel time, which accounts for accessing a rail station and penalties for transferring between transportation modes, for each destination. Second, an efficiency analysis is conducted by calculating the change in percentage between the accessibility value under the no-action and high-speed rail development scenarios for each location. Third, an equity analysis for each scenario is conducted by calculating the standard deviation of all the accessibility values weighted by population.<sup>108</sup> To validate this methodology, Monzón et al. apply it to the proposed Spanish Strategic Transport and Infrastructure Plan of 2005-2020. Under the efficiency analysis, the level of accessibility increases by an average of 42.4 percent between the no-action and high-speed rail scenarios. The large cities with the highest levels of accessibility under the no-action scenario experience the lowest percentages of improvement. Under the equity analysis, the coefficient of variation decreases from 0.39 in the no-action scenario to 0.30 in the high-speed rail scenario, a 23.1 percent reduction, indicating significant increase in equity.<sup>109</sup> This improvement in economic equity is realized more effectively through Spain's popular but financially unprofitable policies of using high-speed rail to connect commuter areas, periphery regions, regional capitals, and areas with low-density populations, which contrasts with the high-speed rail systems in other countries, such as France and Japan as discussed in 2.1. In addition, these changes toward equity are not distributed consistently throughout the country, and Monzón et al. emphasize the need to consider these factors with greater attention when planning high-speed rail systems.<sup>110</sup>

In working to mitigate the inequitable distribution of agglomeration benefits, Catherine L. Ross and Myungje Woo (2012) consider the second regional model established by Blum et al. (linking together more closely situated economic centers to create a corridor of high intraregional accessibility) and describe the *megaregion* in the United States. Ross and Woo define a megaregion as “networks of connected metropolitan centers and their surrounding areas spatially and functionally linked through environmental, economic, and infrastructure interactions”<sup>111</sup>, which meet the following two criteria: functional interactions between regions, indicated by commodity flow, and high traveler movement between regions, indicated by air passenger

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<sup>108</sup> Andrés Monzón, Emilio Ortega, and Elena López, “Efficiency and Spatial Equity Impacts of High-Speed Rail Extensions in Urban Areas,” *Cities* 30 (2013).

<sup>109</sup> Ibid.

<sup>110</sup> Ibid.

<sup>111</sup> Catherine L. Ross and Myungje Woo, “Identification and Assessment of Potential High-Speed Rail Routes from Megaregion Perspective,” *Transportation Research Record* 2307 (2012): 32.

flow.<sup>112</sup> In the United States, megaregions house more than 76 percent of the total population and employment but occupy only 30 percent of the total land area.<sup>113</sup> Given the importance and prior connectivity within a megaregion, Ross and Woo assert that the best policy would be to invest in high-speed rail systems contained within a megaregion in order to address any equity problems of certain locations or populations being excluded by a high-speed rail system. According to Ross and Woo,

“A megaregion offers a framework for interjurisdictional cooperation, planning and development, funding and investment decisions, and policy development and priorities. Cities anchor megaregions and form an economic unit in world markets that serves a vital and expanded role in the functioning of countries, communities, and regions. In particular, megaregions are an appropriate framework within which to direct infrastructure investment and enhance competitiveness. They provide a mechanism linking infrastructure with economic growth focused on productivity, transformation, mobility, sustainability, and access across borders, including national ones. The positioning and targeting of selected trade corridors, gateways, and economic and population centers has the potential to change the competitive posture and positioning of geographic areas through coordinated transportation, housing, energy policies, and improved natural resources management.”<sup>114</sup>

José M. de Ureña, Manuel Benegas and Immaculada Mohíno (2017) analyze the Spanish high-speed rail system and conclude that high-speed rail has offered significant wider economic benefits, especially in big cities in areas surrounding central stations.<sup>115</sup> In medium-sized cities, such as Córdoba and Zaragoza where stations are located at the center or center-edge of the city, high-speed rail has impacted the overall city structure. High-speed rail has reinforced their historic centers, revitalized major urban redevelopment projects, diversified urban activities and increased public amenities, such as conference centers and bus services.<sup>116</sup> In these ways, the urban and agglomeration impacts and benefits of high-speed rail depend importantly on the location of the rail station, which will be discussed in Section 2.3. Ureña et al. do recognize that high-speed rail alone does not achieve these benefits automatically; local actors must work and cooperate to integrate high-speed rail within the local economic and physical environments. They offer three groups of strategies that these local actors can take to capture the potential wider

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<sup>112</sup> Ibid.

<sup>113</sup> Ibid.

<sup>114</sup> Ibid., 32.

<sup>115</sup> Ureña, Benegas, and Mohíno, “High-Speed Rail in Spain.”

<sup>116</sup> Ibid.

economic benefits: planning, management and promotional measures.<sup>117</sup> Planning measures are undertaken before the high-speed rail line is built and should minimize the negative impacts of the rail station's location and promote development in the surrounding area. Management measures include providing new intermodal connections at the station and revitalizing land development in the station's vicinity. Promotional measures improve the local image by attracting tourists, recruiting business activity and publicizing the newly modernized city.<sup>118</sup>

As Murakami and Cervero (2017) conclude that “the economic development impacts of [high-speed rail] investment in major city-regions of the United States are likely to be more redistributive than generative, unless there are major interventions to change direction”, they also offer strategies for leveraging economic development potential in more equitable ways, since “[high-speed rail’s] business relocation effect within one region need not be a simple ‘zero-sum’ game”.<sup>119</sup> In addition, Murakami and Cervero explain the importance of doing so:

“Some observers maintain that the direct user benefits of new [high-speed rail] and local transit systems alone will unlikely be large enough to cover the full lifecycle costs of [these] investments in a traditionally automobile-oriented society like the US. External accessibility and agglomeration benefits, if leveraged by proactive public policies that reward efficiencies and appeal to high value-added businesses, could help tilt the benefit-cost equation in HSR’s favour. The net economic impacts of HSR investments will likely be negative unless public policies appropriately guide market shifts to station catchment areas that, based on Japan’s experiences, offer comparative business advantages.”<sup>120</sup>

The four recommended policy responses Murakami and Cervero offer are:

1. Efficiently link central business districts, edge cities, international airports and tourist destinations to guide polycentric development as a means of developing a globally competitive region. To achieve this, planning must move to the state, sub-state and inter-state levels, as local governments and metropolitan planning organizations are too geographically constrained.
2. Enact pro-business state assistance through “permissive zoning, targeted public infrastructure investments, expanded and improved feeder bus services that tie into HSR

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<sup>117</sup> Ibid.

<sup>118</sup> Ibid.

<sup>119</sup> Murakami and Cervero, “High-Speed Rail and Economic Development,” 251.

<sup>120</sup> Ibid., 251.

stations, flexible funding programmes, and expedited environmental reviews.”<sup>121</sup> Explore ways to pursue these goals aggressively, such as using eminent domain.

3. Pursue joint development opportunities for land value capture in order to finance the public infrastructure. This can aid in capturing portions of the accessibility and agglomeration benefits for the infrastructure developer.
4. Carry out transit-oriented development with the support of public policy.<sup>122</sup>

These strategies, which are echoed throughout the literature are discussed in greater detail in the following section (Section 2.3).

### **2.2.6 Summary of High-Speed Rail’s Benefits and Impacts**

As discussed in Section 2.1, how high-speed rail is planned, built and operated on the regional, national and international levels varies throughout the world. Depending on its context, the benefits and costs realized once a project is complete vary significantly. Section 2.2 discusses these benefits and costs, the theories that lead to understanding their significance and impacts, and strategies to maximize positive and equitable impacts. To qualify the entire discussion, it is important to note that governments and other infrastructure developers use forecasts and estimates of potential benefits and costs to inform decisions about whether or not to build a project. In reality, the forecasts and estimates used may include unreasonable and optimistic biases and assumptions.

Time savings, an important transportation benefit, depends on the total journey time for a high-speed rail trip, including access times to and from a station, and on passengers’ value of time. Capacity increases to the greater transportation network, while a frequently cited reason in the literature for building high-speed rail, may be less significant than other benefits. In addition, there may be other ways, such as investing in conventional rail, to achieve similar benefits at lower costs. During construction, environmental costs may be large, but reductions in air pollution and greenhouse gas emissions due to travelers diverted from more polluting modes (air and auto), may exceed these costs significantly. These environmental benefits also depend on the type of energy used to produce the electricity used for traction throughout the system. Finally, high-speed rail has the potential to transform local, regional, national and international urban development. In doing so, it may achieve significant wider economic benefits from economies of

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<sup>121</sup> Ibid., 252.

<sup>122</sup> Ibid.

agglomeration; however, it is difficult and controversial to quantify these benefits and, in many cases, they are not distributed equitably throughout regions and even cities. In order to ensure a more equitable distribution, high-speed rail systems should be integrated into the communities and urban areas they serve. Local governments must coordinate and cooperate with other regional governments and stakeholders to create urban development plans that leverage the high-speed rail system.

In reality, each of these benefits and costs and their concomitant considerations interact with each other in various positive or negative ways. For example, promoting equitable distribution of economic benefits by connecting more locations to the high-speed rail system may decrease overall time savings, increase construction and maintenance costs, and increase local environmental costs of noise and particulate matter pollution. If, however, this is done by ensuring proper siting of a local station, the economic benefits from agglomeration economies and improved local image may exceed these costs. Monzón et al. (2013) describe the complexity and interconnectedness of these interactions: “The spatial organization [of a region or city] changes to take advantage of the increased attractiveness of the newly-connected location, in a dynamic process where involving simultaneous and multilevel impacts in the economic, social and environmental spheres.”<sup>123</sup>

## **2.3 Rail Stations and Local Land and Economic Development**

Rail stations are essential components rail systems, including high-speed rail systems. While at a fundamental level they offer access points to the means of movement, rail stations truly serve as connections between the infrastructure system and the surrounding environment: the urban fabric, the political system and the economic system, among others. The discussion presented in Sections 2.1 and 2.2 hint at and refer to these relationships and the importance of rail stations to achieving the objectives of high-speed rail. This section investigates these issues more deeply.

### **2.3.1 Rail Stations as Independent Public Spaces and Infrastructure**

A rail station—*independent of other rail infrastructure*—plays an important role in the public urban, economic and political systems. Matthew Alexander and Kathy Hamilton (2015) discuss these connections and evaluate how communities reclaim, customize and re-appropriate

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<sup>123</sup> Monzón, Ortega, and López, “Efficiency and Spatial Equity Impacts of High-Speed Rail,” 18.

stations in Scotland. To Alexander and Hamilton, rail stations can serve to provide a sense of *place*—a physical location where that provides a sense of belonging for something or someone—to a community. Historically, as railways expanded in the 1800s, stations became central, imposing and essential monuments built with grand architecture. Not only did they function on such large scales, they also served an intimate role in community and personal life, facilitating boarding and alighting trains, arriving at and departing from a known city or town, and meeting or leaving family, friends and acquaintances. In the 1900s, however, as architects and planners have taken a more functionalist approach, rail stations have earned a negative, repulsive reputation—becoming “non-places”.<sup>124</sup> Most recently, preservation movements and renewed interest in developing dense, exciting, pleasant and walkable urban spaces have refocused attention on the benefits rail stations may provide. Alexander and Hamilton cite studies that have shown such interest, such as passengers stating a willingness to wait seven minutes longer and travel ten minutes farther to reach a station with greater aesthetic value.<sup>125</sup> Increasingly, global firms in the private sector also have sought to break down the homogenous image to a more local one through marketing the sense of place in their products and development projects.<sup>126</sup>

Jaymes Phillip Dunsmore (2012) considers this concept of a rail station as a central public space to evaluate the positive and negative aspects of rail stations and public spaces in New York City and London and to develop design principles for the future redevelopment of Union Station in Downtown Los Angeles. Dunsmore describes five key elements for convergent city spaces: connectivity, vibrancy, authenticity, *imageability* and flexibility. These elements must support and reinforce each other to create an effective, attractive public space.<sup>127</sup> Public spaces must remain connected to transportation systems, provide accessible pedestrian connections and maintain visual connections to public spaces and sites beyond. To create vibrancy, public spaces must host activity and movement as well as places for respite. Street widths should be narrow and buildings should be inviting and aesthetically pleasing. Public spaces should remain authentic by drawing on the history of the site and have imageability—the ability to evoke a strong image in an observer—by establishing clear paths through the space,

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<sup>124</sup> Matthew Alexander, and Kathy Hamilton, “A ‘Placeful’ Station? The Community Role in Place Making and Improving Hedonic Value at Local Railway Stations,” *Transportation Research Part A* 82 (2015): 67.

<sup>125</sup> Ibid.

<sup>126</sup> Ibid.

<sup>127</sup> Jaymes Phillip Dunsmore, “Next Great American Station: Union Station and Downtown Los Angeles in the Twenty-First Century” (Master’s Thesis, MIT, 2012).

preserving views to landmarks and fostering a unique district image. Finally, public spaces should be flexible, allowing the public to use it according to its needs for brief or extended periods of time and for multiple functions.<sup>128</sup>

Rebecca J. Heywood (2016) also recognizes the importance of a rail station as an independent component of the infrastructure system and describes how the design of a station may impact its ability to function effectively in the infrastructure system. In addition to focusing on the design and aesthetics of station concourses, rail platforms also must provide sufficient space for alighting and boarding passengers and have sufficient stair, escalator and elevator connections to provide for quick and smooth passenger movement.<sup>129</sup> In-station wayfinding should provide passengers visible and clear information. This is especially important for infrequent passengers, such as tourists, who may impede the movement of passengers, and for promoting a feeling of safety within the station.<sup>130</sup> Stations also must facilitate smooth transfers for passengers. In evaluating the cost of a trip—in money and time—analysts frequently consider a *transfer penalty* if a passenger must transfer between vehicles, operators or transportation modes. The impediments transfers impose can be significant and a major motivation for travelers' route and mode choices. In order to minimize these costs to passengers, rail stations, especially those that host multiple rail operators or modes of transportation, should integrate operators' infrastructure and coordinate fares, ticketing, and wayfinding.<sup>131</sup>

In discussing high-speed rail stations as transportation nodes and places, Anastasia Loukaitou-Sideris and Deike Peters (2017) highlight the Spanish and German models as effective in place-making and operations efficiency: “[W]hile the HSR stations in Germany and Spain often incorporate services similar to those found in an airport (e.g., first-class lounges, boarding areas, luggage services, etc.), the most successful European stations are not designed as airports (inward-oriented and cut-off from the rest of the city). Instead, they are designed as both functional transportation nodes and outward-oriented, social hubs with high levels of connectivity and good integration with the surrounding city fabric.”<sup>132</sup>

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<sup>128</sup> Ibid.

<sup>129</sup> Heywood, “Multi-Scale Regional Transportation Governance.”

<sup>130</sup> Ibid.

<sup>131</sup> Ibid.

<sup>132</sup> Loukaitou-Sideris and Peters, “High-Speed Rail Stations as Transportation Nodes and Places,” 351.



### 2.3.2 High-Speed Rail and Rail Stations: The Importance of Location

The location and placement of high-speed rail stations impacts its competitiveness with other modes of transportation and its ability to achieve its objectives, whether time savings, improved transportation capacity, environmental benefits or wider economic benefits. Achieving each of these objectives, however, may require different actions with regard to rail station placement and function. For example, increasing the number of stops on a high-speed rail line and locating the stations within urban areas may distribute wider economic benefits more equitably and increase accessibility but also may extend the journey time, reducing time savings and high-speed rail's competitiveness with other transportation modes. Within the literature, however, there is consensus that the aim should be to locate high-speed rail stations as close to urban centers as possible, in order to promote accessibility and wider economic benefits wherever a high-speed rail line stops.

As discussed previously in this chapter, high-speed rail's ability to compete with air and auto depends primarily on its journey time relative to these other modes of transportation in addition to other factors, such as cost and comfort. A shorter journey produces the benefit of *time savings*; however, the total door-to-door time of a journey depends not only upon the speed of train but also the time it takes passengers to access the high-speed rail system. Vickerman (1997) connects the issue of access with the location of high-speed rail stations: "However good the high-level international and interregional network is, for firms and individuals in the region, the critical factor will be how easy it is to access that network. Thus, [...] the existence and location of high-speed rail stations is an essential factor in improving a whole region's access [...]"<sup>133</sup> To reduce access time and the total duration of a journey, the high-speed rail system should promote *connectivity*, potentially by stopping more frequently, which in turn slows service. Hugo M. Repolho, Richard L. Church and António P. Antunes (2016), who develop a planning model that considers both station location and fleet and scheduling design, describe the conflicts presented in this dynamic relationship between passenger demand and service:

"The number and location of stations influences the ridership captured by the rail service. More stations imply less access time to rail services and therefore greater ridership. Conversely, more intermediate stations along a given passenger route adds to transit time by increasing the time spent at these stations and additional time spent in accelerating and braking phases for each

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<sup>133</sup> Vickerman, "High-Speed Rail in Europe: Experience and Issues for Future Development," 36.

stop. This increase in travel time may lead to a decrease in ridership. Hence, each additional station increases local demand (because access to service improves) but diminishes global demand (because travel times grow).”<sup>134</sup>

In order to limit the frequency of stops but also to maximize accessibility to the system, Banister and Givoni (2017) emphasize the importance of connectivity between the high-speed rail system and other modes of transportation: “To compensate for the low number of stations, HSR should be fully integrated with the rest of the transport network, and it is this integration that will increase connectivity, namely the ease of getting from trip origin to many destinations.”<sup>135</sup> Integrating high-speed rail into the greater transportation network likely entails building the stations in the center of cities, where public transit networks usually are concentrated.<sup>136</sup> (It may also mean building high-speed rail stations at airports, as is the standard practice in Germany.) In other cases, such as in the United States, this may be less necessary. Deakin (2017) notes that many Californian metropolitan areas do not have a dominant central district, even though many local governments support infill and densification to support their downtowns. This process may take years to change the urban development of these metropolitan areas, and it may not be worth the cost to build central rail stations.<sup>137</sup> In addition, connecting high-speed rail to city centers and central rail stations introduces two conflicts that may increase costs significantly to constructing, operating and maintaining the high-speed rail system. The tracks and equipment must be built in denser urban areas, which may require tunneling or building bridges, and high-speed rail trains may need to share tracks and platforms with conventional rail, which may require more expensive signaling systems, longer dwell times and more chances of problems occurring during operation.<sup>138</sup> Finally, while placing high-speed rail stations closer to city centers may reduce access time and time spent traveling in other, more-polluting modes of transportation (such as auto), it also may introduce other environmental costs, such as noise and visual degradation, to densely populated areas. A variety of strategies exist for

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<sup>134</sup> Hugo M. Repolho, Richard L. Church, and António P. Antunes, “Optimizing Station Location and Fleet Composition for a High-Speed Rail Line,” *Transportation Research Part E* 93 (2016): 439.

<sup>135</sup> Banister and Givoni, “Realising the Potential of HSR,” 25.

<sup>136</sup> Ibid.

<sup>137</sup> Elizabeth Deakin, “Environmental Impact of High-Speed Rail California.”

<sup>138</sup> Loukaitou-Sideris and Peters, “High-Speed Rail Stations as Transportation Nodes and Places.”

mitigating these impacts and are used with other infrastructure that generate similar environmental damages, such as highways.<sup>139</sup>

Haixiao Pan, Song Ye and Minglei Chen (2017) discuss how the Chinese government, in its aims to build its high-speed rail system rapidly and inexpensively, has located stations in suburbs distant from large urban centers. From 1978 to 2011, the total length of tracks in China grew from 51,700 km to 93,200 km, the number of rail passengers increased 128.52 percent with 1.862 billion trips as the growth rate increased from 4.55 percent in 1978 to 11.0 percent in 2011, total passenger-kilometers increased from 1,093 billion to 9,612 billion (779 percent), and passenger intensity—the number of passengers carried per length of rail—reached 20,000 passengers/km, almost 2.5 times highway passenger intensity. Despite this growth, the share of rail in intercity travel in China has decreased from over 30 percent in 1978 to 5 percent in 2001 as highway travel has grown.<sup>140</sup> Since the 1990s, China has planned high-speed rail networks to attract more passengers to rail and generate related benefits, and China’s first high-speed rail line opened in 2003. In 2004, the government passed the *Mid-term and Long-term Railway Network Plan*, and, with further expansions announced in 2008, the government plans to build over 16,000 km of high-speed railway (a portion of the total 120,000 km of new railway) by 2020.<sup>141</sup> In 2017, 9,300 km of the high-speed rail track had been completed.<sup>142</sup>

Many of the Chinese high-speed rail stations are built in the suburbs; of the 24 stations on the Beijing-Shanghai line, 18 are located in the suburbs. Table 2-6 shows examples of these suburban stations. The reasons for locating stations in these locations include lowering costs, avoiding costly and difficult land acquisition, encouraging a polycentric urban structure and new development in peripheral locations, and relieving congestion and development pressure in central areas of cities.<sup>143</sup> In the Chinese political system, larger local governments have more leverage against the national railway authority in negotiating the location of their station, so stations in medium or small cities are located in “exurban fringe” rather than the suburbs.<sup>144</sup>

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<sup>139</sup> Deakin, “Environmental Impact of High-Speed Rail California.”

<sup>140</sup> Haixiao Pan, Song Ye, and Minglei Chen, “The Influence of High-Speed Rail Station Site Selection on Travel Efficiency,” in *High-Speed Rail and Sustainability*, ed. Blas Luis Pérez Henríquez and Elizabeth Deakin (New York: Routledge, 2017).

<sup>141</sup> Ibid.

<sup>142</sup> Cascetta and Coppola, “Evidence from the Italian High-Speed Rail Market.”

<sup>143</sup> Ibid.

<sup>144</sup> Ibid., 131.

| Names of HSR way stations | Number of metro lines | Location of station | Distance from the city centre | Operation situation of metro lines                          | Operation time of high-speed railway stations |
|---------------------------|-----------------------|---------------------|-------------------------------|---|---|
| North Xi'an Station       | 1                     | Suburban            | 13km                          | Line4: not opened   | 2011.1  |
| East Zhengzhou Station    | -                     | Suburban            | 8km                           | —   | 2012.9  |
| East Hangzhou Station     | 2                     | Suburban            | 13km                          | Line1: 2012.11<br>Line4: not opened                         | 2013.6  |
| Shanghai Hongqiao Station | 2                     | Suburban            | 15km                          | Line2: 2000.6<br>Line10: 2010.4                             | 2010.7  |
| South Guangzhou Station   | 4                     | Suburban            | 18km                          | Line2: 2010.9<br>Line7, Line20,<br>Foshan Line2: not opened | 2010.1  |
| South Nanjing Station     | 3                     | Suburban            | 10km                          | Line1: 2011.6<br>Line3, Line6: not opened                   | 2011.6  |
| South Beijing Station     | 4                     | City centre         | 5km                           | Line4: 2010.12<br>Line14: not opened                        | 2008.8  |
| Wuhan Station             | 2                     | Suburban            | 12km                          | Line4, Line5: not opened                                    | 2009.12                                       |
| Tianjin Station           | 3                     | City centre         | 0                             | Line2: 2013<br>Line3: 2012.10<br>Line9: 2012.10             | 2008.8  |
| South Changsha Station    | 2                     | Suburban            | 9.5km                         | Line2, Line3: not opened                                    | 2009.12                                       |

Source: China Urban Transport Planning and Development Report 2010

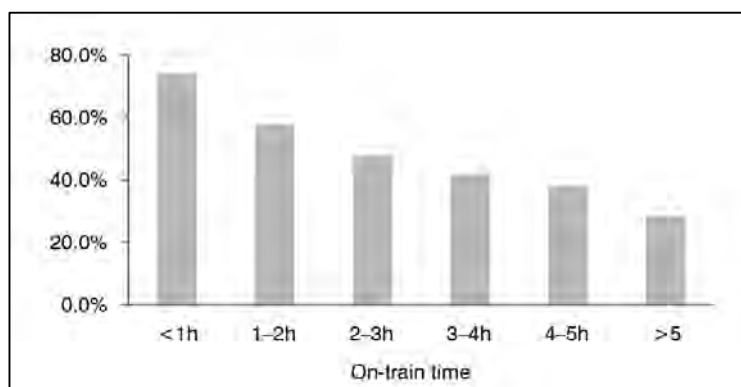
**Table 2-6.** China's major high-speed rail station site locations and rail line plans. (Pan, Ye and Chen 2017)

To investigate the effects of station location on travel behavior, Pan, Ye and Chen conduct a survey of passengers at the Hongqiao high-speed rail station that serves Shanghai, although it is located 15 km from the city center. The results show that the average passenger travel distance is 377.4 km—lower than expected during the planning stages of the station—and that 50 percent of passengers' trips originate in Shanghai's central urban area, while 40 percent originate in the city outskirts (and 10 percent in outer suburban areas).<sup>145</sup> 74.9 percent of passengers use public transit—mostly metro—to access the high-speed rail station, and even 53.9 of car-owning passengers access the station by metro (with 13.6 driving).<sup>146</sup> The results also show that access time and waiting time frequently exceed time on-board, especially for shorter trips (Figure 2-3). Average access time is 56 minutes, and average waiting time is 61 minutes.

<sup>145</sup> Ibid.

<sup>146</sup> Ibid.

For trips under 300 km, which account for over half of the total trips, travel time on-board the high-speed train accounts for only 25 percent of total travel time.<sup>147</sup> Given these results, Pan, Ye and Chen conclude that extending multimodal transportation connections to high-speed rail stations may attract more passengers; however, these connections still are expensive to build and still require longer access times than required by stations closer to central urban areas.<sup>148</sup> These conclusions support the recommendations discussed in this section that locating high-speed rail stations in city centers may provide the best system.



**Figure 2-3.** Off-train time as percentage of total travel time by on-train travel times. (Pan, Ye and Chen 2017)

The location of high-speed rail station impacts and relates to *wider economic benefits* in similar ways as it does to other benefits, such as time savings and air pollution reductions. The more passengers a high-speed rail system attracts, the more opportunities there are for connections on all relevant spatial scales that serve as the foundation of economies of agglomeration. An additional consideration in this case, however, is the equitable distribution of these wider economic benefits. As previously discussed, smaller cities in China may have less political power to negotiate for a more central location for the local high-speed rail stations. In Spain, similar issues arise. In evaluating where high-speed rail stations are located in or near Spanish cities with more than 10,000 residents, Ureña, Benegas and Mohino (2017) find that stations in the more populated cities are central and connected to the conventional rail system while stations in a majority of the smallest cities are distant from the city centers. Since in Spain urban improvements have been more rapid and substantial near more centrally located stations, this reduces the equitable distribution of benefits among larger and smaller cities.<sup>149</sup> To ensure

<sup>147</sup> Ibid.

<sup>148</sup> Ibid.

<sup>149</sup> Ureña, Benegas, and Mohino, “High-Speed Rail in Spain.”

that these smaller cities secure benefits from new high-speed rail stations, Ureña, Menerault, Garmendia (2009) recommend connecting these stations with urban redevelopment projects with a mix of residential, office, commercial and leisure areas. Not only would these projects provide direct economic benefits, they would help create a more modern image for the city and attract higher-level business activities.<sup>150</sup> The following section discusses in greater detail how to accomplish these goals.

### **2.3.3 High-Speed Rail and Transit-Oriented Development**

Achieving the local-level wider economic benefits related to station location and ensuring that smaller, intermediate cities benefit from high-speed rail development frequently requires a concerted and cooperative effort among local stakeholders—governments, developers, residents, and others. Roger Vickerman (2015) describes this as follows: “[There are a] number of issues concerning the problems which the development of HSR has posed for intermediate cities, whether or not they achieve direct access to the network. In part this is caused by the dominance of the inter-metropolitan flows, in part by the economics of HSR operation and in part by the failure of local government authorities to recognise that the provision of access to new infrastructure does not bring automatic benefits.”<sup>151</sup> This section addresses this failure of local governments, or rather their ability to work with the infrastructure.

A significant method of ensuring that high-speed rail stations are well-placed and take advantage of agglomeration benefits is transit-oriented development (TOD). Christopher D. Higgins and Pavlos S. Kanaroglou define transit-oriented development as “the provision of higher-density, mixed-use, amenity-rich, and walkable development around rapid transit systems”.<sup>152</sup> Frequently transit-oriented development is concerned with local public transportation systems, such as bus service, subway and commuter rail; however, it also may be applied to high-speed rail, and there is much enthusiasm to do so.<sup>153</sup> When applied to high-speed rail, it serves similar purposes, albeit with potentially even more significant economic outcomes dependent on factors related to the regional, national and even international scales. These issues

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<sup>150</sup> Ureña, Menerault, and Garmendia, “The High-Speed Rail Challenge for Big Intermediate Cities.”

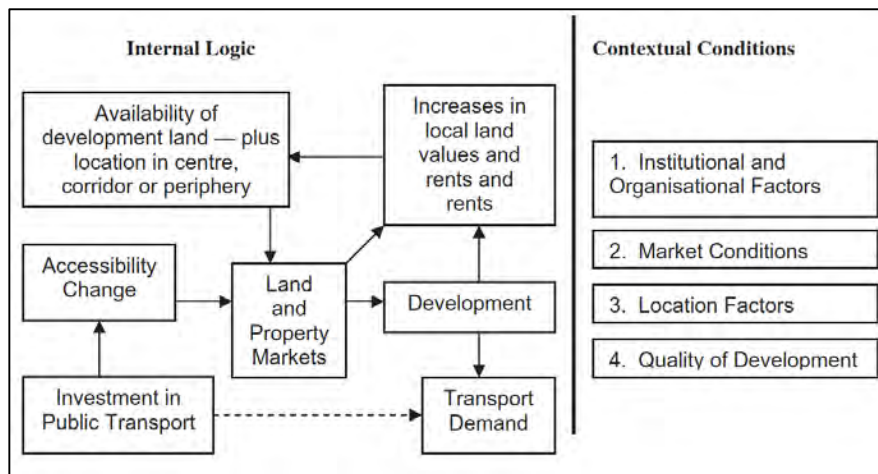
<sup>151</sup> Roger Vickerman, “High-Speed Rail and Regional Development: The Case of Intermediate Cities,” *Journal of Transport Geography* 42 (2015): 164.

<sup>152</sup> Christopher D. Higgins and Pavlos S. Kanaroglou, “A Latent Class Method for Classifying and Evaluating the Performance of Station Area Transit-Oriented Development in the Toronto Region,” *Journal of Transport Geography* 52 (2016): 61.

<sup>153</sup> Brian Edward Johnson, “American Intercity Passenger Rail Must be Truly High-Speed and Transit-Oriented,” *Journal of Transport Geography* 22 (2012).

are familiar by now to the reader, since they have been discussed, referenced and implied in many of the preceding sections. In addition, if the property adjacent to a rail station is publicly owned or belongs to the high-speed rail developer, the property value increases and local economic benefits can be leveraged to finance the high-speed rail line. In Japan for example, the privatized Central Japan Railway and private real estate developers worked to co-develop successful major office towers and shopping malls around newly opened high-speed rail stations.<sup>154</sup>

Banister and Thurstain-Goodwin (2011) describe high-speed rail’s micro economic effects, which include labor market and business effects as well as impacts on land and property values. Compared to high-speed rail’s macro-economic and meso-economic effects (discussed in Section 2.2.5), its micro-economic effects and can be controlled for and measured with a reasonable level of confidence.<sup>155</sup> Figure 2-4 shows the interactions and factors involved with using transportation development to generate land development, including contextual conditions that may be unrelated to the transportation infrastructure.



**Figure 2-4.** Schema of structural relationships. Businesses may be trying to minimize costs while maintaining competitiveness and market share, with tradeoffs among accessibility, cost of land or rents and other costs. (Banister and Thurstain-Goodwin 2011)

Ming Yin, Luca Bertolini and Jin Duan (2015) describe three development zones that may define the scope of the high-speed rail station area related to transit-oriented development. The primary development zone is within five to ten minutes’ (500 meters or so) reach of the station. Within this zone, a traveler does not need to use complementary means of transportation

<sup>154</sup> Murakami and Cervero, “High-Speed Rail and Economic Development.”

<sup>155</sup> Banister and Thurstain-Goodwin, “Quantification of the Non-Transport Benefits.”

to reach the station, ideal for high-grade office and residential functions in dense development.<sup>156</sup> The secondary development zone is within 15 minutes' reach of the station, frequently by complementary modes of transportation, and can host similar land uses, albeit with lower density and property values.<sup>157</sup> The tertiary development zone is beyond 15 minutes from the station and may see indirect development effects rather than benefits directly related to the high-speed rail station.<sup>158</sup> The impact on development also depends on the type of land use. Banister and Thurstain-Goodwin explain that commercial development usually is concentrated within 400 meters of the stations, while residential impacts could extend to 1000 meters (0.6 miles).<sup>159</sup>

While the characteristics discussed in Section 2.3.1 make good station design and support transit-oriented development, Murakami and Cervero describe how transit-oriented development near high-speed rail stations may be different than development near other transit stations:

“Successful transit-oriented developments around HSR stations, however, are likely to be considerably different than that of metropolitan rail systems, thus the same design templates should not be employed. Whereas housing is often a prominent feature of urban-rail TODs in the US, due to HSR’s logistical designs, busy intermodal connections, and the potentially higher nearby land prices that are bid up by time-sensitive firms, office and retail uses are apt to be more common in HSR TODs.”<sup>160</sup>

Banister and Thurstain-Goodwin also discuss methods of determining local development impacts at or near high-speed rail stations. The most common method is hedonic pricing, which uses distance thresholds to determine the impact on property values.<sup>161</sup> Geographically weighted regression used the same foundational assumptions but considers multiple factors that may be related to geographic proximity to the rail station in a statistical framework.<sup>162</sup> In analyzing the impacts of new urban rail lines in Naples, Francesca Pagliara and Enrica Papa (2011) delineate catchment areas around each station at 500 meters and choose control areas that had similar characteristics to the catchment area and was beyond 500 meters from a station. In calculating the average change in the property values within the catchment areas compared to the control

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<sup>156</sup> Ming Yin, Luca Bertolini, and Jin Duan, “The Effects of the High-Speed Railway on Urban Development: International Experience and Potential Implications for China,” *Progress in Planning* 98 (2015)

<sup>157</sup> Ibid.

<sup>158</sup> Ibid.

<sup>159</sup> Banister and Thurstain-Goodwin, “Quantification of the Non-Transport Benefits.”

<sup>160</sup> Murakami and Cervero, “High-Speed Rail and Economic Development,” 253.

<sup>161</sup> Ibid.

<sup>162</sup> Ibid.



areas, the results show that from 2001 through 2008 residential and office property values within the catchment areas consistently increased at a rate greater than the control properties. Retail property values, however, experienced a decline in the relative rate of increase from 2005 through 2008. These differences were more pronounced in areas that were closer to the city center but did not have good accessibility to other urban, regional and national rail services prior to the opening of the new metro line.<sup>163</sup>

There are ample examples of high-speed rail stations impacting nearby property values. A report from the Australasian Railway Association (2012) reviews 15 cases from Europe and three cases from Asia. The review finds that high-speed rail stations have varied impacts on local property values.<sup>164</sup> In smaller cities, the effects consistently were positive; however, in larger cities results were mixed, perhaps because the areas near the stations already had high accessibility and experienced further environmental costs, such as noise, with the new nearby high-speed rail service.<sup>165</sup> Of course, many of these stations were built differently and generated well-designed transit-oriented development differently.

Ureña, Menerault and Garmendia (2009) discuss criteria and objectives common in successful high-speed rail transit-oriented developments. These projects juxtapose traditional and modern urban areas within city centers and host a mixture of uses—office, residential, leisure and community. They also connect to the public transportation network at the international, national, regional and urban levels. Concerning the financing and construction of the development itself, they opened land previously used for rail infrastructure to property development, used signature architecture to provide a modern and international image, and used a combination of public and private financing.<sup>166</sup> This model is being encouraged and replicated with more project and in other countries. In the United States, California Senate Bill 375, which was passed in 2008, allowed for, encourages and requires (depending on the local context) transit-oriented development with higher densities, less parking and mixed land uses near high-speed rail stations.<sup>167</sup>

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<sup>163</sup> Francesca Pagliara and Enrica Papa, “Urban Rail Systems Investments: An Analysis of the Impacts on Property Values and Residents’ Location,” *Journal of Transport Geography* 19 (2011).

<sup>164</sup> David Hensher, Zheng Li, and Corinne Mulley, “The Impact of High Speed Rail on Land and Property Values,” *Australasian Railway Association*, 2012.

<sup>165</sup> *Ibid.*

<sup>166</sup> Ureña, Menerault, and Garmendia, “The High-Speed Rail Challenge for Big Intermediate Cities.”

<sup>167</sup> California Environmental Protection Agency Air Resources Board. “Sustainable Communities,” 2017.

