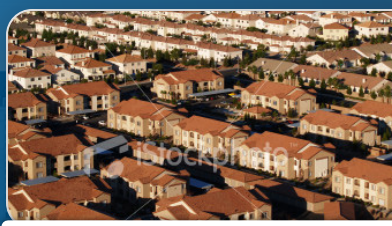
I-11 and Intermountain West Corridor Study

Business Case



Prepared for

NEVADA DOT and ADOT

September 2014

I-11 AND INTERMOUNTAIN WEST CORRIDOR STUDY

Business Case

Prepared for

Nevada Department of Transportation

and

Arizona Department of Transportation

September 2014

Prepared by

CH2MHILL® AECOM and HDR

In association with:
ESI Corporation, and RCG Economics LLC

DISCLAIMER

The contents of this planning document are based on information available to the Arizona Department of Transportation and the Nevada Department of Transportation (herein referred to as the Sponsoring Agencies) as of the date of this document. Accordingly, the document may be subject to change.

The Sponsoring Agencies' acceptance of this document as evidence of fulfillment of the objectives of this study does not constitute endorsement/approval of any recommended improvements; neither does it constitute approval of their location and design or a commitment to fund any such improvements. Additional project-level environmental impact assessments and/or studies of alternatives will be necessary.

The Sponsoring Agencies do not warrant the use of this document, or any information contained in this document, for use or consideration by any third party. Neither do the Sponsoring Agencies accept any liability arising out of reliance by a third party on this document, or any information contained in this document. Any use or reliance by third parties is at their own risk.

Contents

Appendices

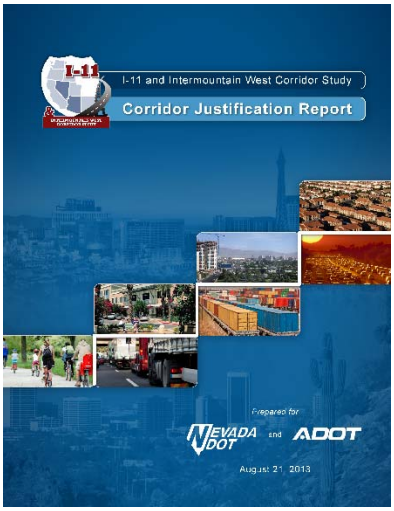
1. Introduction

The Arizona Department of Transportation and Nevada Department of Transportation, in consultation with the Federal Highway Administration (FHWA) and the Federal Railroad Administration, and in partnership with the Maricopa Association of Governments and the Regional Transportation Commission of Southern Nevada are conducting the Interstate 11 (I-11) and Intermountain West Corridor Study.

The 2-year study includes detailed corridor planning of a possible high-capacity transportation link connecting Phoenix and Las Vegas and high-level visioning for extending the Corridor north of Las Vegas to Canada and south of Phoenix to Mexico. The Corridor is proposed to include an upgraded highway facility, but it could be paired with rail and other major infrastructure components—such as energy and telecommunications.

Purpose of the Business Case

The I-11 and Intermountain West Corridor Study is an initial, planning-level enquiry intended to articulate the principal characteristics, together with the challenges and opportunities, benefits, and costs, of this major undertaking. Among the various deliverables of the I-11 and Intermountain West Corridor Study, this Business Case presents a comprehensive set of economic benefits that this investment could provide to the states of Arizona and Nevada. The materials presented in this Business Case draw from the August 2013 *I-11 and Intermountain West Corridor Study Corridor Justification Report* (NDOT and ADOT 2013) and seek to extend, refine, and supplement the insights offered by that report.



The *I-11 and Intermountain West Corridor Study Corridor Justification Report* determined that the I-11 and Intermountain West Corridor (the Corridor) represented a unique opportunity to strengthen economic growth, help build the region's future economy while serving the current travel demand growth. This Business Case describes the scale of this opportunity and presents the results of a variety of analyses intended to illustrate the merits and viability of this proposed initiative. It also presents the results of the project analysis and justification work to date and provides a compelling case for prioritized, strategic investment in this Corridor. This investment would address ongoing growth in the regional economy, while providing the Intermountain West with needed north-south transportation capacity to expand its manufacturing capabilities, including "shared production" manufacturing with Mexico and Canada.

This Business Case presents the potential return on investment for the I-11 and Intermountain West Corridor from the Mexican border at Nogales, Arizona, through Northern Nevada. While this study focuses on the Sponsoring Agencies' states of Arizona and Nevada, the principles described in the Business Case apply to the entire Corridor from Mexico to Canada.

The transformational nature of this opportunity is not readily identified through standard transportation project evaluation tools; therefore, a variety of analyses and information has been included to convey the scale of the opportunity that this Corridor presents. Specifically, this Business Case includes:

- A set of economic development opportunities that can be facilitated by I-11 (Chapter 2)
- A conventional benefit-cost analysis (BCA) (Chapter 3)
- A macroeconomic analysis to show the future induced economic effects associated with the completion of the Corridor (Chapter 4)
- Sampling of projects in other United States (U.S.) jurisdictions documenting the return on highway investments (Chapter 5)

2. Significant Return on Investment

The *I-11 and Intermountain West Corridor Study Corridor Justification Report* (NDOT and ADOT 2013) articulated the vision of the I-11 and Intermountain West Corridor as an important, transformational investment that would respond to ongoing growth in travel demand, while at the same time positioning the regional economy to take singular advantage of important emerging trends in global trade. The Intermountain West will, under a wide range of alternative future scenarios, experience significant sustained growth in the regional economy, accompanied by corresponding growth in travel demand. By strategically enhancing regional transportation infrastructure, the region may also have the opportunity to enjoy incremental and significantly enhanced economic growth related to important trends in regional and national trade.

This section documents that investing in the I-11 and Intermountain West Corridor has the potential to generate a significant return on investment because it will:

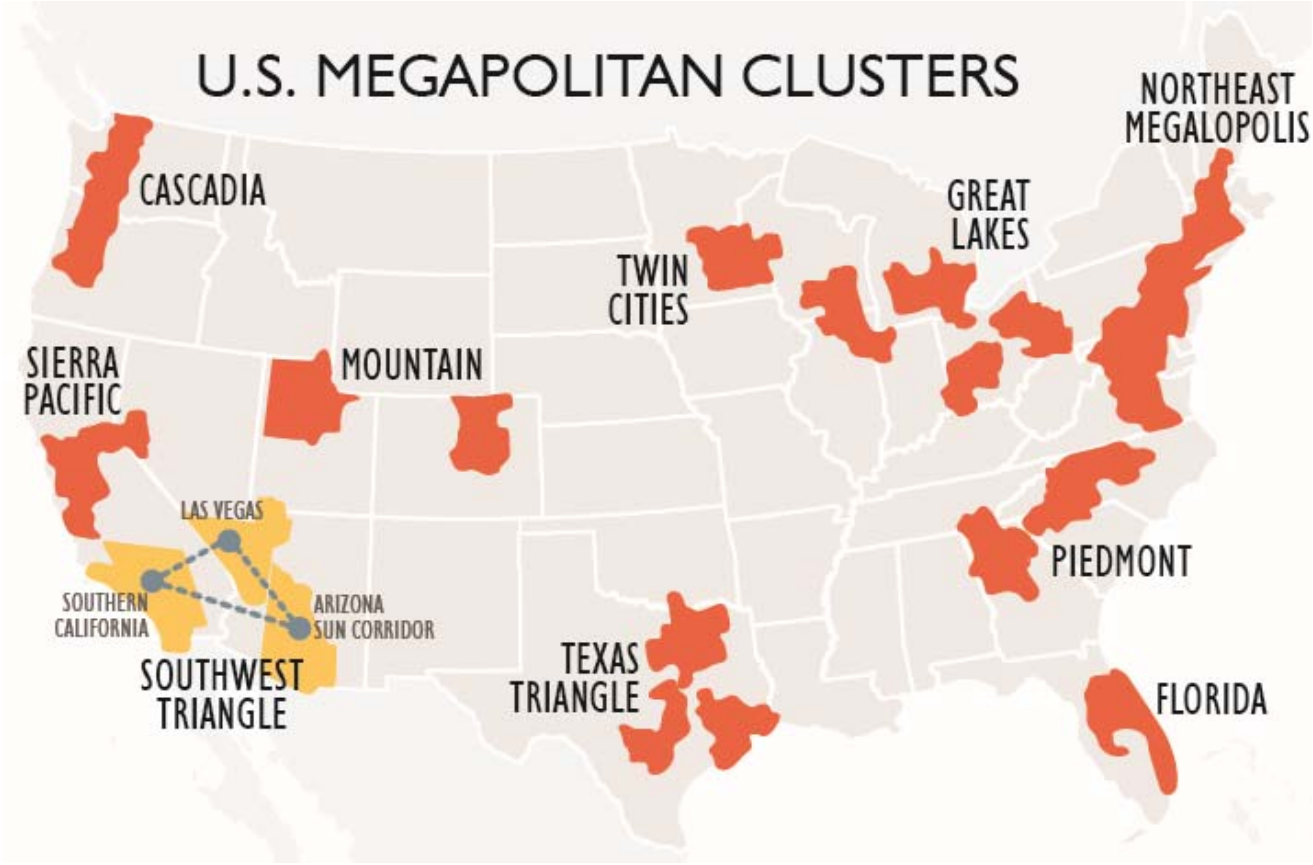
- Connect regional economies to each other and to global markets
- Create opportunities for integrated manufacturing
- Advance the economic development plans of Arizona and Nevada
- Improve efficiencies at Arizona's international borders

Connect Regional Economies to Each Other and to Global Markets

This vision is strongly supported by current regional economic growth models that stress the enabling power of strong transportation links in supporting competitive advantage through economic integration at the inter-city level. The Brookings Institution, Regional Plan Association, and others have developed and furthered the concept of "megapolitans" as the key U.S. areas of integration with world trade. A megapolitan, as shown on **Figure 2-1**, can be defined as a conglomeration of two or more intertwined metropolitan areas with a combined population of 5 million or more, and is characterized by interlocking economic systems, shared natural resources and ecosystems, and common transportation and other infrastructure systems.