Transit-oriented development around high-speed rail stations can play many different roles. It can create effective infill development within or near city centers, it can encourage denser development or, in a longer time frame, even new business hubs in suburban areas, and it can help finance a high-speed rail line. If the project is successful, in the very long-term, the location may be less of concern as the development, the businesses and the residents locate near the station rather than the station being located in city center and generate revenue for the project rather than incurring additional costs. With the cases discussed here, which are relatively recent, it is still unclear whether these longer-term changes will occur near stations currently distant from urban and economic centers.

## **2.4 Evaluating Stakeholder Interests in High-Speed Rail Networks**

The discussion in all of the previous sections of this chapter refer to but never directly address issues regarding stakeholder's interests and how they participate in the planning, development and operations of high-speed rail networks, lines and stations. In the discussion of benefits and costs, a major conclusion offered by Banister and Givoni (2017) is that rational decision-making in planning and developing public high-speed rail routes is no longer relevant. Stakeholders have other political and personal reasons for supporting or opposing such projects.<sup>168</sup> This does not concern only the problem with forecasting, optimism bias and other technical issues, it concerns how stakeholders value the transportation system within other strongly held beliefs and the political context. Issues, such as *image* or *prestige*, are much more important in this context than in rational decision-making alone. In addition, the issues regarding equitably distributing wider economic benefits and appropriately siting rail stations are highly political.

This section continues the discussion of what stakeholders are involved in the governance of infrastructure projects and how these stakeholders assert their interests, methods of evaluating stakeholder influence, and the importance of political interest and will in carrying out infrastructure development projects.

### **2.4.1 Governance of Infrastructure Projects**

How an infrastructure project is organized directly influences how the project is constructed and is operated. Thomas Ahola et al. (2013) discuss the importance of distinguishing

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<sup>168</sup> Banister and Givoni, "Realising the Potential of HSR."

the understanding of project governance from general governance. Project governance becomes complex when an individual project involves various organizations. In this case, each task, including decisions about control and modification of a project, must be assigned to a specific organization or individual within the group.<sup>169</sup> Additionally, some firms are involved only in very similar kinds of projects, while other firms increasingly take on a variety of kinds of projects and face challenges on the portfolio level. This adds another level of complexity. The authors describe two different types of project governance. The first considers how project-based firms must coordinate multiple projects in their portfolios. In these cases, governance systems can be used to protect the parent organization from risks in a single project. Sometimes, this may create issues with determining which person or entity (within the project itself or within the parent organization) has agency over certain decisions.<sup>170</sup> The other type of project governance considers governance a structure internal to a specific project. In cases where multiple organizations are involved in the project, it is important for these organizations to develop shared goals and establish clear leadership within the project. Care must be taken to ensure that the interests of the involved organizations remain aligned to work toward a joint goal. In addition, projects also should be aligned with external factors, such as regulations or public demands.<sup>171</sup>

Many projects involve multiple stakeholders, who must collaborate under a given governance structure. In “Collaboration: The Key to Success in Transportation”, Michael D. Meyer et al. (2005) define collaboration as a “purposeful process of working together to do any or all of the following: plan, create, solve problems, and manage activities”.<sup>172</sup> In the framework developed in this article, competition is the direct opposite of collaboration (Figure 2-5). In order to investigate why transportation agencies have undertaken collaborative efforts, the authors evaluate a variety of cases in the United States.

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<sup>169</sup> Tuomas Ahola, Inkeri Ruuska, Karlos Arto, and Jaakko Kujala, “What is Project Governance and What are its Origins?” *International Journal of Project Management* (2013).

<sup>170</sup> Ibid.

<sup>171</sup> Ibid.

<sup>172</sup> Michael D. Meyer, Sarah Campbell, Dennis Leach, and Matt Coogan, “Collaboration - The Key to Success in Transportation,” *Transportation Research Record* (2005): 153.

| TABLE 1 Characteristics of Collaborative and Competitive Interaction |        |  |
|--|--------|--|
| Collaboration  |        | Competition  |
| Process-oriented   |        |  |
| Top leaders support collaboration                                    | versus | Top leaders foster competition   |
| Open communications  | versus | Withholding of information   |
| Staff assigned to foster collaborative activities                    | versus | Staff assigned to encourage and attain competitive advantage               |
| Focus on joint problem solving                                       | versus | Individual action to “beat” other competitors                              |
| Institutional mechanisms for joint action                            | versus | Separate structures for individual action                                  |
| Reward staff who are successful in collaborative activities          | versus | Reward staff who are able to “beat” the competition                        |
| Possible evolutionary growth into full partnership on many issues    | versus | Little chance for cooperative partnership                                  |
| Individuals’ perspectives  |        |  |
| Common language and terminology designed to foster communications    | versus | Different language and terminology designed to guard competitive advantage |
| Concern for mutual benefit and gain                                  | versus | Focus on own interests   |
| Emphasis on trust among participants                                 | versus | Distrust of others   |
| Respect for the interests of those collaborating                     | versus | Suspicion of the motives of others   |
| Easy access to other partners  | versus | Little interaction with others   |
| Readiness to be helpful  | versus | Use of threats and coercion  |

**Figure 2-5.** Characteristics of collaborative and competitive interaction (Meyer et al.)

Collaboration exists for various purposes and in is carried out in a variety of ways. Importantly, collaboration should develop to address shared needs. These needs include public needs for multi-jurisdictional or multimodal transportation systems, integrating technology that transcends each transportation agency’s infrastructure, coordinating planning efforts, and sharing infrastructure costs to produce economies of scale.<sup>173</sup> Major challenges to collaboration begin with establishing the collaborative effort, since collaboration still is a difficult and unusual action for many transportation agencies. Other challenges include aversion to the potential of taking on another organization’s risk, incompatible organizational structures, and disparity in organizational influence within the collaborative effort. Meyer et al. emphasize the importance of educating the public about collaborative efforts to maximize their positive recognition and to gain useful and informed public input.<sup>174</sup>

To guide collaborative efforts, Meyer et al. propose a linear process. This process begins with defining the common purpose, motivation and needs for the collaboration. It continues with establishing ground rules for decision-making, responsibilities, and communication. Once these steps are complete, the collaboration can begin to move forward, maintaining coordination

<sup>173</sup> Ibid.

<sup>174</sup> Ibid.

among the organizations and reevaluating the standards of the collaboration. While decision-making processes among collaborating organizations may differ and these organizations likely will remain independent, well-established collaborative efforts could seek joint funding as an independent body to be shared among these collaborating agencies. Eventually, this may develop into creating an independent organization to carry out the responsibilities of the collaboration. This could be effective, however, only if the responsibilities of the collaborative effort can be made independent of the responsibilities of the original collaborating agencies. Otherwise, the addition of another organization to facilitate the collaboration could make the collaboration more difficult and complicated.<sup>175</sup>

In summary, collaboration exists to carry out shared responsibilities or to respond to shared needs in order to improve transportation infrastructure development and management. The more similar organizations' structures, cultures and missions are, the easier it is for collaboration to occur. Collaboration is a process that requires a concerted effort that is usually beneficial for the participating organizations and can lead to further success with new projects or emerging needs.

In order to evaluate the effects of project governance on risk management, Feng Guo et al. (2014) conduct a case study comparison of two major infrastructure projects: The Yi-wan Railway construction project in China and the Northern Gateway Toll Road project in New Zealand, both important projects to the countries' respective infrastructure systems. The authors conducted interviews with 42 representatives from stakeholder organizations and followed up with nine of the key stakeholders over two years. They focused data collection on describing emerging risks during the construction process, initiatives adopted by stakeholders to address these risks and effectiveness of these measures.

The Yi-wan Railway project, constructed from 2004 through 2010, consisted of a network of eight railways across the country and required an investment of \$3.325 billion. The rail project took a centralized approach to incorporate a risk management system into the construction process. The Project Management Headquarters had the power to enforce any changes in the project in order to deal with risks.<sup>176</sup> The Northern Gateway Toll Road was the

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<sup>175</sup> Ibid.

<sup>176</sup> Feng Guo, Yan Chang-Richards, Suzanne Wilkinson, Ti Cun Li, "Effects of Project Governance Structures on the Management of Risks in Major Infrastructure Projects: A Comparative Analysis," *International Journal of Project Management* (2014).

first fully electronic toll road in New Zealand and was one of the country's largest and most challenging road construction projects. It cost \$235 million and was completed early and under budget in 2009 after five years of construction. The project was headed by the Northern Gateway Alliance, a group of eight organizations that collectively managed risk. The alliance managed and coordinated construction work among the various organizations.<sup>177</sup>

In comparing these two cases, the authors conclude that each model had certain benefits. The single empowered stakeholder in the Yi-wan Railway project could respond to all changes in the project quickly and with control. The alliance governance model, however, did consider uncertainties and established a clear risk-sharing methodology before undertaking the project. In this case stakeholders felt a greater sense of ownership and developed solutions to risks independently. In either case, the governance structure played a major part in improving risk management. Guo et al. also emphasize the benefits of case study analyses in their ability to incorporate the economic, social and environmental implications of a project. A case study focuses on the entire process and history of a project rather than picking a certain element and evaluating it independently. Case studies also serve to disseminate knowledge, especially internationally.<sup>178</sup>

#### **2.4.2 Stakeholder Evaluation**

In order to evaluate stakeholder influence, Ronald K. Mitchell, Bradley R. Agle and Donna J. Wood (1997) develop a theory of stakeholder typology and *salience*, or “the degree to which managers give priority to competing stakeholder claims”.<sup>179</sup> Salience is then determined by which of three attributes a stakeholder possesses: power, legitimacy and urgency.

Power is a stakeholder's ability to bring about the outcomes it desires by being able to influence another stakeholder to do something it otherwise would not have done. Power may be coercive in that it depends on physical force or restraint, utilitarian or based on material or financial resources, or normative or based on symbolic authority or resources.<sup>180</sup> As a distinct attribute from power, legitimacy denotes that a stakeholder acts in a desirable, proper or appropriate way within social norms and values. As a broad term, legitimacy can refer to a

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<sup>177</sup> Ibid.

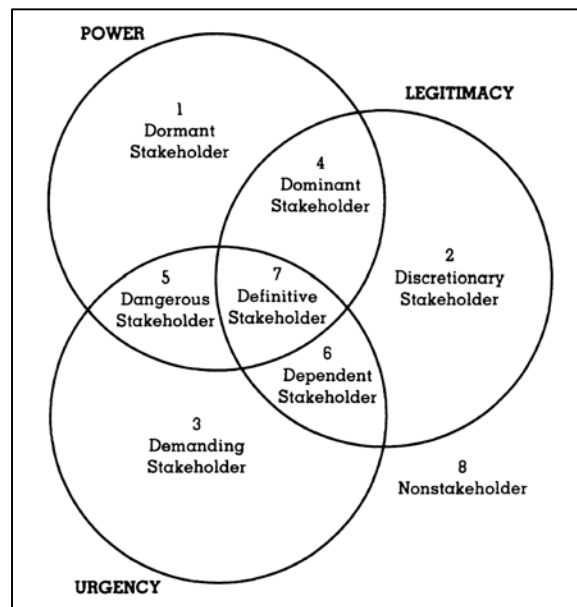
<sup>178</sup> Ibid.

<sup>179</sup> Ronald K. Mitchell, Bradley R. Agle, and Donna J. Wood, “Toward a Theory of Stakeholder Identification and Salience: Defining the Principle of Who and What Really Counts,” *Academy of Management Review* 22 (1997), 854.

<sup>180</sup> Ibid.

stakeholder with legal rights (entered into a contract or a land owner), one that may be harmed by a decision or is at-risk, or one with moral claims.<sup>181</sup> While legitimacy and power are distinct attributes, when coupled together a stakeholder may have authority. Without power, however, a legitimate stakeholder has little ability to gain rights.<sup>182</sup> Finally, urgency depends on meeting two conditions: (1) time sensitivity and (2) criticality. In cases where a stakeholder’s claim requires immediate action and is of great importance to the stakeholder, this stakeholder holds urgency.<sup>183</sup>

In practice, while Mitchell et al. describe these attributes as relating to a business firm, they easily may apply to other actors, such as a sociotechnical or infrastructure system like high-speed rail. Mitchell et al. cite R. E. Freeman’s (1984) definition of a stakeholder as “any group or individual who can affect or is affected by the achievement of the organization’s objectives” to explain that no potential stakeholders are excluded from consideration from the outset in this framework.<sup>184</sup> With this broad view, stakeholder saliency may be determined by assigning each stakeholder any number of the attributes (Figure 2-6). A stakeholder can either hold power, legitimacy and/or urgency or not; in this model, a stakeholder cannot hold an attribute in part. The more attributes belonging to a stakeholder, the greater saliency it has. If a stakeholder holds none of the attributes, it is considered a non-stakeholder.



**Figure 2-6.** Stakeholder typology: one, two or three attributes present. (Mitchell et al. 1997)

<sup>181</sup> Ibid.

<sup>182</sup> Ibid.

<sup>183</sup> Ibid.

<sup>184</sup> Ibid., 854.

Mitchell et al. emphasize that this is a dynamic model. Stakeholders may gain or lose attributes, and therefore saliency, depending on the circumstances. The authors describe the possible changes of stakeholder saliency in this dynamic system: “Power gains authority through legitimacy, and it gains exercise through urgency”; “Legitimacy gains rights through power and voice through urgency”; and Urgency “in combination with legitimacy [...] promotes access to decision-making channels, and in combination with power, it encourages one-sided stakeholder action. In combination with both, [it] triggers reciprocal acknowledgement and action between stakeholders and managers.”<sup>185</sup>

### **2.4.3 The Importance of Political Will for Infrastructure Development**

Values also play a central role in infrastructure development. In a webinar, Ian Brown (2016), former Managing Director of London Rail, discusses the importance of political and social interest in infrastructure development and maintenance. During the process for the devolution of London’s government in 1980s and 1990s, the London government developed a strong interest in making London a world-class city and supporting growth. According to Brown, the “invest like hell” attitude is what has supported London’s excellence, with approximately 50 percent of all wealth in the UK produced in London.<sup>186</sup> Rail infrastructure is very difficult to construct, especially in a dense and old city like London. It is also difficult to forecast demand for a new rail line or the effects of a new rail line on the larger rail system. According to Brown, forecasting the impacts correctly is not as much of a concern as delivering a safe, quality project, built on-time and on-budget, that continues to earn the public’s trust and support. Maintaining constant development depends on continued growth or at least the ability of government to continue to invest. Continued and consistent rail development as the London government’s priority, regardless of the greater economic environment, has been the foundation of rail infrastructure renaissance in the city, including Crossrail<sup>187</sup> and Thameslink<sup>188</sup>.

As reported in a 2013 *The Guardian* article, Nicola Shaw, the chief executive of the High-Speed 1 project in the United Kingdom, believes that the government has learned how to construct high-speed rail projects from its experience with the High-Speed 1 British high-speed

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<sup>185</sup> Ibid., 869-870.

<sup>186</sup> Ian Brown, “Eno Webinar: The Strategy and Economics of London's Major Rail Projects with Ian Brown,” 2016.

<sup>187</sup> Established in 2001, Crossrail is a public agency under Transport for London that is building an underground rail line through the center of London (Crossrail, 2016).

<sup>188</sup> Thameslink is commuter rail system in the London metropolitan area. It originally connected to King’s Cross Station in London, but moved into a new station that connected to St. Pancras Station in 2007 (Thameslink, 2016).



rail project. Shaw expects that the UK will do a more effective with future projects.<sup>189</sup> While forecasts for the benefits of infrastructure never embody a perfect science and frequently demonstrate biased optimism,<sup>190</sup> as discussed, it is nevertheless apparent that the UK government has an interest in creating these high-profile but very costly infrastructure projects. Shaw uses London's recent hosting of the summer Olympics in 2012 as an example.<sup>191</sup>

In a radio interview titled, "Public Transportation in America: How It Stalled and Where It's Going" (2016), Fred Salvucci, senior lecturer in civil and environmental engineering at MIT and former Massachusetts Secretary of Transportation, discusses the development of urban rail systems in the United States. As opposed to rail development in London, urban subway development in the US has stalled in the past decades. Transportation funding that the federal government does provide is allocated primarily to highway development. Political will, based on the private sector's benefits from public investment, is necessary to build infrastructure. Much of the country, however, does not believe it benefits from subway and rail infrastructure, for which demand is focused in select urban areas.<sup>192</sup> Salvucci, with views similar to Brown's, states that the public's trust in government is necessary for infrastructure development. In the US, the public does not view the government as credible or capable of effectively using taxes to follow through on development projects. With little trust in government, it becomes more difficult to gain support for infrastructure development, because the infrastructure already in-place is maintained poorly.<sup>193</sup>

## **2.5 Combining High-Speed Rail, Agglomeration Economies and Stakeholders**

The three master's theses mentioned in Chapter 1 involve components of all of the issues discussed in this literature review. They offer examples of how high-speed rail's different designs and uses, benefits and impacts, and infrastructural components and stakeholders relate in applied case studies. With the results of these theses, this thesis may continue their line of research to extend the examination to local-level political and economic issues at and near high-speed rail stations.

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<sup>189</sup> Tamsin Rutter, "Nicola Shaw: What HS2 Can Learn from HS1," *The Guardian*, September 26, 2013.

<sup>190</sup> Flyvberg, *Megaprojects and Risk: An Anatomy of Ambition*.

<sup>191</sup> Rutter, "Nicola Shaw."

<sup>192</sup> Robin Young and Jeremy Hobson, "Public Transportation in America: How It Stalled and Where It's Going," 2016.

<sup>193</sup> *Ibid.*

Samuel J. Levy (2015) addresses the California High-Speed Rail Authority's (CHSRA) decision to adopt a blended track system where tracks are shared by high-speed and conventional trains on portions of the future high-speed rail line. While this decision would reduce construction costs, it would add more complexity to planning and designing the infrastructure and to operating the system.<sup>194</sup> Shared track among freight and passenger rail operators is common across the United States; however, many tracks are near capacity and experience frequent delays that likely would be intolerable for a high-speed rail system. In these conditions, the CHSRA's decision adds further pressure on and complexity to the system. These challenges include building tracks platforms that accommodate a wide variety of rail car models (or building rail cars that function with station and platform infrastructure), coordinating track maintenance, establishing rules for operator priority, and managing competition among passenger rail operators.<sup>195</sup> A major point of potential conflict is the proposed Transbay Transit Center in downtown San Francisco. This station would bring the Baby Bullet—a regional commuter service—to the city center and its many businesses and jobs, and host the California High-Speed Rail line when completed. Its planned six platforms (two dedicated for high-speed rail and four for conventional rail), however, would not be able to accommodate all of the rush-hour service on both the Baby Bullet and high-speed routes.<sup>196</sup> When comparing this situation to Penn Station in Manhattan, Levy notes that the Transbay Transit Center will be owned and operated by Transbay Joint Powers Authority, a group independent of any of the rail operators the station will host, which has the potential to limit conflicts between stakeholders.<sup>197</sup> Levy emphasizes how local-level decisions, such as platform design and height for commuter rail operators in various metropolitan areas in the state and the operations of the Transbay Transit Center, impact the overall operations of the statewide high-speed rail system. Levy concludes that there are many points of potential conflict along these rail tracks in California and that the blended service as proposed would prevent effective high-speed rail service.<sup>198</sup>

Levy recommends the various stakeholders—the CHSRA, the Transbay Joint Powers Authority, freight operators, and others—work to coordinate rail car and platform design and

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<sup>194</sup> Samuel J. Levy, "Capacity Challenges on the California High-Speed Rail Shared Corridors: How Local Decisions Have Statewide Impacts" (Master's Thesis, MIT, 2015).

<sup>195</sup> Ibid.

<sup>196</sup> Ibid.

<sup>197</sup> Ibid.

<sup>198</sup> Ibid.

train scheduling well before the high-speed service begins. In addition, the major stations in along the high-speed rail route, especially the Transbay Transit Center and Los Angeles Union Station, should work to design more flexible operations and capacity with platforms shared by high-speed and conventional trains and coordinated schedules. Doing so would also ensure that high-speed service would run to these central rail stations upon its inception rather than temporarily terminating at suburban stations and would help the high-speed rail service attract passengers more easily and quickly.<sup>199</sup>

Naomi E.G. Stein (2013) conducts site visits and stakeholder interviews and applies theories on urban scales and high-speed rail development to assess the goals for regional restructuring among Portuguese cities, especially those brought within a one-hour's travel time of larger cities. Stein emphasizes the 3E model of holistic sustainability—economy, environment and equity, establishes that coordinated policy across level of government is necessary to maximize the benefits in these three areas, and focuses on the distribution of power to influence high-speed rail development and the uncertainty associated with land use changes and agglomeration benefits.<sup>200</sup>

Stein's results and conclusions are much in line with those presented in the previous sections of this literature review. These include:

- High-speed rail development should be coordinated with land-use policy that restricts sprawl and encourages sustainable to achieve its environmental and economic goals.
- Advocates for high-speed rail emphasize its sustainability and economic goals in ways that require connecting smaller, intermediate cities to the broader system.
- High-speed rail creates new and more valuable opportunities for intra-regional and national-local collaboration for joint economic development and transit management.
- Most travelers will not take advantage of new abilities to commute longer distances. Local governments should recognize that these impacts are less important than may be expected and work to avoid the social stratification this may encourage.
- Greater focus should be given to the meaning of *polycentricity* and whether it implies a balance in flows—passenger, resources or financial—or an even distribution of the size

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<sup>199</sup> Ibid.

<sup>200</sup> Naomi E.G. Stein, "Spatial Dimensions of High-Speed Rail: Intermediate Cities, Inter-jurisdictional Planning, and the Implications for High-Speed Rail in Portugal" (Master's Thesis, MIT, 2013).

of urban center. It may be appropriate to plan for an economic hierarchy among cities and regions.<sup>201</sup>

Stein emphasizes how the location of a high-speed rail station is central to all of these issues and to achieving these goals. With regards to the high-speed rail system in Portugal, planners should reconsider the locations of some stations serving smaller, intermediate cities but located a significant distance away from these cities' centers.<sup>202</sup>

In recognizing the importance of rail stations to the overall efficacy of a high-speed rail network, Rebecca J. Heywood (2016) evaluates how issues in governance at major and complex rail stations may impact the overall success of regional high-speed rail systems. Heywood reviews literature on governance and cooperation and discusses how stakeholders must be interdependent, have defined and agreed upon goals, be able to measure progress, and be able to bear the costs of cooperation in order to collaborate effectively.<sup>203</sup> Heywood focuses on evaluating the governance structure at Penn Station in Manhattan, which is owned and operated by Amtrak but also hosts the Long Island Rail Road and New Jersey Transit. In addition, Amtrak is pursuing plans to build an independent secondary terminal for intercity trains and an eventual international-quality high-speed rail line.<sup>204</sup> While Penn Station is located entirely within Manhattan, and more broadly New York City, and even more broadly New York State, tens or even hundreds of legitimate stakeholders have interests in and influence over this piece of infrastructure. Municipal, state and federal authorities have different kinds of direct oversight, and the rail operators use the station. Other stakeholders, however, also have legitimate interests in the station. The commuter and intercity rail lines that use Penn Station run throughout the region into bordering cities and states and beyond. Each of the local government authorities and populations all depend on Penn Station.<sup>205</sup>

Following a detailed evaluation of many of these stakeholders, Heywood offers a variety of recommendations. The spatial hierarchies and decision-making structures are ill-suited for each other, and key stakeholders should build stronger collaborations in order to meet the physical scale of the system. A new regional authority may be the ultimate and most effective

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<sup>201</sup> Ibid.

<sup>202</sup> Ibid.

<sup>203</sup> Rebecca J. Heywood, "Multi-Scale Regional Transportation Governance: Evaluating Cooperation and Decision-making at New York Penn Station" (Master's Thesis, MIT, 2016).

<sup>204</sup> Ibid.

<sup>205</sup> Ibid.

product of these collaborations, and stronger cooperation among current stakeholders would enable such an authority to function. To accomplish this, stakeholders also must build leadership and trust even on the individual level to develop sustained and productive partnerships.<sup>206</sup> On the station level, Amtrak and the other rail operators must work to improve the customer experience. Passengers frequently do not care which operator provides service as long as the service is frequent, reliable, fast and brings them as close as possible to their destinations. Knowing this, operators should work to integrate fare structures, wayfinding and station amenities.<sup>207</sup>

These results echo many of the results and recommendations presented previously in this literature review. They demonstrate the importance of high-speed rail stations and local-level cooperation and infrastructure integration in order to provide an efficient high-speed rail system that provides quick, reliable and accessible service. This thesis builds upon this work and these results in that it aims to evaluate how local-level economic benefits relate to and may support high-speed rail development, especially given a good station location, stakeholder cooperation and infrastructure integration.

## **2.6 Summary**

This literature review considers high-speed rail systems and the variety of roles they can serve across the world. High-speed rail may provide transportation-related benefits, such as time savings and connectivity, but it also may provide indirect benefits, such as greenhouse gas emissions reductions and regional, urban and local economic development and regeneration. The location of high-speed rail stations is central to the system's competitiveness and its ability to achieve these benefits. By locating stations near central urban areas, passengers' access times will be shorter, thereby shortening their total journey time, the high-speed rail system will have greater connectivity to other transportation networks, and there will be fewer trips using more polluting modes of transportation. In addition to serving as a node in the rail system, high-speed rail stations also serve as places and should be designed in ways that facilitate passengers' fast and easy movement as well as in ways that integrate with the broader urban context. Transit-oriented development, which refers to building a dense and walkable urban realm in close range surrounding the rail station, is a way to achieve these design objectives directly and potentially leverage the profits to finance the high-speed rail project. Finally, high-speed rail systems and

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<sup>206</sup> Ibid.

<sup>207</sup> Ibid.

stations are complex and involve many stakeholders. In order to develop and operate high-speed rail effectively, stakeholders must collaborate honestly and with shared goals that may transcend their geographic location. Since many high-speed rail projects are publicly-funded, there must be sufficient political will and support to carry out these projects. The California High-Speed Rail project, intermediate cities in Portugal and Penn Station in Manhattan all involve these many issues. They provide a research base for this thesis.

Where relevant to the specific subject, additional literature will be presented in following sections. Chapter 3, in which the case study of St. Pancras Station in London, UK, is discussed, follows.



### **3 Case Study: St. Pancras International Railway Station in London**

This section presents the history and analysis of the St. Pancras Station redevelopment in London, which is the first of two case studies considered in this thesis. First, background history and literature relevant to this case study specifically are discussed. Then, an analysis, based in part on a stakeholder analysis of this case study (Appendix A), is presented. This case study will be used further to evaluate the relationship between local rail station and land development and high-speed rail development in following sections.

A central aspect of this case is the relationship between public support for high-speed rail and local land development opportunities. The extension of a high-speed rail line to a specific site within London's urban center generated private and public benefits—financial and social. Because of the public nature of the project, broad social benefits, such as improved public image and urban design, are also relevant to understanding the project and its outcomes.

#### **3.1 Context: Passenger Rail in the United Kingdom**

##### **3.1.1 History of Rail Nationalization and Privatization**

In order to present and evaluate the case study of St. Pancras Station, which is simply one component of the larger rail network in the United Kingdom (UK), it is important to have a foundational understanding of the politics and history of rail in the UK. In *Regulating Infrastructure: Monopoly, Contracts, and Discretion* (2003), José Gómez-Ibáñez discusses infrastructure management, describing the process of rail nationalization and privatization in the UK. In 1948, following World War II, the UK government nationalized all rail in the country into a single entity, called British Railways.<sup>208</sup> This provided the government more control over the system, which was greatly damaged and degraded during the war. From the 1950s through the 1980s, rail demand declined because of competition from the automobile and poor system maintenance. This decline, however, was less pronounced in commuting regions, such as London. Although the Conservative government under Prime Minister Margaret Thatcher began to privatize many national industries in the 1980s in order to reduce public expenditures and promote efficiency, it reduced subsidies for the declining rail system by eliminating unprofitable lines and less-used branch lines rather than by relying on privatization for this public system.<sup>209</sup>

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<sup>208</sup> José Gómez-Ibáñez, *Regulating Infrastructure: Monopoly, Contracts, and Discretion*, 2003.

<sup>209</sup> Ibid.



In 1992, the governing Conservative Party finally announced the privatization of British Rail. British Rail would become 70 separate franchises, the largest being Railtrack, which would operate the existing rail lines. The government would award separate franchises for maintaining rolling stock, which would be leased to the rail agencies, and for rail engineering and maintenance services. These franchises were sold between 1995 and 1997, and Railtrack was fully privatized in 1996. As the bidding for franchises continued in the late 1990s, the rail companies increased in value, signaling optimism about the privatization scheme.<sup>210</sup> Under the Railway Act of 1993, two new regulatory positions were created to promote growth of the industry and ensure that Railtrack did not abuse its monopolistic position. These agencies would oversee the bidding for and awarding of franchises. They also set rates for fares, annual changes in fares, and minimum and maximum route frequencies. The agencies would levy access charges for rail agencies to use tracks, with fixed and variable costs determined by the number of trains being run and other cost allocation schemes.<sup>211</sup>

In the years following privatization, ridership increased 24 percent from fiscal year 1992/93 to fiscal year 2000/01. A major factor in the demand increase was the better service quality and quantity.<sup>212</sup> During this time, government subsidies also declined and fares increased minimally (5 percent between 1992/93 and 2000/01). Despite the declining subsidies, franchises were able to expand service.<sup>213</sup> In the late 1990s, however, problems in the privatization scheme began to emerge. Because the regulatory structure charged Railtrack with much higher fixed costs than variable costs, rail operators were encouraged to increase service frequency. This in turn caused significant congestion and delays on the lines. By fiscal year 1998/99, the gains in reliability and punctuality had begun to erode.<sup>214</sup> In 1997, the Labour Party gained control of Parliament and began to develop new regulations aimed at encouraging Railtrack to accommodate greater congestion. These measures included increasing the amount of variable costs Railtrack could claim, on which the access fees for additional trains were based, and setting uniform cost schedules for additional trains to reduce the costs of negotiating.<sup>215</sup> In October 2001, before these regulations were to go into effect, a major and fatal accident occurred in

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<sup>210</sup> Ibid.

<sup>211</sup> Ibid.

<sup>212</sup> Ibid.

<sup>213</sup> Ibid.

<sup>214</sup> Ibid.

<sup>215</sup> Ibid.

Hatfield, which exposed problems in the rail privatization scheme. With different companies responsible for leasing tracks, maintaining rolling stock and maintaining the rails, too many incentives were misplaced to allow the system to run effectively. This led to deteriorating tracks and signaling and scheduling issues, which caused the Hatfield accident and most likely other fatal rail accidents in preceding years.<sup>216</sup>

During this time, the government tried to encourage franchises to invest more in infrastructure development, especially Railtrack's West Coast Line project, which would rebuild and improve rail service between London and Glasgow. Following Railtrack's failure to negotiate this project, however, the government lost confidence in Railtrack. By October 2001, the government forced Railtrack into bankruptcy by withholding subsidies.<sup>217</sup> In bankruptcy, Railtrack was reorganized into Network Rail, which is a non-profit agency governed by a board of a hundred members for stakeholder groups instead of by shareholders. In all other regards, Network Rail has the same responsibilities as Railtrack had.<sup>218</sup>

Gómez-Ibáñez notes that this arrangement may not have addressed the issues with the privatization scheme. When the UK government worked to privatize the rail industry, it focused on vertical unbundling, or the separation of the control and maintenance of tracks from the control, operations and maintenance of rolling stock. Railtrack's reorganization into Network Rail, however, did not change this fundamental and problematic structure. Gómez-Ibáñez believes that Network Rail must work to improve coordination among the rail infrastructure organizations to address the problems presented by vertical unbundling.<sup>219</sup> Network Rail's diverse board, however, makes this goal even more difficult.

The makeup of the British rail system has remained mostly unchanged since the restructuring of Railtrack into Network Rail. From 2010-2015, the Conservative and Liberal Democrat coalition government continued to push for rail decentralization—less regulatory oversight and control at the national level and fewer public subsidies. As Prime Minister David Cameron outlined in a March 2012 speech on infrastructure, the major focus of this government was to increase decentralization and localization of planning and governance of infrastructure development and operations. According to Cameron, the purpose of these continued initiatives

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<sup>216</sup> Ibid.

<sup>217</sup> Ibid.

<sup>218</sup> Ibid.

<sup>219</sup> Ibid.

was to promote long-term infrastructure investment but with private investment. At the time, the United Kingdom had been subsidizing rail at rates twice as high as the French, Dutch and Swiss governments, but British rail had 40 percent higher running costs and 30 percent higher fares.<sup>220</sup> Under the national government's stable lead, private sector banks, developers and operators could provide sufficient funding for major infrastructure projects. According to Cameron, private sector financing also would be better for effectively constructing projects.

The UK's Department for Transport's transportation planning reports of the time, including the 2012 consultation response, "Reforming Our Railways: Putting the Customer First", and the 2012 command paper, "Rail Decentralisation: Devolving Decision-Making on Passenger Rail Services in England", were in line with these policy directives. Both reports state that Britain's railways were unacceptably inefficient but not to the point where a full overhaul would be needed. The solution they offered was further decentralization of the rail system, by giving more authority to rail franchises and local authorities. While the government remained committed to subsidizing the rail system, it also started to put greater pressure on franchises to reduce costs.

Despite rail privatization and decentralization, the debate over government's role with the UK rail system has continued. In 2013, the Conservative government announced the re-privatization of the East Coast rail service between London and Edinburgh, which was taken over by government when its private owner gave it up in 2009.<sup>221</sup> In an August 2013 opinion piece in *The Guardian*, Caroline Lucas, former leader of the Green Party, argues that British rail should have never been privatized and that Labour, despite its weakened political power, should again push for a government takeover of rail. Lucas notes the irony in other nationalized European agencies, including Deutsche Bahn, being major franchisees in the British rail system.<sup>222</sup> The re-privatization of East Coast rail was carried out in April 2014, with the largest rail union, the Rail, Maritime and Transport union, protesting.<sup>223</sup>

### **3.1.2 Political Views on Rail Development in the United Kingdom**

As discussed in Chapter 2 ("Literature Review"), political views also play a central role in infrastructure development in the United Kingdom. As discussed in Chapter 2 ("Literature

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<sup>220</sup> David Cameron, "PM Speech on Infrastructure," 2012.

<sup>221</sup> Josephine Moulds, "East Coast Rail Privatisation Ignores Franchise Failures, Say Critics," 2013.

<sup>222</sup> Caroline Lucas, "Privatising the Railways was a Disaster. It's Time to Renationalise," 2013.

<sup>223</sup> BBC, "RMT Rail Union Protests over East Coast Privatisation." 2014.

Review”) David Banister and Moshe Givoni (2017)<sup>224</sup>, Ian Brown (2016)<sup>225</sup>, and Nicola Shaw<sup>226</sup> all highlight the political nature of infrastructure and high-speed rail development and use examples from the UK to support this argument. In the 1980s and 1990s, London’s government significantly invested in major infrastructure development for its goals to support economic growth and to make London a world-class city. For the government, issues such as constructing projects on time and on-budget, operating safe and reliable systems, maintaining a modern and positive image, and earning the public’s trust and support are paramount, while reducing costs and maximizing revenue are secondary. These viewpoints are borne out in the construction of major infrastructure projects in addition to High-Speed 1, such as Crossrail<sup>227</sup>, Thameslink<sup>228</sup> and the 2012 London Olympics. With more experience, there may be greater optimism for building successful infrastructure projects that meet budget and time constraints as well as public safety, image and trust goals.

Brexit, or the 2016 referendum in favor of the United Kingdom withdrawing from the European Union, however, may impede this cycle of infrastructure development and dampen political enthusiasm. Brown describes how public infrastructure investment supports economic growth, which leads to increases in wealth and the government’s ability to invest in new infrastructure projects.<sup>229</sup> With Brexit, London’s economy, which is based in part on international finance, may suffer disinvestment. The potential of slowing growth or even decline in the economy puts the need for major infrastructure development (following the completion of Crossrail) in London into question.<sup>230</sup>

This chapter continues this discussion with a case study focusing on the choice to rehabilitate St. Pancras Station in London and use it as the terminus for the international high-speed rail project, High-Speed 1. This project led to significant local economic effects and had profound impacts on the public’s opinion of large-scale rail infrastructure projects and its willingness to support future projects.

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<sup>224</sup> Banister and Givoni, “Realising the Potential of HSR.”

<sup>225</sup> Brown, “Eno Webinar: The Strategy and Economics of London's Major Rail Projects with Ian Brown.”

<sup>226</sup> Rutter, “Nicola Shaw: What HS2 Can Learn from HS1.”

<sup>227</sup> Established in 2001, Crossrail is a public agency under Transport for London that is building an underground rail line through the center of London (Crossrail, 2016).

<sup>228</sup> Thameslink is commuter rail system in the London metropolitan area. It originally connected to King’s Cross Station in London, but moved into a new station that connected to St. Pancras Station in 2007 (Thameslink, 2016).

<sup>229</sup> Brown, “Eno Webinar: The Strategy and Economics of London's Major Rail Projects with Ian Brown.”

<sup>230</sup> Michael Kimmelman, “London’s New Subway Symbolized the Future. Then Came Brexit,” *New York Times*, July 31, 2017.

## 3.2 Case Study: St. Pancras International Railway Station

### 3.2.1 St. Pancras Station before High-Speed Rail

St. Pancras Station in northern London was built by the Midland Rail Company and was completed in 1877 after two decades of construction. Midland Rail held a large portion of the rail market north of London, and the project asserted Midland Rail's presence in the London rail market by occupying a prominent location with astonishing Victorian Gothic architecture (Figure 3-1), all intended to outdo the Great Northern Railway's adjacent King's Cross Station.<sup>231</sup> The station was built in two stages: the head house, which contained a hotel and offices, and the train shed. The train shed, engineered by William Henry Barlow and Rowland Mason Ordish and built of iron and glass, was the largest contained space in the world for over twenty years following its construction (Figure 3-1). Architecturally, these two components created a mismatch of styles. With these unique characteristics in addition to its important transportation services, St. Pancras became a destination in itself soon after its opening. The architecture influenced the design of other train stations across the world, including Grand Central Station in New York City.<sup>232</sup>



**Figure 3-1.** St. Pancras Station head house (Wikipedia).



**Figure 3-2.** Barlow train shed (Wikipedia).

During the two World Wars, the station essentially was commandeered by the military to serve to transport materials and personnel. It experienced multiple destructive bombings during World War II, leading to quick repairs that covered over much of the glass train shed and interfered with the station's architecture.<sup>233</sup>

<sup>231</sup> Neil Cossons, "Oubliez Waterloo: The St Pancras Effect," 2010.

<sup>232</sup> Ibid.

<sup>233</sup> St. Pancras International, "Look Up History."

During the rail nationalization that followed World War II, Midland Rail, along with St. Pancras Station, was subsumed under British Railways. As rail ridership plummeted in the 1960s, British Railways proposed to demolish St. Pancras Station and King's Cross Station and combine them in a new, unified station in order to cut costs and improve efficiency. Following the demolition of the nearby historic gate of Euston Station, however, activists protested the proposed destruction of St. Pancras Station. Their actions earned St. Pancras Station an important Grade I listing from English Heritage, a government body that oversaw and protected historic and culturally meaningful structures and places in England.<sup>234</sup> The Grade I listing meant that the station could not be altered from its original form and any change would have to be approved by English Heritage. Despite the protection offered by this classification, the station fell into disuse and disrepair in the 1980s. Since the Thameslink service and other intercity lines used King's Cross Station, only infrequent commuter rail lines used St. Pancras Station. When the hotel in the head house was closed, it first was converted into offices. In 1988, however, the head house was completely abandoned, because it did not meet fire codes.<sup>235</sup>

### **3.2.2 The High-Speed 1 Project**

High-Speed 1 (HS1), originally called the Channel Tunnel Rail Link (CTRL), was established in 1987 with the Channel Tunnel Act under significant bi-partisan support.<sup>236</sup> The route extends for 68 miles from London's St. Pancras Station to Gare du Nord, Paris or Brussels-South via Stratford, Ebbsfleet and Ashford, England (Figure 3-3).<sup>237</sup> In 2007, the project was completed on time and on-budget at a cost £6.16 billion.<sup>238</sup> To oversee the project's construction, Parliament established a Planning Forum parallel to the Channel Tunnel Rail Link Act. This forum included the Central Government, local governments, English Heritage and Natural England. These stakeholders met annually with the Minister for Transport, and their input was incorporated into the route design.<sup>239</sup> Union Railways directed the route optioning from 1991-1993, using Environmental Resources Management as its consultant. Although not required by law, the environmental consultation featured almost 100 formal consultation meetings (37 local authorities and 60 local consultation groups), another 55 informal groups with some of the same

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<sup>234</sup> Cossons, "Oubliez Waterloo: The St Pancras Effect."

<sup>235</sup> Ibid.

<sup>236</sup> Nicola Shaw, *personal comments*, February 1, 2016.

<sup>237</sup> Bechtel, "High Speed 1, England."

<sup>238</sup> London and Continental Railways, "History."

<sup>239</sup> Nicola Shaw, *personal comments*, February 1, 2016.

consultees, and 650 more meetings with other consultees, special interests, professional bodies, and individuals.<sup>240</sup>

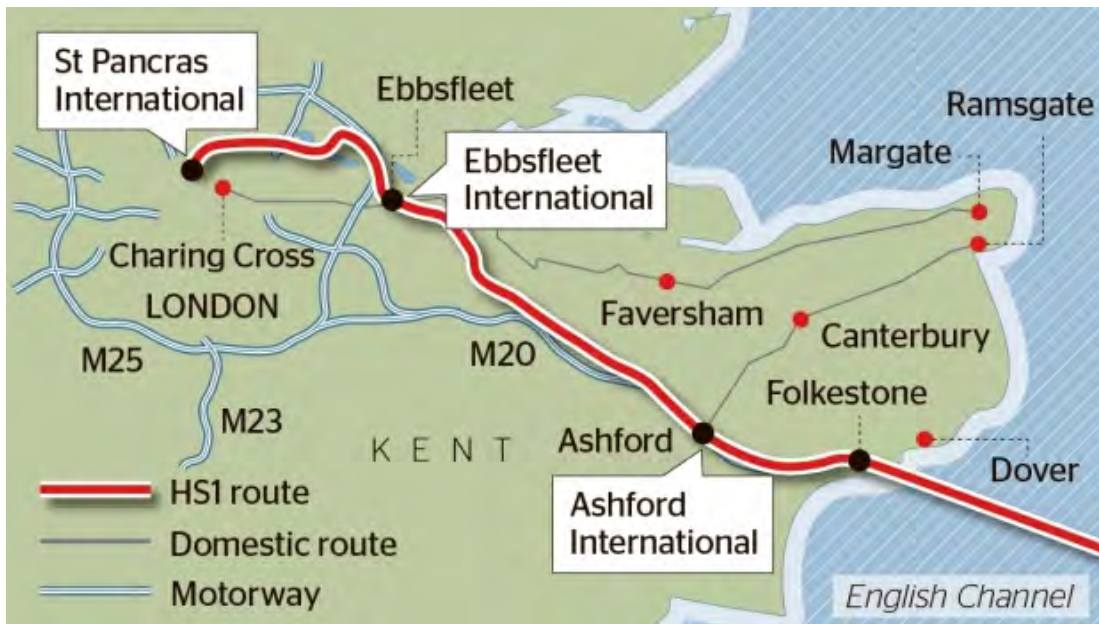


Figure 3-3. High-Speed 1 route. (*The Times* 2016)

High-Speed 1 introduced high-speed rail to the United Kingdom. Without high-speed rail, rail lines in the UK could not connect to the already well-developed high-speed rail network in Western Europe. Therefore, the motivation for the Channel Tunnel Rail Link included the following objectives:

- Provide additional capacity for international rail business via the Channel Tunnel and to reduce journey times to continental European destinations.
- Provide a major increase in capacity, speed, quality and reliability of journeys between London and part of Kent.
- Provide high quality transportation to unlock development potential of the East Thames Corridor area and parts of Kent.<sup>241</sup>

Additional expected benefits included the following:

- As one of the largest infrastructure project in the UK, it would provide a major boost to the construction industry.

<sup>240</sup> Environmental Resources Management, “Channel Tunnel Rail Link Environmental Statement: Main Report.”

<sup>241</sup> Environmental Resources Management, “Channel Tunnel Rail Link Environmental Statement: Main Report,” 17.

- It would complete an important link in the development of European HSR.
- It would strengthen the status of London as one of the world's most important capitals and financial centers.
- It would increase business connections and markets with continental Europe.
- The regeneration of the area around King's Cross and St. Pancras Stations would demonstrate government's effective transportation and land-use planning.
- It would allow increased freight business by freeing capacity on the existing rail network.<sup>242</sup>

While the route always was planned to terminate in London, the final choice for a station was delayed until January 1994 when the government announced that it had chosen St. Pancras Station as the London terminus for the Channel Tunnel Rail Link.<sup>243</sup> This decision will be discussed in the following section. In November 1994, the government released the final Channel Tunnel Rail Link Environmental Statement, which outlined the full environmental review that led to the final route choice for the Channel Tunnel Rail Link.<sup>244</sup>

The Channel Tunnel Rail Link Bill of 1996 awarded the project to London and Continental Railways (LCR).<sup>245</sup> LCR established a joint group, called Rail Link Engineering, for project management. This group included the private firms, Bechtel, Arup, Halcrow and Systra.<sup>246</sup> In 1998, however, after LCR failed to raise sufficient capital, the government issued debt to cover the project, effectively establishing a public-private partnership with a majority public ownership.<sup>247</sup>

In 2003, Section 1 of the Channel Tunnel Rail Link, which consisted of a high-speed rail line through the Channel Tunnel to Fawkham Junction in north Kent and then a rail connection on local tracks to Waterloo International Station in London, was completed.<sup>248</sup> The construction of the high-speed rail route to St. Pancras followed in the project's second phase. To accommodate construction, St. Pancras Station was mostly shut to all rail traffic in 2004.<sup>249</sup> The

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<sup>242</sup> Ibid., 18.

<sup>243</sup> Environmental Resources Management, "Channel Tunnel Rail Link Environmental Statement: Main Report."

<sup>244</sup> Ibid.

<sup>245</sup> London and Continental Railways, "History."

<sup>246</sup> Ibid.

<sup>247</sup> Dan Milmo, "Mark Bayley, the Rail Boss Who Put St. Pancras Back on Track, is Moving On," 2011.

<sup>248</sup> Bechtel, "High Speed 1, England."

<sup>249</sup> BBC, "St. Pancras Close is End of Era."



station was reopened on November 6, 2007, and the construction phases of the Channel Tunnel Rail Link were complete.<sup>250</sup>

In 2007, the Central Government sold High-Speed 1 operations back to London Continental Railways as a franchise; however, the company became insolvent again in 2009, and the government bought the project back fully to maintain its operations.<sup>251</sup> In 2010, the government again worked to privatize the High-Speed 1's operations. It awarded a 30-year, 2.1-billion-pound concession to a consortium of Canadian pension funds, including Borealis Infrastructure and the Ontario Teachers' Pension Plan. Subsidiaries of Network Rail own and operate St. Pancras Station.<sup>252</sup> Eurostar and Deutsche Bahn operate the international high-speed rail service on the High-Speed 1 tracks for passenger and freight respectively. Southeastern Rail operates domestic high-speed rail service to Ebbsfleet International Station, Ashford International Station and other local stations in Kent and the South East of England.<sup>253</sup>

### **3.2.3 Choosing St. Pancras Station as High-Speed 1's London Terminus**

One of the most significant planning choices, and a focus of this case study and thesis, is the decision to rehabilitate St. Pancras Station and repurpose it to serve as the London terminus for the Channel Tunnel Rail Link. As briefly discussed previously, the Central Government announced this decision in January 1994 following an extended environmental review process. The following directives governed the environmental review:

- Use of existing transport corridors
- Avoidance of built-up areas
- Avoidance of areas valued for their agricultural, aquatic, historic and cultural, ecological or landscape resources
- Inclusion of local mitigation measures<sup>254</sup>

From September 1990 through May 1991, two route options for the Channel Tunnel Rail Link were considered. The first option, which was proposed by Rail Europe, planned a southern approach through London to terminate at King's Cross Station. The second option, which was proposed by Ove Arup and Partners ("Arup"), also terminated at King's Cross Station but took

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<sup>250</sup> St. Pancras International. "Look Up History."

<sup>251</sup> Milmo, "Mark Bayley."

<sup>252</sup> St. Pancras International. "Look Up History."

<sup>253</sup> Ibid.

<sup>254</sup> Environmental Resources Management, "Channel Tunnel Rail Link Environmental Statement: Main Report," 8.

an easterly route to London.<sup>255</sup> In May 1991, the government chose the Arup proposal, because it believed that the route would minimize environmental impacts and impacts on residential property more effectively.<sup>256</sup> Arup's proposed route did not cause any loss in benefits compared to the other options and was also financially feasible as a joint venture; however, in March 1993, the government began to consider using St. Pancras Station as the London terminus as a modification to the Arup proposal. This route modification would allow more of the route to be constructed at-grade along an existing rail corridor in London.<sup>257</sup>

The government announced its preference for the St. Pancras Station alternative in January 1994, following the release of a British Railways report that offered a design for the St. Pancras Station scheme including proposed tunnels and grade-separated junctions.<sup>258</sup> In this plan, links to commuter rail lines could be maintained at St. Pancras Station. In addition, there was a popular possibility of including the new Thameslink station proposed for the King's Cross district in the redevelopment of St. Pancras Station.<sup>259</sup> The final design alternative accepted by the government (Figure 3-4) recognized that St. Pancras Station could accommodate less physical separation between international and domestic train platforms than the other options. This design, however, still required a tunnel and grade-separated junction in the approach north of both St. Pancras Station and King's Cross Station.<sup>260</sup>

In addition to the justifications given in the environmental statements, other reasons were recognized for choosing St. Pancras Station at the London terminus. According to project managers for the St. Pancras Station rehabilitation, only a project the size of the Channel Tunnel Rail Link could justify the costs to rehabilitate St. Pancras Station. In addition, the project would provide sufficient stimulation for nearby redevelopment, since it would be bringing in major international and domestic rail services.<sup>261</sup> The Main Report for the Channel Tunnel Rail Link environmental statement recognized the same thing, stating: "The construction and operation of the new Terminus will provide a catalyst for commercial development on the King's Cross

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<sup>255</sup> ERM, "Channel Tunnel Rail Link Environmental Statement: Annex 3, The Main Alternatives."

<sup>256</sup> Ibid.

<sup>257</sup> Ibid.

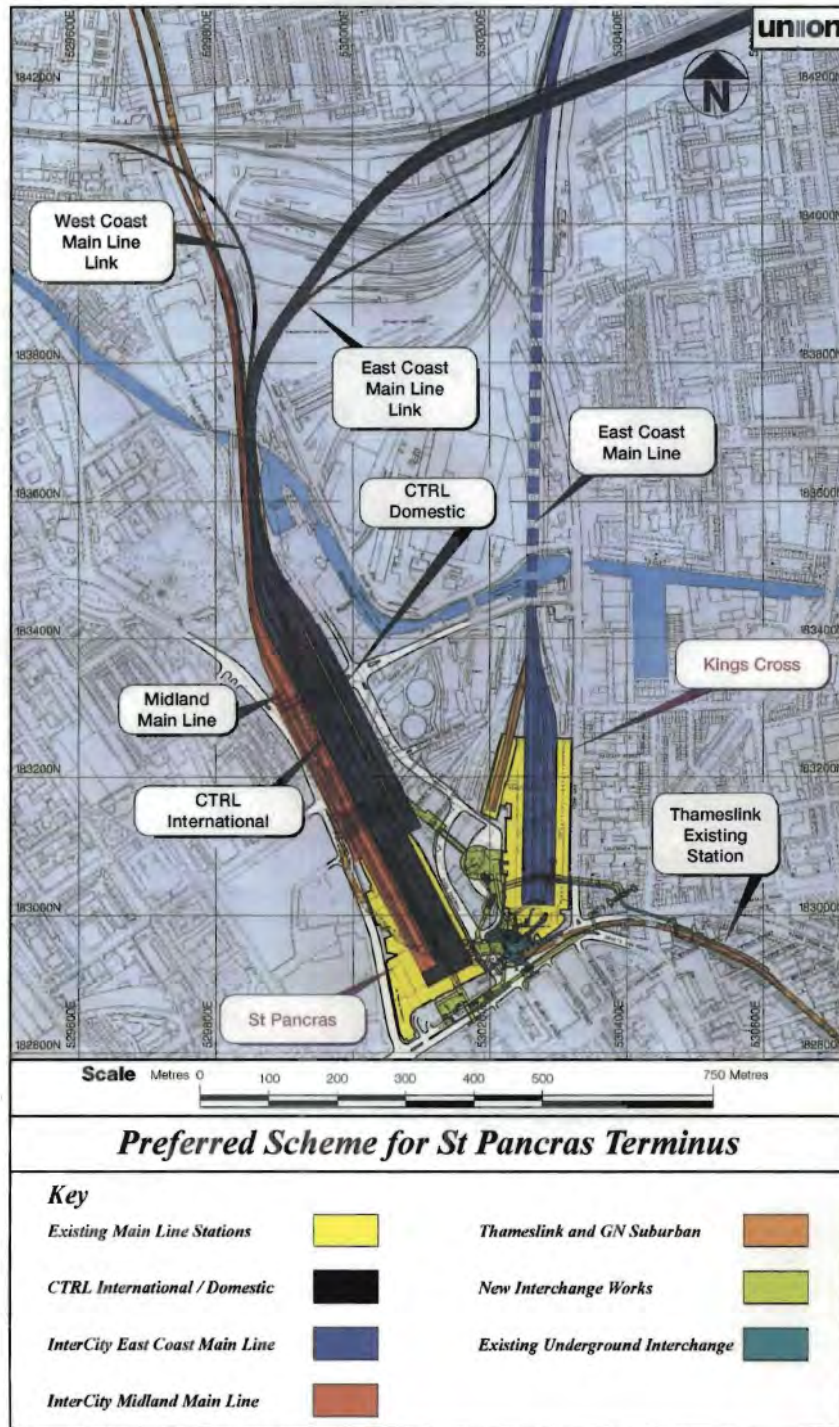
<sup>258</sup> Ibid.

<sup>259</sup> Ibid.

<sup>260</sup> Ibid.

<sup>261</sup> Ian Gardner and Tim Smart, "Channel Tunnel Rail Link Section 2: St Pancras International Station," 2007.

Railway Lands and at St. Pancras Station, in accordance with local and strategic planning policies seeking to regenerate the environment and economy of the wider area.”<sup>262</sup>



**Figure 3-4.** Final, preferred design alternative with St. Pancras Station terminus. (ERM 1994)

<sup>262</sup> Environmental Resources Management, “Channel Tunnel Rail Link Environmental Statement: Main Report,” 1994, 87.

### 3.2.4 Rehabilitating St. Pancras Station for High-Speed 1

In addition to the station being underused and the adjacent neighborhoods suffering from years of extreme underinvestment, St. Pancras Station “as a grade 1 listed building in a dilapidated condition was not an attractive proposition”.<sup>263</sup> The entire rehabilitation of St. Pancras Station, which took place from 2001 through 2007 and cost near 800 million pounds (as part of the total 5.8-billion-pound Channel Tunnel Rail Link project), was constructed under the direct and strict oversight of English Heritage.<sup>264</sup> Despite the important historic character of the station, the architectural mismatch of styles that already existed between the head house and Barlow shed was used to inform the incongruously modern style of the recent additions to the station.<sup>265</sup>

At the station itself, the train shed was expanded to accommodate the 400m-long Eurostar trains. This was done in a flat-roofed modernist steel and glass structure that appears to float above the tracks. The six international Eurostar tracks (5-10) occupy the original platforms and extend through the additional train shed. The seven domestic tracks, located at either side of the international tracks, begin where the Barlow train shed and new train shed meet (Figure 3-5).<sup>266</sup> In order to maintain commuter service throughout construction, the new train shed was constructed one half at a time. The domestic rail service first occupied the original platforms, as one set of the adjacent domestic platforms and half of the train shed were built. Then this service used the new platforms as the other half of the train shed was built. Building the main entrances at the East and West sides of the station—in middle of the Eurostar platforms and the end of the commuter rail platforms—mitigated the long walking distances along the length of the station.<sup>267</sup>

The other major change to the station design was the repurposing of the ground floor, formerly a storage area, as the station’s concourse. With the head house no longer the entrance, the new entrances lead to the ground floor concourse. Using reinforced concrete facilitated the intensive construction without damaging the original structure and dampened vibrations from construction and future trains. In addition, it allowed the floor of the platform level to open up for light to reach the ground floor concourse (Figure 3-6). The concourse is separated into areas

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<sup>263</sup> Gardner and Smart, “Channel Tunnel Rail Link Section 2,” 44.

<sup>264</sup> Ibid.

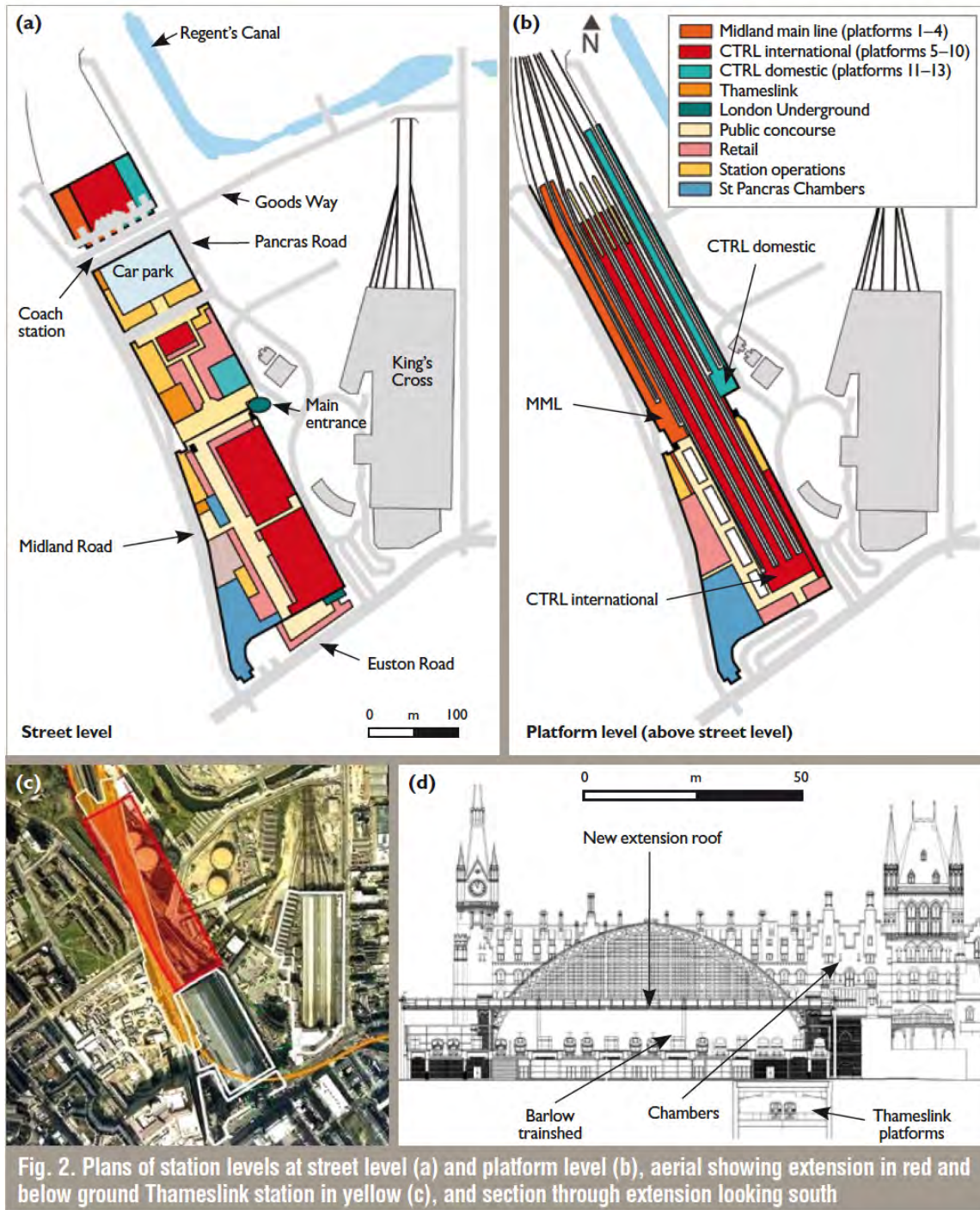
<sup>265</sup> Cossons, “Oubliez Waterloo: The St Pancras Effect.”

<sup>266</sup> Gardner and Smart, “Channel Tunnel Rail Link Section 2.”

<sup>267</sup> Ibid.



for international travel and domestic travel and other purposes. The international concourse has full-service customs and immigration kiosks with special ramped moving sidewalks to facilitate passenger flow and ease with baggage.<sup>268</sup>



**Figure 3-5.** Plan of St. Pancras Station platforms and concourses. (Gardner and Smart 2007)

<sup>268</sup> Ibid.



**Figure 3-6.** Refurbished St. Pancras Station: Barlow train shed, new train shed, platforms and below-ground concourse. (*The Guardian*)

A few protected properties (lower than Grade 1 listing) adjacent to St. Pancras Station, including a gymnasium that predated St. Pancras Station itself, were demolished with the approval of English Heritage. The gymnasium and other buildings were rebuilt according to their original design and now house HVAC and other systems for St. Pancras Station.<sup>269</sup> Finally, the refurbishment of the Thameslink station underground and adjacent to St. Pancras Station ultimately was included in this project. Like the other commuter rail services, Thameslink service also was maintained throughout the project as the station was renovated and expanded.<sup>270</sup>

### **3.2.5 Land Development Adjacent to St. Pancras Station**

The design for High-Speed 1's approach to St. Pancras Station would open up 20 hectares (49 acres) of land north of the station, which previously housed railway-related industrial uses, for new uses, such as high-density commercial development and housing.<sup>271</sup> According to the original agreement between the Central Government and London and Continental Railways, the UK Department for Transport should receive 50 percent share of LCR's net profit

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<sup>269</sup> Ibid.

<sup>270</sup> Ibid.

<sup>271</sup> ERM, "Channel Tunnel Rail Link Environmental Statement: Main Report."

in this venture.<sup>272</sup> In 2001, LCR selected Argent as a private partner for this project and began the planning process and negotiations with the London Borough of Camden, in which St. Pancras Station is located. Section 106 of the Town and Country Planning Act of 1990 provides legal authority to local governments in negotiating development requirements or financial commitments from private developers.<sup>273</sup> In 2006, Argent and the Borough of Camden, along with English Heritage, the Greater London Authority and other local community groups, produced a detailed Section 106 Agreement. In 2008, another 7-hectare (17-acre) triangular piece of land owned by DHL was included in the development agreement and master plan, and LCR, Argent and DHL jointly formed the King’s Cross Central Limited Partnership (KXC).<sup>274</sup>

The agreement and master plan provide for a land-use split of 40 percent principal open space and 60 percent built space, which includes courtyards and gardens. The plan includes the following main elements (Figure 3-7):

- High-density, mixed use development,
- Refurbishment and repurposing of 20 historic buildings,
- Approximately 50 new buildings,
- Enhancements to Regent’s Canal, including three new bridges,
- 25,000 jobs supported by skills and recruitment initiatives for local residents,
- Up to 650 units of student housing and 1,900 homes, a substantial amount—40 percent—*affordable* (28 percent public and 12 percent for those on moderate incomes),
- The University of the Arts London,
- Public primary school,
- Primary healthcare center,
- Preservation and renovation of the 91-room Great Northern Hotel, and
- 14 wind turbines, ground source heat pumps, and provision for biomass energy.<sup>275, 276</sup>

The plan stipulates floor space maxima (Table 3-1), which in sum exceed the total allowed development for the site. This guarantees diverse land use but allows for flexibility; land

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<sup>272</sup> Hiroaki Suzuki, Jin Murakami, Yu-Hung Hong, and Beth Tamayose, “Financing Transit-Oriented Development with Land Values: Adapting Land Value Capture in Developing Countries,” 2015.

<sup>273</sup> Ibid.

<sup>274</sup> Chris Gossop, “King’s Cross Opportunity Area” (paper presented at the 43<sup>rd</sup> ISOCARP Congress, 2007).

<sup>275</sup> Suzuki, Murakami, Hong, and Tamayose, “Financing Transit-Oriented Development with Land Values.”

<sup>276</sup> Gossop, “King’s Cross Opportunity Area.”



uses may be increased or decreased to a limited extent depending on market conditions over the 10- to 15-year construction period. By 2014, the redevelopment project was approximately half complete, and its completion is expected by 2020 at a total cost of £3 billion.<sup>277</sup> At this time, one-fifth of the 1,309 single-family units were constructed and sold.<sup>278</sup> In addition, major tenants have committed to move to the area. In 2013, Google announced that it purchased a 1-hectare (2.4-acre) plot with a 999-year lease and will be constructing a 93,000-sq. m. property.<sup>279</sup>



**Figure 3-7.** King's Cross Central plan. (Gossop 2007; Argent)

| Use                                     | Floor space (sq. m.) |
|---|----------------------|
| Mixed-use development—total permissible | 739,690              |
| Offices                                 | Up to 455,510        |
| Retail                                  | Up to 45,925         |
| Hotels/served apartments                | Up to 47,225         |
| D1 (nonresidential institutions)        | Up to 74,830         |
| D2 (assembly and leisure)               | Up to 31,730         |
| 1,900 homes                             | Up to 194,575        |

**Table 3-1.** King's Cross Central floor space following Section 106 agreement in 2006. (Gossop 2007)

### 3.2.6 General Impacts of High-Speed 1

In 2015, the United Kingdom Department for Transport published the “First Interim Evaluation of the Impacts of High-Speed 1: Final Report” to evaluate the impacts of High-Speed 1 on transportation users and providers, on the net effect on economic productivity (i.e. wider economic benefits), on the regeneration of local development and activity, and on government shareholdings and asset values. The evaluation assumes a 60-year operating period for the

<sup>277</sup> “ULI Case Studies: King’s Cross,” *Urban Land Institute*, 2014.

<sup>278</sup> *Ibid.*

<sup>279</sup> *Ibid.*



project, meaning that it incorporates empirical data from the first eight years of operation and forecasts for the next 52 years of operation to make its conclusions on the project's past success and future viability.<sup>280</sup> These impacts are discussed briefly, as the focus of this chapter and case study is the impacts in the immediate area surrounding St. Pancras Station.

High-Speed 1 has had significant impacts on travel time savings, travel demand and travel patterns. International travelers on the Eurostar service save 33 minutes compared to the pre-High-Speed 1 route, and domestic travelers on Southeastern Rail also save time, for example 47 minutes from Ashford to London.<sup>281</sup> High-Speed 1 also has increased peak capacity on the longer-distance line from North and East Kent to London by 40 percent, and there has been a system-wide reduction in crowding and increase in punctuality, likely due to the net effects of High-Speed 1 service.<sup>282</sup> Concerning demand for High-Speed 1 service, 23 percent of high-speed rail trips were newly generated rail demand, and these were more likely to be longer distance journeys. This demonstrates the impact High-Speed 1 has had on making longer distance commuting and leisure trips to London more feasible. In addition, 18 percent of respondents to a survey used in the interim evaluation stated that High-Speed 1 was a factor in their choice of a location when moving their home or job.<sup>283</sup>

The interim report finds that over its 60-year operating period High-Speed 1 should generate over £10.2 billion of benefits in 2010 pounds to passengers and operators on the system, while the total construction cost was £6.16 billion. Travel time savings contribute £4.7 billion to this value, added passenger benefits for switching from car to rail, such as additional comfort or productivity, contribute £0.9 billion, rail revenue contributes £5.9 billion, and loss of tax receipts for the government contributes £0.8 billion of loss. Under a sensitivity analysis changing forecasting and appraisal assumptions, the total value ranges from £9.2 billion to £12.3 billion in 2010 pounds.<sup>284</sup> In addition, the report forecasts that the net value of wider economic benefits over the project's 60-year operating period will exceed £1.3 billion in 2010 pounds, or 23-25 percent of passenger benefits.<sup>285</sup> Finally, High-Speed 1's annual operating costs are estimated at

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<sup>280</sup> United Kingdom Department for Transport, "First Interim Evaluation of the Impacts of High-Speed 1: Final Report," 2015.

<sup>281</sup> Ibid.

<sup>282</sup> Ibid.

<sup>283</sup> Ibid.

<sup>284</sup> Ibid.

<sup>285</sup> Ibid.

£240 million.<sup>286</sup> The report also notes that these values were calculated in 2010, only four years into High-Speed 1's operating period and during a recession—or “exceptionally adverse conditions in the wider economy and development market”.<sup>287</sup> Actual ridership and other important factors were much lower than forecasted during planning stages. With improvements to the wider economy, these values are expected to increase.

These benefit and cost values seem to lead to the conclusion that High-Speed 1 would have a positive net present value; however, when the total costs include additional costs to the government due to financing and debt issues, the net present value becomes significantly negative. With these considerations, in 2010 values, costs increase to £12.60 billion and benefits (environmental, time savings, and crowding and reliability reach £6.70 billion. Including the £1.33 billion of wider economic benefits, increases total benefits to £8.03 billion. In sum, this leads to net present values of -£5.90 billion and -£4.57 billion and benefit-cost ratios of 0.53 and 0.64 for costs and benefits excluding and including wider economic benefits respectively.<sup>288</sup> This signals that the project was not beneficial to build. A sensitivity analysis of these results, however, revealed that these results are especially sensitive to assumptions on government subsidies, passengers' value of time and demand growth. In certain cases, High-Speed 1 could result in a benefit-cost ratio that exceeds 1 or a positive net present value.<sup>289</sup>

The next section discusses the impacts of High-Speed 1 and the choice of St. Pancras Station as its terminus on the immediate area surrounding the station.

### **3.2.7 Economic Impacts at St. Pancras Station**

St. Pancras Station is located in northern inner London in King's Cross Ward of the Borough of Camden (Figure 3-8). Prior to the rehabilitation of St. Pancras Station, this area experienced decades of disinvestment and did not attract major businesses or industry. Following this rehabilitation, the area has significantly changed and has attracted investment, new residents, wealth and businesses. While the entire High-Speed 1 may not be beneficial to society, determining the regeneration and wider economic benefits in vicinity of St. Pancras Station due to St. Pancras Station's approximately £800 million rehabilitation is of greater importance to this case study and thesis. As discussed in Chapter 2.3.3, these local wider economic benefits likely

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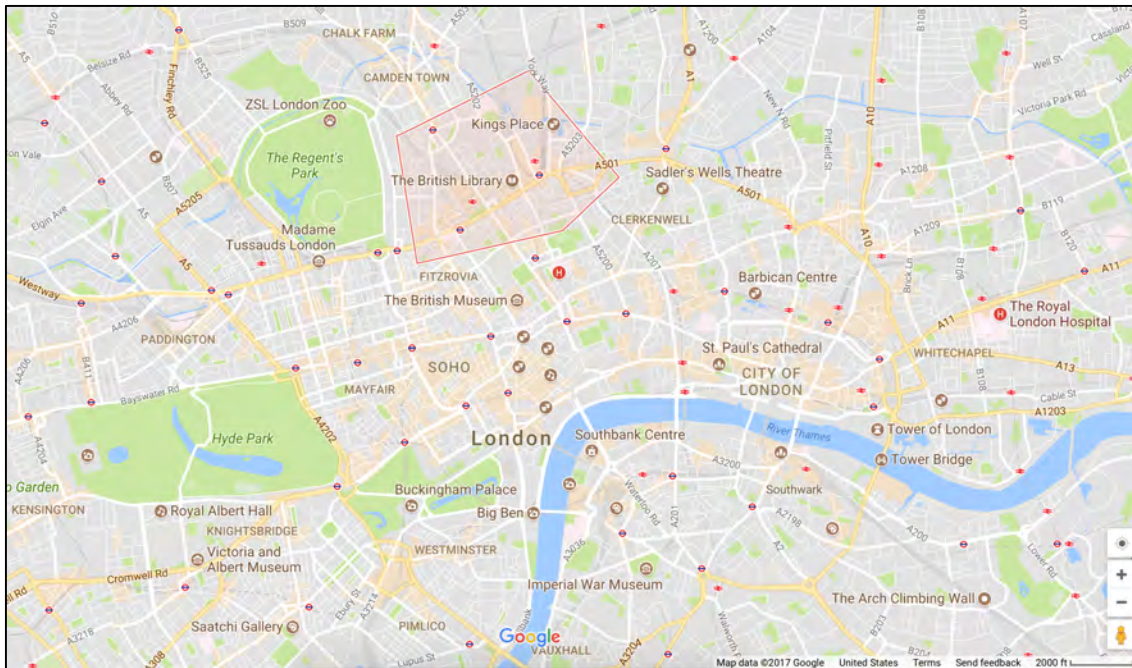
<sup>286</sup> Ibid.

<sup>287</sup> Ibid., 11.