Throughout the U.S., megapolitans are expanding and merging their economies together to form megapolitan clusters. These megapolitan clusters contain most of the nation's major ports and international airports, and provide a powerful presence in world trade. This trend is in line with global competitors in Asia and Europe who are creating Global Integration Zones by linking specialized economic functions across vast geographic areas and national boundaries with high-speed rail and dedicated goods movement systems. The increased mobility of workers, business travelers, and goods between the cities of these megapolitans enables greater collaboration, flexibility, and innovation. Efficient mobility is a major competitive advantage on the global playing field, where time savings creates value.

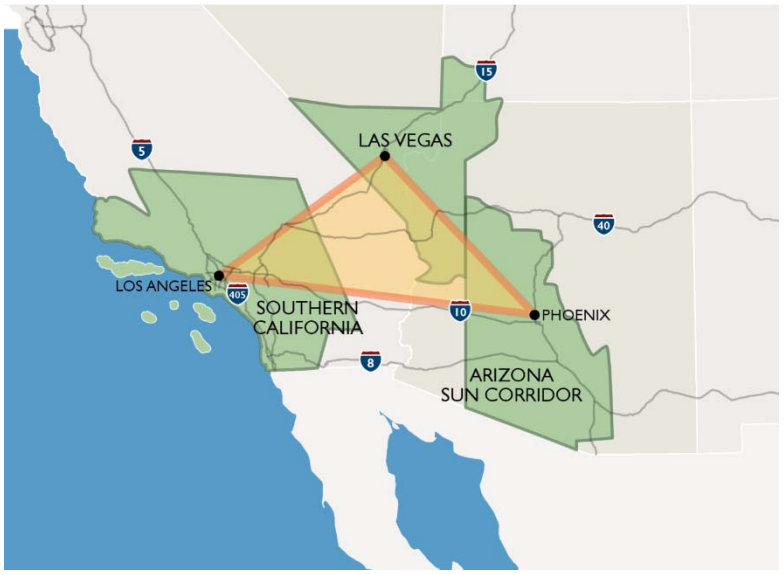
Figure 2-1. Megapolitans in the U.S.



Source: Nelson and Lang 2011

The megapolitan areas in the greater southwestern U.S.—Southern California, Las Vegas, and the Sun Corridor— have expanded and are interlinked, forming the "Southwest Triangle" that maintains a population approaching 30 million (**Figure 2-2**).

Figure 2-2. The Southwest Triangle



The Southwest Triangle is linked by transportation, economy, and environment. Major international airports anchor each subregion. Ground-based transportation in the region includes several major Interstates and limited passenger rail capacity. A proposed high-speed rail link that would connect Southern California to Las Vegas has been under discussion and in various stages of preliminary development for some time. The major regions in this Southwest Triangle share many economic interdependencies in sectors such as logistics, healthcare, entertainment, tourism, and technology. Leaders in Las Vegas and the Sun Corridor—areas surrounded by desert—are actively engaged in wind and solar research and development, equipment manufacturing, and green energy production.

For the last half century, Southern California has built America's most significant connections to Asia,

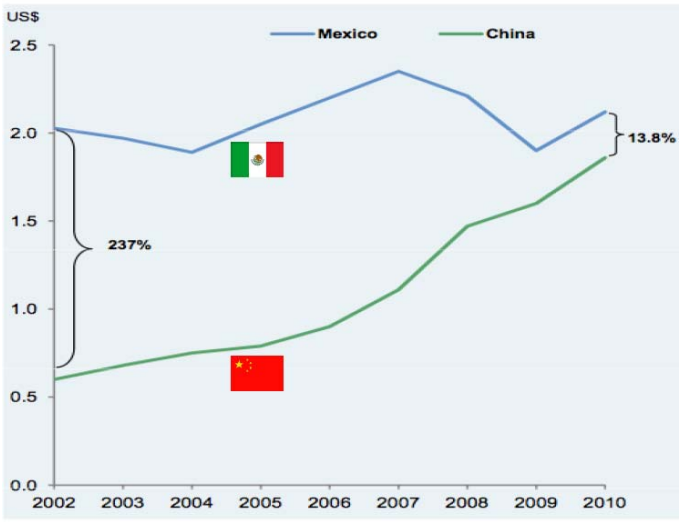
displacing San Francisco as the leading region for this trade. Southern California is now hyperlinked to Asia. Las Vegas and the Sun Corridor are actively engaged in establishing new trade with Latin America.

The Southwest Triangle is on a trajectory to be a leading American region that maintains linkages to the world's fastest emerging economies in both Asia and Latin America; therefore, improving the infrastructure in the Southwest Triangle is an important national priority as the Southwest seeks more trade and exports as a way to diversify its economy from consumption and real estate toward technology, innovation, and high-value manufacturing. The megapolitan cluster capacity for trade is a key element in this economic transition. Failure to establish adequate infrastructure to move people and goods around the country and the region would significantly constrain future economic growth.

Create Opportunities for Integrated Manufacturing

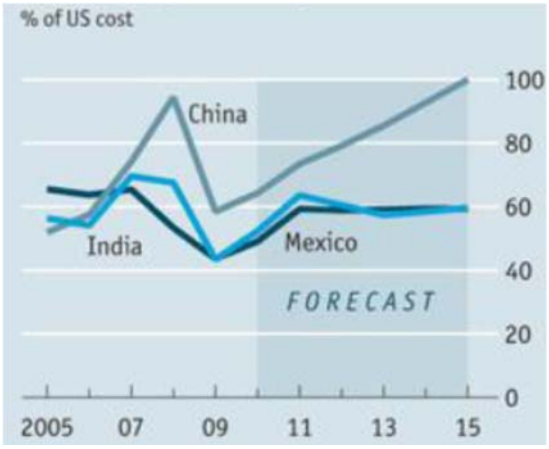
The I-11 and Intermountain West Corridor is strongly positioned to take advantage of important current developments in international trade. Nearshoring refers to the current trend of moving manufactured goods production, much of which was previously in Asia, to Mexico. Since the enactment of the North American Free Trade Agreement (NAFTA), bilateral trade has grown exponentially and reached a record high of nearly $400 billion in 2010. Mexico's gross domestic product (GDP) growth of 5.4 percent in 2010 resulted in a $35 billion increase in Mexican purchases from the U.S. (New Policy Institute 2012). This trend reflects the advantages of Mexico's proximity to the U.S. market and its growing strength as the 14th largest economy in the world. In addition, China's labor cost advantage in relation to Mexico's is estimated to have shrunk to 14 percent (see **Figure 2-3**), making Mexico more competitive for manufacturing outsourcing, as shown on **Figure 2-4** (Thunderbird [no date]).

Figure 2-3. Wages in the Manufacturing Sector



Source: Thunderbird School of Global Management [no date]

Figure 2-4. Manufacturing Outsourcing Cost Index

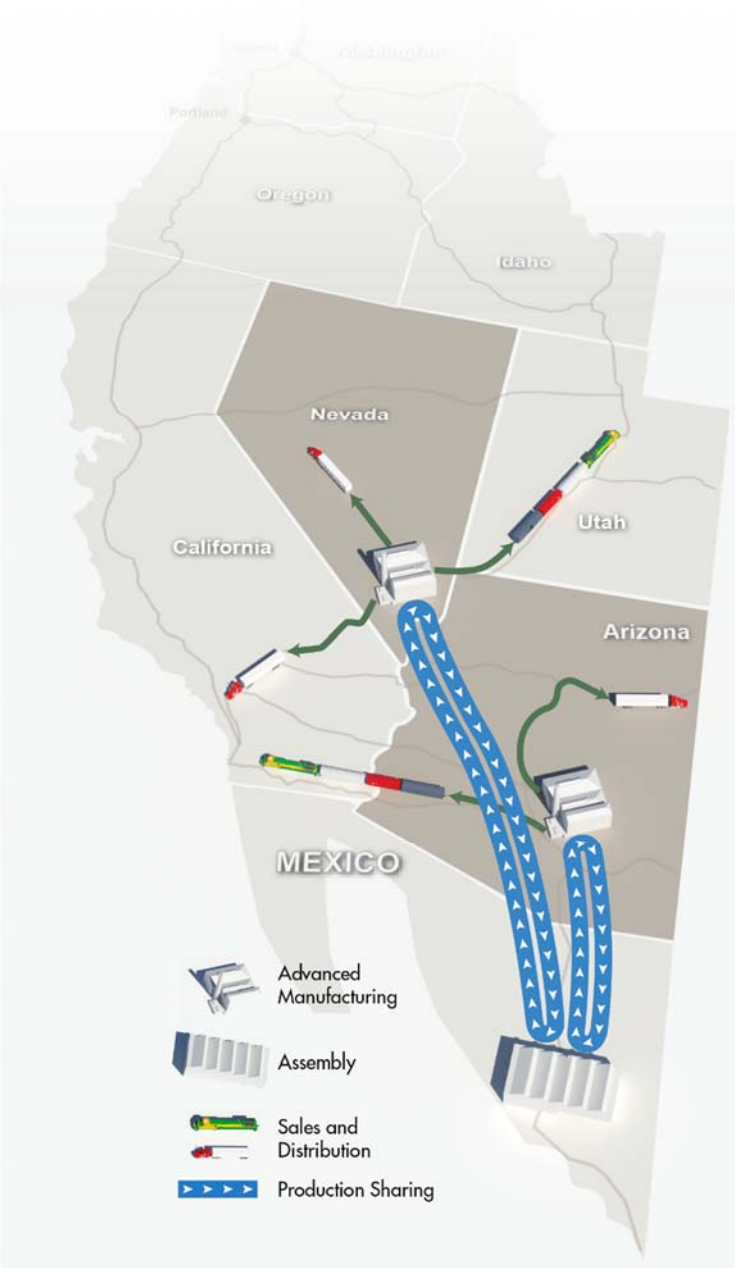


Source: Thunderbird School of Global Management [no date]

Nearshoring offers the opportunity to create new economic activity in the Intermountain West through the phenomenon of production sharing, shown on **Figure 2-5**, whereby an integrated manufacturing complex that spans the U.S./Mexico border emerges in response to cross-border goods movement in support of U.S. manufacturing. With production sharing, the U.S. and Mexico have built a partnership working together to produce goods, not just trade them. Several U.S. industries, including auto, appliances, machinery, aerospace, electronics, and medical devices, work with Mexico to manufacture goods,

which often involves moving components across the border multiple times during production. Unlike trade with Asia, this trade-related economic activity has resulted in significant manufacturing employment growth in both countries. Six million U.S. jobs are dependent on U.S.-Mexico trade. More than 160,000 jobs in Arizona and Nevada are dependent on trade with Mexico compared to 692,000 and 463,000 trade-related jobs in California and Texas (Wilson 2011). Realization of these integrated manufacturing benefits in the Intermountain West relies upon strong mobility of freight back and forth through the border and along the I-11 and Intermountain West Corridor.