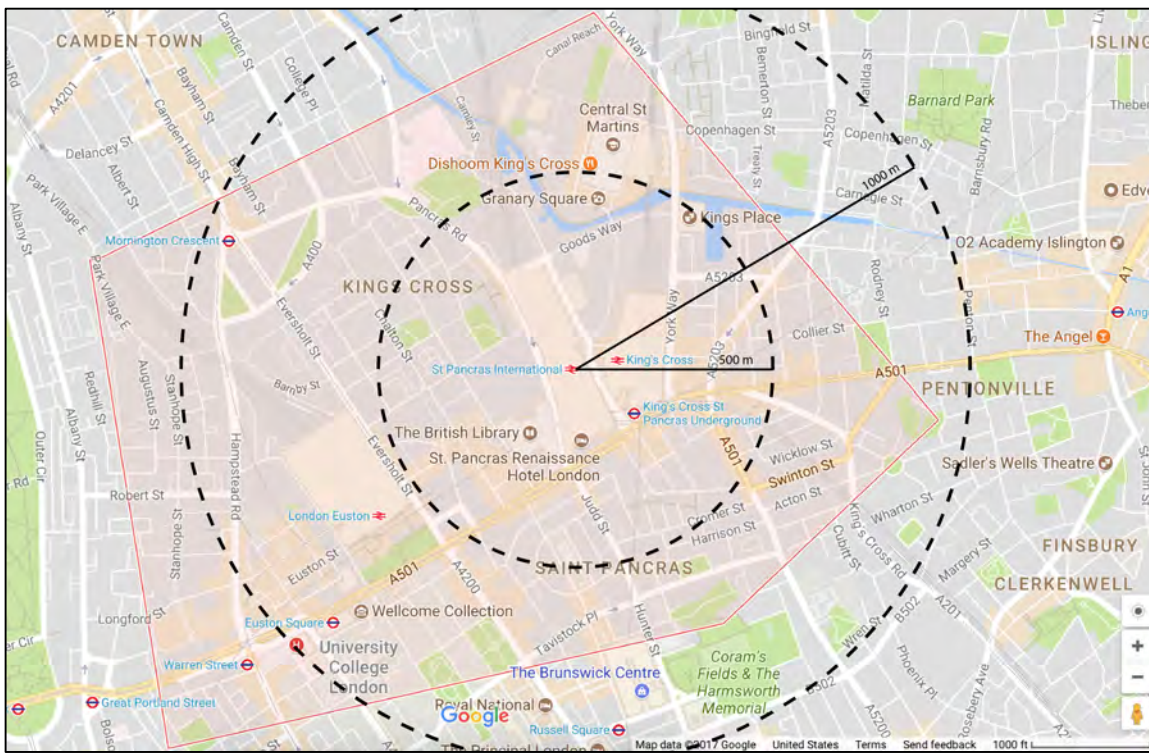
<sup>288</sup> Ibid.

<sup>289</sup> Ibid.

would occur within 500-1000 meters of the high-speed rail station (Figure 3-9). In addition, regeneration impacts may be a result of a redistribution of economic activity to sites adjacent to high-speed rail stations rather than overall economy-wide increase in activity.



**Figure 3-8.** Inner London with the King's Cross Ward of the Borough of Camden highlighted. (Google Maps 2017)



**Figure 3-9.** King's Cross Ward highlighted with 500 meter and 1000 meter buffers around St. Pancras Station.

According to the Department for Transport interim report, between 2005 and 2010 the average value of business properties within 500 m of St. Pancras Station increased by 53.1 percent and the average value of business properties within 2 km of St. Pancras Station increased by 46.0 percent, both more than twice the amount of properties in the vicinity of the other new High-Speed 1 stations. Camden, the district in which St. Pancras Station is located, also experienced the greatest percentage increases in business property values out all of the areas with high-speed rail stations. These trends likely were related to a combination of High-Speed 1, the St. Pancras Station rehabilitation, and other local and broad economic and social factors.<sup>290</sup> During this time period, the number of commercial properties increased by 5.1 percent within the 500-m buffer zone, by 2.9 percent within the 2-km buffer zone and by 0.1 percent in Camden.<sup>291</sup> Additionally, in the 2-km buffer zone around St. Pancras Station, average house prices increased by 50 percent from 2009-2013.<sup>292</sup> Likely due to the recession, employment declined throughout the High-Speed 1 corridor. During the recession, higher value sectors, which are more concentrated in inner London, experienced the worst employment declines and likely contributed to the pronounced decline in employment around St. Pancras Station from 2005-2010.<sup>293</sup>

The report also includes a survey of stakeholders from each of the high-speed rail station along the High-Speed 1 route. Business-owners generally did not believe High-Speed 1 had a direct impact on staff recruitment and retention or an influence when deciding on their companies' location, although most of the companies did not consider relocating from 2007 through 2014 when the survey was conducted. Some large companies, such as Google, already have located or are planning on locating offices in the area. These respondents, however, did recognize the significant time savings for business travel.<sup>294</sup> Other key stakeholders near St. Pancras Station, including local governments and developers, recognized the importance of the station's rehabilitation to the area's economic and cultural regeneration. In these stakeholders' opinions, this was due in greater part to the billions of pounds of public investment and new commercial activity in the district working to bring interest to the area rather than to provision of the high-speed rail service.<sup>295</sup> The report concludes that, for stakeholders in the King's Cross-St.

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<sup>290</sup> Ibid.

<sup>291</sup> Ibid.

<sup>292</sup> Ibid.

<sup>293</sup> Ibid.

<sup>294</sup> Ibid.

<sup>295</sup> Ibid.

Pancras and Stratford areas, “[High-Speed 1] was seen to have played a catalytic role [...] in the regeneration of the area.”<sup>296</sup> For the time immediately following the project’s completion, the redevelopment of St. Pancras Station seems to have brought about some of the regeneration in the King’s Cross area that was listed as part of High-Speed 1’s objectives in the original environmental impact statements. As time progresses and there are more opportunities for companies to relocate, these trends may be even more pronounced.

Ennio Cascetta, Francesca Pagliara, Valerio Brancaccio and John Preston (2010) also evaluate the regeneration impacts at St. Pancras Station. Between 2001 and 2004, housing prices in Camden, which contains King’s Cross Ward and St. Pancras Station, follow the average trend of London. Starting in 2006—close to the reopening of St. Pancras Station—increases in housing prices in Camden began to exceed London’s average. In 2006, prices increased by 10 percent, compared to London’s average of 6 percent. In 2007, housing prices in Camden increased 20 percent compared to a 15 percent average increase in London, and these values were 7 percent compared to no change to respectively in 2008. At the onset of the recession in 2009, however, housing prices decreased in line with London’s average housing prices. In sum from 2006 through 2008, housing prices in Camden experienced a net increase of 13 percent compared to the average increase in London, which is likely linked to the reopening of St. Pancras Station as the terminus for High-Speed 1.<sup>297</sup> More current data provided by London’s government<sup>298</sup> show that, except for 2009, these trends hold through 2013 but reverse from 2013 through 2016, with average London housing prices increasing at a greater rate than those in Camden. At this point, the novelty of St. Pancras Station and interest in developing in the area relative to other neighborhoods in London may have decreased, especially in comparison to other high-profile transportation and development projects, such as Crossrail.

Using methods discussed in Chapter 2.3.3,<sup>299</sup> Francisco Martinez, Francesca Pagliara and Adriano Tramontano (2013) compare housing prices in the area within 500 meters of St. Pancras Station are to those in a control area outside that catchment area but still within a 1000-meter radius of the station (Figure 3-9). Martinez et al. find that the new accessibility produced by

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<sup>296</sup> Ibid., 101.

<sup>297</sup> Ennio Cascetta, Francesca Pagliara, Valerio Brancaccio, and John Preston, “Evaluating Regeneration Impacts of the Channel Tunnel Rail Link” (paper presented at WCTR, Lisbon, July 11-15, 2010).

<sup>298</sup> Mayor of London and London Assembly, “UK House Price Index,” Accessed June 2017.

<sup>299</sup> Pagliara and Papa, “Urban Rail Systems Investments.”

High-Speed 1 and the redevelopment of St. Pancras Station only impacts housing prices within areas very close to the station (within 500 m) rather in a broader area, as has occurred with other high-speed rail stations in England.<sup>300</sup> These results may be caused by there being billions of pounds of new investment and land development within this catchment area (i.e. King's Cross Central). This major project may have captured some of the value created by the new accessibility that could have been distributed to other existing properties further from the station.

While it is clear that property values—business, office and residential—have increased throughout Camden and especially near St. Pancras Station soon before and after the station's opening, it is difficult to determine the exact impact High-Speed 1 and the £800 million St. Pancras Station rehabilitation played in this. While housing prices in Camden experienced a net 13 percent increase compared to the London average between 2006 and 2008 and continued to increase at a greater rate the London average (and compared to other inner boroughs) through 2013, these trends reversed following 2013. In addition, some research has shown that the impacts from St. Pancras Station are more influential within a close area to the station, and the Borough of Camden extends well beyond this catchment area. Data that separates the values and quantities of housing sales by London ward show that the King's Cross Ward has experienced significant fluctuations in the average value of from 2007 through 2015.<sup>301</sup> These values and fluctuations, however, may be more representative of what property went on the market at the time, such as multiple units in the King's Cross Central development, rather than overall trends in the ward.

It is definite that the King's Cross Central development would not have happened without the £800 million St. Pancras rehabilitation in addition to the £3 billion investment in the development itself). Planning estimates from 2010 forecast that the Department for Transport should earn £100-200 million in 2010 pounds annually as 50 percent of the net profits from this project.<sup>302</sup> (The Department for Transport and LCR have agreed to a 50-50 profit-sharing structure.) That would mean the total annual profits from the project would be £200-400 million. By 2014, when one-fifth of the residential properties had been sold, prices were twice as high

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<sup>300</sup> Francisco Martinez, Francesca Pagliara, and Adriano Tramontano, "Hedonic Value of Accessibility on Residential Properties: Random Bidding Foundation and Application to New Rail Track," *Ingegneria Ferroviaria* (2013).

<sup>301</sup> Mayor of London and London Assembly, "Average House Prices, Ward, LSOA, MSOA," Accessed June 2017.

<sup>302</sup> Suzuki, Murakami, Hong, and Tamayose, "Financing Transit-Oriented Development with Land Values."

than expected (£1400 per sq. ft. rather than £700 per sq. ft.).<sup>303</sup> This may point to much higher profits that the expected annual £200-400 million. These profits are on the order of magnitude as the costs. Combined with other agglomeration benefits in the area, such as increased employment, these benefits could outweigh the total costs of redevelopment at and around St. Pancras Station, even if the entire High-Speed 1 project were not beneficial, as discussed in the previous section (3.2.6).

The next section discusses other benefits that occurred at St. Pancras Station. These are more difficult to quantify than land values but seem to be of great value to the public.

### **3.2.8 Cultural and Political Outcomes at St. Pancras Station**

As discussed in Section 3.1.2, political views and interests have become much more important in the process of determining the value of infrastructure projects in the UK. This section discusses how stakeholders reacted to the results of St. Pancras Station's rehabilitation with respect to its aesthetic appeal and quality and social value.

St. Pancras Station was worth little when it became protected under Grade I listing; however, it now offers significant benefits to travelers and the economy and is a source pride for the people of London and the United Kingdom.<sup>304</sup> In a 2007 review in *The Guardian* of the about-to-open St. Pancras Station, Jonathan Glancey enthusiastically praises the station—its public openness, its amenities and its historic preservation. He writes in conclusion, “Whether you have business in Brussels, a lunch date in Paris or are simply keen to avoid airport hell, whether you are a railway buff, an engineer, curious shopper, architectural historian or a Friday-evening champagne Charlie, the new-look St Pancras is very likely to suit you. Here is a gothic fairy tale brought up to date, setting a new standard for Britain's railways, and bringing new life to one of Europe's most compelling buildings.”<sup>305</sup> Glancey also praises the station's architecture. While others, especially in previous times, may have ridiculed the station's Victorian Gothic style as garish and inappropriate for something as unbeautiful as a train station, Glancey is amazed at how a train station can be such a significant landmark, on par with great buildings of earlier times.<sup>306</sup>

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<sup>303</sup> “ULI Case Studies: King's Cross.”

<sup>304</sup> Cossons, “Oubliez Waterloo: The St Pancras Effect.”

<sup>305</sup> Jonathan Glancey, “The Miracle of St Pancras,” 2007.

<sup>306</sup> Ibid.

The approval extends beyond architecture critics. Ever since St. Pancras Station reopened in 2007, it has topped the National Rail Passenger Survey's every-six months' ratings of all of Network Rail's stations.<sup>307, 308</sup> In Autumn 2015, about 23 percent of people who spent time at St. Pancras Station did so for reasons other than travel. This was much higher than the average for all of Network Rail's stations.<sup>309</sup>

Another critic, Etienne Riot suggests that St. Pancras Station serves upper class passengers and that the station's new "high-quality" events may be contributing to gentrification in the King's Cross area, because of the influx of international travelers. He also states: "the modern part of St. Pancras Station looks more like an international airport. Nonetheless, the retention and refurbishment of the old building is a reminder that trains are still not planes."<sup>310</sup> The aesthetics and programming of St. Pancras Station are impacting the surrounding area.

In considering the development of King's Cross Central beyond St. Pancras Station itself (but resulting from the rehabilitation of the station), Rowan Moore (2014), an architecture critic believes the project accomplishes many admirable goals. Moore praises the incorporation of historic buildings and infrastructure on the site and other physical constraints, such as few towers to preserve views of St. Paul's Cathedral in the distance and nearby tracks that contain the area.<sup>311</sup> Moore also values the social mix created by a high percentage of affordable housing, which is lacking in many other contemporaneous developments throughout London. In comparison to these other projects, Moore states:

"The bigger concern rather [than whether similar social objectives could be achieved some way other than through the King's Cross Center project] is this: there is too little sign of other large developments in London, or other British cities, pursuing social goals to degree. In the stacked-up unites of luxury housing now being waved through [...], you see nothing of the richness of King's Cross. An essential part of its success has been the balance of power between developers and local authorities [...]"<sup>312</sup>

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<sup>307</sup> Transport Focus, "National Rail Passenger Survey – NRPS – Autumn 2015 – Network Rail Station Report," 2016.

<sup>308</sup> Nicola Shaw, *personal comments*, February 1, 2016.

<sup>309</sup> Transport Focus, "National Rail Passenger Survey – NRPS – Autumn 2015 – Network Rail Station Report."

<sup>310</sup> Etienne Riot, "A European perspective on the planning of major railway stations: considering the cases of St. Pancras Station and Paris Gare du Nord," (2014): 200.

<sup>311</sup> Rowan Moore, "All Hail the New King's Cross – But Can Other Developers Repeat the Trick?" *The Guardian*, October 12, 2014.

<sup>312</sup> Ibid.



### **3.2.9 Stakeholder Interests and the Outcomes of the St. Pancras Station Redevelopment**

It is important to understand stakeholders' interests and which stakeholders hold the greatest saliency in this project in order to understand how the benefits and costs would be valued. The stakeholder analysis (see Appendix A), which uses the Mitchell Framework for evaluating stakeholder saliency (see Chapter 2.4.2), shows that the UK Central Government and English Heritage, itself a government agency, are the two stakeholders with the greatest saliency. Other stakeholders, such as London and Continental Railways, were essential to the project but had financial and other difficulties that impeded their effectiveness. While demands from banks and financiers (for repayment of debt and profitability) significantly contributed to these difficulties and could have delayed or even canceled the project, the Central Government's purchase of this debt and renationalization of LCR made these demands less impactful. Ultimately, the Central Government planned, financed and oversaw the construction of the project, and English Heritage oversaw and approved any architecture or design decisions at St. Pancras Station.

Certain outcomes are more relevant to these stakeholders' interests. As discussed in the previous section, infrastructure planning and development in the UK has become much more political over time. While the Central Government would benefit from profits from land development, it also seeks to provide good transportation services and create attractive public spaces. English Heritage, wishes to protect and preserve significant cultural and historic landmarks. The High-Speed 1 project may not have been profitable, but it did meet these goals; the expert and public reactions to the rehabilitation of St. Pancras Station and the regeneration of the adjacent area were overwhelmingly positive, and the station itself and nearby historic sites and properties were beautifully renovated. The fact that the Central Government saved the project from bankruptcy multiple times shows that it believed that goals other than profitability were valuable and that it had sufficient public support to pursue these goals.

### **3.3 Case Study Conclusions**

The research in this section presents a case study of a high-speed rail project (High-Speed 1) creating the political and financial means to redevelop of St. Pancras Station, a major rail station in the United Kingdom. The UK government has worked to ensure that the project would be privately financed and built; however, it has been unsuccessful in meeting these goals and has repeatedly purchased the project's debt to allow it to proceed. While it is possible that High-

Speed 1 will not provide sufficient benefits to exceed its costs, St. Pancras Station's rehabilitation and the development of adjacent properties likely have led to increases in property values and economic activity in the area, especially within 500 meters of the station. Importantly a £3 billion land development project is near completion on land that High-Speed 1's route opened up north of St. Pancras Station and King's Cross Station. This project already has been able to attract major business tenants, such as Google, has maintained high amounts of affordable housing and public open space, and has restored and repurposed over 20 historic structures and sites.

In order to evaluate what these benefits mean to the most salient stakeholders and determine stakeholders' influences over the project, a stakeholder analysis is conducted (Appendix A). This analysis concludes that the Central Government, as well as English Heritage, held the greatest saliency in this system. Ultimately all the stakeholders were dependent on the leadership and funding of the Central Government in order to carry out this major project. Because of public support for high-speed rail and its significant control over the project, the Central Government was able to choose St. Pancras Station as the London terminus for the new high-speed rail system. The rehabilitation of St. Pancras Station, and High-Speed 1 in general, is viewed in a very positive light in the United Kingdom, demonstrating the project's success measured by public and expert opinion, both of important value to the most salient stakeholders.

In addition, the culture and attitude in general towards rail infrastructure development in London is exceptionally supportive and positive. At the same time, the Central Government, which also enthusiastically supports rail development, had the greatest amount of saliency (see Section 2.4.2) to be able to control the project, holding firm on the final decision to redevelop St. Pancras Station. Given that the specific project to rehabilitate St. Pancras Station was a success, in at least many if not all senses, the stakeholder analysis indicates that having a strong, central stakeholder with a variety of interests and goals could lead to successful infrastructure development, even if its profitability is questionable.

Even during the planning stages, the Channel Tunnel Rail Link project took a very broad view of environmental protection and protection of English heritage. To the project, environmental protection included agricultural scenery and noise pollution as well as places of historic significance. These criteria seem to focus on human-related needs rather than what one might think of as environmental needs. By focusing on the human side during the environmental

review, the central government incorporated other goals and metrics for success and other stakeholders' input into the planning process, forming the project in a way that would achieve this variety of goals.

Currently, rail decentralization is a continued goal of the Central Government in the United Kingdom. Given the history of High-Speed 1 and St. Pancras Station, however, this does not seem like a productive objective. The central authority guiding High-Speed 1 and the development of St. Pancras Station made the project such a success, and, without it, the private sector would have not been able to fully fund and complete the project. In much the same way as the value of supporting rail infrastructure development seeming to take priority regardless of other needs, it seems as though the Conservative government values privatization regardless of the fact that its largest and very successful High-Speed 1 project was essentially a public project. These aims may not necessarily produce projects with as wide-ranging benefits and public popularity as the rehabilitation of St. Pancras Station.

Chapter 4, which discusses this thesis' second case study, follows.

## **4 Case Study: Los Angeles to Las Vegas High-Speed Rail Link**

This section presents the history and analysis of former and proposed passenger rail links between Los Angeles and Las Vegas. As the second of two case studies considered in this thesis, this section focuses on the current proposal for a high-speed rail link by XpressWest, a private company organized to carry out this project alone. First, background history and literature relevant to this case study specifically are discussed. Then, an analysis, based in part on a stakeholder analysis (Appendix B) and a benefit-cost analysis (Appendix C) of this case study, is presented. This case study will be used further to evaluate the relationship between local land development and high-speed rail development in following sections.

A central aspect of this case is the involvement of the private sector. Considering the case study of High-Speed 1 and local land development at St. Pancras Station in Chapter 3, the UK government bore most of the costs of the project. In turn, public-oriented benefits, such as pride in the city and country's international rail gateway and a customer satisfaction with the station itself, are especially relevant to the St. Pancras Station case. In this case, however, private-sector profits and the project's financial viability are central themes to evaluating the benefits and costs of the project.

### **4.1 Context: Passenger Rail in the Western United States**

#### **4.1.1 Intercity Passenger Rail in the Western United States**

Amtrak operates intercity and long-distance passenger rail throughout the United States and is managed as a for-profit, publicly funded corporation (Figure 4-1). Amtrak was founded in 1971 to take over operations of passenger rail routes from private companies when ridership was declining rapidly and providing service became exceptionally unprofitable. Since then, Amtrak has altered, combined and eliminated routes with the aim to reduce financial losses while still providing service throughout the country.<sup>313</sup> Of particular relevance to this case study, Amtrak eliminated its "Desert Wind" route between Los Angeles and Ogden, Utah, via Las Vegas and Salt Lake City. With elimination of this service, Las Vegas became one of two of the 100 largest metropolitan areas in the United States without any Amtrak rail service within its metropolitan

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<sup>313</sup> Robert Puentes, Adie Tomer, and Joseph Kane, "A New Alignment: Strengthening America's Commitment to Passenger Rail," 2013.

area or close to a metropolitan area with rail service, along with Boise, Idaho. Amtrak, however, does contract bus service between the Southern California region and Las Vegas.<sup>314</sup>

Currently, Amtrak remains unprofitable. While its short-distance routes, with lengths under 400 miles, are as a group profitable, net losses from Amtrak's long-distance routes, which run up to 2,438 miles long, greatly exceed net profits from all of its profitable routes.<sup>315</sup>

Amtrak's two short-distance routes in California, the "Pacific Surfliner" between San Diego and Los Angeles and the "Capitol Corridor" between Sacramento and Oakland or San Jose, are its most popular routes after the "Northeast Corridor" and the "Acela" routes in the northeast region of the country.<sup>316</sup> Amtrak's long-distance routes in California, including the "California Zephyr" between San Francisco and Chicago and the "Sunset Limited" between Los Angeles and New Orleans, are among its least-popular routes and lose hundreds of millions of dollars in operating expenses a year.<sup>317</sup>



Figure 4-1. Map of the Amtrak system with large metropolitan areas highlighted. (Wikipedia)

<sup>314</sup> Ibid.

<sup>315</sup> Ibid.

<sup>316</sup> Ibid.

<sup>317</sup> Ibid.

#### 4.1.2 Public and Private Interest in and Political Views on Intercity Rail Development

From 1997 through 2013, passenger rail ridership in the US has increased dramatically, by 55 percent. Amtrak's short-distance and most popular routes experienced the greatest increases in ridership.<sup>318, 319</sup> Additionally, there is increasing interest in expanding passenger rail service throughout the country and especially in the Western United States. Reasons backers offer for supporting expanding passenger rail include changing lifestyles and urban development, combating climate change, revitalizing the economy, and reducing traffic congestion.<sup>320</sup>

High-speed rail has garnered a significant amount of this interest and investment. The American Recovery and Reinvestment Act of 2009 provided \$8 billion to 38 high-speed rail projects in 31 states. None of these projects, however, has been completed yet.<sup>321</sup> California High-Speed Rail (CAHSR) received \$2.3 billion of the funds, which has allowed the agency to undertake the first phase of the project from Anaheim and Los Angeles to San Francisco. Ultimately upon completion of CAHSR, high-speed rail will connect cities throughout California, with termini in San Francisco, Sacramento and San Diego. While the first phase of the project currently is under construction with significant public and political support, this project remains a perennially contentious issue in California, especially resulting from the cost, schedule and progress of the project.<sup>322, 323</sup>

Private companies and public-sector agencies also have proposed and are developing technologies that may be used as alternatives to (or in competition with) intercity passenger rail. Since the 1980s, the Nevada Maglev Commission has explored opportunities for maglev high-speed rail between Los Angeles and Las Vegas, although this has lost political support.<sup>324</sup> This proposal will be discussed further in this section.

In addition, in 2013 technologist and entrepreneur Elon Musk released a proposal for the "Hyperloop". This technology is inspired by the pneumatic tube and conceived to transport pods of passengers (or freight) long distances at speeds up to 700 miles per hour, as an alternative to

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<sup>318</sup> Ibid.

<sup>319</sup> Amtrak, "Amtrak Ridership and Revenues continue strong growth in FY 2014," 2014.

<sup>320</sup> US High-Speed Rail Association.

<sup>321</sup> Puentes et al., "A New Alignment: Strengthening America's Commitment to Passenger Rail," 2013.

<sup>322</sup> Ralph Vartabedian, "Federal Warning of Higher Bullet-Train Costs Prompts Sharp Opinions, Plans for Congressional Hearings," 2017.

<sup>323</sup> The Press Enterprise, "Editorial: High-Speed Rail Still off the Tracks," July 2, 2016.

<sup>324</sup> Richard N. Velotta, "Harry Reid: 'No One Is Stopping' Maglev Train Proposal," 2010.

the California High-Speed Rail project.<sup>325</sup> Since then, two private companies have invested millions of dollars in attempt to develop the technology and plan and obtain rights-of-way for the proposed network of Hyperloop routes.<sup>326</sup>

With the 2016 US presidential elections, federal politics radically changed. Following President Trump's inauguration in January 2017, he began to advocate for a \$200 billion public infrastructure investment plan, with the expectation that it would generate over \$1 trillion of private investment. As part of its advocacy, his administration released two lists of infrastructure projects across the country that were pertinent to national security or safety, "shovel-ready", direct job-creators and/or able to bolster US manufacturing.<sup>327</sup> Neither list included California High-Speed Rail or a high-speed rail connection between Southern California and Las Vegas; however, one of the lists did include a high-speed rail project: the proposed private high-speed rail between Houston and Dallas/Fort Worth in Texas.<sup>328</sup> Given the volatility in the federal government and the political environment, it is unclear whether the Trump Administration will be effective in its advocacy for infrastructure development and whether its support will galvanize further political, public and private support for intercity and high-speed rail development.

## **4.2 Case Study: Los Angeles to Las Vegas High-Speed Rail Link**

Given the history of intercity passenger rail and recent increased support of and investment in high-speed rail in the Western United States, such as California High-Speed Rail and the project in Texas, as well as the industries present in Las Vegas, proposed rail links between Southern California and Las Vegas are of relevance to this thesis. In this case study, we review and analyze XpressWest's proposal for a private high-speed rail link between the Southern California region and Las Vegas to spur tourism and economic development in Las Vegas.

Las Vegas is a hub of tourism centered around gambling and entertainment, which fundamentally are based on land development (through hotels, casinos, theaters, etc.). In addition, the city hosts international- and national-level conventions. In 2015, 42.3 million people visited Las Vegas, a majority being tourists. Smaller numbers of visitors come to Las

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<sup>325</sup> Elon Musk, "Hyperloop Alpha," 2013.

<sup>326</sup> Ryan Bradley, "The Unbelievable Reality of the Impossible Hyperloop," 2016.

<sup>327</sup> Lynn Horsley, Steve Vockrodt, Walker Orenstein, and Lindsay Wise. "EXCLUSIVE: Trump Team Compiles Infrastructure Priority List." 2017.

<sup>328</sup> Ibid.

Vegas to attend conventions, travel for business-related work or visit family or friends.<sup>329</sup> In recent decades, Las Vegas has experienced an extreme boom-and-bust cycle, dependent on visitors' ability to travel and spend more money while visiting. Recently during the recovery from the recession between 2010 and 2015, visitor volume increased at a compound annual growth rate of 2.6 percent.<sup>330</sup>

#### **4.2.1 Current Connections between Southern California and Las Vegas**

In 2015, 29 percent of all visitors to Las Vegas came from California. Of these visitors, 80-85 percent resided in the Southern California region, which is home to 22.6 million people and is defined by the Las Vegas Convention and Visitors Authority (LVCVA) as the following eight counties: Imperial County, Los Angeles County, Orange County, Riverside County, San Bernardino County, San Diego County, Santa Barbara County and Ventura County.<sup>331, 332</sup> In addition, there is a significant portion of visitors to Las Vegas who travel through Southern California en route to or from Las Vegas either while traveling domestically or internationally. 75 percent of international travelers to Las Vegas, who comprise 16 percent of the city's total visitors, arrive in the United States via other cities, such as Los Angeles and San Francisco.<sup>333</sup>

In 2015, 57 percent of the total visitors to Las Vegas, and 90 percent of the visitors from Southern California, arrived by road, including by bus and RV.<sup>334</sup> Almost all of these drivers travel on Route I-15, joining at Palmdale and passing through Victorville in San Bernardino County and the Mojave Desert (Figure 4-2). On these highway routes, uncongested drive time between four to six hours depending on the departure (or destination) location in Southern California.<sup>335</sup> Around 25 percent of car trips in a week occur during peak periods. Northbound to Las Vegas, highway traffic is most congested on Thursdays and Fridays. Southbound from Las Vegas, peak congestion occurs on Sundays. and on Sunday in the southbound direction from Las Vegas for the return leg. During these periods, travel time can be significantly extended and unreliable.<sup>336</sup> Additionally, commercial bus operators run services between California and Las

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<sup>329</sup> Las Vegas Convention and Visitors Authority, "Frequently Asked Questions," 2016.

<sup>330</sup> Steer Davies Gleave, "High Desert Corridor: Investment Grade Ridership & Revenue Forecasts," 2017.

<sup>331</sup> Las Vegas Convention and Visitors Authority, "Frequently Asked Questions," 2016.

<sup>332</sup> Steer Davies Gleave, "High Desert Corridor: Investment Grade Ridership & Revenue Forecasts," 2017.

<sup>333</sup> Ibid.

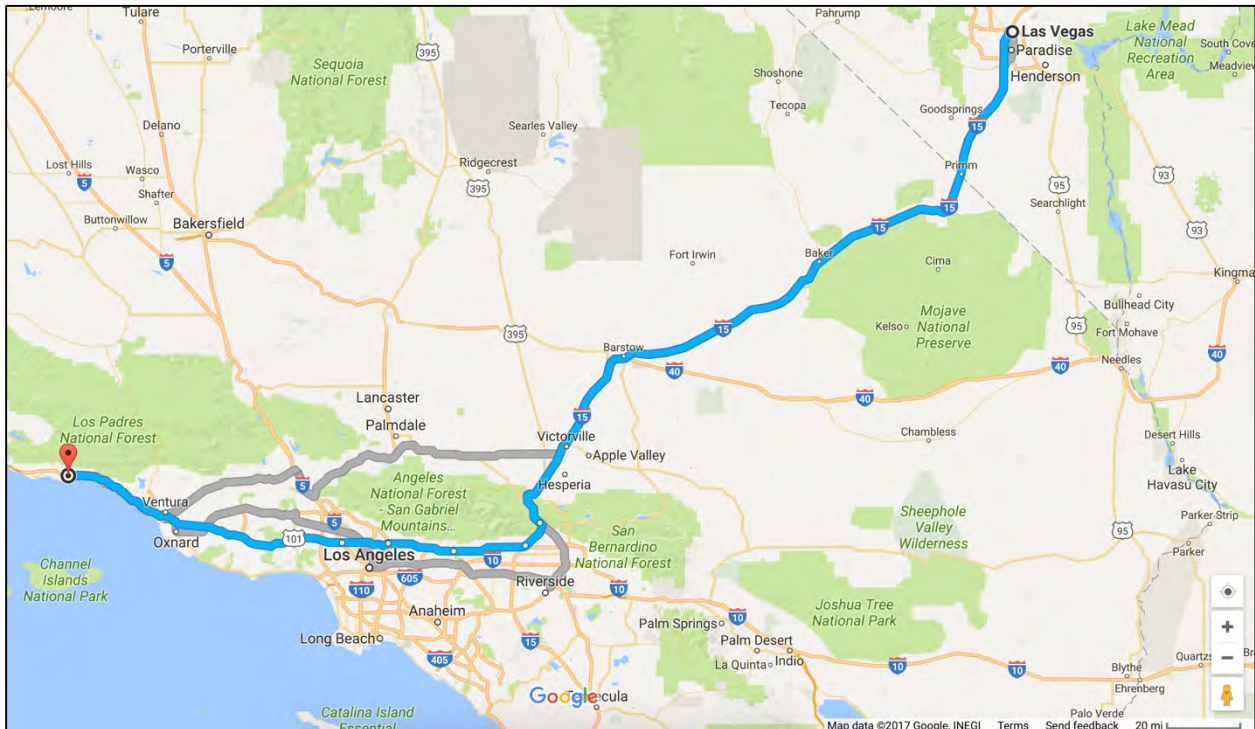
<sup>334</sup> Ibid.

<sup>335</sup> Ibid.

<sup>336</sup> Ibid.



Vegas; however, travel times on these routes are frequently longer than by car, due to stops and other delays.<sup>337</sup>



**Figure 4-2.** Driving routes between Southern California Region (Santa Barbara) and Las Vegas. (Google Maps)

170 daily flights connecting to six airports in Southern California and five airports in Northern California arrive at Las Vegas McCarran International Airport in each direction. Demand for flights also peaks on Thursdays and Fridays going to Las Vegas and on Sundays coming from Las Vegas. Depending on a variety of factors, including travel dates and airline, round-trip airfares may range from \$40 to over \$450.<sup>338</sup>

#### **4.2.2 Proposals for a New Passenger Rail Link between Los Angeles and Las Vegas**

Following the discontinuation of Amtrak’s “Desert Wind” service between Los Angeles and Ogden, Utah, via Las Vegas and Salt Lake City in 1997, residents, tourists, passenger rail interest groups and politicians, among others, have advocated for a variety of different options to replace the rail service. Currently, the most popular option supported by the political establishment and with private-sector interest is XpressWest’s proposal for a high-speed rail route between Palmdale, CA, and Las Vegas with the potential to continue on to Salt Lake City,

<sup>337</sup> Ibid.

<sup>338</sup> Ibid.

Phoenix and/or Denver. XpressWest's proposal for a high-speed rail line between the Southern California region and Las Vegas is the focus of this case study for three primary reasons:

1. This project currently garners the most political support and public attention.
2. The technology used in this project, i.e. high-speed rail, has the potential to integrate with other underway and proposed high-speed passenger rail projects in the region, primarily California High-Speed Rail.
3. Since XpressWest has completed the environmental review for the project, there is sufficient information for review and analysis.

Other proposals include two different high-speed rail alternatives and two different conventional passenger rail alternatives. Politicians and private developers have been exploring a maglev rail route between Anaheim and Las Vegas. California-Nevada Interstate Maglev has led this effort since the late 1980s after the States of California and Nevada created the California-Nevada Super Speed Train Commission.<sup>339, 340</sup> This project previously agreed to form a public-private partnership with American Magline Group (AMG), a subsidiary of Transrapid, which is a partner in the Shanghai Airport maglev.<sup>341</sup> Interest in maglev has waned, however, with growing interest in the potentially cheaper XpressWest proposal, which in 2010 was expected to cost \$6 – 6.5 billion rather than \$12.1 billion.<sup>342, 343</sup> In 2009 following years of inaction, then-Senate Majority Leader Harry Reid from Nevada announced he supported the XpressWest proposal over maglev, and the Nevada state legislature re-appropriated \$45 million in federal grants from the maglev project to a highway project at McCarran International Airport.<sup>344</sup>

In 2010, Genesis High Speed Rail America LLC announced plans for a high-speed rail route called “Desert Lightning” to add to the mix of proposed high-speed rail projects. While the high-speed rail technology would be similar to that of XpressWest's project and use dedicated tracks, the proposed Desert Lightning route would run south of rather than north of the Mojave

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<sup>339</sup> California-Nevada Super Speed Train Commission and American Magline Group, “California-Nevada Interstate Maglev Project (CNIMP),” 2008.

<sup>340</sup> Jeffrey A. Perlman, “Countywide: Firms Meet Deadline on Fast-Train Plans,” 1990.

<sup>341</sup> Ibid.

<sup>342</sup> FRA, *Final Environmental Impact Statement and Final Section 4(f) Evaluation for the Proposed DesertXpress High-Speed Passenger Train Victorville, California to Las Vegas, Nevada*, 2011.

<sup>343</sup> Dug Begley, “High Speed, High Stakes Dominate Vegas Rail Race,” 2010.

<sup>344</sup> Richard N. Velotta, “Harry Reid: ‘No One Is Stopping’ Maglev Train Proposal,” 2010.

National Preserve, leading toward Phoenix, Arizona, as well as Las Vegas and capturing the Palm Springs, California, market.<sup>345</sup> Following the 2010 announcement, however, Desert Lightning has not progressed.