Figure 2-5. Integrated U.S.-Mexico Manufacturing Supply Chain



To date, the transportation needs of the emerging U.S.-Mexico integrated supply chains have been supported elsewhere, particularly at the Texas border crossings with Mexico (reflected in the production sharing jobs statistics referenced above). In the Intermountain West, investment in regional transportation infrastructure (including border crossings and land ports of entry) has not kept pace with population growth and changing economic trends and thus does not have sufficient reserve capacity to support a regional industrial complex needed for integrated manufacturing.

Manufacturing growth in Arizona and Nevada exceeded the U.S. average, indicating a strengthening economic sector positioned to capitalize on the benefits of integrated manufacturing with Mexico. Manufacturing is a target industry cluster for the state economic development departments of Arizona and Nevada, needed to diversify and further develop their economies. An interconnected and efficient transportation system will facilitate both the transport of goods and the attraction and retention of business.

Advance the Economic Development Plans of Arizona and Nevada

Over the past few years, Arizona and Nevada have renewed their focus on economic development, and both states recognize the importance of creating high-wage jobs, leveraging existing statewide assets, and improving the foundations that support economic development, such as the construction of efficient transportation infrastructure.

To compete nationally and globally, each state has developed an economic development plan focused on building its economy and targeting specific industry clusters, as shown in **Table 2-1**.

Table 2-1. Arizona and Nevada Industry Targets and Clusters

Industry Targets	Arizona	Nevada	Requires Regional Transportation Network
Advanced Manufacturing	•	•	•
Aerospace, Aviation, Defense	•	•	•
Agriculture	•	•	•
Biotechnology	•		•
Healthcare	•	•	
Information and Computer Technology	•	•	
Life Sciences	•		•
Mining and Materials	•	•	•
Optics	•		•
Renewable Energy	•	•	•
Science and Technology	•		•
Tourism, Gaming, and Entertainment	•	•	•
Transportation and Logistics	•	•	•

Sources: Arizona Commerce Authority 2013, Greater Phoenix Economic Council 2013, Tucson Regional Economic Opportunities 2006, Nevada Governor's Office of Economic Development 2013

Table 2-1 shows the specific industry targets that depend on a reliable transportation network. All of these industries rely on efficient highway infrastructure, and some of these can be served by rail or air—depending on distance and urgency.

The Nevada Governor's Office of Economic Development has identified five key components needed to attract major industries to the state and thereby diversify and strengthen its economy. Two of these components (shown in bold type below) are directly dependent on favorable transportation infrastructure. Other components listed indirectly rely on transportation infrastructure.

- Availability of qualified workforce
- Competitive cost environment (such as **transportation**, labor, utilities, real estate, and taxes)
- **Favorable logistics/accessibility**
- Favorable business environment
- Quality of place

Improve Efficiencies at Arizona's International Borders

Nogales, Arizona Port of Entry

As integrated manufacturing between Mexico and the U.S. Intermountain West continues to increase, so will goods traversing the Arizona-Mexico land ports of entry (LPOEs). About 75 percent of U.S.-Mexico bilateral trade by value crossed through LPOEs in 2011, and less than 10 percent of it flowed through Arizona. Approximately 90 percent of goods that flowed through Arizona crossed at Nogales. The volume of freight transported through LPOEs in Texas and California currently dwarfs freight that is transported through Arizona LPOEs. More than $144 billion of goods flowed through Laredo, Texas, in 2011, which is more than six times the value that flowed through Nogales (**Figure 2-6**). However, depending on the destination, goods that enter through LPOEs in Texas, New Mexico, and California may be more efficiently transported via I-11.

Figure 2-6. Top Five Southern United States Land Ports of Entry, 2011

Source: Bureau of Transportation Statistics 2012

Continued investments in LPOEs are key to mitigating congestion and encouraging the use of an I-11 and Intermountain West Corridor by making crossing times shorter and more predictable. In the context of the enabling effect of LPOEs with ample capacity, limited congestion, and quality transportation links, it can be argued that the number of LPOEs and the quality of associated infrastructure in Texas have had a decisive impact on the volume of freight using Texas highways and railways to access the American Heartland. This volume of freight has undoubtedly been predominantly determined by the large populations in the Eastern Seaboard and Midwest, but would have been less pronounced and/or shifted to other locations without the enabling influence of the LPOE investments seen in Texas in recent years. Improvements to LPOEs are being recommended in a series of border master plans, such as the *Arizona-Sonora Border Master Plan*.

The I-11 and Intermountain West Corridor exhibits strong background growth in travel demand and will

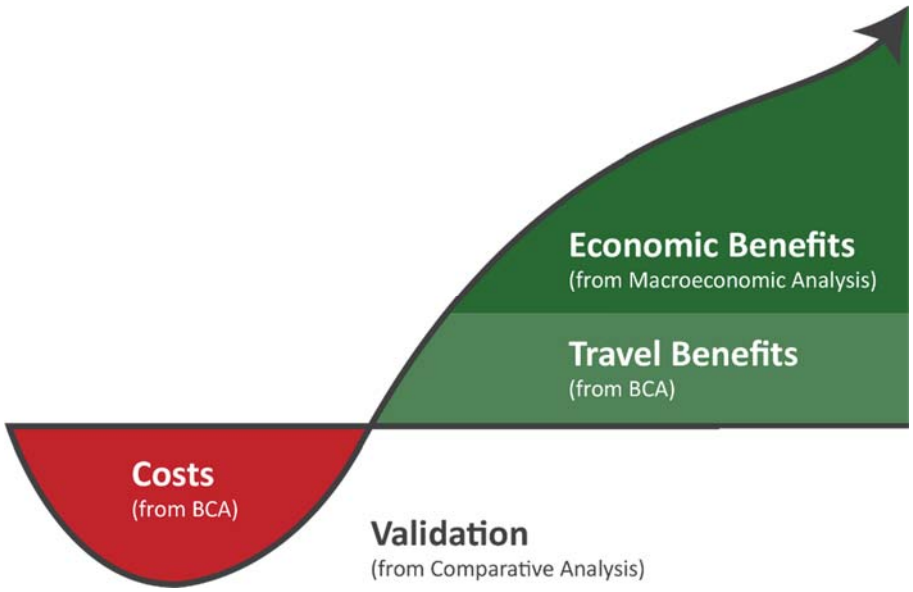
require continued investment in transportation infrastructure to continue to compete economically. Developing a north-south Interstate highway or multimodal facility through Arizona and Nevada can provide the foundation for a renewed, stronger, and diversified economy in the Intermountain West. The I-11 and Intermountain West Corridor could provide essential freight linkages between existing U.S. West Coast ports, new and expanding ports in Mexico and Canada, and future inland ports and commerce centers crucial to distributing goods across North America. With the growing importance of NAFTA-based north-south trade flows, integrated manufacturing with Mexico, and enhanced border crossings into Arizona, tremendous opportunity exists for the Corridor to capture new north-south trade and related economic activity in transportation, manufacturing, and related support services.

Project Analysis Methodology

This section documents that investing in the I-11 and Intermountain West Corridor will connect regional economies to each other and to global markets, create opportunities for integrated manufacturing, advance the economic development plans of Arizona and Nevada, and increase the efficient flow of goods across international borders through Arizona. The return on this investment is assumed to be significant but is difficult to precisely quantify. Therefore, a multifaceted approach was used, shown on **Figure 2-7** and listed below, combining quantitative approaches with qualitative work to compare and validate the estimated costs against the potential travel and economic benefits of an I-11 and Intermountain West Corridor.

- Travel benefits and cost estimates: benefit-cost analysis
- Economic benefits: macroeconomic scenario-based analysis
- Validation: Comparative analysis from other regions of the U.S.

Figure 2-7. Return on Investment Analysis



Travel Benefits and Cost Estimates: Benefit-Cost Analysis (BCA)

Conventional project justification analysis for transportation projects in North America has traditionally been based on a BCA that compares the value of the benefits to travelers and the system resulting from the project investment with the magnitude of the costs incurred in constructing and operating the project. A net present value (benefit minus cost) greater than zero, and a benefit-cost ratio (benefit divided by cost)

greater than one, are general measures of a project's feasibility. This robust approach is well-proven and is helpful as a quantitative tool in comparing competing alternative projects. For the I-11 and Intermountain West Corridor, the BCA reflects costs and benefits for a highway-only corridor from Mexico to Las Vegas. However, the direct user benefits (such as travel time reductions and safety improvements) measured in a conventional BCA do not capture the full value of the economic benefits of a particular investment. The types of benefits that are not explicitly captured by conventional BCA are those related to the effects of strategic transportation investment on the regional economy.

These BCA limitations are not of concern when used for comparing competing alternatives for relatively small and isolated projects where economic effects are not anticipated to be a major factor. The conservative bias of this tool in assessing the absolute magnitude of project benefits is generally acknowledged and is of significant concern only for larger projects such as the I-11 and Intermountain West Corridor. Because the I-11 and Intermountain West Corridor is an investment opportunity with the potential to significantly affect the nature of the region's economy, it is appropriate to employ additional techniques to complement BCA to understand the full potential of the investment.

Economic Benefits: Macroeconomic Scenario-Based Analysis

Macroeconomic assessment tools provide a helpful alternate view of the wider economic benefits that are usually associated with major infrastructure investments. For instance, these tools are used to estimate the induced economic activity derived from other activities, such as releasing of pent-up demand, enhancing land values by improving access, and transforming the regional economy by improving competitiveness and attracting new classes of industry that would not have occurred without the Corridor.

Macroeconomic tools are available to assess system-wide effects of changes in the supply and structural features of key inputs in the economy, including transportation. These tools have widespread application in economic analysis and can be used (with care) to address the limitations of BCA. However, the results of these analyses must be combined with the results of BCA carefully, because the potential exists to over-estimate the magnitude of induced economic effect and improved competitiveness. For example, an increase in land value due to improving access through the construction of a transportation project can be argued to be a manifestation of the reduced travel costs experienced by those accessing the site (which would be captured by a BCA) and so should not be counted again in assessing the project's merits. It can also be argued that economic activity that occurs due to improved competitiveness associated with transportation investment in one region occurs at the expense of another region, essentially moving economic activity around the nation, rather than creating new economic activity.

Validation: Comparative Analysis from Other Regions of the U.S.

Qualitative analyses are helpful to describe the broad range of economic possibilities and to illustrate the potential benefits postulated by conventional BCA and macroeconomic methods. This analysis presents highlights from a body of information assembled to illustrate the relationship between transportation corridor investment and economic outcomes from other U.S. jurisdictions.

Balanced Assessment

This three-pronged approach provides a balanced assessment of the merits of the I-11 and Intermountain West Corridor investments, each with its own limitations:

- A modified BCA that can safely be considered a lower bound estimate of the merits of the project (Chapter 3)
- A macroeconomic scenario-based analysis, to illustrate the potential magnitude of the economic benefits of the I-11 and Intermountain West Corridor (Chapter 4)
- A body of descriptive material intended to help validate the quantitative analyses and characterize some of the new types of economic activity anticipated to occur as a result of the development of the I-11 and Intermountain West Corridor (Chapter 5)

This information is presented to provide the merits of the Corridor investment and consider questions such as:

- What is the benefit-cost ratio (BCR) net present value (NPV) for the proposed corridor investments, recognizing the inherent conservative bias of the benefits estimation methods it uses?
- How much additional benefit, of the type captured by the macroeconomic analysis, might reasonably be attributed to the project over and above the results of the BCA (recognizing that the additive benefits estimated by both methods are not strictly appropriate)?
- What magnitude and types of benefits have been realized in other jurisdictions that have embarked on similar transformational projects to enhance competitiveness through transportation investment?
- How does all of this information tie together a story of the opportunity for this Corridor to become a worthy investment?

3. Travel Benefits and Cost Estimates: Benefit-Cost Analysis

Benefit-Cost Analysis is a conceptual framework that calculates and compares the benefits and costs of a project. BCA, the industry standard for major transportation infrastructure projects, serves two purposes:

- To provide a measure of project feasibility
- To provide a basis for comparing two or more projects, or alternatives, within a single project

Benefit-Cost Analysis Framework

Within the BCA framework, benefits are broadly defined. Benefits represent the extent to which people affected by the project are made better off, as measured by their own willingness to pay. In other words, central to BCA is the idea that people are best able to judge what is good for them and to identify what improves their well-being or welfare.

Costs generally include capital costs, right-of-way costs, and operating and maintenance costs (O&M) during the analysis period.

BCA is typically a forward-looking exercise, seeking to anticipate the welfare impacts of a project or proposal over its entire life cycle. Future welfare changes are weighted against today's changes through discounting, which is meant to reflect society's general preference for the present, as well as broader inter-generational concerns. Discounting takes into account that benefits accrued in later years are worth less than benefits received nearer to the present day. In this analysis, all costs and benefits are discounted to their present day values at the assumed discount rate to provide a level comparison between alternatives. BCA typically results in two standard metrics where the streams of future benefits and costs are discounted to today's (2013) dollars:

- NPV = Discounted Benefits – Discounted Costs
- BCR = Discounted Benefits / Discounted Costs

A structure and logic diagram showing the relationship between the input and output metrics is shown in **Figure 3-1**. Appendix A includes detailed information on the BCA.

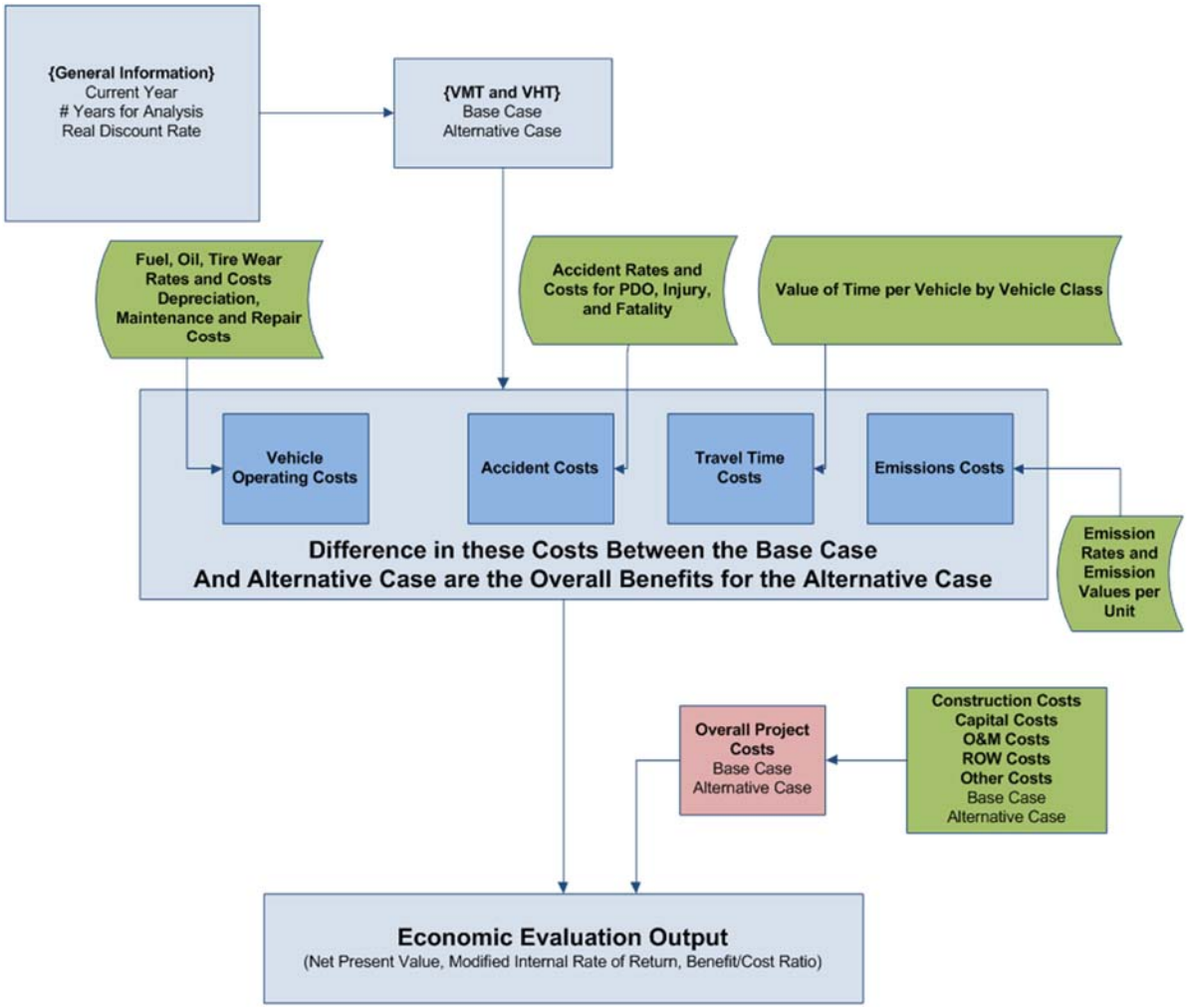
Discounting

Discounting is a method used to convert future costs and benefits into a common year for comparison. It is a procedure to express future outcomes in their present value. The conversion typically requires the use of a discount rate: the annual percentage change in the present value of a future dollar.

The basic proposition underlying discounting is a very simple one – namely, that in general people attach less value to outcomes that occur in the future as compared to outcomes that occur in the present. In other words, discounting relates to the idea that, even with zero inflation, the value attached to $1 received one year from now is typically less than the value attached to $1 received today. This in turn, reflects a general preference for the present, for instant rather than delayed gratification. This is why interest rates exist on savings accounts: people need to be paid something in order to delay the enjoyment of their money.

The purpose of discounting is to level the playing field when comparing alternatives whose costs and benefits occur through time at different rates and in different amounts. It is standard practice to compare discounted benefits and costs when computing net present value (NPV) and benefit-cost ratio (BCR). Since transportation projects generally consist of up-front costs followed by long periods of benefits, if the NPV or BCR were computed using non-discounted costs and benefits would overstate the benefits of the project.

Figure 3-1. Structure and Logic for the Benefit-Cost Analysis



O&M operating and maintenance
PDO property damage only
ROW right-of-way
VHT vehicles hours traveled
VMT vehicle miles traveled

The specific methodology developed for this analysis is consistent with United States Department of Transportation (USDOT) guidelines. The methodology involves:

- Establishing existing and future conditions under a Trend Scenario and two alternative scenarios: Interim and Full Build
- Measuring benefits in dollar terms, whenever possible, and expressing benefits and costs in a common unit of measurement
- Using USDOT guidance for the valuation of travel time savings, safety benefits, and reductions in air emissions, while relying on industry best practices for the valuation of other effects

Corridor Implementation Scenarios

A key consideration in structuring the BCA relates to the timing of construction of the improvements. In reviewing the challenge of funding and implementing a program of this magnitude over a relatively short period of time, the following observations were made:

- Implementation of the complete Corridor to Interstate standards over a short period (for example, 5 to 7 years) is not practical given the scale of the project costs.
- Many important Corridor improvements that will enable the realization of the I-11 vision are already identified and in some cases are programmed as priority projects.
- Improvements already identified along the Corridor will provide additional capacity in the short term, allowing for studies of the build-out condition to determine an appropriate multimodal solution for the long term.
- The designation of the I-11 and Intermountain West Corridor as a branded corridor with a special interim status (not yet an Interstate, but in the process of becoming one) will begin to yield many of the benefits of the overall Corridor project, while moderating the funding needs of implementation over time.