The two conventional rail alternatives, which are essentially identical, are titled the “X Train” (or Las Vegas Railway Express) and the “Z Train”. Both were announced by private companies in mid-2010, and either project would serve as a replacement to Amtrak’s discontinued “Desert Wind” service, utilizing priority scheduling on existing freight rail lines for a five and a half-hour one-way journey between Los Angeles and Las Vegas.<sup>346</sup> In both proposals, service would focus on providing luxury amenities onboard, including entertainment, fine dining and potentially gambling. As the projects continue to claim service is imminent, the X Train has purchased and refurbished mid-century rail cars.<sup>347</sup> It is unclear, however, what kind of service it would offer. In 2014, the X Train announced it would offer chartered service for private events rather than regularly scheduled public service.<sup>348</sup>

#### **4.2.3 The XpressWest Proposal for High-Speed Rail**

Founded in 2005 as DesertXpress, XpressWest is a private venture company with plans to design, fund, construct, and operate a high-speed rail corridor linking Southern California with Las Vegas, Nevada.<sup>349</sup> In this thesis, both the company and project are referred to as “XpressWest”, since the company currently refers to itself and its proposed project with this name. Founded in 2005, XpressWest is led by Marnell Companies, a group of real estate and development companies based in Las Vegas.<sup>350</sup> As a development and real estate company, the Marnell Companies have an interest in bringing more tourists to the Las Vegas area in order to expand their business, and, as a private high-speed rail operator XpressWest’s presumed aim is to maximize its profits in running this rail service. In developing this high-speed rail route, XpressWest states that the project will provide the following, summarized public benefits:

- Increase public safety by attracting passengers from more dangerous modes of transportation, like driving.

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<sup>345</sup> Richard N. Velotta, “Another Train Enters Fray for L.A. to LV Route,” 2010.

<sup>346</sup> Richard N. Velotta, “Group Says ‘Brand X’ Stole its Idea for L.A.-to-Vegas Plan: Low-Speed Train Proposal Clash,” 2010.

<sup>347</sup> X Train, “Our Railroad Car Fleet.”

<sup>348</sup> Richard N. Velotta, “X Train Derails Plan for Scheduled Service, To Offer Charter Trips Instead,” 2014.

<sup>349</sup> XpressWest, “XpressWest.”

<sup>350</sup> XpressWest, “China Railway International U.S.A. Co., LTD., and XpressWest to Develop Nevada – California Interstate High-Speed Passenger Rail System,” 2015.

- Reduce traffic congestion/increase capacity for goods movement.
- Enhance U.S. infrastructure and regional connectivity.
- Create jobs.
- Increase economic output.
- Reduce air pollutant and greenhouse gas emissions.
- Reduce dependence on oil.
- Reduce energy consumption.
- Increase tax revenues (especially in Las Vegas).<sup>351</sup>

These stated public goals are similar to the goals offered in recent statewide transportation plans in both California and Nevada. The goals listed in the 2016 *California Transportation Plan 2040: Integrating California's Transportation Future* are:

- “Improve multimodal mobility and accessibility for all people.
- Preserve the multimodal transportation system.
- Support a vibrant economy.
- Improve public safety and security.
- Foster livable and healthy communities and promote social equity.
- Practice environmental stewardship.”<sup>352</sup>

and the “guiding principles” of the 2008 Nevada *Statewide Transportation Plan* are:

- “Safety: Improve safety for all modes of the transportation system. [...]
- Customer Service: Improve internal and external customer service and satisfaction. [...]
- Asset Management: Protect the public’s investment in our transportation system. [...]
- Mobility/Accessibility: Provide statewide, multimodal, interconnected, efficient transportation system that enhances Nevada’s Economic Competitiveness. [...]
- Freight Movement: Improve the safety and mobility of freight movers. [...]
- Environmental Stewardship: Ensure the human and natural environments are considered when developing the transportation system.”<sup>353</sup>

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<sup>351</sup> XpressWest. “Benefits.”

<sup>352</sup> Caltrans, *California Transportation Plan 2040: Integrating California's Transportation Future*, 2016, p. 18.

#### 4.2.4 The XpressWest Route

The XpressWest company originally planned to build the route from Victorville in San Bernardino County, California, to Las Vegas along the I-15 right of way (Figure 4-3). The rails lines would be double track with no at-grade crossings, using the I-15 median or running parallel to the highway. Since this route traverses the Mojave Desert, a region with few inhabitants, it has no intermediate stops.<sup>354</sup> The route also passes through only San Bernardino County in California and Clark County in Nevada, limiting the number of regional governments with direct oversight over the project. At approximately 185 miles long, the journey would take under 80 minutes at speeds exceeding 150 mph.



**Figure 4-3.** Map of the California passenger rail network upon completion of XpressWest and California High-Speed Rail. XpressWest shown in blue, including High Desert Corridor from Palmdale to Victorville. (XpressWest)

<sup>353</sup> NDOT, Intermodal Planning Division, *Statewide Transportation Plan: Moving Nevada Through 2028*, 2008, p. ES-2 – ES-3.

<sup>354</sup> FRA, *FEIS*, 2011.

In 2011, XpressWest priced round-trip fares at \$89, a similar price to that proposed for the X Train, considerably cheaper than available flights and competitive with the cost of travel by road.<sup>355</sup> Since 90 percent of visitors to Las Vegas from Southern California drive, competitiveness with air travel is less important than competitiveness with automobile travel for the success of the project.<sup>356</sup> In a 2017 report, XpressWest updated round-trip ticket prices to be between \$91 and \$206.<sup>357</sup>

Since the route follows the I-15 right of way, siting a station at Victorville is ideal. All traffic from Southern California to Las Vegas funnels into I-15 at Victorville via the extensive network of major highways in the region.<sup>358</sup> Potential passengers currently driving to Las Vegas on any of these paths would not have to change their route in order to access the XpressWest station. This arrangement, however, does require passengers to travel up to an hour by car (in normal traffic conditions), depending on the starting location in Southern California.

In 2012, XpressWest proposed an extension of the route to Palmdale, California, which would be built in a second phase (Figure 4-3 and Figure 4-4). The 50-mile extension would travel within the right-of-way currently planned for the High Desert Corridor highway project, a public works project intended to provide multimodal connections between the fastest growing cities in Southern California.<sup>359, 360</sup> The station in Palmdale also would connect the XpressWest line with Metrolink, the public commuter rail system in the Los Angeles region. In addition, once built, California High Speed Rail will make stops in Palmdale. This XpressWest extension to Palmdale then also would connect with the CAHSR system. Although there are no concrete plans or proposals for doing so, XpressWest trains continue on to Los Angeles Union Station, on Metrolink or CAHSR tracks (Figure 4-4). This would create the first direct rail connection between Los Angeles and Las Vegas since the discontinuation of Amtrak's "Desert Wind" service.

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<sup>355</sup> FRA, *FEIS*, 2011.

<sup>356</sup> Steer Davies Gleave, "High Desert Corridor: Investment Grade Ridership & Revenue Forecasts," 2017.

<sup>357</sup> *Ibid.*

<sup>358</sup> FRA, *FEIS*, 2011.

<sup>359</sup> Steer Davies Gleave, "High Desert Corridor: Investment Grade Ridership & Revenue Forecasts," 2017.

<sup>360</sup> Los Angeles County Metropolitan Transportation Authority, "High Desert Corridor."





**Figure 4-4.** XpressWest High Desert Corridor extension and other potential extensions. (Steer Davies Gleave)

Finally, XpressWest also has announced intentions to expand beyond Las Vegas toward Phoenix, Salt Lake City and Denver to realize the Southwest Network as identified by the Federal Railroad Administration in June, 2014.<sup>361</sup> XpressWest, however, has given no timeline for these additional extensions.

#### **4.2.5 The Las Vegas Terminus**

Through environmental review, the Federal Railroad Administration recommended two different sites for the Las Vegas terminal station. Two sites, out of four considered, were chosen to allow for flexibility until XpressWest could undertake further financial analysis before construction.<sup>362</sup> In addition, each of these sites would be in close proximity to the Las Vegas Strip, would have sufficient parking space and would be accessible by taxi, car, bus and potential extensions of the Las Vegas Monorail (Figure 4-5).<sup>363</sup> Other significant factors that contributed to these selections were that these sites have no known cultural or environmental resources and both sites are located outside of the 100-year floodplain zone.

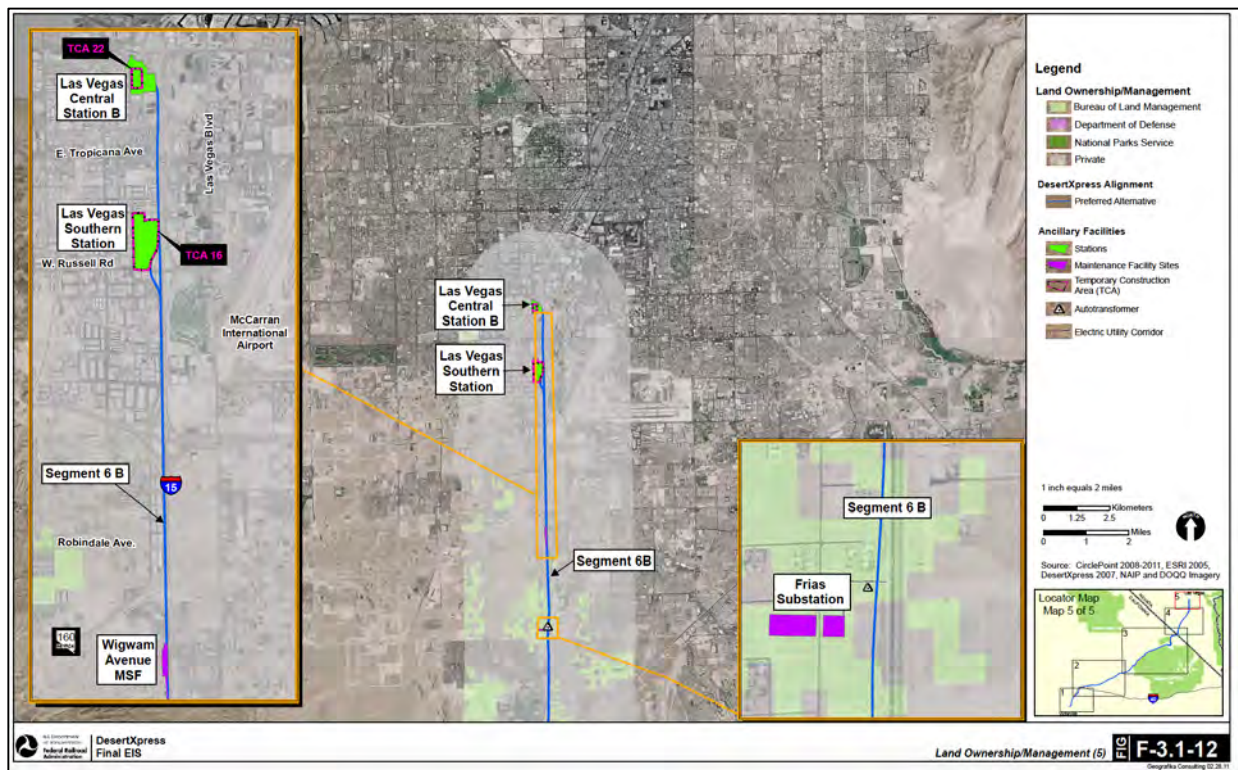
One site, called the Southern Station is located south of the city and close to McCarran International Airport. It would displace no businesses or residents. It would also shorten the route

<sup>361</sup> XpressWest. "XpressWest."

<sup>362</sup> FRA, *Draft Environmental Impact Statement and 4(f) Evaluation for the proposed DesertXpress High-Speed Passenger Train, Victorville, California to Las Vegas, Nevada*, 2009.

<sup>363</sup> *Ibid.*

by two to six miles of elevated tracks entering Downtown Las Vegas, potentially reducing construction and maintenance costs significantly.<sup>364</sup> The other site, called Central Station B, is closer to Downtown Las Vegas and would displace two industrial businesses (a go-kart alley and a storage area with a warehouse). XpressWest already has communicated with these businesses and begun to establish a plan for their potential displacement. XpressWest has not reached any financial agreements with these businesses, especially since it has not yet decided on this site for the station; however, while this site would require an extended route, costs would be reduced, because the current property owner already has conducted much of the site planning for the station. This site would take less area than the Southern Station site; however, it would be sufficient for rail, parking and other infrastructure needs.<sup>365</sup> The other two sites that were rejected during environmental review were also located in central Las Vegas and closer to Downtown. These sites would require more elevated rail and adversely impact local traffic conditions more than the two preferred sites.<sup>366</sup>



**Figure 4-5.** The two options for the Las Vegas terminal station—Central Station B and Southern Station—selected in the XpressWest preferred alternative. (FEIS, 3.1-12)

<sup>364</sup> Ibid.

<sup>365</sup> Ibid.

<sup>366</sup> Ibid.



Further discussion of selecting station sites and the importance of the stations for the case studies considered in this thesis will be presented in Chapter 5, in comparing this case study with the St. Pancras Station case study in Chapter 3.

#### **4.2.6 XpressWest's Political and Financial Progress**

By 2011, XpressWest had completed the environmental review process and obtained all necessary right-of-way permits and authorization from the Surface Transportation Board to construct and operate the high-speed rail system from Victorville to Las Vegas.<sup>367</sup> In order to support phase two of the project between Victorville and Palmdale, XpressWest strengthened its connections with the LA Metro and the Southern California Regional Rail Authority, which is the operator of Metrolink. In 2017, XpressWest completed “investment grade” ridership and revenue forecasts for this High Desert Corridor extension.<sup>368</sup> Despite these achievements, XpressWest has been unable to procure sufficient funds from the private sector beyond those used for the design and planning of the system and therefore has been unable to commence construction. XpressWest has applied for federal loans, which would be repaid using revenue generated during operations, to augment private investments.

In June 2013, XpressWest received notice from the federal Department of Transportation and Federal Railroad Administration that they had suspended consideration of XpressWest's multi-billion-dollar loan application submitted under the Railroad Rehabilitation and Improvement Financing Program two and a half years before. Transportation Secretary Ray LaHood cited continued difficulty complying with “domestic manufacturing requirements” (commonly known as the “Buy America” provision) as one of the reasons for denying the loan, which was the largest loan the Department of Transportation had ever considered.<sup>369</sup> The letter noted that the Federal Railroad Administration expects loan recipients to “purchase steel, iron, and other manufactured goods produced in the US for their projects, regardless of whether the rolling stock is separately financed.”<sup>370</sup>

In June 2015, the State of Nevada passed legislation forming the Nevada High Speed Rail Authority (the “Authority”) with the goal of facilitating the implementation of high-speed rail

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<sup>367</sup> Ibid.

<sup>368</sup> Steer Davies Gleave, “High Desert Corridor: Investment Grade Ridership & Revenue Forecasts,” 2017.

<sup>369</sup> Ray LaHood, “Ray LaHood's Letter to XpressWest.”

<sup>370</sup> Ibid.

between Las Vegas and Southern California.<sup>371</sup> While the Authority was not created explicitly to support the private XpressWest venture, and it emphasizes this on public information flyers, the two initiatives are likely connected; XpressWest was the only project close to meeting the Authority's requirements for its support.<sup>372</sup> In November 2015, the Nevada High Speed Rail Authority predictably awarded the franchise for the project to XpressWest.<sup>373</sup>

In September 2015, XpressWest announced a partnership with China Railway International USA to establish a joint venture to “accelerate the launch of the XpressWest rail project.”<sup>374</sup> China Railway International USA was formed as a partnership between China Railway International, China Railway Group, and other Chinese rail companies. Together with XpressWest, they were to complete final design, finance, and construct the project. Construction was planned to start in September of 2016. China Railway International USA would provide \$100 million in initial capital, a modest sum for a project that in total would cost several billion dollars. On June 9, 2016, XpressWest announced that their partnership with China Railway International would not proceed. XpressWest said that their ambitions “outpace CRI’s ability to move the project forward” as quickly as XpressWest wanted to.<sup>375</sup> XpressWest also cites their biggest challenge as still being the Buy America provision, which requires their rolling stock be manufactured in the United States.

The announcement of the Oakland Raiders, a National Football League team, moving to Las Vegas by 2020 and the publication of the High Desert Corridor ridership study in 2017 have added new enthusiasm to the XpressWest project.<sup>376</sup> In addition, since President Trump and his administration may be less stringent concerning Buy America stipulations than the Obama Administration, XpressWest also has renewed its interest in obtaining a federal loan.<sup>377</sup> In late May and early April 2017, Brian Sandoval, Governor of Nevada, Robert A. Lovingood, Chairman of the High Desert Corridor Joint Powers Authority, Andy Kuntz, President and CEO of the US High Speed Rail Association, and Douglas J. McCarron, General President of the

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<sup>371</sup> Nevada High-Speed Rail Authority, “Fact Sheet.”

<sup>372</sup> Ibid.

<sup>373</sup> Ibid.

<sup>374</sup> XpressWest, “China Railway International U.S.A. Co., LTD., and XpressWest to Develop Nevada – California Interstate High-Speed Passenger Rail System,” 2015.

<sup>375</sup> XpressWest, “XpressWest to Continue Development of Nevada – California Interstate Highspeed Passenger Rail System Without Assistance from China Railway International U.S.A., Co., LTD. (“CRI”),” 2016.

<sup>376</sup> Richard N. Velotta, “Arrival of Las Vegas Raiders Breathes New Life into High-Speed Rail Project,” 2017.

<sup>377</sup> Ibid.

United Brotherhood of Carpenters and Joiners of America, each sent letters to President Trump, Secretary of Transportation Elaine Chao and Gary Cohn, Director of the United States National Economic Council housed at the White House, expressing their support for the XpressWest project and wishes that the federal government lend funds to the project, despite difficulties with Buy America provisions.<sup>378, 379, 380, 381</sup> At the time of the writing of this thesis, the final outcomes for XpressWest's funding and ultimate realization are unknown.

#### **4.2.7 The Economic Impact of the XpressWest Project in Las Vegas**

While the final outcomes of the XpressWest project are unknown, the planning and environmental review process provide sufficient information to evaluate the motivations for the project and understand what would be necessary for the project to be successful. It is abundantly clear that XpressWest wishes to earn a profit on providing frequent high-speed rail service from Southern California to Las Vegas in order to support the regional tourism and entertainment economy in Las Vegas. This economy is based on the ability to move tourists and other visitors into (and out of) the city and on the ability to provide accessible entertainment venues and lodging. In 2017, it is the Oakland Raiders transferring from Oakland to Las Vegas that is increasing interest in XpressWest again.<sup>382</sup> While funding may not be readily available, the company states that it is committed to the long haul; it believes that waiting for the appropriate funding sources, which would be willing to take longer-term risks on infrastructure projects, to become available is worthwhile as long as the tourism economy expands in Las Vegas.<sup>383</sup>

To aid in evaluating these foundations for the XpressWest high-speed rail project, a benefit-cost analysis (BCA) and a financial analysis from XpressWest's perspective (Appendix C) as well as a stakeholder analysis (Appendix B) are used. A benefit-cost analysis sums the total monetized values of the expected benefits and costs of a project, discounted based on the year that the benefit or cost is expected to occur, which results in a positive or negative net present value. A positive net present value (NPV) signifies that the project's benefits exceed its costs within the timeline used in the benefit-cost analysis. A negative net present value signifies the opposite, suggesting that it would be detrimental to build the project. A financial analysis uses

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<sup>378</sup> Brian Sandoval, "XpressWest High Speed Rail Service," 2017.

<sup>379</sup> Robert A. Lovingood, "XpressWest High Speed Rail Service," 2017.

<sup>380</sup> Andy Kuntz, "XpressWest High Speed Rail," 2017.

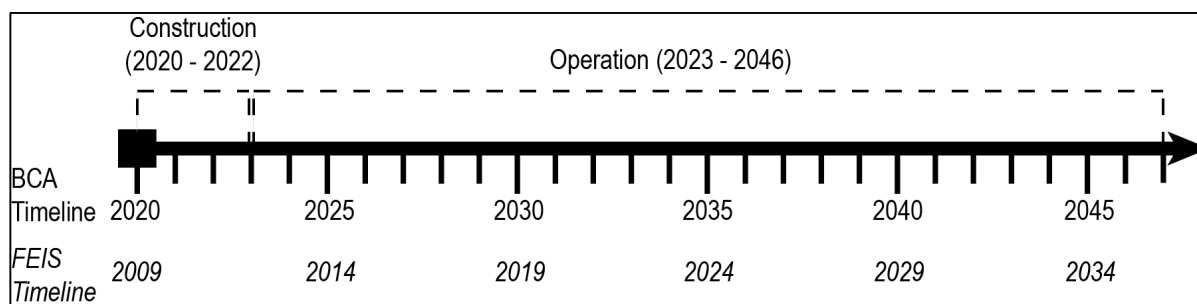
<sup>381</sup> Douglas J. McCarron, "XpressWest High Speed Rail Service," 2017.

<sup>382</sup> Richard N. Velotta, "Arrival of Las Vegas Raiders Breathes New Life into High-Speed Rail Project," 2017.

<sup>383</sup> Ibid.

identical methods; however, it considers the costs and benefits (or revenues) from the perspective of a single stakeholder, which in this case is XpressWest.

Primarily using numerical values and information from XpressWest’s *Final Environmental Impact Statement and Final Section 4(f) Evaluation for the Proposed DesertXpress High-Speed Passenger Train Victorville, California, to Las Vegas, Nevada* (2011)<sup>384</sup> (*FEIS*) and a timeline from 2020 through 2046, shifted from the unrealistic timeline presented in the *FEIS* (Figure 4-6), the following benefits and costs were evaluated in this analysis (Table 4-1).



**Figure 4-6.** Benefit-cost analysis timeline compared to the timeline presented in *FEIS*.

| <b>Benefits</b>  | <b>Costs</b>   |
|--|--|
| <ul style="list-style-type: none"> <li>- Time Savings</li> <li>- Safety</li> <li>- Air Pollution Reduction during Operations</li> <li>- Indirect Economic Gains from Employment by XpressWest</li> <li>- Indirect Economic Effects in Las Vegas: Induced Land Development and Economic Growth</li> </ul> | <ul style="list-style-type: none"> <li>- Construction</li> <li>- Rolling Stock</li> <li>- Employment</li> <li>- Energy Consumption</li> <li>- Maintenance</li> <li>- Station Operations</li> <li>- Insurance</li> <li>- Contingency</li> <li>- Air Pollution during Construction</li> <li>- Indirect Economic Losses in Barstow, CA</li> </ul> |

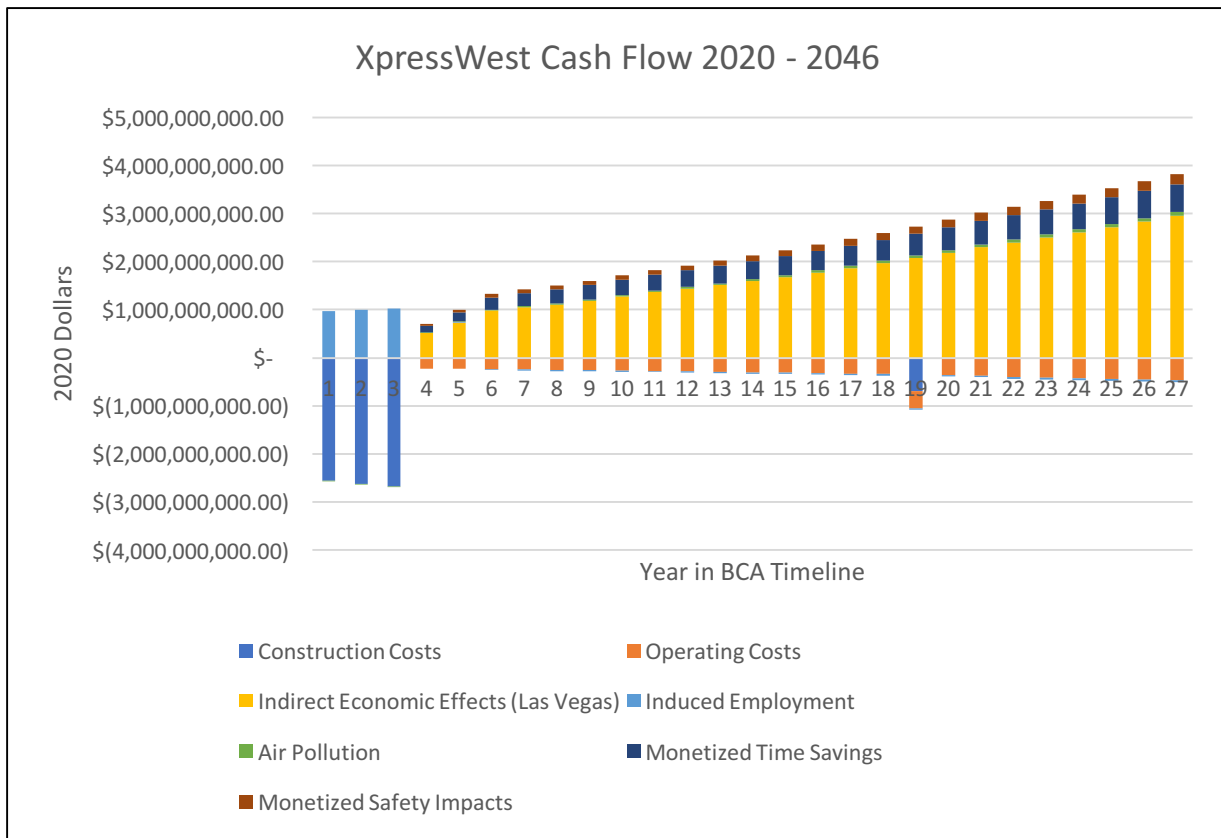
**Table 4-1.** Benefits and costs considered in the Los Angeles - Las Vegas case benefit-cost analysis.

Some of the values used in this analysis are based on broad assumptions and estimates. For example, because indirect economic benefits in Las Vegas were not quantified in the *FEIS*, these values were calculated using general data about the Las Vegas economy and ridership forecasts for XpressWest. On the other hand, the economic losses due to the project in Barstow, California, the major rest stop on I-15 en route to Las Vegas, were presented in great detail in the *FEIS* and included in this analysis with greater confidence. The financial analysis (from

<sup>384</sup> XpressWest originally was founded as “DesertXpress” and may be referred to with that title in this thesis.

XpressWest’s perspective) considered fare revenue and construction and operation costs to calculate the net present value of the project. Please see Appendix C for detailed discussion.

Figure 4-7 shows XpressWest’s cash flow evaluated in the benefit-cost analysis (Appendix C). Construction costs and indirect economic benefits in Las Vegas are on the order of billions of dollars, while the remaining costs and benefits reach hundreds or tens of millions of dollars. For example, environmental benefits from greenhouse gas emissions reach only \$73 million in the final year of analysis. Excluding indirect economic benefits, the results of both the benefit-cost analysis and the financial analysis are significantly negative net present values: -\$3.6 billion value for society as a whole and -\$6.2 billion value for XpressWest in the financial analysis in 2020 dollars, using a 12 percent discount rate.<sup>385</sup> Both values signify that the costs considered outweigh the benefits considered. When indirect economic benefits in Las Vegas—increased visitors’ spending and hotel and hotel-casino land value increases—are included in the benefit-cost analysis, however, the net present value increases to a positive \$4.5 billion in 2020 dollars. These indirect economic impact present potentially major benefits due to the project.



**Figure 4-7.** XpressWest benefits and costs from 2020 through 2046.

<sup>385</sup> In both analyses, these monetary values were discounted to 2020 dollars.

It is important to consider how the costs and benefits of the project are distributed. We may assume that this private project only would be developed if XpressWest were to believe it could make a profit. Since the financial analysis results in a negative profitability for XpressWest, the organization would require further funds to make a profit. Even in the sensitivity analysis (see Appendix C), XpressWest's financial analysis NPV remains significantly negative. Two potential sources for funding would be public funds and private funds from businesses that could benefit from real estate development. As discussed, XpressWest has a history of seeking public funding, especially from the federal government. If indirect economic benefits are not as significant as estimated in this BCA, using public funding may mean that the public is subsidizing a socially detrimental project. If using private funding, which so far also has been unsuccessful, takes advantage of these private-sector benefits, it may mean that this project has significant private benefits with minimal public benefits (or net public costs). Both cases would raise concern for any party aiming for public benefit, and points to caution in moving forward with the project. Regardless, as discussed, public agencies and politicians in both Nevada and California support the project.

#### **4.2.8 Stakeholder Interests in the XpressWest Project**

The benefit-cost analysis of the XpressWest project hints how stakeholder interests, may conflict or support each other. The stakeholder analysis, which uses the Mitchell Framework for evaluating stakeholder saliency, as used in the St. Pancras Station case study in Chapter 3, is especially relevant to this case study, because of the conflicts between private and public interests. XpressWest is proposing a project with expected public benefits; however, it has the aim to profit off of this project.

This stakeholder analysis determines that the definitive stakeholders, which are the stakeholders with the greatest saliency in the system, are the US Department of Transportation, the State of Nevada, the California Department of Transportation and potential intercity rail developers and operators, such as XpressWest. All of these definitive stakeholders are supportive of high-speed rail development in the region. Other than the US Department of Transportation, each of these stakeholders supports the XpressWest proposal. The US Department of Transportation, however, has decided to not offer XpressWest a public loan, although the other stakeholders now are requesting it to reconsider its decision. Given the volatility of the political climate in the federal government in 2017, it is unclear how effective these requests will be.

Because of the difficulties with obtaining public loans, XpressWest may wish to work with private-sector interests to help fund construction of the high-speed rail system and/or to subsidize its service. These private interests are not the most salient stakeholders in the system; however, they are the stakeholders who would benefit the most from real estate development, which was not included in the benefit-cost analysis. These benefits must be significant (on the order of billions of dollars<sup>386</sup>) in order for the net present value of the project to be positive.

#### **4.2.9 XpressWest Collaboration with Private-Sector Land Developers**

There may be a variety of options available to XpressWest, if it were to build collaborations with other private stakeholders, primarily land developers in Las Vegas, instead of relying on only collaboration with public agencies, public funding and private joint ventures exclusively supporting the high-speed rail line. The potential collaborations in this situation could be different than the failed joint venture between XpressWest and China Railways. In “Using Increased Private Sector Involvement to Allow for Resource-Constrained Transit Growth” (2015) and in “Developing Strategies for Resource-Constrained Transit Growth through Increased Private Sector Involvement” (2015), Michael A. Gordon describes how public transit agencies may contract with private-sector transit and bus operators to augment their public transportation service and make them more efficient. Public agencies may subsidize private services and determine necessary service levels and routes, and private contractors must supply their own rolling stock and facilities and arrange their own scheduling and personnel.<sup>387, 388</sup>

If XpressWest also were viewed as a transportation service for land developers in Las Vegas rather than a completely independent private venture, land developers may take on a similar role as that of the public transit agency and subsidize the XpressWest service. In order to increase future revenue, XpressWest may propose increased fares, and developers (broadly including casino, hotel and entertainment venue owners) could subsidize these fares for passengers with tickets to their events or reservations at their venues. Alternatively, local land developers can pay regular contributions to joint fund for XpressWest to support XpressWest’s operations. This arrangement could be viewed as a large-scale, regional equivalent of a local

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<sup>386</sup> Gaming revenue in Clark County exceeded \$9 billion in 2015. (Las Vegas Convention and Visitors Authority, “Frequently Asked Questions,” March 2016)

<sup>387</sup> Michael A. Gordon et al., “Using Increased Private Sector Involvement to Allow for Resource-Constrained Transit Growth,” 2015.

<sup>388</sup> Michael A. Gordon, “Developing Strategies for Resource-Constrained Transit Growth through Increased Private Sector Involvement” (Master’s Thesis, MIT, 2015).

transportation management association (“TMA”). TMAs are funded by contributions from participating entities, frequently a cluster of employers in a city neighborhood, and manage and operate (or contract out the operations of) local transit.<sup>389</sup> While these subsidies do not address XpressWest’s immediate issue of obtaining a construction loan, it could sign contracts describing these subsidy arrangements. This guaranteed future support may aid XpressWest in obtaining other private loans or joint venture partners for constructing the system.

### **4.3 Case Study Conclusions**

The research in this section presents a case study of the proposed private high-speed rail route between Southern California and Las Vegas. While intercity passenger rail travel is not common and is unprofitable in the Western United States and no international-quality high-speed rail routes—privately or publicly operated—operate in the United States, XpressWest gradually has gained political support and regulatory approval for its project. XpressWest lists substantial public benefits, including reducing traffic congestion on I-15 between Victorville, CA, and Las Vegas, reducing air pollution and creating jobs, as parts of its motivation to build this project. It, however, has been unable to obtain funding for construction, either through a private joint venture or through federal transportation development loans. According to XpressWest, the greatest difficulty with satisfying requirements for the federal loans are Buy America conditions, which prohibit XpressWest from purchasing rolling stock and materials from international manufacturers. Since high-speed rail is new to the United States, domestic manufacturers do not have experience with this technology.

In siting the right-of-way and stations, XpressWest avoids significant detrimental impacts by using the media of I-15 or running alongside the highway. In Las Vegas, the two potential station sites selected in the preferred alternative are located on vacant or minimally-used land with no cultural or environmental resources. Each site is located within driving and public transit distance of the Las Vegas Strip and the other major attractions. In addition, the sites can accommodate transit-oriented development and are covered by master plans for development and urbanization. In planning the high-speed rail line, XpressWest has incorporated additional options for extending its route in California to Palmdale in order to connect with California

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<sup>389</sup> Ibid.



High-Speed Rail, which currently is under construction. Eastward, XpressWest has stated that its route could extend to Salt Lake City, Phoenix and Denver.

In order to evaluate the potential viability of the XpressWest project and the factors important to this case study, a benefit-cost analysis, a financial analysis from the perspective of XpressWest and a stakeholder analysis using the Mitchell Framework. These analyses are reported on in detail in the appendices. These analyses concluded that the XpressWest project likely would have net negative impacts on society and be unprofitable, unless indirect economic benefits in the Las Vegas area from additional visitor spending and increased hotel and hotel-casino property values are factored into these evaluations. If these benefits outweigh the costs considered, which they do in the broad benefit-cost analysis presented here, then high-speed rail would have the potential to foster significant local land development. XpressWest itself, however, would not profit from these increased economic benefits.

Using this understanding that its project could provide benefits to other private-sector stakeholders, XpressWest may wish to collaborate with local property owners and land developers to capture these financial benefits in order to obtain funding for construction and increase revenues during operations. These collaborations may include hotels, casinos and other entertainment venues subsidizing XpressWest tickets for their own customers or these other private contributing to a fund that supports XpressWest. These kinds of collaborations are increasingly common among groups of employers and local private or public bus and other transit services in city neighborhoods; however, it would be an unusual partnership for a largescale intercity high-speed rail service. This case may provide the opportunity to experiment with these kinds of collaborations, and, with its support, XpressWest may be able to accomplish its project.

Both this case study and the St. Pancras Station case study from Chapter 3 will be compared, contrasted and evaluated together in Chapter 5, which follows.

## 5 Comparing the Two Case Studies

The two case studies discussed in Chapter 3 and Chapter 4 are based on decisions that relate to both high-speed rail development and local land development. In the St. Pancras Station case (Chapter 3), the Central Government of the United Kingdom decided to use St. Pancras Station, adjacent to King's Cross Station in the Borough of Camden, as the London terminus for High-Speed 1, also called the Channel Tunnel Rail Link. High-Speed 1 is the first high-speed rail project in the UK. It connected the UK to the greater high-speed rail system throughout Western Europe and was the most expensive infrastructure project in the UK. Using St. Pancras Station required an expensive (£800 million) refurbishment with special care for its architecture, which is protected under historic landmark status. This project also opened up new land (27 hectares) north of the station, which currently is being developed as part of the £3 billion King's Cross Central project and will house diverse business, commercial, residential and cultural uses. The rehabilitation of St. Pancras Station as well as its related projects in the surrounding area likely have caused land values in Camden, and especially in the King's Cross ward, to increase significantly. In addition, this project has garnered wide acclaim for its architectural achievements and place-making. It remains the most popular station for travelers in the UK's rail system, and it attracts shoppers and tourists to the area.

In the Los Angeles to Las Vegas high-speed rail link case (Chapter 4), XpressWest, a private high-speed rail developer founded in 2005, is proposing to build and operate a high-speed rail line between Victorville, California, to Las Vegas, Nevada. While Victorville is north of most of the Los Angeles metropolitan area, it is located at the intersection of many Southern California highways and Interstate-15. Interstate-15 is the primary vehicular route between Los Angeles and Las Vegas, and the proposed XpressWest route follows the highway, running adjacent to it or within its median. In addition, XpressWest more recently has proposed an extension of its high-speed rail line from Victorville to Palmdale, CA, along the proposed multimodal High-Desert Corridor. Palmdale is located on the Metrolink, Los Angeles' commuter rail system, and the future California High-Speed Rail line. With these two stations, passengers will be able to access the XpressWest system by car, conventional rail and—in the future—high-speed rail. 57 percent of Las Vegas' total visitors and 90 percent of visitors to Las Vegas from Southern California travel by car. XpressWest plans to compete with this transportation mode by offering frequent, quicker, more reliable and more comfortable service.

A benefit-cost analysis of the project shows that the XpressWest project likely will have net negative impacts when considering only transportation benefits, such as time savings, and environmental benefits. Wider economic benefits, in part derived from economies of agglomeration on the regional and urban scales and transit-oriented development on the local scale, however, could be on the order of billions of dollars. When they are added to this calculation, the net present value of the project becomes positive. For XpressWest as a private developer, the project likely still will be highly unprofitable, unless it captures the value of much of these wider economic benefits in some way, potentially by cooperating with private land developers and entertainment venue owners to share profits or subsidize passengers' tickets.

This chapter discusses these two cases and the important decisions, upon which they depend. For the St. Pancras Station case, the major decision considered is the choice of St. Pancras Station rather than any other station in London as the terminus for High-Speed 1. For the Los Angeles to Las Vegas case, the major decision considered is whether or not to build the XpressWest project. While these decisions have different scopes—the station or rail line—their local-level impacts are most relevant to this thesis. The evaluation in this chapter considers the major physical/spatial, economic and social aspects related to these projects in order to inform the research questions of this thesis. These questions relate to the role that local-level station and land development play in high-speed rail development.

## **5.1 Physical Context and Impacts**

As discussed in Chapter 2 (“Literature Review”), the physical and spatial context of a high-speed rail system and its stations is central to the system's efficacy. The physical context for each of the two cases presented in this thesis are considerably different; however, they demonstrate how similar issues related to high-speed rail systems develop within different spatial and urban contexts. Both projects and stations connect their respective cities to larger high-speed rail networks and other regional and local modes of transportation, and they both create local-level benefits in areas that are accessible by a prevalent local-level transportation mode (walking and subway for the St. Pancras Station and driving in Las Vegas).

### **5.1.1 Regional Scale and Scope**

For both cases, the high-speed rail lines—High-Speed 1 and XpressWest—are intercity routes that fit within the 1.5- to 3-hour range at which high-speed rail competes best with air and auto (see Chapter 2.1). The high-speed rail line's ability to compete with other modes of

transportation is especially important in Las Vegas, since the number of visitors from Southern California is dependent on and limited by the capacity of the highway system. In addition, each system would connect the city to a much larger high-speed rail network and other major economies: The Western European high-speed rail network for London and the California High-Speed Rail system for Las Vegas. High-Speed 1 hosts both international service and domestic commuter service, which accounts for 30 percent of its ridership.<sup>390</sup> In contrast, all of the passengers on XpressWest—forecasted to increase from around 200,000 to 600,000 annually over the first twenty years of operation—would be intercity travelers between the Southern California region and Las Vegas.<sup>391</sup> Regional travel also is much more important in Las Vegas than at St. Pancras Station. The wider economic benefits in Las Vegas depend upon longer-term visitors to stay in the city to gamble, spend money on entertainment and go to events. For St. Pancras, there are all types of travelers and visitors to the station and adjacent neighborhood—commuters, intercity travelers and other people who do not travel by high-speed rail. This also allows a greater diversity in land uses, including residential and office in addition to commercial, in the area adjacent to St. Pancras Station.

### **5.1.2 Urban Context: London**

London is a global city of 8.8 million of people with one of the largest urban economies in the world, based in finance and business.<sup>392</sup> When considering the St. Pancras Station case, it is important to note that the High-Speed 1 route would have connected to London regardless of the particular station it used. In this sense, the outcomes of the decision to use St. Pancras Station may have resulted in similar outcomes for London as a whole city as any other choice of a well-located rail station. In addition, it is possible that these local-level impacts may have captured political interest and economic growth that could have focused on other parts of the city rather than creating completely new economic and social benefits. The decision, however, did generate direct local impacts in King’s Cross ward and the Borough of Camden in that it brought commerce, business and land development to the area. St. Pancras Station was an appropriate choice for a high-speed rail station, because it did meet relevant criteria that could leverage the capital from these industries. The station is close to the city center and areas of economic

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<sup>390</sup> UK Department for Transport, “First Interim Evaluation of the Impacts of High-Speed 1.”

<sup>391</sup> FRA, *FEIS*.

<sup>392</sup> UK Office for National Statistics, “Population Estimates for UK, England and Wales, Scotland and Northern Ireland,” accessed August 7, 2017.

activity, it is connected to urban and regional transportation systems (the London Underground and commuter and intercity rail lines), and it is integrated with the surrounding urban space—and will be even more so when the King’s Cross Central transit-oriented development project is complete. In addition, the station itself was rehabilitated to create an attractive, unique and memorable space around the transportation node. In addition, land supply is limited in London and demand is driving extreme gentrification throughout the central parts of the city. A land development project like King’s Cross Central is especially important in London, since it provides additional land for a variety of uses in high demand. Similar to XpressWest’s potential to increase total visitor capacity in Las Vegas, St. Pancras Station has increased the amount of developable land in London.

### **5.1.3 Urban Context: Las Vegas**

Compared to London, Las Vegas is a smaller, albeit rapidly growing, city of 630,000 people.<sup>393</sup> Rather than having a diverse and resilient economy like London’s, Las Vegas’ economy is dependent on the related industries of tourism, gambling and entertainment, which react strongly to the broader economic climate since they depend on visitors’ disposable income. Las Vegas also is much less densely populated than London, making it easier and less costly to build the high-speed rail station near the city center and its major attractions. In addition, the XpressWest route would be less costly to build, since it would follow the Interstate-15 right-of-way. On the other hand, Las Vegas, as a much newer city than London, grew based on highways and driving, and it is United States where a culture of driving is prevalent.

Both of the preferred locations for the Las Vegas XpressWest station would accommodate sufficient space for parking and are placed near the city center, the airport and future light rail transit lines, connecting the high-speed rail system with many of the other transportation systems. Because driving is a common and preferred mode of transportation within the city, the catchment area for the station, which may be broadly defined as a 10-minute distance (see Chapter 2.3.3), contains much of the city within a reasonable driving distance. In this sense, the wider economic benefits and land development throughout the city may be considered local-level impacts of the XpressWest project just as the King’s Cross Central development is within St. Pancras Station local-level catchment area. Importantly, these wider

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<sup>393</sup> US Census Bureau, “Annual Estimates of the Resident Population for Incorporated Places of 50,000 or More, Ranked by July 1, 2016 Population: April 1, 2010 to July 1, 2016 – United States,” accessed August 7, 2017.

economic benefits and land development opportunities are the most significant benefits considered in the benefit-cost analysis of this project. The proposed XpressWest route and either of the Las Vegas stations are also well positioned to enable these benefits.

## **5.2 Economic Context and Impacts**

In both of the cases, the high-speed rail projects aim to use investments in high-speed rail infrastructure to generate economic benefits—revenue from fares, agglomeration or wider economic benefits, and land development. At St. Pancras Station, the major spatial impacts of the station’s rehabilitation are local, and the major economic impacts are realized in this local context. The station hosts shops, restaurants and other commercial activities. In the immediate vicinity of the station, private developers have invested £3 billion in housing, retail and office projects, which are in high demand and low supply in London. This economic activity and growth is on the neighborhood scale. For this case, however, these economic impacts are only some of the project’s most relevant benefits. Other benefits, such as refurbished architectural heritage and new appealing urban spaces, are in of themselves valuable to relevant stakeholders and build on the economic benefits of the project. All of these benefits are additional to the approximately £5 billion of time-savings benefits for users of the high-speed rail line.<sup>394</sup>

The entire XpressWest project also costs on the order of billions of dollars. As discussed in the previous section, its local economic benefits, generated by additional tourists and business visitors, would be felt citywide. These additional tourists would provide more business for gambling and entertainment venues, more commercial activity in shops and restaurants, and more opportunities to build hotels, casinos and business convention areas. These industries, especially tourism, gambling and entertainment, are dependent on visitors having disposable income and may be especially unstable. In addition, since a private company would build and operate the XpressWest project, XpressWest’s economic benefits—revenue from fares—would have to exceed its costs to be a profitable enterprise. As discussed in Chapter 4.2.9, XpressWest and other private-sector businesses could explore methods of transferring the monetary value of some of these wider economic benefits to support XpressWest. Such arrangements would be additional means by which XpressWest could fund and construct its project, and may be one of the most significant viable options still open to XpressWest.

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<sup>394</sup> UK Department for Transport, “First Interim Evaluation of the Impacts of High-Speed 1.”

## **5.3 Social Context and Stakeholders' Interests**

The public-sector stakeholders in each case and the private-sector stakeholders in each case have similar interests; however, the public-sector stakeholders have greater saliency in St. Pancras Station case, and the private-sector stakeholders have greater saliency in the Los Angeles to Las Vegas high-speed rail link case. Understanding this point is important to understanding the relevance of the different urban and economic contexts in each case and to understanding the importance of different costs and benefits.

### **5.3.1 Public-Sector Interests**

In the St. Pancras Station case, the Central Government proposed the High-Speed 1 project and the rehabilitation of the station; through a private-public partnership. Multiple attempts at this scheme ultimately failed, however, and the public sector ended up funding the project, because it still was interested in fulfilling the project's goals. The purpose of the project was to facilitate regional and local economic growth. In addition, the government explicitly supported local economic growth by requiring London and Continental Railways to use transit-oriented land development as a funding mechanism for the public infrastructure project.

The government, the local borough authority and Heritage England, however, also highly valued other benefits of the project. Although it was a protected historic landmark, St. Pancras Station had been neglected and in poor repair. The High-Speed 1 project activated public interest and funding to finally repair the station and give it a useful function, and Heritage England was able to oversee and approve every plan and action for St. Pancras Station's rehabilitation. Because of this meticulous approach and high-quality historic preservation, architecture critics and the general public have praised the results with enthusiasm. The station and nearby urban development attract residents, businesses and tourists. Both the economic activity and the generally improved urban atmosphere are important to the most salient public-sector stakeholders. In addition, half of the residential properties in the King's Cross Central development are affordable housing, thereby increasing economic equitably in the city. There is a general attitude that the infrastructure project, especially the rehabilitation of St. Pancras Station, was worthwhile, even if the financial benefits of the project ultimately do not exceed its costs.

Although XpressWest is a private infrastructure project, the public-sector stakeholders in the Los Angeles to Las Vegas high-speed rail case do support the project politically. The public

sector, however, is reluctant to support the project financially, as demonstrated by XpressWest's unsuccessful petition for a loan of up to \$6 billion from the federal government. Even recently in early 2017, the governor of Nevada and the chairman of the High Desert Corridor Joint Powers Authority, among other political advocacy groups, sent letters to President Trump expressing support for this project. It is their hope that the federal Department of Transportation, which previously had decided against lending money to the project, will reconsider its decision. Their arguments are that the project will have wide benefits to the public, from job creation during construction and operation to the wider economic benefits throughout the Las Vegas economy.

While the direct and indirect economic benefits of the XpressWest project are apparent, it is also clear that the State of Nevada and the City of Las Vegas view high-speed transportation as a boon to its image. For decades, the state had put its support behind a maglev train between Las Vegas and Los Angeles. When XpressWest was proposed, the government switched support to the project it deemed more viable, and currently Nevada also hosts test tracks for Hyperloop One. Throughout its history, Las Vegas has been known for gambling, entertainment and other similar industries. In any of these potential cases (maglev, high-speed rail or Hyperloop), if a first-of-its-kind high-speed intercity transportation system were built between Las Vegas and Los Angeles, the image of the city and the state could transform with more varied and positive associations.

### **5.3.2 Private-Sector Interests**

Private-sector interests in both cases also support the high-speed rail projects; however, they have had minimal success in securing funding for the projects and remaining profitable. In the St. Pancras Station case, London and Continental Railways originally was privately funded, but it was unable to make payments on its debt. In order to save the High-Speed 1 project, the United Kingdom Central Government bought LCR's debt, essentially making it a public project. LCR still has worked to earn profits on the project through various means. The most relevant to this thesis is the King's Cross Central land development project that should serve to earn LCR (and the UK Department for Transport) around £400 million in profits annually, accumulating to billions of pounds in profits over the coming decades. In this way, private-sector interests unite with those of the public sector. The realization of these profits is still dependent on public investment and continued support. On the other hand, these profits are important but not vital for the project to move forward and maintain financial and political support from the public sector.



(While the government does expect additional revenue from the project, it does not depend on the revenue itself exceeding the cost of the project’s construction and operation in order to proceed with the project.)

The Los Angeles to Las Vegas high-speed rail link presents a similar situation with some roles reversed. Since the project is private, it must be profitable for XpressWest to construct and operate it. For years, XpressWest has had difficulty obtaining funding, a sign that investors believe the project likely will be unprofitable or, at least, that there are better opportunities elsewhere. XpressWest claims that its project is indeed profitable but investors are unwilling to make long-term and riskier commitments. It also claims that “Buy America” provisions from the federal Department of Transportation undermined its partnership with Chinese investors and made the project unviable. The government—the public sector—could grant XpressWest an exemption from these provisions. As discussed in the previous section, the local state and city governments support the project but do not have the means or political interest to fund it. In this case, the public sector depends upon the private sector to provide the infrastructure that may generate wide economic and social benefits.

Within the private sector, land owners and land developers may gain significant profits from the XpressWest project. In the benefit-cost analysis, wider economic benefits were calculated at a total of over \$11 billion (discounted to 2020 values), and these local property owners and land developers would capture much of these benefits. If these stakeholders were to determine that these profits would be significant enough, they may wish to collaborate with XpressWest and help fund the project. If this arrangement were to be the main source of funding for construction, these land developers would need to contribute \$6 billion, or more than half of their potential benefits, to the project up-front—a serious undertaking for these stakeholders. In this way, however, different stakeholders within the private sector could support each other, avoiding the need for public-sector support.

## **5.4 Summary**

In the urban context, the limiting factor to develop land in London is the availability of land, which is a local-level constraint. In Las Vegas, the limiting factor is number of visitors, which is a regional (and beyond) constraint. The St. Pancras Station rehabilitation and King’s Cross Central projects provide access to a large amount of developable land, and the XpressWest project has the potential to provide hundreds of thousands of additional visitors to Las Vegas. In

these ways, both projects address the limitations to further economic growth and land development at the appropriate scale.

The economic context of each project and the projects' economic benefits are characterized by these different urban contexts. The St. Pancras Station rehabilitation may create billions of pounds in revenue at the neighborhood scale—visitors to the commercial areas of the station and King's Cross Central as well as new residents and businesses in King's Cross and Camden. XpressWest may augment the entire Las Vegas economy, especially since either proposed Las Vegas high-speed rail station would be accessible by car from most of the major sites in the city within around a 10-minute drive.

The political context for each case is defined by public-sector and private-sector interests and ability to fund and support the high-speed rail projects. At St. Pancras Station, the public sector values social benefits highly, even if the project may not earn sufficient revenues to exceed its costs. When LCR, the private-sector developer, was unable to pay its debts and continue constructing the project, the UK government funded it. In Las Vegas, the private sector must build and operate the XpressWest project, regardless of how much political support the public sector offers. If XpressWest continues to be unprofitable or at least unable to find funding, then the project will remain unbuilt. There are incentives, however, for local land developers to collaborate with XpressWest in order to generate common benefits through constructing the high-speed rail line.

This thesis now concludes with Chapter 6.



## **6 Conclusions**

This chapter presents an overview of the previous chapters of this thesis, the overall conclusions of this thesis and a review of potential future work that could be conducted based on the work and results presented in this thesis.

### **6.1 Thesis Overview**

Chapter 1 introduces this thesis. High-speed rail's potential impacts and benefits are clear. Other recent master's theses have investigated and evaluated how high-speed rail and its stakeholders interact and create benefits along tracks shared with conventional rail, in small intermediate cities, and at large central rail stations in dense cities. This thesis is motivated by this work and aims to evaluate and understand how high-speed rail's benefits are realized on the local level and how various stakeholders interact on the local-level at or near high-speed rail stations.

In Chapter 2, the literature review establishes the importance of high-speed rail as a mode of intercity transportation present throughout the world, especially in Western Europe and East Asia. The chapter reviews the costs and benefits of high-speed rail and how the location of a high-speed rail station is central to the system's competitiveness and its ability to achieve benefits. Transit-oriented development can maximize benefits of high-speed rail on the local and the value of land adjacent to rail stations. The review also discusses how stakeholders connected to complex infrastructure systems can collaborate across geographic and political boundaries to improve the system's efficiency and efficacy.

Chapter 3 presents the case study of the rehabilitation of St. Pancras Station, which was part of the High-Speed 1 project in the United Kingdom. In effect, the Central Government of the UK planned and funded this project. St. Pancras Station and the adjacent King's Cross Central development have garnered widespread acclaim for their architectural preservation and public place-making. In addition, there has been significant economic growth in the Borough of Camden and the King's Cross Ward where St. Pancras Station is located. It is difficult to determine the exact impact that the rehabilitation of St. Pancras Station has played in this economic growth; however, it likely has contributed significantly to it. The King's Cross Central development is expected to earn £200-400 annually, split between London and Continental Railways the United Kingdom Department for Transport. In this case, the financial benefits of

the entire High-Speed 1 project may not have justified its high costs; however, the public sector funded the project, at least in part because it valued these other social and cultural benefits in addition to the financial benefits. In addition, high-quality infrastructure development and place-making at the local level received enthusiasm and interest among the public and industry and generated local economic growth.

Chapter 4 presents the case study related to the high-speed rail link between Southern California and Las Vegas as proposed by XpressWest, a private infrastructure developer. Since the XpressWest route follows the right-of-way of Interstate-15 directly into Las Vegas, its construction should be less costly than the construction of other urban high-speed rail lines. This project, however, would be the first international-quality high-speed rail line in the United States and the first completely privately funded intercity route. XpressWest has had difficulties in obtaining funding from the private sector or loans from the federal government to begin construction. A benefit-cost analysis shows that the project would be socially detrimental and financially unprofitable for XpressWest, unless wider economic benefits are considered. Many of these benefits would be focused in Las Vegas' gambling, entertainment and convention industries, which depend on building hotels, casinos, entertainment venues and convention centers. With this understanding, these other private-sector stakeholders could collaborate with XpressWest and transfer a portion of their financial benefits to XpressWest so that it may earn a profit on the project. They could subsidize the high-speed rail project outright by contributing to a fund to support XpressWest, or they may subsidize tickets for passengers, who stay at related hotels or go to certain events.

Chapter 5 evaluates, compares and contrasts these two case studies under three themes: physical and spatial context, economic context, and social and political context. In the urban context, each project addresses the limitations to further economic growth and land development at the appropriate scale: local neighborhood land development in the St. Pancras Station case and regional tourism for the Los Angeles to Las Vegas high-speed rail link case. The economic context of each project and the projects' economic benefits are characterized by these different urban contexts. The St. Pancras Station rehabilitation may create wealth and economic growth at the neighborhood scale by attracting residents, businesses and visitors. XpressWest may augment the entire Las Vegas economy by bringing more tourists and visitors to the city and creating further demand for hotels, casinos and entertainment venues. In both cases, these benefits depend

on the high-speed rail stations being located close to central areas of the city and integrated in the surrounding urban environment. In the St. Pancras Station case, the design of the station and surrounding area has garnered high praise. The political context for each case is defined by public-sector and private-sector interests and ability to fund and support the high-speed rail projects. At St. Pancras Station, the public sector values social benefits highly, even if the project may not earn sufficient revenues to exceed its costs. In Las Vegas, XpressWest must build and operate a profitable high-speed rail route regardless of how much political support there is.

## **6.2 Thesis Conclusions**

Chapter 3 and Chapter 4 offer conclusions for the St. Pancras Station case and the Los Angeles to Las Vegas high-speed rail link case, respectively, and Chapter 5 offers an overview and joint evaluation of these case studies. Here, the most important and universal conclusions for these case studies are discussed.

Appropriate placement and design of a high-speed rail station is essential to the efficacy of a high-speed rail system and its local impacts. The literature review discussed how the placement and design of high-speed rail stations impacts the efficacy of the system in many ways. A station's location can increase or decrease passengers' total travel time, it can impede or ease passengers' access to the high-speed rail system, and can be separated from or integrated with the surrounding urban area. In both of the cases considered, the local-level benefits are dependent on the station's location and design. In the St. Pancras Station case, the station is located in a central area of London, facilitates passengers' movements through different concourses and commercial areas within the station, and integrates well with surrounding urban neighborhood. These are the characteristics that have earned it such a positive image and that have created the significant local benefits in and around the station. The two proposed Las Vegas stations similarly are located near the city's entertainment district and are planned to integrate well with a variety of other modes of transportation. If built, the station should fit well with Las Vegas' urban structure and characteristics in order to facilitate the connections upon which local-level benefits depend.

The exact nature and type of local benefits that occur at or near high-speed rail stations vary and depend on the urban, economic and political contexts. For example, the station itself might be a destination. In addition to providing transportation services, St. Pancras Station is a historic landmark with distinctive architectural beauty, which attracts cultural and political

interest. The commercial district at St. Pancras Station and in King's Cross Central is defined by and builds upon the station. In that area, walking and public transit are common modes of transportation.

In Las Vegas, connections to other sites across the city, such as hotels and casinos, rather than the station itself being a destination would be a more important quality for the high-speed rail station. In this way, it could support the most important local-level benefits of the XpressWest project. Visitors who use the XpressWest high-speed rail line and the station in Las Vegas likely wish to spend time beyond the station on longer visits. Even so, the station can be designed and built to provide for the local-level benefits appropriate for that situation.

Stakeholders' interests are major factors in developing high-speed rail infrastructure. High-speed rail can serve a variety of purposes—potentially supportive or conflicting. In order to ensure that the most valuable impacts are realized, high-speed rail systems should address the opinions and values of the relevant stakeholders, especially those with the greatest saliency in the system and even more so the stakeholders that are funding the project. Many high-speed rail systems may not be profitable on revenue alone. These projects may not even provide sufficient financial benefits to justify their cost. Some stakeholders, however, also may value the provision of modern amenities, a more equitable distribution of or access to industry, or a city's or a nation's image. It is difficult to monetize these benefits, and it may be difficult to determine their wider impacts on economic growth. In certain cases, such as at St. Pancras Station, high-speed rail development in fact can provide these kinds of additional benefits and they likely had positive impacts on local economic growth. When stakeholders value profitability as a necessary outcome, then it becomes more difficult to justify a project using these other benefits; however, there may be ways of quantifying and leveraging indirect benefits to support high-speed rail development.

This discussion points to the conclusion that high-speed rail's local-level benefits can be significant. The value of these benefits has the potential to make a project have socially net positive benefits and be even financially profitable. Many of these local-level benefits, however, are controversial, because they are difficult to gauge and they are difficult to connect directly to a high-speed rail project. In many cases, the benefits may be caused by a combination of the high-speed rail development and broader economic and social factors rather than the by the infrastructure alone. Every stakeholder has its own principles and its own willingness to take

risks on a project, and certain stakeholders may value certain benefits highly when others do not. With the understanding that many different local-level benefits are possible and with the motivation to explore how best to produce these benefits, stakeholders can take charge of a project or collaborate with each other in order to develop their desired high-speed rail system. The two case studies presented in this thesis demonstrate these processes and offer examples of certain opportunities for coupling high-speed rail development with goals for local benefits based on successful rail station and land development.

### **6.3 Future Work**

This thesis evaluates the reasons behind and impacts of two decisions—one realized and one potential—to invest in high-speed rail infrastructure. Both decisions are influenced by the potential for local-level benefits. The work in this thesis, however, leaves many opportunities for further research.

As discussed in Chapter 5 (“Comparing the Two Case Studies”), these two case studies considered very different situations. The defining decisions considered different scale of project—a rail station or an entire high-speed rail line. The projects are on different continents and connect very different cities. One project is publicly funded while the other is proposed by a private developer. Case studies with more characteristics in common could provide clearer and more detailed information on exactly what factors in high-speed rail development create the best local-level benefits. These additional case studies with more minor differences would improve upon the work and results presented in this thesis.

While this thesis evaluated the presence of local-level land development benefits and compared them to the costs of the projects, it did not consider the opportunity costs of the decisions to choose high-speed rail development over other infrastructure projects or over other private or public investments. In many ways, this thesis does address these considerations. The XpressWest project has failed to obtain funding, because both private- and public-sector stakeholders have invested funds in other projects, demonstrating that they think there is greater value in other places. Investigating these other options in greater detail, however, may offer insight into the true costs, benefits and uses of high-speed rail and local land development. For example, the literature review (Chapter 2) discussed how investing in conventional rail rather than high-speed rail may create a more equitable distribution of economic benefits. On the other hand, other more advanced technologies may provide better and perhaps less expensive service,



displacing high-speed rail in the future. It would be useful to conduct further research into these questions about pursuing other opportunities instead of high-speed rail development and what these other projects might be.

## **6.4 Final Considerations**

This thesis aimed to better understand the relationship between high-speed rail and local benefits, primarily land development at or near rail stations. In doing so, it discussed the many factors that are involved in ensuring high-speed rail is effective, efficient and equitable—all goals which depend on the location and design of the rail stations. The two case studies in London and Las Vegas presented here exemplify how these goals have been or may be accomplished and demonstrate how local land development may turn an unprofitable project into a viable and popular one. Even with the variation among these case studies and the projects' different stages of planning and construction, hopefully they added insight into how land development may be leveraged to support quality high-speed rail development.

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## **Appendix A: St. Pancras Station Case Stakeholder Analysis**

A stakeholder analysis is conducted following the Mitchell Framework, discussed in Chapter 2. This analysis focuses on the role of the stakeholders during the planning and development of St. Pancras Station's rehabilitation. Depending on the timescale following the completion of the project, whether looking at times within the 30-year concession or for longer periods, the salience of these stakeholders may change. A summary of the results is presented in Table A-1, and descriptions of the salience for individual stakeholders follows. Conclusions for the entire stakeholder analysis are found in Chapter 3.2.9 ("Stakeholder Interests and the Outcomes of the St. Pancras Station Redevelopment").

**Central Government** – In developing St. Pancras Station, the Central Government, whose primary representative in this case was the Department for Transport, had the greatest saliency among all of the stakeholders. It funded the project, especially when the private sector could not support itself, it directed the environmental review, it convened stakeholders, and it made the ultimate decisions about which routes to design and to develop. Regardless of the political party leading the government, there has been consistent support for major rail infrastructure development. In this sense, the central government has been much more stable than most of the other stakeholders involved, especially the rail organizations that could have had influence on planning and design decisions. Changing values within government concerning privatizing rail had led to disruption within the rail industry; however, this did not impact the central government's own saliency.

**Camden (Local Authority)** – As a local government, it holds little direct power over the project at St. Pancras Station; however, it was directly involved in the planning process. In the project scheme with the King's Cross Central development, the local Camden authority held considerable power and urgency under Section 106.

**Public in King's Cross Area** – The immediate neighbors of St. Pancras Station felt the most significant economic impacts of increased activity and increased property values; however, they are also feeling the pressures of gentrification and the local environmental impacts of noise and visual impacts (ignoring the renovation and beautification of St. Pancras Station itself). These residents have legitimacy in that their homes are being impacted and they reside in the vicinity of the project. It appeared that the objective of rehabilitating St. Pancras Station was in part to benefit the immediate surroundings, working in these stakeholders' interests. If the public's concerns are not met with urgency, however, the situation may escalate and the public's opinions even may become more unified.

**English Heritage** – The Grade I listing of St. Pancras Station gave English Heritage absolute control over how the station was built. Every architectural design and material had to be approved by this stakeholder, giving it urgency and power. As a part of the central

government itself, English Heritage has the support of the government's power. In addition, English Heritage's role has been greatly empowered by public movements for historic preservation.

**London and Continental Railways (LCR) and Network Rail (HS1 – Public-Private Partnership)** – LCR operated the HS1 development, including St. Pancras International and the Channel Tunnel Rail Link (CTRL). LCR included four fully private firms to create Rail Link Engineering in its public-private partnership. Initially this was intended to be completely private, but debt became unmanageable for LCR, so it was taken over by the UK government. Its legitimacy and urgency over the project are clear; however, LCR was unable to manage itself and became completely dependent on the central government, losing much of the power it could have had. Following the completion of construction, Network Rail purchased the project from LCR and holds the same stakeholder saliency, except with greater independence from the central government.

**Public – London/UK** – The public was one of the main beneficiaries of the project, and therefore it has legitimacy. The power that it holds, however, is through local governments and the central government. If the public's concerns are not met with urgency, the situation may escalate and the public's opinions even may become more unified. Since the public of London and the UK is a very large group with direct influence on government through the electoral system, its urgency is amplified if opinions within the public become unified.

**Other European Countries** – European countries benefitted from this project and had an interest in there being efficient rail connections between their countries and the UK. They had little power over the UK's domestic infrastructure systems (the UK was the last major Western European country to integrate into the HSR system). They had little legitimacy in the UK's infrastructure systems and management, since these were planned and directed (and funded when needed) by the UK government and had the greatest impacts on the UK domestically. They did hold urgency, since their companies, population and economies depended on and interacted with this HSR infrastructure system. In addition, with rail privatization in the UK, many of these countries had direct holdings in rail companies in the UK. Finally, following Brexit, these countries hold influence over the UK in their negotiations over its exit from the European Union; however, this is a clear sign that the UK wants even greater independence from these other stakeholders.

**International Rail Companies** – Rail companies, such as Eurostar and Deutsche Bahn, would use the rail infrastructure and deal with the systems general operators—HS1 and Network Rail—once the project would be completed. These companies hold little power in a competitive market. They hold legitimacy, since they are an essential part of the infrastructure system, but little urgency since their role becomes involved once the construction of the infrastructure is complete.

**Airline Industry and other Transportation Modes** – These stakeholders would be impacted the project, probably negatively as their ridership would decrease. They, however, would have little power over the planning of the project, and their needs could be ignored without any consequences to the progress of the project.

**Labor and Unions** – These stakeholders benefitted from the jobs created by project; however, they had little influence in the planning or organizing of it, and they did not significantly influence the project’s schedule, cost or outcomes to be different than planned.

**Banks and Financiers** – These stakeholders are essential to the project; however, they did not exercise great power over it, because the Central Government was able to buy back the project’s debt and re-nationalize on multiple occasions. If it were not for this context, LCR’s inability to pay back its debt would have crippled the project.

**Property Developers** – Property developers had little power or legitimacy at St. Pancras Station itself. In order for the project to successfully integrate with and support outside development, these stakeholders’ needs had to be considered and met. Beyond St. Pancras Station, the property developers led the initiative to build King’s Cross Central.

**Businesses** – Similar to property developers, business interests had little legitimacy or power at St. Pancras Station. In addition, they had little power in the broader land development, although they ultimately would be some of the wealthiest tenants of the project.

*Brief Conclusions*

This analysis shows that the Central Government, as well as English Heritage, which was an agency of the central government, held the greatest saliency. The rail organizations experienced financial difficulties and were reorganized so frequently that they had little power and became dependent on the central government. Almost all of these stakeholders have legitimacy, and this is in part because the central government made an effort to include all stakeholders in the planning process as legitimate parties. Ultimately the stakeholders were all dependent on the leadership and funding of the Central Government in carrying out this major project. Please see Section 3.2.9 for further discussion.

| Stakeholder                    | Power | Legitimacy | Urgency | Typology              |
|--------------------------------|-------|------------|---------|-----------------------|
| Central Government             | P     | L          | U       | (P L U)<br>Definitive |
| Camden (Local Authority)       | 0     | L          | U       | (0 L U)<br>Dependent  |
| Camden and King’s Cross Public | 0     | L          | U       | (0 L U)<br>Dependent  |
| English Heritage               | P     | L          | U       | (P L U)<br>Definitive |
| LCR and Rail Link Engineering  | 0     | L          | U       | (0 L U)<br>Dependent  |



| <b>Stakeholder</b>           | <b>Power</b> | <b>Legitimacy</b> | <b>Urgency</b> | <b>Typology</b>          |
|------------------------------|--------------|-------------------|----------------|--------------------------|
| Public – London and UK       | 0            | L                 | U              | (0 L U)<br>Dependent     |
| European Countries           | 0            | 0                 | U              | (0 0 U)<br>Demanding     |
| International Rail Companies | 0            | L                 | 0              | (0 L 0)<br>Discretionary |
| Airline Industry             | 0            | L                 | 0              | (0 L 0)<br>Discretionary |
| Labor and Unions             | 0            | L                 | U              | (0 L U)<br>Dependent     |
| Banks and Financiers         | 0            | L                 | U              | (P L U)<br>Dependent     |
| Property Developers          | 0            | 0                 | U              | (0 0 U)<br>Demanding     |
| Businesses                   | 0            | 0                 | U              | (0 0 U)<br>Demanding     |

**Table A-1.** Summary of Mitchell Framework stakeholder analysis results.

## Appendix B: Los Angeles-Las Vegas Case Stakeholder Analysis

A stakeholder analysis is conducted following the Mitchell Framework, discussed in Chapter 2. This analysis focuses on the role of the stakeholders during the planning of the proposed XpressWest high-speed rail line. A summary of the results is presented in Table B-1, and descriptions of each of the individual stakeholders follows. Conclusions for the entire stakeholder analysis are found in Chapter Stakeholder Interests in the XpressWest Project”).

### GOVERNMENT

**Congress** – The United States Congress is the Federal legislative body which drafts and approves the bills to alter the Federal law of the United States. Congress is comprised of the upper Senate, which consists of 2 representatives from each of the 50 states, and the lower House of Representatives which consists of 435 representatives from sub-state districts apportioned by population. Bills passed by Congress are sent to the President for approval, and the President may veto bills. Being in charge of appropriating funds to the Federal government, Congress is an important player in infrastructure projects because it can support local projects with Federal funds.

**US Department of Transportation** – The U.S. Department of Transportation is a cabinet-level department in the executive branch of the Federal government responsible for overseeing development and operation of the national transportation system. There are ten agencies within the Department of Transportation, most of which focus directly on specific modes of transportation, from highways to transit. These agencies largely support the work of state-level and local transportation agencies through federal grants, system planning, project approval, and research.

**Federal Railroad Administration (FRA)** – The FRA is one of the ten agencies within the Department of Transportation and oversees the operation and development of rail projects nationwide. Particularly relevant to new rail projects, the FRA reviews all proposals for railroad projects in the United States. They have already granted XpressWest preliminary approval but hurdles remain.

**Federal Highway Administration (FHWA)** – The FHWA is an agency within the U.S. Department of Transportation that supports state and local agencies in developing, operating, and maintaining highways. Though not typically directly involved in rail projects, the Federal Highway Administration has been directly involved in the permitting process for high-speed rail between Las Vegas and Southern California because XpressWest plans to run largely in the right-of-way of I-15 between Victorville, CA and Las Vegas, NV. The FHWA has issued guidelines for the construction of high-speed rail in or near freeways, including barriers to prevent highway vehicles from entering the tracks in the event of a collision and other separation guidelines.

**Federal Aviation Administration (FAA)** – The FAA is an agency within the U.S. Department of Transportation responsible for overseeing the airline industry in the U.S., including

airlines, airports, and general aviation. The FAA is not directly involved in the changing flight demand between Southern California and Las Vegas

**Federal Transit Administration (FTA)** – The FTA is responsible for encouraging the development of mass transit in urban areas throughout the country. The FTA will play a role in the development of mass transit connections at either end of the intercity rail trip.

**Environmental Protection Agency** – The EPA is a cabinet-level federal agency given jurisdiction over environmental issues. Though the EPA does not directly address transportation issues, their involvement with pollution and air quality ensures that they will be interested in the development of high-speed rail.

**Department of Commerce** – The Department of Commerce is a cabinet-level department focused on promoting American businesses, creating ideal conditions for job creation and economic growth, and improving the lives of American workers. With regard to a rail link between Southern California and Las Vegas, the Department of Commerce will be interested in promoting development of American high-speed rail industry, including the manufacturing of trainsets and methods for efficiently constructing high-speed rail tracks.

**Bureau of Land Management (BLM)** – Much of the land between the San Gabriel Mountains and Las Vegas is owned by the Federal Government and its use is overseen by the Bureau of Land Management, a subcabinet administration of the Department of the Interior. In order to construct new infrastructure on the Federal lands between Los Angeles and Las Vegas, the Bureau must approve the project. XpressWest's proposal has already gained approval from the BLM

**State of Nevada** – XpressWest has been a priority for the State of Nevada and for the now retired Senator Harry Reid, who has championed it in the Senate and advocated for a federal loan for the project. The benefits for the economy of Las Vegas and for tourism to Las Vegas are both key to the wellbeing of the state.