Thus, the analysis has been configured around three scenarios in terms of the implementation strategy of the Corridor, as follows:

- The Trend (No Build) Scenario includes projects in both Arizona and Nevada that are funded in long-range transportation plans. These projects have already been identified and prioritized by the respective public agency (state Departments of Transportation or regional Metropolitan Planning Organizations) for the sake of improving the regional transportation network. Other scenarios will be compared to this effective baseline to assess both costs and benefits of the scenarios shown below.
- The Interim Scenario assumes implementation of the Trend Scenario projects, plus additional targeted improvements as required to create an interim end-to-end corridor through both states. The goal of implementing this interim condition is to achieve a continuous, efficient, high-capacity corridor as quickly as possible and at the lowest cost.
- The Full Build Scenario builds upon the previous two scenarios to complete build-out of a full interstate with sufficient capacity.

Arizona Governor Jan Brewer and Nevada Governor Brian Sandoval at Future I-11 Sign Unveiling Ceremony

The two scenarios (Interim and Full Build) are each compared against the Trend Scenario. These implementation strategies reflect costs and benefits for a highway-only corridor from Mexico to Las Vegas. Other modal improvements are considered partnering opportunities, but are not something the state DOT's can implement.

I-11 and Intermountain West Corridor Benefits and Costs Calculation

Although the study area spans the entirety of both states, the alternatives evaluation analysis conducted for the Northern Nevada Future Connectivity Segment—the segment from Las Vegas to the Northern Nevada border—requires further examination so that a recommended corridor can be sufficiently defined and a BCA conducted. This analysis, therefore, documents the BCA from the Mexican border at Nogales, Arizona, through the Las Vegas metropolitan area.

Summary information is provided below on the benefits categories, project cost estimate, and BCA findings. A detailed description is available in Appendix A.

Benefit Categories

Several benefit categories have been approximated and monetized to facilitate comparisons against the estimated costs. These benefit categories include travel time savings, vehicle operating costs, safety benefits, emissions benefits, and freight logistics benefits. More detail on each of these benefit categories is provided in Appendix A. **Table 3-1** shows the total for the Interim and Full Build Scenarios relative to the Trend Scenario**.** Benefits are presented in both discounted and non-discounted terms, in billions of 2013 dollars.

Table 3-1. Total Benefits By Scenario, Billions of 2013 Dollars

	Interim (billions of 2013$)	Full Build (billions of 2013$)
Not Discounted	8.5 – 17.2	25.8 – 39.0
Discounted	2.8 – 5.6	8.5 – 12.8

Note: All benefits were estimated relative to the Trend Scenario.

Project Cost Estimate

Table 3-2 shows the capital, O&M, and total costs by scenario. Costs are presented in both discounted and non-discounted terms, in billions of 2013 dollars. The scenarios can be viewed as building upon each other; that is, the Interim Scenario contains all of the improvements slated to occur under the Trend Scenario as well as some additional improvements. Incremental cost is the cost of those improvements beyond the Trend Scenario. Similarly, the Full Build Scenario builds on the Interim Program. Due to the three current alternatives for the I-11 and Intermountain West Corridor near Las Vegas, a range of costs is presented.

Table 3-2. Capital and Operating and Maintenance Costs By Scenario, Billions of 2013 Dollars

	Cost Category	Trend Total Cost (billions of 2013$)	Interim Incremental Cost (billions of 2013$)	Full Build Incremental Cost (billions of 2013$)	Full Build Total Cost* (billions of 2013$)
Not Discounted	Capital Cost	4.1 - 5.2	3.2 - 3.9	7.5 - 7.5	10.7 – 11.4
	O&M Cost	0.5 - 0.7	0.4 - 0.5	0.9 - 1	1.3 – 1.5
	Total Cost	**4.6 - 5.8**	**3.6 - 4.4**	**8.4 - 8.5**	**12 – 12.9**
Discounted	Capital Cost	2.2 - 2.8	1.7 - 2.2	4.1 - 4.1	5.8 – 6.3
	O&M Cost	0.2 - 0.2	0.1 - 0.2	0.3 - 0.3	0.4 – 0.5
	Total Cost	**2.4 - 3.1**	**1.9 - 2.3**	**4.4 - 4.5**	**6.3 – 6.8**

** Full Build Total Cost includes Interim Incremental Cost and Full Build Incremental Cost, but not the cost of the Trend, as that is considered baseline.*

Summary Findings of BCA

This section presents summary BCA results and findings shown for each alternative, Interim and Full Build, compared to the Trend Scenario. **Table 3-3** shows the NPV and BCR of each of the two alternatives. The NPV is calculated by subtracting the total discounted costs from the total discounted benefits, while the BCR is calculated by dividing total discounted benefits by total discounted costs. An NPV greater than zero and a BCR greater than one are general measures of the feasibility of a project.

The ranges shown in Table 3-3 are due to the range of alternatives in Las Vegas (Y, Z and BB-QQ). The Interim Scenario generates net benefits of $427 million to $3.7 billion, while the Full Build Scenario has an NPV of $1.8 billion to $6.5 billion. The Interim Scenario has a BCR range of 1.2 to 3.0, while the Full Build Scenario has a BCR of 1.3 to 2.0. Because the Full Build Scenario NPV exceeds that of the Interim Scenario, it

is expected that the **Full Build Scenario will generate more net benefits** overall than the Interim Scenario. On the other hand, the BCR in the Interim Scenario exceeds that of the Full Build, meaning that it is expected that the **Interim Scenario has a higher return on investment**.

Table 3-3. Net Present Value and Benefit-Cost Ratio by Scenario, Billions of 2013 Dollars

Scenario	Total Benefits (billions of 2013$)	Total Costs (billions of 2013$)	Net Present Value (billions of 2013$)	Benefit-Cost Ratio
Interim	2.8 – 5.6	1.9 - 2.3	0.4 – 3.7	1.2-3.0
Full Build	8.5 – 12.8	6.3 - 6.8	1.8 – 6.8	1.3-2.0

Note: All benefits and costs were estimated relative to the Trend Scenario, and reflect discounted values.

4. Economic Benefits: Macroeconomic Scenario-Based Analysis

To help understand the nature and scale of the economic returns as a result of a potential I-11 and Intermountain West Corridor investment, a scenario-based analysis was performed. Specifically, three important trends currently shaping the regional economy were considered, and three separate scenarios were constructed to model the effects of each in terms of travel demand, GDP, population, and employment in the region. The results provide some indication of the scale of economic activity and of travel demand that each scenario may produce. These scenarios are based on important current trends that, should they continue, will alter the needs for transportation, levels of trade, and overall development in the region. These scenarios were unconstrained; that is, the analysis assumed a strong supply of quality transportation and other key enabling factors. These scenarios are meant to be illustrative; a "what if" analysis, with the understanding that some combination of scenarios and effects is more realistic. This analysis is described in detail in the Preliminary Business Case Foundation chapter of the *I-11 and Intermountain West Corridor Study Corridor Justification Report* (NDOT and ADOT 2013).

Baseline Scenario

The Baseline Scenario serves as the background against which the results of the other scenarios are compared, and is the same as the Trend (No-Build) Investment Strategy used in the BCA. The Baseline Scenario assumes that transport and trade continue as currently forecast; this assumption includes existing international trade forecasts, continuation of the existing trends in balance of trade, continuation of the distribution of trade between major trading partners, and continuation of the existing trade route distribution. The Baseline Scenario has associated 2040 projections for Arizona and Nevada employment, labor income, value added (proxy for GDP), and population. These projections are shown in **Table 4-1**. The focus is on these economic indicators because growth in these metrics is strongly indicative of overall growth in transportation demand, both for direct travel consumption and to service the industries that provide goods and services to the growing population.

Table 4-1. Study Area Economic Metrics, 2012 Levels and 2040 Baseline Projections

Economic Indicator	Arizona 2012	Arizona Baseline 2040	Nevada 2012	Nevada Baseline 2040
Employment	3,192,519	5,791,860	1,518,833	2,179,769
Labor Income	$157 billion	$269 billion	$75 billion	$104 billion
Value Added (State GDP)	$261 billion	$467 billion	$120 billion	$175 billion
Population	6,553,255	10,993,641	2,758,931	4,084,473

Sources: HDR, ESI Corp., and IMPLAN projections using FHWA Freight Analysis Framework 3 (FAF3) data, inflated to 2012 value by the Consumer Price Index inflation factor provided by the Bureau of Labor Statistics Consumer Price Index inflation calculator

Growth in Asia Pacific Trade Scenario

This scenario is based on the continued growth of the trade flows with Asia that have characterized West Coast trade during recent decades. This scenario is predicated on the continued growth in U.S. imports of a

wide array of low-cost consumer goods from China and other low-cost Asian sources. This scenario assumes that the current trends in manufacturing in the Asia Pacific region continue and that the U.S. continues to receive a growing volume of goods from Asia. Under this scenario, West Coast ports (Ports of Los Angeles and Long Beach) would reach capacity by approximately 2020, requiring major additional capacity by that point. To accommodate the demand, Mexican ports are assumed to add port capacity and attract a share of traffic destined for the U.S.

Nearshoring Scenario

Nearshoring refers to the current trend of moving manufactured goods production, much of which was previously in Asia, to Mexico. This scenario assumes that Asia Pacific manufacturing for the U.S. market flattens and significant production growth occurs in Mexico while other major features of the Baseline Scenario remain unchanged. This scenario would add demand for north-south transportation facilities, including the I-11 and Intermountain West Corridor. Experience from other jurisdictions also suggests that nearshoring produces integrated cross-border manufacturing networks, with added value occurring both in the U.S. and Mexico. Thus, the magnitude of associated domestic economic benefits is significantly greater than for the equivalent manufacturing sourced from Southeast Asia.

State Economic Development Plans are Fully Realized Scenario

This scenario assumes that Arizona and Nevada are able to realize their major economic development goals, including growing their economies through an industry cluster-based strategy as well as increasing trade with Mexico and Canada. An industry cluster is a geographic concentration of interconnected businesses, suppliers, and associated institutions in a particular field. Identification of these clusters included analyzing industries, their growth trends, job quality, ability to be a trading sector, and finally assessing the states' ability to grow the cluster. The end result is a group of industry clusters that has the ability to generate economic growth both in the short-term and long-term.