**Nevada High Speed Rail Authority (NHSRA)** – Created by the State of Nevada in June 2015, this organization has the goal of supporting the development of high-speed rail between Las Vegas and Southern California. The Authority chose XpressWest as its franchisee in December 2015, marking XpressWest as the state's preferred rail operator.

**State of California** – The government of California is the only government in the country that is currently implementing an international-quality high-speed rail system. Thanks to Proposition 1 passed by the citizens of California in 2008, California is constructing high-speed rail between Los Angeles and San Francisco, with eventual extensions to Sacramento and San Diego. The State of California is less invested than the State of Nevada in an interstate high-speed rail system aimed at promoting tourism in Las Vegas. California stands to benefit somewhat from the system, with some Nevadans possibly using the system to visit Southern California and connecting their system to more destinations.

**California Department of Transportation (Caltrans)** – Caltrans is responsible for managing more than 50,000 miles of California's extensive highway and freeways, providing intercity rail service, and coordinating with local agencies. For any rail project, Caltrans would be involved, at the very least, in a regulatory capacity.

**California High-Speed Rail Authority (CHSRA)** – The California High-Speed Rail Authority was formed in 1996 to develop and implement high-speed rail in California. Following the approval of Proposition 1 in 2008, the Authority has been focused on coordinating planning efforts to ensure the delivery of the system approved by voters. The Authority is unlikely to widen their efforts to include building high-speed rail between Las Vegas and Los Angeles, but the new system will probably have to cooperate with the north-south trunk in some way.

**Southern California Association of Governments (SCAG)** – SCAG was established as an association of local governments to address regional issues. SCAG is a federally-designated Metropolitan Planning Organization (MPO). The SCAG region is comprised of 6 county governments and 191 city governments who determine an 86-member regional council. SCAG is heavily involved in regional transportation planning, developing a multimodal long-term transportation plan.

**Clark County, Nevada** – Clark County contains the Las Vegas metropolitan area, including the cities of Las Vegas, North Las Vegas and Henderson as well as almost 1 million people who live in unincorporated areas, which include the famed Las Vegas Strip. Clark County acts as a city government would for those living in unincorporated areas and is responsible for services like zoning and public works. Clark County is served by a seven-member County Commission that oversees county government.

**Los Angeles County Metropolitan Transit Authority (LACMTA)** – The Los Angeles County Metropolitan Transit Authority provides transit service to urban Los Angeles County, namely the part of LA County that is southwest of the San Gabriel Mountains. LA Metro operates two heavy rail lines, four light rail lines, and two bus rapid transit lines, in addition to local bus service throughout Los Angeles. LA Metro also partially funds the Metrolink commuter rail service. If rail service extends into Los Angeles Union Station, LA Metro will be the primary rapid transit provider for people connecting to the rail service.

**Southern California Regional Rail Authority (SCRRA)** – The Southern California Regional Rail Authority governs the Metrolink commuter rail system serving Los Angeles, San Bernardino, and Orange Counties. Metrolink uses Los Angeles Union Station as its main hub, with six lines terminating there. Metrolink operates on 388 miles of track that they own and 124 miles of track owned by Union Pacific, BNSF, or North Coast Transit District. Depending on the routing of the rail service, Metrolink could face new competition for train slots on the freight-owned tracks that it runs on. It is also possible that high-speed rail to Las Vegas could use one of the Metrolink stations as a transfer point, as is currently the plan for XpressWest from Palmdale, in which case Metrolink would be inclined to cooperate to provide good feeder service.

**Regional Transportation Commission of Southern Nevada (RTC)** – The RTC provides bus transit service to the Las Vegas metropolitan area. The RTC plays a slightly different role in the development of the system than LA Metro and Metrolink because there is no conflict between high-speed rail and commuter rail services as there would be if high-speed rail were to serve Los Angeles and the surrounding areas. Instead, the sole role of RTC would be to provide local transportation service for passengers arriving on high-speed rail to help them reach their destinations and accommodations.

**Las Vegas Convention and Visitors Authority (LVCVA)** – The Las Vegas Convention and Visitors Authority is a governmental agency in charge of promoting Las Vegas and its tourist attractions. The Authority is led by a 14-member board of directors, 6 of whom are from the private sector and the remainder appointed by local governments. The public-private partnership exists to further the public benefits of the gaming, hotel and convention industry; the hospitality and leisure sector accounts for 30% of all Clark County jobs (BLS, 2016).

## PRIVATE SECTOR

**Potential Intercity Rail Operators** – Potential operators of intercity rail between Los Angeles and Las Vegas, such as XpressWest or Las Vegas Railway Express, are the stakeholders who are most likely to push for agreement about what the rail link should look like. Potential operators have the potential to be closely aligned with property developers and attraction operators (as we have already seen from XpressWest, which is headed by a real estate developer). Operators will want to make as much profit as possible, but will likely have to work with other organizations, public or private, in order to get the capital required for necessary infrastructure.

**Property Developers** – Property developers along the Las Vegas Strip are among the primary beneficiaries of increased tourism to the Las Vegas area. When more people come to visit, the sustained demand for hotel rooms will spur the construction of new buildings. Encouraging more visitors keeps the demand for new properties high.

**Attraction/Entertainment Operators** – Las Vegas is famous for its casinos and entertainment options. In 2015, 42 million people from around the country visited Las Vegas. The core of the Las Vegas economy is built on the gaming, hotel, and convention industry, as seen by the fact that the hospitality and leisure sector accounts for 30% of all jobs in Clark County.

**Airlines** – In the absence of fast rail options, short-haul passenger flights meet the demand to travel between two cities faster than driving. 1.35M people flew round-trip from Southern California airports to Las Vegas between April 2015 and March 2016, with half of that number from LAX alone. In total, passengers made 2,694,000 one way trips between Las Vegas and Southern California airports over the last year (BTS, 2016).

**Freight Railroad Operators** – Union Pacific Railroad currently owns tracks for freight traffic and operates freight service between Los Angeles and Las Vegas. Freight operators frequently lease track rights to passenger rail operators (as they do for Amtrak and many commuter rail operators). The vast majority of conventional rail rights-of-way in the U.S. are owned by freight railroads. If a conventional railroad option were to be pursued, freight railroads would have to be engaged for easements. Even for high-speed rail running on dedicated track, freight railroad operators stand to be affected by shifting mode shares.

**Intercity Bus Operators** – In addition to existing air service, intercity bus companies currently offer routes between Los Angeles and Las Vegas, sharing I-15 with cars. Operators include Megabus, BoltBus, Greyhound, and Amtrak Thruway.

**Labor Unions** – Labor unions are organized associations of workers used to coordinate contract negotiation through collective bargaining over wages, working conditions, and benefits for workers. Labor unions are common in many different industries in the United States, from school teachers to bus drivers to construction workers. They have a strong (although waning) political presence and play an important role in the operation of government services like schools and public transportation. Unions will play a major role in the construction, operation, and maintenance of a high-speed rail system.

## TRANSPORTATION USERS

**Intercity passengers** – This group of users includes all passengers who travel between Southern California and Las Vegas, whether for business purposes or for tourism. This group includes all modes on which passengers travel, including car, bus, plane, and rail in the future. I-15 faces congestion problems during periods of peak use, and a high-speed rail project specifically aimed at alleviating congestion on I-15 will directly affect users of the corridor, whether they use the rail project or not. Additionally, air travel will face a competitive alternative for passengers who want to minimize travel time, resulting in more mode shifts.

**Regional passengers** – This group of users includes all who travel within one of the metropolitan regions along the route, namely Southern California and Las Vegas. These users generally live in the area of one of the stations and stand to be affected by the presence of additional people who have arrived on intercity transportation. In the Greater Los Angeles area, XpressWest may have a direct effect on operations of the Metrolink commuter rail system, which currently serves approximately (SCRRA, 2016). Metrolink riders are largely commuters who use the service during peak commuting hours. Depending on how far into the city the new rail link reaches, Metrolink might be an important way of transporting passengers to the new system. Alternatively, the new project may need to use Metrolink tracks, putting Metrolink into direct competition for track space with the new service. Commuters who use Metrolink will be affected by whatever service changes are enacted to respond to the new project, even if they do not plan to be users of the project.

**Freight users** – Freight users of both Interstate 15 and the existing freight connections between Southern California and the rest of the west will be affected by the capacity changes resulting from a rail link. The Southern California area includes two of the busiest ports in the country, the Port of Los Angeles and the Port of Long Beach. Rising freight traffic along rail corridors makes it difficult to run reliable conventional trains along tracks shared with freight.

| Stakeholder | Power   | Legitimacy  | Urgency  | Typology           |
|-------------|---|---|--|--------------------|
| Congress    | P<br>Congress is the ultimate governmental power, with the ability to grant large loans to projects | L<br>As Congress is the highest legislative body in the country, they have the ability to affect all transportation projects in | 0<br>Partisan gridlock means Congress has little urgency for most tasks, but especially little for funding novel | (PL 0)<br>Dominant |

| Stakeholder                | Power   | Legitimacy  | Urgency   | Typology              |
|----------------------------|---|---|---|-----------------------|
|                            | which it deems worth  | the nation.   | transportation projects   |                       |
| US Dept. of Transportation | P<br>The USDOT reviews and approves projects for construction and reviews projects for grants and loans.                            | L<br>The USDOT is recognized as the foremost authority on transportation projects in the country.   | U<br>The USDOT has been pushing for more HSR around the country, and a link between two high-profile cities would help increase interest elsewhere. | (P L U)<br>Definitive |
| Dept. of Commerce          | P<br>Regulates business environment in the U.S. and would be involved in the private sector aspects of the project                  | 0<br>The role of the department of commerce is tangential to that of infrastructure   | 0<br>Commerce does not possess urgency for a quick implementation of an alternative for the market  | (P 0 0)<br>Dormant    |
| Dept. of Interior          | 0<br>The DOI does not generally get much say in approving projects.   | L<br>Especially considering the nature of the land through which the project passes, the DOI has a strong say in whether the project can continue | U<br>The DOI is interested in a project which does not adversely affect the sensitive land between LA and LV.                                       | (0 L U)<br>Dependent  |
| US EPA                     | 0<br>US EPA has a role in environmental review of projects, but cannot push a project through                                       | L<br>EPA has a strong claim to encouraging projects which will reduce pollutants and GHG emissions  | U<br>EPA has a strong interest in programs which can reduce emissions from combustion vehicles  | (0 L U)<br>Dependent  |
| State of Nevada            | P<br>LA-LV HSR has been a key interest in Nevada for several years. Nevada has the ability to clear the way for the project.        | L<br>Nevada has the legitimacy to involve itself in an infrastructure project which would benefit them economically as well.                      | U<br>Maintaining a dependable connection to the LA market is important for the economy of Nevada as a whole.  | (P L U)<br>Definitive |
| NHSRA                      | 0<br>In contrast to the CHSRA, the NHSRA was established largely to support the XpressWest project and facilitate its construction. | L<br>As an advocacy group for HSR development between Southern California and Las Vegas, it has legitimacy.                                       | U<br>NHSRA has a very strong interest in getting HSR between Las Vegas and Los Angeles as quickly as possible                                       | (0 L U)<br>Dependent  |

| Stakeholder         | Power   | Legitimacy   | Urgency  | Typology                 |
|---------------------|---|--|--|--------------------------|
| State of California | P<br>Could choose to dedicate resources to the project if seen to benefit the California HSR system under development   | L<br>Though benefits largely go to Nevada, the project still greatly concerns California, and since the route largely passes through California, the state has the legitimacy to affect it | 0<br>The State of California has relatively little interest in developing this link quickly, though in the long run it can tie into their network. | (P L 0)<br>Dormant       |
| Caltrans            | P<br>Caltrans operates I-15 between LA and Las Vegas, giving them power to negotiate construction in the right-of-way   | L<br>Caltrans manages the Interstate which the project will run along  | U<br>The HSR project has the potential to take load off of I-15 which would help Caltrans keep the roadway flowing well.                           | (P L U)<br>Definitive    |
| CHSRA               | 0<br>Since the LA-LV project lies primarily outside of the domain of CHSRA, they have little power, except for cooperating with transferring riders at Palmdale.                              | L<br>The CHSRA is the only agency nationally which is currently implementing true high-speed rail.   | 0<br>CHSRA is occupied with implementing their own system and has little interest in the LA-LV system.   | (0 L 0)<br>Discretionary |
| SCAG                | 0<br>SCAG has power over long-term master planning but relatively little power over specific projects.  | L<br>Being the MPO for Southern California gives SCAG a legitimate claim to influence the development of HSR.  | 0<br>Though the project is ultimately in SCAG's long term vision, its prompt completion is not one of SCAG's primary concerns.                     | (0 L 0)<br>Discretionary |
| LACMTA              | P<br>LACMTA provides urban transportation which would help passengers reach stations and controls Union Station, which would likely be a terminal if the project eventually extended into LA. | 0<br>LACMTA does not have legitimacy because doesn't operate conventional rail transit and would not be affected by HSR operations.  | 0<br>Other than possibly bringing more ridership to its services, LACMTA does not need HSR to thrive.  | (P 0 0)<br>Dormant       |
| SCRRA               | P<br>SCRRA has control over many of the tracks operating into the LA area as well as control over commuter flow to suburban transfer  | L<br>SCRRA has a substantial legitimacy, as it could prove to be redundant or complementary to its service in the LA region.   | 0<br>While the SCRRA might benefit from track upgrades, their system does not need the HSR proposal to survive.                                    | (P L 0)<br>Dominant      |



| Stakeholder                        | Power  | Legitimacy   | Urgency  | Typology                 |
|------------------------------------|--|--|--|--------------------------|
|                                    | stations.  |  |  |                          |
| RTC of So. NV                      | 0<br>Though the RTC functions as the MPO for the Las Vegas area, they do not own any infrastructure important to the project and will complement it in whatever form it takes. | L<br>As the MPO for the Las Vegas area, the RTC has a claim to review projects to judge whether they fit with their long-term view.                                    | U<br>The RTC has a strong interest in diversifying the modes of transportation available to residents of Clark County.                         | (0 L U)<br>Dependent     |
| LAC, SBC, OC                       | 0<br>Local counties have some input over alignment options, but largely have little ability to make the project happen   | L<br>Local counties have a strong claim to a project which satisfies local residents, minimizing disruptions   | 0<br>Like SCAG, local counties feel less pressing need to see the project completed  | (0 L 0)<br>Discretionary |
| Clark County                       | 0<br>Clark County does not have the power to push this project to completion without support from higher governmental bodies   | L<br>Like the local counties in LA, Clark County has a legitimate claim to review and make sure that the project is satisfactory to local residents                    | U<br>Unlike local counties in Southern California, Clark County's economy is much more linked to the success of a high-speed rail project      | (0 L U)<br>Dependent     |
| LVCVA                              | 0<br>LVCVA has lobbying power but little power on its own to make sure the project satisfies their needs   | 0<br>LVCVA has little claim to the review the project  | U<br>LVCVA will benefit strongly from the project and has strong interest in solidifying tourism to Las Vegas                                  | (0 0 U)<br>Demanding     |
| Potential Intercity Rail Operators | P<br>Since they are the agencies that are building the system, they have power over it.  | L<br>Since they are the agencies that are building the system, they have legitimacy in it.   | U<br>Since they are the agencies that are building the system and their needs must be met for the system to function, they have urgency in it. | (P, L, U)<br>Definitive  |
| Property Developers                | P<br>Property developers in Las Vegas have access to large amounts of capital and have the potential to spearhead a privately funded project.                                  | 0<br>Since transportation projects are generally government-led, the legitimacy of property developers executing a large-scale infrastructure project is questionable. | U<br>Property developers are keen to be able to secure a reliable means of transportation for patrons from the Los Angeles area.               | (P 0 U)<br>Dangerous     |
| Attraction                         | P  | 0  | 0  | (P 0 0)                  |

| <b>Stakeholder</b>         | <b>Power</b>  | <b>Legitimacy</b>   | <b>Urgency</b>   | <b>Typology</b>          |
|----------------------------|---|---|--|--------------------------|
| Owners                     | Attraction owners have a large presence in the Las Vegas development arena and substantial political clout  | Attraction owners have little legitimate claim to a piece of infrastructure   | Attraction owners are more content with the status quo than property developers because their business does not require constant growth of tourism | Dormant                  |
| Airlines                   | 0<br>As a private industry in a different transportation sector airlines are a competitor to HSR and can only lobby for projects which protect their business         | L<br>Airlines currently carry a large percentage of people from Southern California to Las Vegas                                      | U<br>Adding another reliable mode to the market will disrupt air's market share  | (0 L U)<br>Dependent     |
| Intercity Bus Operators    | 0<br>Intercity bus operators have no power over determining what happens to other modes of transportation in the market   | 0<br>Intercity bus operators do not have the legitimacy to influence the project, and instead will react to its impacts on the market | U<br>Adding a reliable mode between LA and LV has the potential to disrupt bus service, putting business at risk                                   | (0 0 U)<br>Demanding     |
| Freight Railroad Operators | P<br>The only rail alignments currently linking LA and Las Vegas are owned by freight railroads, meaning any low-capital plan would have to satisfy freight operators | L<br>Freight railroads have legitimacy to make decisions about their tracks, some of which could be important to XpressWest's plan    | 0<br>Freight railroads are largely satisfied by the status quo, and adding new passenger rail lines would not disrupt their service.               | (P L 0)<br>Dominant      |
| Unions                     | 0<br>Unions can endorse a project which benefits them but in the long run they can only lobby government officials for their preferred option                         | 0<br>Unions, though a respected interest group in politics, will have little legitimacy to influence the development of the project   | U<br>Unions would benefit from construction jobs created by the project and from jobs operating the system   | (0 0 U)<br>Demanding     |
| Intercity Passengers       | 0<br>Though users are ultimately who the project is for, they have little collective power because they are not an organized body                                     | L<br>Intercity users have legitimacy because they will ultimately determine whether the system is successful or not                   | U<br>Intercity passenger have urgency because the corridor between LA and LV is congested and options are limited                                  | (0 L U)<br>Dependent     |
| Regional Passengers        | 0<br>Regional passengers have no power over what  | L<br>Regional passengers have a legitimate claim  | 0<br>Regional passengers are satisfied with the status   | (0 L 0)<br>Discretionary |

| <b>Stakeholder</b> | <b>Power</b>  | <b>Legitimacy</b>   | <b>Urgency</b>  | <b>Typology</b>      |
|--------------------|---|---|---|----------------------|
|                    | happens to the intercity market   | to the preservation of commuter service, and keeping disruptions from high-speed service to a minimum | quo and do not require a new solution to greatly improve their service                                |                      |
| Freight Customers  | 0<br>Freight customers can't make or break the project directly or indirectly | 0<br>Freight customers do not have a legitimacy to affect how passenger rail is developed             | U<br>Freight customers have interest in any project which will increase the reliability of the system | (0 0 U)<br>Demanding |

**Table B-1.** Summary of Mitchell Framework stakeholder analysis results.

## Appendix C: Los Angeles-Las Vegas Case Benefit-Cost Analysis

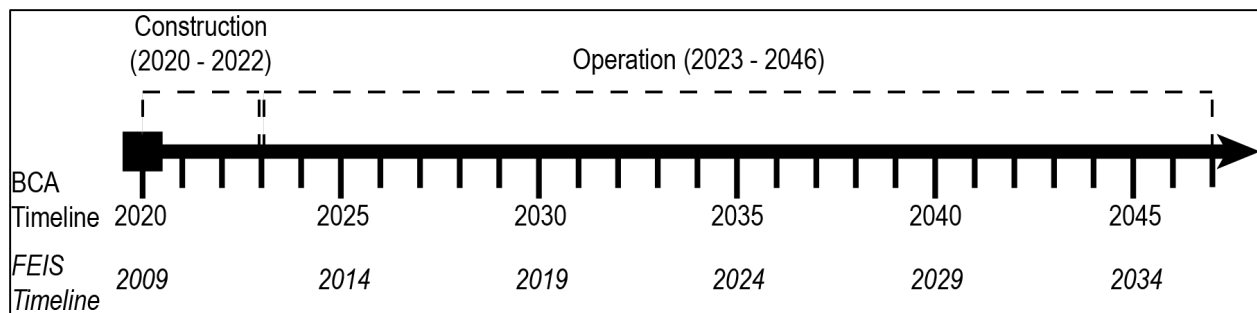
The Benefit-Cost Analysis (BCA) is conducted using information primarily gathered from the *Final Environmental Impact Statement and Final Section 4(f) Evaluation for the Proposed DesertXpress High-Speed Passenger Train Victorville, California, to Las Vegas, Nevada* (FEIS) (2011)<sup>395</sup> and the project’s *Draft Environmental Impact Statement* (2009) (DEIS) and the *Supplementary Draft Environmental Impact Statement* (2010). (DesertXpress is now XpressWest. The company is referred to as XpressWest regardless of its name at the time of the event being discussed.)

### TIMELINE AND EVALUATION HORIZON

Throughout the *FEIS*, which was published in 2011, it is assumed that construction would commence in 2009 and be complete within 3 to 4 years. Ridership estimates run from 2012 through 2035, and other estimates, such as the employment estimates, assume operations begin in 2012. The *FEIS* describes an 18-year “operations evaluation horizon”, which would end in 2030,<sup>396</sup> and contains many estimates for the year 2030. At this year, contemporaneous highway and transportation project planning estimates and proposals discussed in the *FEIS* also end.

At the time of writing in 2017 (as well as when the *FEIS* was published), it is obvious that these timeline predictions were false. While XpressWest continues to predict imminent commencement of construction, without sufficient funding, it is unclear when construction actually will progress. Still assuming that the project is built, the timeline of this BCA starts in 2020, a commencement year reasonably in the future, with a 3-year construction period followed by a 24-year operation period, running from 2023 through 2046 (Figure C-1).

Figure C-1. Benefit-cost analysis timeline compared to timeline presented *FEIS*.



This takes advantage of the full ridership estimates provided in the *FEIS*. In this BCA, these estimates are assumed to be the same values as in the *FEIS* but delayed by 11 years (from 2023 through 2046). These ridership estimates incorporate many assumption and predictions for population growth, economic factors, and other infrastructure development, among other factors,

<sup>395</sup> <https://www.fra.dot.gov/Page/P0401>

<sup>396</sup> *FEIS*, 3.5-140.

for the specific years from 2012 through 2035. By changing the expected years for these ridership estimates, these assumptions and predictions may be incongruous for the years used in this BCA (2023 through 2046). While it is beyond this work to produce new estimates and predictions, it may be likely that the population in the region will increase and interest in taking high-speed rail as a less carbon-intensive transportation mode will also increase, barring any unknown technological advancements or extreme environmental, social or political events, which were not included in the ridership estimates anyway. In these cases, ridership would be greater than predicted and benefits probably also would be greater, meaning that this BCA offers conservative estimates in this area.

All monetary values are adjusted for inflation, using historical data from the United States Bureau of Labor Statistics (BLS) and predicted inflation rates through 2021 from the International Monetary Fund.<sup>397</sup> For future inflation past 2021, this analysis assumes a 3% rate per year, as used in California High-Speed Rail operating cost analyses.<sup>398</sup>

## COSTS

Costs are separated into two groups: construction costs and operating costs. The nature of the costs of the project are significantly different depending on the stage of the project. In addition, various impacts, costs and externalities are discussed in the *EIS*. These include impacts to hydrology, visibility, environmental justice communities, noise and vibration, geology and soils, farmlands and grazing lands, and cultural and paleontological resources. The *EIS* asserts these impacts would be minimal, since the Preferred Alternative route follows Interstate 15's right-of-way and even is contained within its median for much of the route. Therefore, the addition of HSR tracks would not create significant changes from the current situation for these issues. For this reason, the environmental and social externalities of the factors discussed in this paragraph are not included in the BCA. Environmental impacts caused by greenhouse gas emissions and other particulate air pollution are included in this BCA.

## CONSTRUCTION COSTS

### *Construction*

The *FEIS* estimates that the capital cost for project would be \$6 – \$6.5 billion.<sup>399</sup> A 2012 online news article concerning a possible route extension and XpressWest's application for a federal loan, states the expected price as \$6.9 billion, which is equivalent to \$6.5 billion in 2009 dollars using the same BLS inflation data.<sup>400</sup> We chose \$6.5 billion in 2009 dollars (or \$7.67 billion in 2020 dollars) as the construction cost for the BCA. With hindsight of current delays in the

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<sup>397</sup> <https://www.statista.com/statistics/244983/projected-inflation-rate-in-the-united-states/>

<sup>398</sup> [http://www.hsr.ca.gov/docs/about/business\\_plans/BPlan\\_2012Ch6\\_OpMaintCosts.pdf](http://www.hsr.ca.gov/docs/about/business_plans/BPlan_2012Ch6_OpMaintCosts.pdf)

<sup>399</sup> *FEIS*, ES-11.

<sup>400</sup> Velotta, Richard N. June 7, 2012. <http://vegasinc.com/business/real-estate/2012/jun/07/desertxpress-inks-deal-add-train-link-victorville/>.

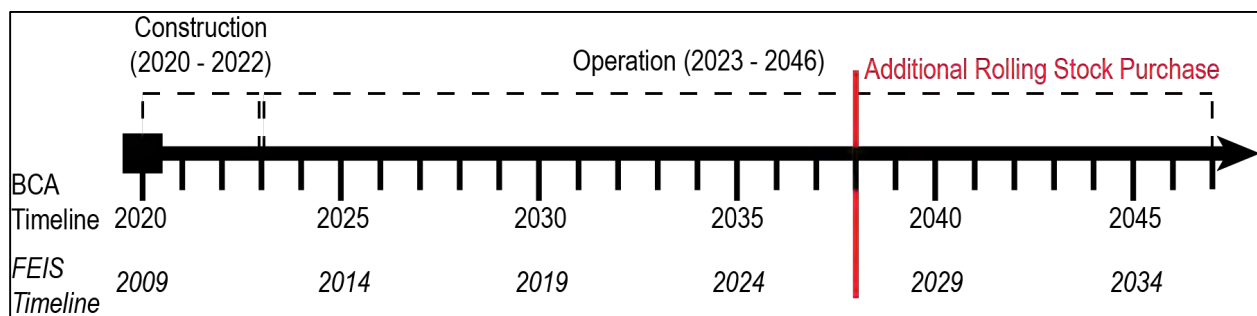
commencement of construction and the frequency of cost overruns for infrastructure projects in general, it is likely that the eventual price will actually be higher if the project is constructed. Using the amount presented in the *FEIS*, however, is in line with the other values used in this analysis. The BCA estimates that this cost is spent equally throughout the planned 3-year<sup>401</sup> construction period.

### Rolling Stock

It is assumed that the initial procurement costs for the rolling stock were included in the project’s construction budget. As presented in the *DEIS*, this initial procurement would consist of 16 Bombardier electric multiple unit (EMU) train sets with 10 passenger cars each.<sup>402</sup> Based on ridership estimates, which forecast rail ridership under an operation phase from 2012 through 2035, the project would require an additional 4 train sets for 2027.<sup>403</sup>

The rolling stock procurement costs from other HSR projects can help us estimate the cost of these additional train sets. In August 2016, it was announced that the United States federal government would lend \$2.45 billion to Amtrak for procurement of 28 new Acela (HSR) train sets and other infrastructure improvements.<sup>404</sup> (Amtrak has purchased Acela trains from a Bombardier and Alstom partnership previously.) Assuming that the entire cost would be used toward the 28 train sets to create a high (conservative) estimate, each train set would cost \$88 million. This cost is greater than the procurement costs of a 2009 Chinese project for 80 Bombardier HSR train sets (similar in size to those in the DesertXpress project proposal) at an average of \$50 million each.<sup>405</sup> We use the higher United States estimate, however, because the project is also in the United States. The BCA, therefore, includes a purchase of 4 train sets at \$88 million each in 2038 (equivalent to 2027 in the *FEIS* timeline, Figure C-2).

**Figure C-2.** Benefit-cost analysis timeline compared to timeline presented *FEIS*.



<sup>401</sup> *FEIS*, 3.2-12.

<sup>402</sup> *DEIS Appendix C*, 5.

<sup>403</sup> *Ibid.*, 5.

<sup>404</sup> <https://www.washingtonpost.com/news/dr-gridlock/wp/2016/08/26/biden-announces-upgrades-for-amtraks-northeast-corridor/>.

<sup>405</sup> <http://www.bombardier.com/en/media/newsList/details.883-bombardier-sifang-wins-contract-to-build-80-very-high-speed-trains-for-china.bombardiercom.html?filter-bu=all&f-year=2009&f-month=8&f-type=all&show-by-page=50&page=1&f-min-year=2002>.

*Air Pollution*

During construction, overall air pollution would increase, because auto demand would remain constant and construction requires using vehicles and other energy-intensive activities (most of which would come from non-renewable, polluting sources). This BCA would use the same values of pollutant reductions shown in Table C-2 and factored in with 2020-dollar values. It is also assumed that the value of an increase in emissions is the negative of the same factors.

**Table C-2.** 2020-dollar value associated with air pollution emissions [\$ per ton]. (Author, based on Delft, 2008)

| CO <sub>2</sub> | NO <sub>x</sub> | PM <sub>2.5</sub> | PM <sub>10</sub> |
|-----------------|-----------------|-------------------|------------------|
| 32              | 477             | 3,383             | 1,353            |

**Table 0-3** Table C-2 and Table C-3 show the increase in emissions expected for four years of construction. As will be discussed, this BCA considers only three years of construction, so the fourth year’s values are incorporated into the values for the third year in the BCA. These emissions are multiplied by negative numbers of the factors in Table 0-3 to estimate the total social costs of air pollution during construction from 2020 through 2022 (Table C-5).

**Table 0-3.** Construction period pollution in Mojave Desert Air Basin, CA. (FEIS, 3.11-26)

| Evaluation Year              | Criteria Pollutant Emissions (tons per year) |                 |     |                  |                   | CO <sub>2</sub> e Emissions, tons per year <sup>a</sup> |
|------------------------------|--|-----------------|-----|------------------|-------------------|---|
|                              | ROC  | NO <sub>x</sub> | CO  | PM <sub>10</sub> | PM <sub>2.5</sub> |   |
| Year 1                       | 7  | 17              | 103 | 70               | 32                | 18,103  |
| Year 2                       | 28   | 80              | 452 | 99               | 35                | 80,594  |
| Year 3                       | 26   | 75              | 427 | 99               | 34                | 75,166  |
| Year 4                       | 12   | 38              | 197 | 64               | 32                | 34,024  |
| General Conformity Threshold | 50   | 100             | --  | 100              | --                | --  |
| Exceed Threshold?            | No   | No              | N/A | No               | N/A               | N/A   |

Source: ICF/Jones & Stokes, 2011.  
<sup>a</sup> Criteria pollutant emissions expressed in short tons (1 ton = 2,000 lbs); CO<sub>2</sub>e emissions expressed in metric tons (1 ton = 2,204.62 lbs)

**Table C-4.** Construction period pollution in Clark County, NV. (FEIS, 3.11-26)

| Table F-3.11-21 Revised Construction Period Regional Criteria Pollutant and Greenhouse Gas Emissions, Clark County, Post Mitigation |  |                 |     |                  |                   |   |
|---|--|-----------------|-----|------------------|-------------------|---|
| Evaluation Year   | Criteria Pollutant Emissions (tons per year) |                 |     |                  |                   | CO <sub>2</sub> e Emissions, tons per year <sup>a</sup> |
|   | ROC  | NO <sub>x</sub> | CO  | PM <sub>10</sub> | PM <sub>2.5</sub> |   |
| Year 1  | 1  | 4               | 22  | 15               | 7                 | 4,371   |
| Year 2  | 6  | 20              | 96  | 23               | 7                 | 19,561  |
| Year 3  | 5  | 19              | 88  | 23               | 7                 | 17,661  |
| Year 4  | 2  | 10              | 40  | 13               | 7                 | 7,898   |
| General Conformity Threshold  | 50   | 100             | 100 | 70               | --                | --  |
| Exceed Threshold?   | No   | No              | No  | No               | N/A               | N/A   |

Source: ICF/Jones & Stokes, 2011.  
<sup>a</sup> Criteria pollutant emissions expressed in short tons (1 ton = 2,000 lbs); CO<sub>2</sub>e emissions expressed in metric tons (1 ton = 2,204.62 lbs)

**Table C-5.** Total social costs of air pollution during construction in millions of 2020 dollars.

| 2020 | 2021 | 2022 |
|------|------|------|
| 0.97 | 3.61 | 5.14 |

## OPERATION COSTS

Figures for the overall expected costs of operating the system were not available. Some costs are inferred using information available throughout the *FEIS*. Additional costs are inferred by using data provided by California High-Speed Rail.

### Employment

The direct employment salaries of the project were calculated using information gathered from the *FEIS* concerning the number of jobs that would be created during the operation phase and the direct costs of the employment opportunities, shown in Table C-6.<sup>406</sup> Please see the following section in this appendix, titled “Indirect Economic Impacts: Costs and Benefits”. for a more detailed description of how these values were calculated.

**Table C-6.** Estimated employment and salaries during operation phase in 2020 dollars.

| Location          | Direct Employment | Direct Employment Total Salaries (millions) |
|-------------------|-------------------|---|
| Victorville       | 361               | \$10.1                                      |
| Baker             | 8                 | \$233.3                                     |
| Greater Las Vegas | 154               | \$13.9                                      |
| Total             | 523               | \$24.6                                      |

<sup>406</sup> *FEIS*, 3.2-12-17.



### Energy Consumption

In calculating the total reduction in energy consumption for the region with XpressWest, the *FEIS* gives an estimate for the annual project energy consumption: 2,588,000 MMBTUs.<sup>407</sup> It is assumed that the project would use electric multiple unit (EMU) trains, which would run on electricity.<sup>408</sup> Using an estimate for industrial electricity rates in San Bernardino County (0.0988 \$/kWh = 28.94 \$/MMBTU in 2020 dollars)<sup>409</sup>, the annual cost of powering the project can be estimated.

### Additional Operation Costs

Additional operation costs are inferred from the California HSR, a new HSR megaproject in California, outlined in the project's *Revised 2012 Business Plan (2012)*<sup>410</sup>, as shown in Table C-7. While California HSR is a much a larger project than XpressWest, the lines will operate in a relatively similar environment, and, as a larger, public project, California HSR provides greater information. The costs gained from this data are: maintenance, stations (assumed 3 stations—Las Vegas, Victorville and Palmdale), insurance, and contingency. Administration and support costs were already included in employment costs.

**Table C-7.** Expected operation costs for California HSR.

| Exhibit 6-2. Cost categories and unit cost assumptions (2009\$) |  |  |
|---|--|--|
| Category of Cost  | Unit Cost  | Basis  |
| Train operations and maintenance                                | \$20 per trainset mile, plus \$83.33 per revenue service hour for feeder coach service | Operating crew costs from comparable U.S. operations and labor practices, electricity cost from power demand simulations and California large user rates with green surcharge, and train maintenance cost from French HSR experience. Feeder service cost based on review of similar systems in California and elsewhere in the U.S. |
| Maintenance of infrastructure                                   | \$200,000 per route mile   | French HSR experience adapted to California requirements and benchmarked against other HSR systems   |
| Stations  | \$4,100,000 per station per year   | U.S. staffing for high-volume, access-controlled stations and reserved seating ticketing practices   |
| Administration and support                                      | 10% of O&M costs excluding contingency   | Standard industry allowance to cover management, accounting, sales, marketing, and control center  |
| Insurance   | \$25,000,000 per year  | Review of insurance costs for rail passenger service in the U.S. Costs include necessary indemnities   |
| Contingency   | 10% of total O&M costs   | Contingency applied to account for unknowns  |
| Inflation   | 3% per year, price base date of 2010   | Long-term year-over-year percentage increase for the Consumer Price Index in the region  |

<sup>407</sup> *FEIS*, 3.13-3.

<sup>408</sup> *DEIS Appendix C*, 6.

<sup>409</sup> <http://www.electricitylocal.com/states/california/san-bernardino/>

<sup>410</sup> [http://www.hsr.ca.gov/docs/about/business\\_plans/BPlan\\_2012Ch6\\_OpMaintCosts.pdf](http://www.hsr.ca.gov/docs/about/business_plans/BPlan_2012Ch6_OpMaintCosts.pdf).

## FURTHER COSTS NOT INCLUDED IN BCA

There are additional operating costs (or benefits) that could be considered, such as advertising and taxes; however, these are significantly smaller than the other factors included and there is insufficient data to estimate or quantify these issues.