Key Findings of Scenarios

Each scenario was defined by comparison to a Baseline Scenario, which assumes that trade and freight flows, both international and domestic, grow as forecasted by the USDOT. While the Baseline Scenario does take into account some future planned infrastructure projects such as the Panama Canal improvements already underway, it does not include the I-11 and Intermountain West Corridor. Therefore, because the Corridor has the potential to structurally alter how goods move throughout the region, the analysis may understate the total volume of goods that would be expected to use the Corridor. The cumulative baseline freight flows mapped on **Figure 4-1** are the value in 2012 dollars of the two-way (inbound and outbound) flows by direction, which shows that the predominance of east-west flows currently observed are projected to continue in the future. Specific freight transport flows were estimated for each scenario (**Table 4-2**) to permit the quantification of the potential economic impacts of each scenario.

Figure 4-1. Baseline 2040 Cumulative Freight Projections for Nevada and Arizona, 2012 Dollars

Source: FHWA FAF3 data, inflated to 2012 value by Consumer Price Index inflation factor provided by the Bureau of Labor Statistics Consumer Price Index inflation calculator. Values reflect all modes of transportation collected by FAF including truck, rail, air, multiple modes and mail, pipeline, and other and unknown.

Table 4-2. Freight Flow Assumptions Relative to the Baseline by Scenario

Scenario	South In	South Out	West In	West Out	North In	North Out	East In	East Out	Within
Baseline Condition	FHWA FAF3 2040 Forecast								
Growth in Asia Pacific Trade	Base + 5–10%	Base	Base	Base + 2%	Base	Base + 5–10%	Base + 5–10%	Base + 5–10%	Base + 5–10%
Nearshoring	Base + 20–30%	Base + 20–30%	Base	Base + 5–12%	Base	Base + 5–12%	Base	Base + 5–12%	Base + 5–12%
State Economic Development Plans	Base + 3–6%	Base + 3–6%	Base + 3–6%	Base + 3–6%	Base + 3–6%	Base + 3–6%	Base + 3–6%	Base + 3–6%	Base + 3–6%

Source: I-11 and Intermountain West Corridor Study Corridor Justification Report (NDOT and ADOT 2013)

The freight flows shown in Table 4-2 were estimated directly as primary inputs to the scenario analysis. The range of potential system response in the observed trade flows for each scenario were based on professional judgment. The scenario freight flows are not the maximum conceivable, but they are large enough to illustrate the nature and scale of the associated effects.

It can be argued that under the Growth in Asia Pacific Trade scenario, the anticipated 5 to 10 percent incremental growth above baseline for "South In" may also be associated with a marginal increment of growth for the "North In" from similar value chains that touch Canada or Denver. In addition, this scenario

may also be associated with incremental growth above base for "West In" freight flows from the ports of Los Angeles and Long Beach. The Nearshoring Scenario may have incremental growth above Base for "West In" trade flow, reflecting intermediate goods from China or California, for incorporation into products coming in from Mexico. These effects illustrate the secondary induced trade flows, which while individually modest in scale, amplify and broaden the trade effects anticipated under each of these scenarios.

While this analysis considers that these future economic scenarios might exist alone, it is more likely that a combination of the three alternatives will occur. This analysis does not attempt to quantify the relative likelihoods of each scenario; each is subject to risks that make the realization of that scenario more or less likely. For example, a rise in East Asian labor costs would make the Growth in Asia Pacific Trade Scenario less likely and the Nearshoring Scenario more likely. Potential benefits to the regional economy associated with the three scenarios discussed above can be realized only if the region maintains its current relative competitiveness and is able to attract the level of activity described. Transportation is a key and necessary enabler of economic development.

Each of the scenarios examined has the potential to make a major contribution to the economic well-being of the region's residents, bringing up to an additional 240,000 jobs and $22 billion in economic output to the region over the next 25 years. The specifics of the modeled increases in economic output, population, and employment are shown in **Table 4-3**.

Table 4-3. Key Modeled Results Corresponding to Each Scenario

2040 Scenarios	Economic Output ($ billions)	Total Population (high range)*	Total Employment (high range)*	Unacceptably Congested Highways (%)**
Current Conditions (2011)	381	9,253,806	4,711,352	9
Projected Baseline Conditions (2040)	642	15,078,114	7,971,629	28
Growth in Asia Pacific Trade	649–666	15,361,219 (1.9%)	8,121,168 (1.9%)	34
Trade with Mexico Expands (Nearshoring)	651–664	15,535,411 (3.0%)	8,213,079 (3.0%)	Up to 43
State Economic Development Plans are Fully Realized	646–650	15,247,957 (1.1%)	8,061,322 (1.1%)	34

Source: I-11 and Intermountain West Corridor Study Corridor Justification Report (NDOT and ADOT 2013)

** The percentages in parentheses represent the percentages of additional jobs created under each alternative scenario as compared with the Projected Baseline Conditions.*

*** Includes major highway corridors in Arizona, California, and Nevada; and assumes completion of trend improvements.*

5. Validation: Comparative Analysis from Other Regions of the U.S.

The material presented in previous chapters provides quantitative indications of the benefits to the proposed investment. Because the I-11 and Intermountain West Corridor is an investment that will forever alter the economic landscape of the Southwest, the benefits will be numerous and widely dispersed throughout the economy. For this reason, the benefits are difficult to capture using conventional economic analysis.

The macroeconomic analysis suggests that the I-11 and Intermountain West Corridor offers the potential to enable the introduction of new economic activity related to the emerging manufacturing and trade relationship with Mexico that has been enabled by NAFTA and the current economic trend of nearshoring manufacturing previously sourced in Asia. These benefits are evident in Texas and states north along the I-35 corridor. The nature of this trade-related economic activity, referred to by economists as "production sharing," is fundamentally different from that fostered by Asia Pacific trade. With Asian imports, limited value-adding occurs after consumer goods are imported. However, efficient transportation links with Mexico create significant opportunities for specialized manufacturing in the U.S., supported by Mexican production. Thus, each country is able to exploit its inherent competitive advantages. The supply chain relationships seen in cross-border manufacturing are complex and often involve components crossing the border multiple times and add value incrementally in both countries. This activity is additive to the basic transportation-related activity engendered by imported goods arriving from Asia (port activity, transportation, warehousing, and distribution). The potential economic footprint of production sharing with Canada and Mexico is larger and more diverse than that seen for Asian imports.

This chapter presents highlights from a body of information assembled to illustrate the relationship between transportation corridor investment and economic outcomes from other U.S. jurisdictions. This information is provided to validate the expectation that these effects will occur and to assist with the interpretation of the analysis presented above. Given the nature of the new and growing economic relationship between U.S. border states and Mexico, the potential scale of this relationship for the Intermountain West may potentially be larger than shown.

Impacts of a New Highway or Highway Improvements on Economy

A technical memorandum was prepared documenting a review of available literature on the regional impacts of a new highway or highway improvements in terms of economic growth, economic development, reduced commuting times and costs, along with other benefits. The full technical memorandum is provided in Appendix B, but the findings of one study evaluated in this review are summarized below.

The Best Investment a Nation Ever Made: A Tribute to the Dwight D. Eisenhower System of Interstate and Defense Highways (Cox 1998) provides a comprehensive look into the benefits of infrastructure investment. The work discusses the impact of the Dwight D. Eisenhower System of Interstate and Defense Highways at its 40th anniversary in 1996. Interesting findings of that work are that the road system has:

- Saved the lives of an estimated 187,000 people and prevented injuries to another 12 million
- Returned more than $6 in increased economic productivity for each $1 spent on construction
- Had numerous intangible impacts such as increased international competitiveness, increased personal mobility, and increased international security

The work discusses these impacts by state. For Nevada, Cox estimates the number of roadway fatalities was reduced by 80 in 1994, and by 1,600 over the 40-year period, by the use of the Interstate Highway System. This resulted in the fatalities-avoided ratio per 1,000 population of 2.13, compared to the national ratio of 0.86. Additionally, injuries in Nevada were reduced by an estimated 3,800 in 1994 and 70,000 over the 40-year period. In Arizona, the use of the Interstate Highway System reduced the number of roadway fatalities by 170 in 1994 and by 4,200 over the 40-year period, resulting in a fatalities-avoided ratio per 1,000 population of 1.7. Injuries in Arizona were reduced by an estimated 4,800 in 1994 and 103,000 over the 40-year period.

Finally, Cox estimated the economic loss attributable to the use of the Interstate Highway System was reduced by $180 million in Nevada and $300 million in Arizona in 1994 (in 1996 dollars) and quality of life was improved by $580 million in Nevada and $950 million in Arizona in 1994. Between 1957 and 1996, economic loss in Nevada was reduced by $2.6 billion, the equivalent of $3,500 per capita, and in Arizona the economic loss was reduced by $5.2 billion, the equivalent of $2,100 per capita. These figures are greater than the national per capita amount of $1,700.

Overall, infrastructure investment has been shown to have a positive impact on economic growth, productivity and return on investment. According to the report *Economic Returns from Transportation Investment* (Eno Transportation Foundation, Inc. 1996), which discusses various infrastructure studies, social rates of return on infrastructure investment are significant and positive, and infrastructure investment has helped raise the nation's productivity and reduce its costs of doing business.

An important conclusion of this study is that an increase in infrastructure investment reduces costs in almost all manufacturing industries and in many service industries, which also shows a corresponding increase in productivity.

The Eno Transportation Foundation, Inc. study also found, however, that the impacts of transportation vary widely from time to time and from place to place. Social rates of return have fallen rapidly in the past and vary according to place and the economic environment. The construction of new roads has a significant impact on the regions, but eventually new roads are merely substitutes for older ones as localities mature. To maximize the positive economic impacts of transportation investments, the study recommends an examination of how and when this effect is likely to occur (Eno Transportation Foundation, Inc. 1996).

The detailed analysis using industry data covering the entire U.S. economy, *Contribution of Highway Capital to Industry and National Productivity Growth* (Nadiri and Mamuneas 1996), came to the same conclusions as the FHWA study that highway investments lower production costs for industries thus increasing economic productivity and growth. This study also found that the highway investment has a significant effect on the demand for capital, labor, and materials in all industries.