## BENEFITS

The XpressWest website (2016)<sup>411</sup> highlights a list of benefits of the project:

- Economic benefits during construction and operations (with a *multiplier effect*)
- New industry jobs
- Increased economic output
- Reduction of pollutant emissions
- Reduction of oil dependence
- Reduction of energy consumption
- Reduction of traffic congestion and increased capacity for goods movement
- Increased public safety
- Enhancement of United States infrastructure
- Increased tax revenue

Many of these benefits (and related costs) are addressed in the *EIS*.

Other benefits, such as enhancement of the image of and support for infrastructure in the United States or reduction in oil dependence, are general and very difficult to monetize. They relate to national trends, on which this relatively small and unique, albeit first-of-its-kind, project likely would not have significant impacts.

A discussion of the benefits that are included in this BCA follows.

## TIME SAVINGS

Currently, car/bus and air travel comprise the travel options between Southern California and Las Vegas. A flight takes 1.5 hours. A car trip as well as an intercity bus trip between Los Angeles and Las Vegas usually takes 3-4 hours, but can greatly exceed that length with increased traffic.<sup>412</sup> 3.5 hours was used in the BCA, since a majority of the ridership diverted to rail comes from car and bus trips.

The trip duration for XpressWest used in the *FEIS* ridership estimates is 100 minutes.

13% of the XpressWest ridership is predicted to have been diverted from air travel, with the other 87% from automobile and bus travel. Since air and HSR travel would take a similar

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<sup>411</sup> <http://www.xpresswest.com/benefits.html>

<sup>412</sup> *FEIS*, ES-21.

amount of time, especially including security and wait times for air travel, time savings are calculated for only 87% of the total rail ridership, who save 110 minutes (or 1.83 hours) each trip.

The value of time for travelers was calculated using US DOT 2011 guidelines.<sup>413</sup> This formula takes multiple inputs:

- median household annual income of \$54,100 for San Bernardino County<sup>414</sup> (hourly income of \$26.01)
- value of travel time savings (VTTS) ratio for intercity personal travel: 0.7
- multiplier for VTTS ratio for HSR intercity personal travel: 1.9
- assume that 100% of travel is personal<sup>415</sup>

This yields a VTTS estimate of \$41.87 in 2020 dollars.

These time-savings estimates do not include savings for people who still travel by car but experience decreased congestion and shorter travel times on the highway. There is insufficient data available of XpressWest's potential impacts on congestion.

## SAFETY

The *FEIS* states that a reduction in auto traffic caused by diverting ridership to rail could reduce the accident rate and improve traffic safety. In addition, it states that most of the collisions on I-15 between Victorville and Las Vegas involve long-distance travelers and that a majority of the collisions are caused by congested traffic conditions.<sup>416</sup>

The *FEIS* estimates an annual decrease in vehicle miles traveled (VMT) of 0.91 billion miles in 2030 within the project area.<sup>417</sup> Assuming that VMT is linearly proportional to the number of passengers making the trip, there are 162.62 VMT per trip on I-15 between Victorville and Las Vegas, since the *FEIS* ridership forecast 5,595,807 trips diverted from auto to rail in 2030<sup>418</sup>.

According to the Insurance Institute for Highway Safety Highway Loss Data Institute, California experience 0.92 deaths per 100 million VMT.<sup>419</sup> Using the *FEIS* ridership forecasts, the expected amount of lives "saved" from diverting trips from auto to rail could be estimated by multiplying

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<sup>413</sup> [https://www.transportation.gov/sites/dot.dev/files/docs/vot\\_guidance\\_092811c.pdf](https://www.transportation.gov/sites/dot.dev/files/docs/vot_guidance_092811c.pdf).

<sup>414</sup> US Census, <http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=CF>.

<sup>415</sup> *FEIS* states that given the cost of travel and distance between stops, it is unlikely that the project would be used by commuters. It may be used by business travelers for conferences and similar purposes, however, the percentage is unknown. Personal travel time is valued less, so this estimate is conservative.

<sup>416</sup> *FEIS*, ES-23.

<sup>417</sup> *FEIS*, 3.13-3.

<sup>418</sup> *FEIS*, FD-33.

<sup>419</sup> <http://www.iihs.org/iihs/topics/t/general-statistics/fatalityfacts/state-by-state-overview>.

the VMT/trip factor by the expected number of trips diverted from auto to rail and by the rate of deaths/VMT for California.

A US DOT resource guide for TIGER Grant applicants recommends the monetized value of a statistical life to be \$9.4 million per fatality based on considerations such as foregone income.<sup>420</sup> This factor would be multiplied by the number of lives “saved” to estimate the monetary benefit for safety of the diverted auto trips. As this is dependent on the number of rides diverted from auto travel, the monetary value varies by year. As a reference value, the monetized value of safety in 2025, three years into operations, is \$54.5 million.

This is likely a conservative estimate, since the reduction in incidents due to diverted trips is most likely not linear. On a more congested highway, a reduction in congestion may lead to a greater reduction in incidents than on a less congested highway. Additionally, this analysis only takes fatalities and not injuries from car crashes into account. On the other hand, this analysis also assumes that the HSR system would have a perfect safety record. While this may not be true, it would be likely that safety on the HSR system would far exceed safety on the highway.

### AIR POLLUTION REDUCTIONS

During operations, there is expected to be a reduction in pollutant emissions per passenger-mile, as auto traffic is diverted to rail. This BCA would use the same values of pollutant reductions shown in Table C-8 and factored in with 2020-dollar values. It is also assumed that the value of an increase in emissions is the negative of the same factors.

**Table C-8.** 2020-dollar value associated with air pollution emissions [\$ per ton]. (Author, based on Delft, 2008)

| CO <sub>2</sub> | NO <sub>x</sub> | PM <sub>2.5</sub> | PM <sub>10</sub> |
|-----------------|-----------------|-------------------|------------------|
| 32              | 477             | 3,383             | 1,353            |

The *FEIS* estimates the effects of the XpressWest project on regional air pollution emissions in order to determine that regulatory thresholds for acceptable pollution were not exceeded at some points in the future. It splits the predictions between two areas that cover the entire project: the Mojave Desert, California, and Clark County, Nevada. In addition, according to its methodology, the *FEIS* evaluates predicted net air pollution effects in two horizon years: 2013 and 2030, which are equivalent to 2024 and 2041 in this BCA’s timeline (see Figure C-1).<sup>421</sup> With the XpressWest project, there is a net decrease in most pollutant emissions, except for SO<sub>x</sub> emissions. Table C-8, Table C-10, and Table C-12 present the predicted changes in air pollution emissions due to XpressWest, compared to a no-action alternative.

<sup>420</sup> US DOT, “TIGER Benefit-Cost Analysis (BCA) Resource Guide.”  
[https://www.transportation.gov/sites/dot.gov/files/docs/Tiger\\_Benefit-Cost\\_Analysis\\_%28BCA%29\\_Resource\\_Guide\\_1.pdf](https://www.transportation.gov/sites/dot.gov/files/docs/Tiger_Benefit-Cost_Analysis_%28BCA%29_Resource_Guide_1.pdf).

<sup>421</sup> *FEIS*, 3.11-8.

**Table C-9.** Regional pollutant emissions in Mojave Desert Air Basin in 2013. (FEIS, 3.11-12)

| <b>Table F-3.11-7 Preferred Alternative Regional Criteria Pollutant and Greenhouse Gas Emissions, Mojave Desert Air Basin, Opening Year Operations</b> |                                     |                       |           |                       |                        |                         |   |
|--|-------------------------------------|-----------------------|-----------|-----------------------|------------------------|-------------------------|---|
|  | <b>Criteria Pollutant Emissions</b> |                       |           |                       |                        |                         | <b>CO<sub>2</sub>e Emissions, tons per year<sup>a</sup></b> |
|  | <b>ROC</b>                          | <b>NO<sub>x</sub></b> | <b>CO</b> | <b>SO<sub>x</sub></b> | <b>PM<sub>10</sub></b> | <b>PM<sub>2.5</sub></b> |   |
| Railway Emissions  | 1                                   | 75                    | 13        | 8                     | 3                      | 2                       | 47,463  |
| Mobile-source Emissions  | (76)                                | (530)                 | (1,621)   | (3)                   | (37)                   | (34)                    | (322,115)   |
| Net Emissions  | (75)                                | (455)                 | (1,608)   | 5                     | (34)                   | (32)                    | (274,652)   |
| General Conformity Threshold   | 50                                  | 100                   | --        | --                    | 100                    | --                      | --  |
| Exceed Threshold?  | No                                  | No                    | N/A       | N/A                   | No                     | N/A                     | N/A   |

Source: ICF/Jones & Stokes, 2010.

<sup>a</sup> Criteria pollutant emissions expressed in short tons (1 ton = 2,000 lbs); CO<sub>2</sub>e emissions expressed in metric tons (1 ton = 2,204.62 lbs)

**Table C-10.** Regional pollutant emissions in Clark County in 2013. (FEIS, 3.11-13)

| <b>Table F-3.11-9 Preferred Alternative Regional Criteria Pollutant and Greenhouse Gas Emissions, Clark County Air Basin, Opening Year Operations</b> |                                     |                       |           |                       |                        |                         |   |
|---|-------------------------------------|-----------------------|-----------|-----------------------|------------------------|-------------------------|---|
|   | <b>Criteria Pollutant Emissions</b> |                       |           |                       |                        |                         | <b>CO<sub>2</sub>e Emissions, tons per year<sup>a</sup></b> |
|   | <b>ROC</b>                          | <b>NO<sub>x</sub></b> | <b>CO</b> | <b>SO<sub>x</sub></b> | <b>PM<sub>10</sub></b> | <b>PM<sub>2.5</sub></b> |   |
| Railway Emissions   | <1                                  | 18                    | 3         | 2                     | 1                      | 1                       | 11,497  |
| Mobile-source Emissions   | (104)                               | (151)                 | (2,130)   | (2)                   | (7)                    | (4)                     | (108,808)   |
| Net Emissions   | (104)                               | (133)                 | (2,127)   | <1                    | (6)                    | (3)                     | (97,311)  |
| General Conformity Threshold  | 50                                  | 100                   | 100       | --                    | 70                     | --                      | --  |
| Exceed Threshold?   | No                                  | No                    | No        | N/A                   | No                     | N/A                     | N/A   |

Source: ICF/Jones & Stokes, 2010.

<sup>a</sup> Criteria pollutant emissions expressed in short tons (1 ton = 2,000 lbs); CO<sub>2</sub>e emissions expressed in metric tons (1 ton = 2,204.62 lbs)



**Table C-11. Regional pollutant emissions in Mojave Desert Basin in 2030. (FEIS, 3.11-13)**

|                              | Criteria Pollutant Emissions |                 |         |                 |                  |                   | CO <sub>2</sub> e Emissions,<br>tons per year <sup>a</sup> |
|------------------------------|------------------------------|-----------------|---------|-----------------|------------------|-------------------|--|
|                              | ROC                          | NO <sub>x</sub> | CO      | SO <sub>x</sub> | PM <sub>10</sub> | PM <sub>2.5</sub> |  |
| Railway Emissions            | 1                            | 118             | 21      | 12              | 4                | 4                 | 75,122   |
| Mobile-source Emissions      | (77)                         | (366)           | (1,516) | (8)             | (69)             | (63)              | (769,715)  |
| Net Emissions                | (76)                         | (248)           | (1,495) | 4               | (65)             | (59)              | (694,593)  |
| General Conformity Threshold | 50                           | 100             | --      | --              | 100              | --                | --   |
| Exceed Threshold?            | No                           | No              | N/A     | N/A             | No               | N/A               | N/A  |

Source: ICF/ Jones & Stokes, 2010.

<sup>a</sup> Criteria pollutant emissions expressed in short tons (1 ton = 2,000 lbs); CO<sub>2</sub>e emissions expressed in metric tons (1 ton = 2,204.62 lbs)

**Table C-12. Regional pollutant emissions in Clark County in 2030. (FEIS, 3.11-14)**

|                              | Criteria Pollutant Emissions |                 |         |                 |                  |                   | CO <sub>2</sub> e Emissions,<br>tons per year <sup>a</sup> |
|------------------------------|------------------------------|-----------------|---------|-----------------|------------------|-------------------|--|
|                              | ROC                          | NO <sub>x</sub> | CO      | SO <sub>x</sub> | PM <sub>10</sub> | PM <sub>2.5</sub> |  |
| Railway Emissions            | <1                           | 29              | 5       | 3               | 1                | 1                 | 18,197   |
| Mobile-source Emissions      | (85)                         | (74)            | (2,830) | (3)             | (10)             | (5)               | (173,422)  |
| Net Emissions                | (85)                         | (45)            | (2,825) | <1              | (9)              | (4)               | (155,225)  |
| General Conformity Threshold | 50                           | 100             | 100     | --              | 70               | --                | --   |
| Exceed Threshold?            | No                           | No              | No      | N/A             | No               | N/A               | N/A  |

Source: ICF/Jones & Stokes, 2010.

<sup>a</sup> Criteria pollutant emissions expressed in short tons (1 ton = 2,000 lbs); CO<sub>2</sub>e emissions expressed in metric tons (1 ton = 2,204.62 lbs)

These estimates depend on a variety of issues, including other infrastructure projects, such as highway expansion. Nevertheless, these estimates may be used to obtain rough monetized values for benefits due to air pollution reductions throughout the BCA timeline. Assuming that air pollution impacts are proportional to the amount of ridership on XpressWest diverted from auto or bus trips, the air pollution impacts may be calculated for the intervening years between the two snapshot years in the *FEIS*, using ridership estimates. (The 2024, or 2013 in the *FEIS*, value is used for estimates from 2023 through 2034, and the 2041, or 2030 in the *FEIS*, value is used for estimates from 2035 through 2046.) Table C-13 shows the calculated estimates for the snapshot years in 2020 dollars as example values.

**Table C-13.** Monetized benefits of air pollution reductions in two example snapshot years in 2020 dollars.

| <b>2024 (millions)</b> | <b>2041 (millions)</b> |
|------------------------|------------------------|
| \$16.2                 | \$59.9                 |

## **INDIRECT ECONOMIC IMPACTS: COSTS AND BENEFITS**

The *FEIS* focuses on the indirect benefits of the increased employment for the project during the construction and operation phases. Another benefit of this HSR project, however, would be the promotion of general economic growth in Las Vegas through land development and increased tourism during the operation phase of the project. These effects would fall under the category of indirect and agglomerative economic impacts. While the *FEIS* discusses overall economic growth predictions for the region, it does not discuss in quantitative detail the potential impacts of the project itself on the region's economic growth. While there is predicted economic growth regionally and an expectation that the project should induce transit-oriented development on a site-specific scale, the *FEIS* only discusses these benefits in qualitative terms.<sup>422</sup> Without greater detail, it is difficult for this BCA to confidently quantify the broad, indirect economic benefits due the project itself, and only broad estimates based in simple assumptions are included. This presents a deficiency in this BCA.

### **IMPACTS AT BARSTOW**

The *FEIS* does consider indirect economic impacts in Barstow, CA, a town between Victorville and Las Vegas whose economy depends on highway travelers stopping to shop and eat. In this case, Barstow may experience long-term economic losses. To mitigate these losses, XpressWest has committed to heavily advertising employment opportunities in Barstow during construction.<sup>423</sup> Table C-13<sup>424</sup> from the *FEIS* summarizes the economic losses in Barstow once the project begins operation. For the BCA, these annual losses are assumed to be constant over the interval of years between each data point, which are years 1, 3 and 18 of operation.

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<sup>422</sup> *FEIS*, 3.2-29.

<sup>423</sup> *FEIS*, 3.1-32.

<sup>424</sup> *FEIS*, 3.2-14.

**Table C-14.** Economic impacts to Barstow. (FEIS)

| <b>Table F-3.2-2 Summary of Economic Impacts to Barstow During DesertXpress Operation (Year 1, Year 3, and Year 18 Operation)</b> |                                       |   |   |  |
|---|---------------------------------------|---|---|--|
| <b>Impact</b>   | <b>Change Over Time from Baseline</b> |   |   |  |
|   | <b>2009 (Baseline)</b>                | <b>Year 1 Operation – Total Reduction (Percent)</b> | <b>Year 3 Operation – Total Reduction (Percent)</b> | <b>Year 18 Operation – Total Reduction (Percent)</b> |
| Economic Activity   | N/A                                   | -\$18.7 million                                     | -\$41.6 million                                     | -\$51.9 million                                      |
| Job Activity  | 10,463                                | -244 (-2.33%)                                       | -542 (-5%)  | -676 (-6.46%)  |

In addition, the *FEIS* details the direct and indirect economic impacts of the project during the construction phase, when the project would employ a larger number of people throughout the region. While the costs to employ workers are included in construction and operations costs, the indirect benefits of the increased economic activity from these workers are included as indirect economic benefits in the BCA.

### CONSTRUCTION JOBS

Table C-15 uses information gathered from the *FEIS* concerning the amount of jobs that would be created during the construction phase (and then eliminated once construction would be completed) and the direct and indirect economic benefits and costs of the employment opportunities.<sup>425</sup> It is assumed that these benefits are spread out equally over the 3-year construction period.

**Table C-15.** Costs and benefits from employment during construction in 2020 dollars. Direct employment salaries are included in construction costs and induced employment salaries are included in economic benefits. (Author, based on FEIS)

| <b>Location</b>        | <b>Direct Employment (jobs)</b> | <b>DE Total Salaries (millions)</b> | <b>Induced Employment (jobs)</b> | <b>IE Total Salaries (millions)</b> |
|------------------------|---------------------------------|-------------------------------------|----------------------------------|-------------------------------------|
| Barstow                | 2,470                           | \$72.0                              | 2,322                            | \$152.9                             |
| Clark County/Las Vegas | 17,469                          | \$1,573.5                           | 16,432                           | \$1,031.7                           |
| San Bernardino County  | 28,384                          | \$2,662.8                           | 26,699                           | \$1,815.6                           |
| Total                  | 48,323                          | \$4,308.3                           | 45,453                           | \$3,000.1                           |

<sup>425</sup> *FEIS*, 3.2-12-17.



## PERMANENT JOBS

The *FEIS* also provides estimates for number of employees the project would employ during the operation phase (Table C-16).<sup>426</sup>

**Table C-16.** Estimated employment during operation phase (2012 as opening year, 2030 as buildout year). (FEIS, 3.2-20)

| <b>Location</b>                                 | <b>Opening Year<br/>Number of Employees</b> | <b>Buildout Year<br/>Number of Employees</b> |
|---|---|--|
| Victorville Area Jobs                           | 361   | 463  |
| Baker Area Jobs                                 | 8   | 8  |
| Greater Las Vegas Jobs (MSF, Passenger Station) | 154   | 251  |
| <b>Grand Total</b>                              | <b>523</b>                                  | <b>722</b>                                   |

Source: DesertXpress, 2007; CirclePoint, 2008.

Assuming that these jobs earn similar salaries as the jobs in the region during the construction phase and there is a linear relationship between number of employees in the project and induced employment in the region, the expected salaries of these employees (economic cost) and the induced employment (economic benefit) during the operation phase are presented in Table C-17 and Table C-17 for opening and buildout respectively.

**Table C-17.** Estimated employment and salaries during operation phase from 2023 – 2039 in 2020 dollars.

| <b>Location</b>   | <b>Direct<br/>Employment</b> | <b>DE Total<br/>Salaries<br/>(millions)</b> | <b>Induced<br/>Employment</b> | <b>IE Total<br/>Salaries<br/>(millions)</b> |
|-------------------|------------------------------|---|-------------------------------|---|
| Victorville       | 361                          | \$10.1                                      | 339                           | \$22.3                                      |
| Baker             | 8                            | \$233.3                                     | 8                             | \$0.5                                       |
| Greater Las Vegas | 154                          | \$13.9                                      | 145                           | \$9.1                                       |
| Total             | 523                          | \$24.6                                      | 492                           | \$31.9                                      |

<sup>426</sup> *FEIS*, 3.2-20.

**Table C-18.** Estimated employment and salaries during operation phase from 2040 – 2046 in 2020 dollars.

| <b>Location</b>   | <b>Direct Employment</b> | <b>DE Total Salaries (millions)</b> | <b>Induced Employment</b> | <b>IE Total Salaries (millions)</b> |
|-------------------|--------------------------|-------------------------------------|---------------------------|-------------------------------------|
| Victorville       | 463                      | \$13.5                              | 435                       | \$28.6                              |
| Baker             | 8                        | \$0.2                               | 8                         | \$0.5                               |
| Greater Las Vegas | 251                      | \$22.6                              | 236                       | \$14.8                              |
| Total             | 722                      | \$36.3                              | 679                       | \$44.0                              |

### **INDIRECT LOCAL EFFECTS (OR AGGLOMERATION BENEFITS)**

The *FEIS* repeatedly describes the potential indirect regional and local benefits the XpressWest project could produce; however, it does not quantify these benefits, because they are a relatively minor portion of the total regional economy. Las Vegas has the largest economy of all the cities hosting stations on the XpressWest route. In a region experiencing exponential population growth, it is difficult to evaluate the relative increases in population and job growth due to a high-speed rail line. The two stations put forth in the preferred alternative—the Southern Station or the Central Station B—abut vacant land that could host transit-oriented development; however, these areas fall under master plans that already call for significant development and urbanization. Without values in the *FEIS* based on detailed and consistent estimates, such as forecasts of ridership, the regional economy and the total increase in visitors to Las Vegas with high-speed rail compared to the no action alternative, this BCA only can provide rough quantitative estimates.

To estimate a portion of the potential indirect economic effects, it is assumed that all of the XpressWest riders diverted from auto or bus would have traveled to Las Vegas regardless. This means that only remainder of the XpressWest riders are considered new visitors to Las Vegas due to high-speed rail. This creates a conservative estimate, since it is likely that the reduction of drivers on the highway would encourage additional travelers to take these modes of transportation and visit Las Vegas instead of doing something else.

In 2016, 42.9 million people visited Las Vegas.<sup>427</sup> According to the *FEIS* ridership forecasts, 626,654 passengers, should travel by XpressWest and not have been diverted from auto or bus in 2016 (equivalent to 2027 in the BCA).<sup>428</sup> These 626,654 passengers would comprise 1.46 percent of the total visitors to Las Vegas. Assuming that these travelers stay in Las Vegas an average amount of time and spend an average amount of money while there and that this proportion

<sup>427</sup> Las Vegas Convention and Visitors Authority, “2016 Las Vegas Year-to-Date Executive Summary,” 2016.

<sup>428</sup> DEIS Appendix C.

remains consistent, this percentage can be used to calculate these visitors' contributions to the economy and local development in Las Vegas throughout the BCA timeline.

In 2016, visitors spent \$35,491,751,240 in Clark County (including Las Vegas).<sup>429</sup> In addition, hotels and hotel-casinos had \$22,933,044,480 in taxable value in 2016.<sup>430</sup> Without tourists and other visitors, these properties would be worth little. Therefore, as an example, XpressWest passengers contributed \$853,429,649 to the Las Vegas and Clark County economy in 2016 (or 2027 in this BCA).

## **DISCOUNT RATE**

As used in a case study of the Northeast Corridor,<sup>431</sup> a 12% discount rate is appropriate for rail projects. A sensitivity analysis that alters the discount rate, among other factors, is included in the following section.

## **BENEFIT-COST ANALYSIS RESULTS**

Given the included costs and benefits discussed above and a discount rate of 12% and not including the rough estimates for indirect local economic benefits in Las Vegas, the net present value (NPV) of the XpressWest project is -\$3.6 billion in 2020 dollars. Including the indirect economic benefits in Las Vegas, the NPV is \$4.5 billion in 2020 dollars, a significant increase. Figure C-3 shows the benefits and costs of the project as a “cash flow”.

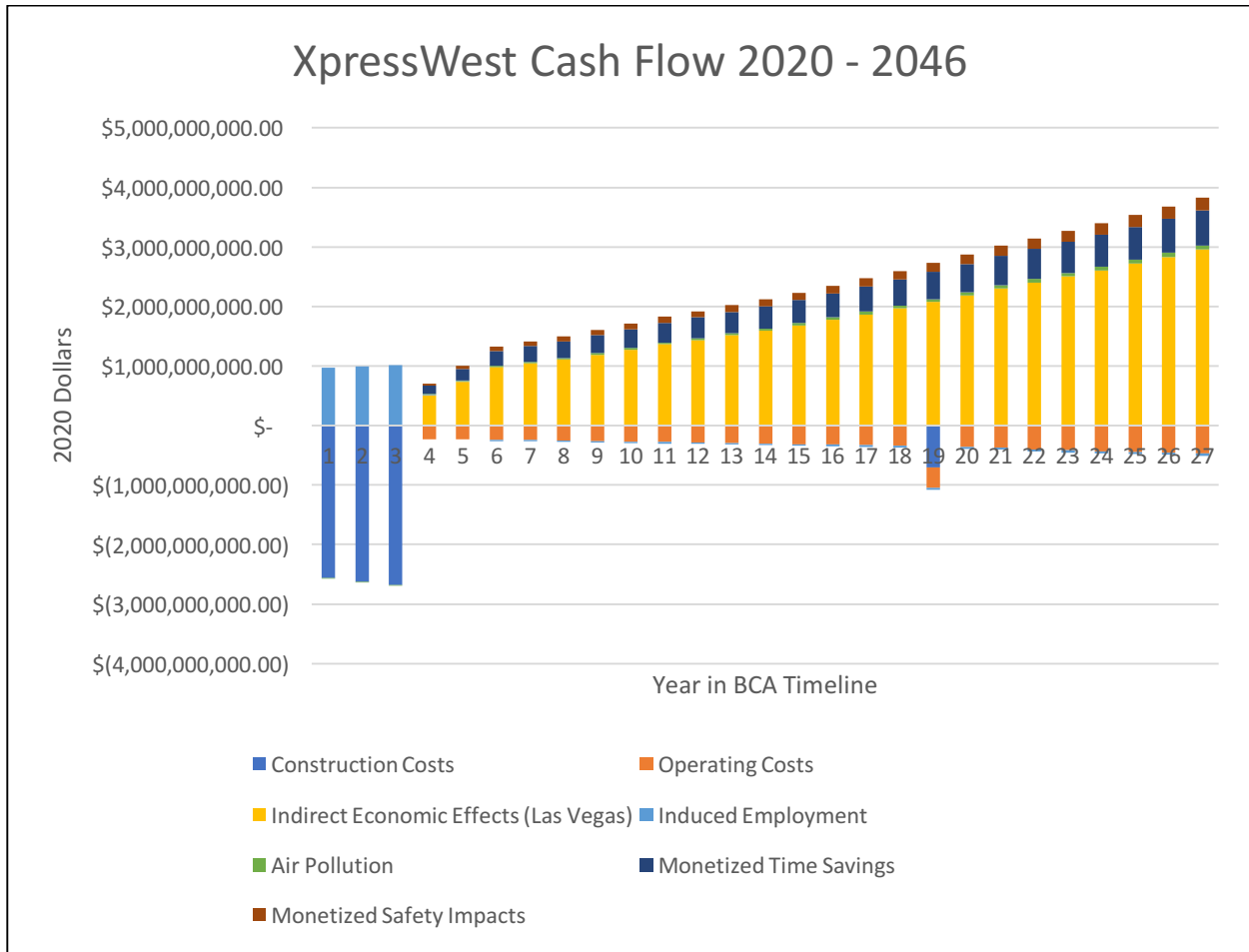
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<sup>429</sup> Las Vegas Convention and Visitors Authority, “The Fiscal Impact of Southern Nevada Tourism,” 2017.

<sup>430</sup> Ibid.

<sup>431</sup> Joseph Sussman et al., 2017.

Figure C-3. XpressWest Benefits and Costs.



### SENSITIVITY ANALYSIS

A sensitivity analysis is conducted to evaluate the impact of potential changes in specific input factors on the BCA results. Table C-19 shows the results for varying discount rate and ridership forecasts. With changes within the range of positive and negative 50 percent, the resulting NPV varies up to 210 percent. The lowest value is -\$0.8 billion, which compared to the maximum of \$14 billion, is not extremely low. The NPV varies linearly with ridership, but not with discount rate.

Table C-19. BCA sensitivity analysis results for varying discount rate and ridership.

|                      | -50% change  |          | -15% change  |          | 15% change   |          | +50% change  |          |
|----------------------|--------------|----------|--------------|----------|--------------|----------|--------------|----------|
|                      | Value (bil.) | % Change | Value (bil.) | % Change | Value (bil.) | % Change | Value (bil.) | % Change |
| <b>Discount Rate</b> | \$14.0       | 210      | \$6.5        | 43       | \$3.1        | -33      | \$0.9        | -83      |
| <b>Ridership</b>     | -\$0.8       | -117     | \$2.9        | -35      | \$6.1        | 35       | \$9.8        | 117      |

## DISCUSSION

Without including indirect economic benefits, this BCA results in a negative NPV. This means that social costs are greater than the benefits of the project if these indirect impacts are not considered. When the indirect economic effects quantified above are included in the BCA, they lead to a positive NPV in the billions of dollars.

## FINANCIAL ANALYSIS

Since the XpressWest project is a private endeavor, it is also appropriate to conduct a Financial Analysis from the perspective of XpressWest. A Financial Analysis considers the costs and revenues for a certain stakeholder in the project. It does not include the externalities that do not impact that specific stakeholder. Similarly, money transfers, that may be considered internal and therefore not relevant in a BCA that considers the costs and benefits of a project to society as a whole, may be relevant in a Financial Analysis, in which a transfer between the stakeholder being analyzed and another stakeholder would be a cost or a revenue.

### COSTS

In this analysis, XpressWest takes on the construction and operation costs discussed above, since XpressWest would be constructing and operating the project.

### REVENUE

In this Financial Analysis, XpressWest would earn revenue through fares collected from passengers.<sup>432</sup> The ridership estimates used were based on a \$55 one-way fare.<sup>433</sup> The total revenue would be this fare multiplied by the total estimated rail trips.

## FINANCIAL ANALYSIS RESULTS

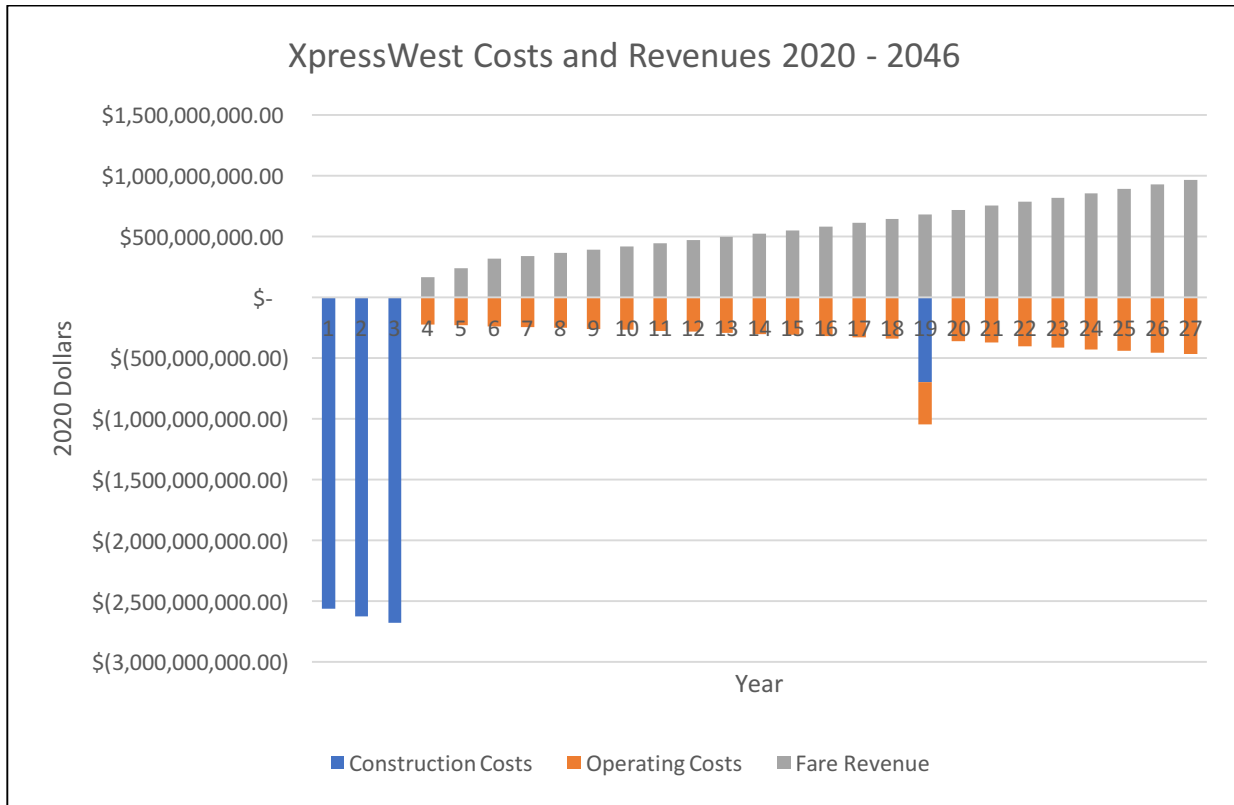
Given the included costs and revenues discussed above and a discount rate of 12%, the net present value (NPV) of the XpressWest project for XpressWest itself is -\$6.2 billion in 2020 dollars. Figure C-4 shows the revenues and costs of the project as a “cash flow”.

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<sup>432</sup> In the BCA, these rail fares were considered an internal transfer, since they did not impact the overall economic value of the entire system.

<sup>433</sup> *DEIS Appendix F-D*, 33.

Figure C-4. XpressWest revenues and costs.



### SENSITIVITY ANALYSIS

A sensitivity analysis is conducted to evaluate the impact of potential changes in specific input factors on the Financial Analysis results. Table C-20 shows the results for varying discount rate, ridership forecasts and fare. With changes within the range of positive and negative 50 percent, the resulting NPV varies up to 21 percent. Variation is much less than in the sensitivity analysis for the BCA. The long-term revenues from fares do not reach the order of magnitude as the long-term revenues in the BCA, so changes in discount rate do not cause as high of an impact on the results. In addition, the NPV varies linearly in the same proportion for both ridership and fare, which are multiplied together to calculate revenues.

Table C-20. Financial analysis sensitivity analysis results for varying discount rate, ridership and fares.

|                      | -50% change  |          | -15% change  |          | 15% change   |          | +50% change  |          |
|----------------------|--------------|----------|--------------|----------|--------------|----------|--------------|----------|
|                      | Value (bil.) | % Change | Value (bil.) | % Change | Value (bil.) | % Change | Value (bil.) | % Change |
| <b>Discount Rate</b> | -\$5.5       | 12       | -\$6.1       | 2        | -\$6.2       | -1       | -\$6.3       | -1       |
| <b>Ridership</b>     | -\$7.5       | -21      | -\$6.6       | -6       | -\$5.8       | 6        | -\$4.9       | 21       |
| <b>Fare</b>          | -\$7.5       | -21      | -\$6.6       | -6       | -\$5.8       | 6        | -\$4.9       | 21       |

## **FINANCIAL ANALYSIS DISCUSSION**

The NPV in the financial analysis is negative and much lower than the NPV for the BCA. Since this is a privately-funded and operated project with a focus on the benefits of economic agglomeration in the form of increased economic activity in Las Vegas (tourism and land development), these other private, profitable ventures could subsidize the losses of this HSR project. As with the BCA, these indirect economic benefits were a major factor in obtaining a positive NPV. In this case, the profits from these other ventures should exceed the losses from the HSR project, assuming that funds could (and would) be transferred among stakeholders in the private sector.

## **INSIGHTS FROM BCA AND FINANCIAL ANALYSIS**

These analyses show that the XpressWest project would create a positive social value but still would not be profitable for XpressWest itself. The agglomeration benefits of real estate development and economic growth in Las Vegas were major factors in obtaining a positive NPV for the BCA. These benefits were not included in the Financial Analysis, since this analysis considers only the costs and revenues that XpressWest pays or earns. Tested under sensitivity analyses, which varied the discount rate, ridership forecast and fare, the BCA remained positive and Financial Analysis remained negative for all values tested, except for the most negative BCA value, which was still greater than -\$100 million.

It is important to consider how the costs and benefits of the project are distributed. We may assume that this private project only would be developed if XpressWest were to believe it could make a profit. Since the financial analysis results in a negative profitability for XpressWest, the organization would require further funds to make a profit. Even in the sensitivity analysis, XpressWest's NPV remains significantly negative. Two potential sources for funding would be public funds and private funds from businesses that could benefit from real estate development. XpressWest has a history of seeking public funding, especially from the federal government. If indirect economic benefits are not as significant as estimated in this BCA, using public funding may mean that the public is subsidizing a socially detrimental project. If using private funding takes advantage of these private-sector benefits, it may mean that this project has significant private benefits with minimal public benefits (or net public costs). Both cases would raise concern for any party aiming for public benefit, and points to caution in moving forward with the project.

Further discussion and analysis of these results is presented in Chapter 4.2.7.