Transportation's Link to the Economy: Synthesis, prepared by the Washington State Department of Transportation reviewed multiple transportation studies and concluded that improvements to surface transportation systems increase economic output, reduce prices, and raise incomes and profits. The study found that transportation contributes economic returns for virtually every person and business in the

affected region. Other studies show that state and national investments in transportation have measurable benefits to the economy. One finding is that each $1 billion of federal highway investment generates 47,500-jobs: 26,500 jobs as roads and bridges are built and an additional 21,000 jobs as those who earn their money directly from transportation activity buy goods and services (Poor et al. 2008).

The study, *Transportation Improvements Grow Wisconsin's Economy: The Economic Benefits of Transportation Investments,* identified the following benefits from increased investment in the Wisconsin State Truck Highway System (CSI 2003):

- $7.0 billion in savings for everyday personal trips such as driving to work, doing errands, or visiting friends.
- $1.5 billion in savings by business persons and truckers while on the clock. The on the clock portion of the benefits (the $1.5 billion) would allow Wisconsin businesses to increase output, hire additional workers, and eventually increase Wisconsin residents' disposable personal income by $2.7 billion.

Therefore, the total benefits of the additional investment are the sum of the $7 billion for personal trips, plus the $2.7 billion of benefits (macroeconomic impacts) created from greater business efficiencies, for a total of $9.7 billion. The benefits ($9.7 billion) of additional investment ($3.2 billion) translate into measurable and significant results. For every dollar of additional investment in the Wisconsin State Truck Highway System beyond that needed to maintain current conditions, Wisconsin would enjoy $3 of benefit.

The study also demonstrated that additional highway investment leads to an increase in permanent new jobs. On an average annual basis, 4,800 more jobs would exist in Wisconsin if the additional investment were made because highway investment reduces the cost of doing business in Wisconsin.

Lessons Learned

I-40 in Arizona

The 360-mile segment of I-40 across northern Arizona was built between 1959 and 1984, with the rural segments generally completed first, thereby creating temporary gaps through various communities along the route. Motorists continued to use old US Route 66, an urban street through the heart of these communities, until the gaps were filled. In each case, the newly completed segment of I-40 enabled travelers to bypass the commercial district with its traveler-oriented services and amenities. The immediate impact was a dramatic downturn in travel-related local business, as pass-by trade was largely eliminated. Construction of the bypass around Winslow, the largest city east of Flagstaff, began in 1977. The last segment of old Route 66, a six-mile segment through Williams, was bypassed in 1984, whereupon this part of the old route was decommissioned as a state highway.

In the years since the completion of I-40, several of the bypassed communities have worked hard to cultivate the tourist trade, in partnership with private organizations and public agencies. They have enjoyed substantial success in this endeavor. Williams has successfully marketed itself as the gateway to the Grand Canyon and scored a major coup with the opening of the Grand Canyon Railway in 1989. The city has also become a golf destination and a recreation center for the Kaibab National Forest. Approximately 50 miles east of Flagstaff, Winslow has focused on promoting its historic downtown, the renovated La Posada Hotel, and nearby attractions such as Meteor Crater and Homolovi State Park, a major prehistoric site. The National Park Service has developed a "Discover Our Shared Heritage Travel Heritage Travel Itinerary" for Route 66, including descriptions of sights along the way and a guide to remaining segments of the old highway. Detailed tourist information for Route 66 across the state is also available on websites such as

www.historic66.com/Arizona/.

I-70 East (Denver, Colorado)

Interstate 70 was built near Denver, Colorado in the 1960s along 46th Avenue to the east of I-25 (Denver's major north-south thoroughfare) and 48th Avenue to the west. The construction of this interstate divided a number of minority and low-income communities and disconnected direct street access between major thoroughfares and destination points. Some neighborhoods that were bisected by I-70 were left isolated from Denver and surrounded by industry. All of these communities were adversely affected by the division caused by the construction of I-70 with an influx of commercial and industrial development, land uses with cumulative impacts from heavy truck traffic and various types of industrial and transportation uses. With the industrial land uses, major railroad lines and spurs running between residential areas, and the proximity of I-70 to the residential areas, these populations are considered disadvantaged.

For the last 50 years, these communities have lost faith and trust in the Colorado Department of Transportation (CDOT), so when CDOT began the I-70 East Corridor EIS study in 2003 to improve transportation along the corridor, they took on a more collaborative approach with the affected communities. In fact, this project was selected by FHWA as one of 10 case studies of Environmental Best Practices due to its thorough and continuous outreach and involvement with the affected communities in the project area. This collaborative approach resulted in a preferred alternative developed by the project team, the community and interested stakeholders along the corridor.

Economic Impacts to Communities

A review of 190 studies of bypass impacts (Liff et al. 1996) reported the following conclusions about the impact of bypasses on communities, with most of the affects based totally, or in part, on business sales.

As shown in **Table 5-1**, most studies have found that a highway bypass has a net positive impact on the local community. Not surprisingly, that finding does not apply to traffic-serving businesses along the old route, for which about half of the studies found that the bypass had a negative impact on traffic-dependent businesses.

Table 5-1. Effects of Highway Bypasses on Communities

	% Positive	% No Impact	% Negative	% Total	Number of Studies
Overall Community	89	4	7	100	141
Traffic-serving businesses along old route	30	22	49	100	88

Other conclusions from the review include:

- Studies of highway bypasses and their effects on the bypassed community indicate that bypasses generally result in decreased retail sales, gasoline service receipts, restaurant sales, and service receipts. The initial decreases are often counteracted by reorientation and refocusing of local stores. The economic impact of highway bypasses on small cities in rural settings is not uniform across cities. Some factors that determine those impacts include:
  - The size of the city: smaller cities are typically affected more severely than larger cities.
  - Average daily traffic on the highway: the greater the traffic flow, the more beneficial the long-term prospects for through-traffic-dependent local businesses.
  - The economic base of an area: the more inflows of funds to the local economy are affected by the highway, the more the bypass will affect local businesses.
  - A highway bypass may cause a decrease in business volumes in small cities. However, other factors such as increases or decreases in economic base industries (for example, tourism) or in the local and regional economy appear to be more important overall in determining the overall level of business sales and employment.
- Bypasses typically seem to have a favorable effect on rural communities and small urban areas, but evidence in these studies is often weak. Interviews with and surveys of residents and businesses indicate that bypasses increase development potential along the fringe areas served by the new route, and at the same time relieve congestion, safety hazards, and other undesirable conditions in the central areas from which traffic is diverted.
- A potential effect of a bypass is that a downtown business district will suffer a decline in retail sales due to lower main street traffic volumes. In some instances, this decline was offset by increased sales at new developments near freeway interchanges. Many bypassed communities that suffered a reduction in retail sales experienced a transformation of the downtown area from a center of retail activity to a center supporting more professional and service businesses.

Another technical memorandum was prepared documenting review of several recent case studies whose findings are especially relevant to the expected outcomes of completing a high-capacity transportation corridor (see Appendix C).

6. Interpretation and Key Findings

The I-11 and Intermountain West Corridor: A Compelling Case for Transformational Investment

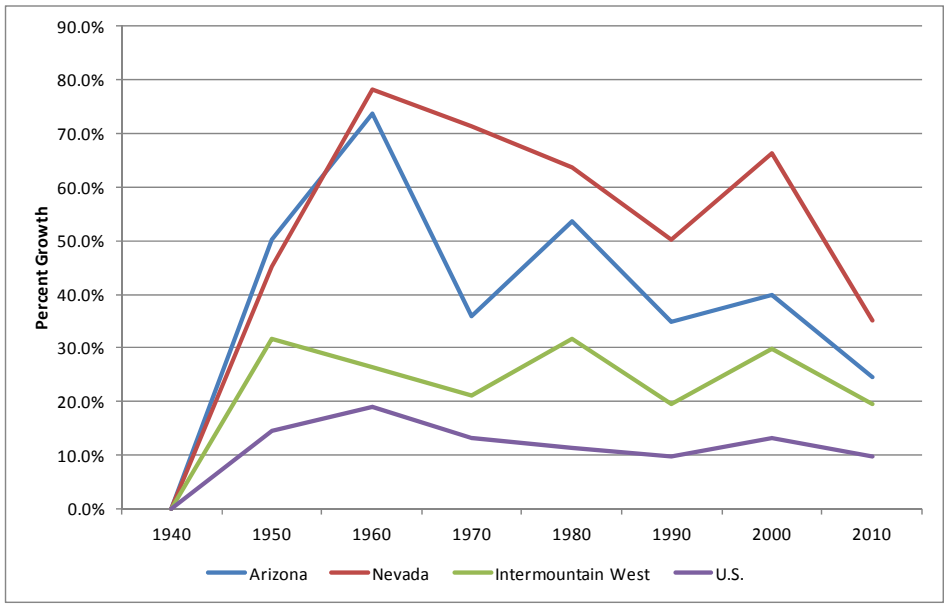
This *I-11 and Intermountain West Corridor Study Business Case* was prepared to address one question: Is this Corridor worthy of investment? The analysis presented in this Business Case provides a positive response to this question, particularly if the Corridor is part of a coordinated program with strategic border improvements to unlock the shared production potential with Mexico and Canada. This potential will allow the I-11 and Intermountain West Corridor to play a key enabling role in building the future economy of the region.

Key Findings

Investing to Sustain Growth

Today, more than ever, the American economy relies on trade, transportation, and goods movement to sustain economic growth through continuous improvement of competitive advantage. The Intermountain West region and Arizona and Nevada have long enjoyed higher than normal growth rates compared to the U.S. as a whole (**Figure 6-1**). Sustaining the competitiveness that will enable this growth to continue requires continued investment to address congestion that will result from incremental, organic growth.

Figure 6-1. Historical Population Growth (1940-2010) for Arizona, Nevada, Intermountain West, and United States



Source: U.S. Census Bureau 2002

Transforming Manufacturing in the Southwest U.S.

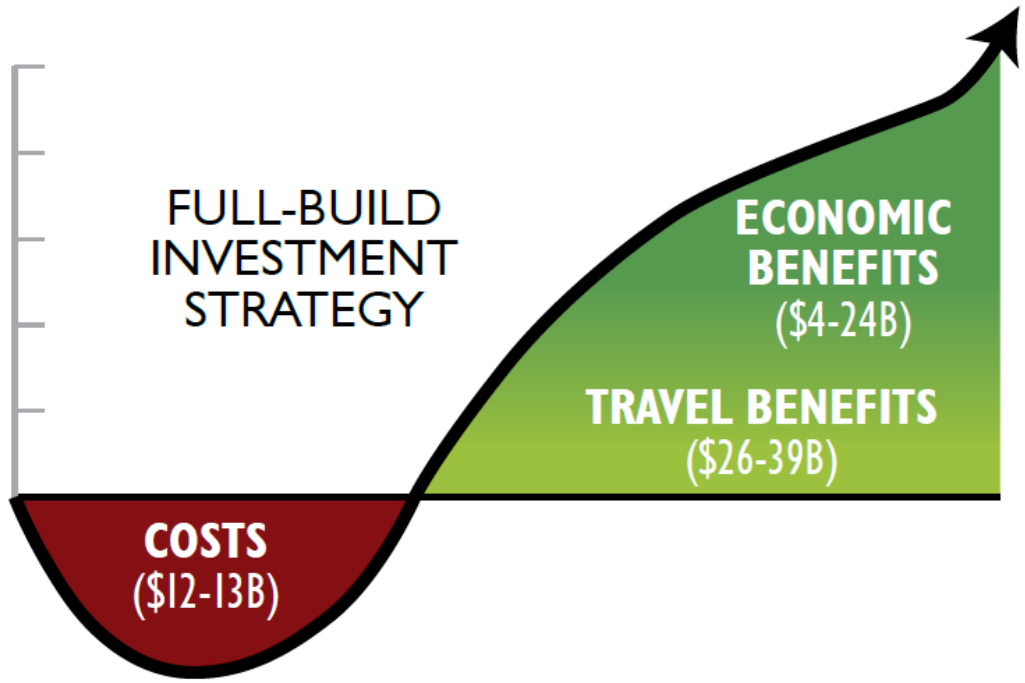
By linking Mexico's burgeoning manufacturing complex to the Intermountain West and ultimately to Canada, with an efficient, high-capacity transportation corridor, the region has the opportunity to participate in the "shared production" integrated supply chain and manufacturing networks that have now arisen across America. In contrast to overseas imports, these networks create significant opportunity and added value in both Mexico and the U.S., over and above the transportation and logistics functions needed

for imported goods distribution. This integration of the competitiveness of both nations can create a combined manufacturing capability with a high degree of global competitiveness. Thus, the Corridor offers the Intermountain West an opportunity to claim a strategic role in the emerging NAFTA-based manufacturing partnership between Mexico and the U.S., which has proven to be highly competitive in global markets.

Benefit-Cost Analysis Plus Macroeconomics: a Compelling Return on Investment

The BCA describes a project whose benefit-cost parameters range between 1.2 and 3.0, depending on the scenario under consideration. These parameters are indicative of a socially beneficial project, despite the conservatism of this analysis for transformational system-level investment. With induced macroeconomic effects estimated at up to $24 billion to the region over the next 25 years, it is clear that the combined economic case for the I-11 and Intermountain West Corridor investment is strong, as shown on **Figure 6-2**. With the opportunity to optimize the sequencing and timing of individual projects over an extended implementation period, the Corridor offers Nevada and Arizona the opportunity to realize above-average economic returns from strategic investments for many years.

Figure 6-2. Approximate Scale of Anticipated Return on Investment



Note: This graphic is solely intended to illustrate the scale of the return on investment potential and not the actual value. Combining the values of the economic and travel benefits may result in an over-estimate due to double counting some factors. The planning level estimates reflect costs and benefits for a highway-only corridor from Mexico to Las Vegas, above and beyond planned improvements.

Investing to Capture Transformational Economic Opportunity

Infrastructure investment has been shown to have a positive effect on economic growth, productivity, and return on investment. The studies referred to in Chapter 5 revealed that social rates of return on infrastructure investment are significant and positive and infrastructure investment has helped raise the nation's productivity and reduce its costs of doing business. Some of the studies also found that additional

highway investment leads to an increase in permanent new jobs and improved safety.

Conclusion

The I-11 and Intermountain West Corridor presents Arizona and Nevada with unique and exciting economic opportunities to:

- Sustain historic growth patterns by building on strong economic sectors such as tourism and recreation
- Tap into the resources of Mexico and Canada to strengthen and grow manufacturing capabilities
- Provide access to national and international markets for goods produced, warehoused, and distributed
- Achieve the economic development and diversification vision for both states

When the combined effects of the Corridor investment are considered, the I-11 and Intermountain West Corridor is a compelling candidate for strategic investment. If delivered through an early, carefully programmed, sustained investment program, it will have a prolonged positive affect on the economy of the region for decades to come.

7. Acronyms and Abbreviations

I-11	Interstate 11
BCA	benefit-cost analysis
BCR	benefit-cost ratio
FAF3	[Federal Highway Administration] Freight Analysis Framework 3
FHWA	Federal Highway Administration
GDP	gross domestic product
LPOE	land port of entry
NAFTA	North American Free Trade Agreement
NPV	net present value
O&M	operating and maintenance
PDO	property damage only
ROW	right-of-way
U.S.	United States
USDOT	United States Department of Transportation
VHT	vehicle hours traveled
VMT	vehicle miles traveled

8. References

Arizona Commerce Authority. 2013. *Job by Industry Report for Arizona, EMSI*.

Brookings Institution. 2011. *An Economic Development Agenda for Nevada*. http://www.brookings.edu/~/media/research/files/papers/2011/11/14%20nevada%20economy/1114_nevada_economy.pdf.

Bureau of Transportation Statistics. 2012. *Transborder Freight Data*. Available at: http://transborder.bts.gov/programs/international/transborder TBDR_QA.html.

Cox. 1998. *The Best Investment a National Ever Made: A Tribute to the Dwight D. Eisenhower System of Interstate and Defense Highways*. Diane Publishing Company.

Eno Transportation Foundation, Inc.1996. *Economic Returns from Transportation Investment*. http://www.fhwa.dot.gov/policy/otps/060320a/060320a.pdf.

Federal Highway Administration (FHWA). 2012. *Freight Analysis Framework Version 3 (FAF3)*. http://www.fhwa.dot.gov/publications/research/safety/05051/05051.pdf. Accessed November 2012.

Greater Phoenix Economic Council. 2013. http://www.gpec.org/home. Accessed January 30, 2013.

Liff, Sally D., et al. 1996. *Effects of Highway Bypasses on Rural Communities and Small Urban Areas*. National Cooperative Highway Research Program. Research Results Digest. Number 210.

Nadiri, Ishaq and Theofanis Mamuneas. 1996. *Contribution of Highway Capital to Industry and National Productivity Growth.* http://ntl.bts.gov/data/letter_am/growth.pdf.

NDOT and ADOT. 2013. *I-11 and Intermountain West Corridor Study Corridor Justification Report.* Prepared for Nevada Department of Transportation and Arizona Department of Transportation. Prepared by CH2M HILL and AECOM in association with HDR, Inc., ESI Corporation, and Partners for Strategic Action, Inc. http://i11study.com/wp/?page_id=237.

Nelson, Arthur and Robert Lang. 2011. Megapolitan America: A New Vision for Understanding America's Megapolitan Geography.

Nevada Governor's Office of Economic Development. 2013. Key Industries. http://www.diversifynevada.com/key-industries.

New Policy Institute and Arizona State University North American Center for Cross-Border Studies. 2012. *Realizing the Full Value of Crossborder Trade with Mexico*. http://21stcenturyborder.files.wordpress.com/2011/12/realizing-the-value-of-crossborder-trade-with-mexico1.pdf.

Regional Plan Association, 2005. *America Megaregions*. http://www.america2050.org/megaregions.html.

Thunderbird School of Global Management. No date. *Arizona-Mexico Supply Chain Landscape Analysis: A Nearshoring Study*. http://www.azmag.gov/Documents/EDC_2012-04-03_Arizona-Mexico-Supply-Chain-Landscape-Analysis-Nearshore-Study.pdf.

Tucson Regional Economic Opportunities. 2006. *Tucson Economic Blueprint Strategic Analysis Report.*

U.S. Census Bureau. 2002. *Demographic Trends in the 20th Century*. http://www.census.gov/prod/2002pubs/censr-4.pdf.

Wilson, Christopher E. 2011. *Working Together: Economic Ties between the United States and Mexico*. http://www.wilsoncenter.org/sites/default/files/Working%20Together%20Full%20Document.pdf.

Appendix A
Technical Memorandum
Benefit-Cost Analysis

I-11 and Intermountain West Corridor Study

Technical Memorandum: Benefit-Cost Analysis

Prepared for

Nevada DOT and ADOT

September 2014

Contents

Tables

Figures

Benefit-Cost Analysis

Benefit-cost analysis (BCA) is a conceptual framework that calculates and compares the benefits and costs of a project. BCA, the industry standard for major transportation infrastructure projects, serves two purposes:

- To provide a measure of project feasibility
- To provide a basis for comparing two or more projects, or alternatives, within a single project

The Benefit-Cost Analysis Framework

Within the BCA framework, benefits are broadly defined. Benefits represent the extent to which people affected by the project are made better off, as measured by their own willingness to pay. In other words, central to BCA is the idea that people are best able to judge what is good for them and to identify what improves their well-being or welfare.

Costs generally include capital costs, right-of-way costs, and the operating and maintenance costs (O&M) during the analysis period.

BCA is typically a forward-looking exercise, seeking to anticipate the welfare impacts of a project or proposal over its entire life-cycle. Future welfare changes are weighted against today's changes through discounting, which is meant to reflect society's general preference for the present, as well as broader inter-generational concerns. Discounting takes into account that benefits accrued in later years are worth less than benefits received nearer to the present day. In this analysis, all costs and benefits are discounted to their present day values at the assumed discount rate (4 percent for this analysis) to provide a level comparison between alternatives. BCA typically results in two standard metrics where the streams of future benefits and costs are discounted to today's dollars:

- Net Present Value (NPV) = Discounted Benefits – Discounted Costs
- Benefit-Cost Ratio (BCR) = Discounted Benefits / Discounted Costs

A structure and logic diagram showing the relationship between the input and output metrics is presented in **Figure 1**.

What is Discounting?

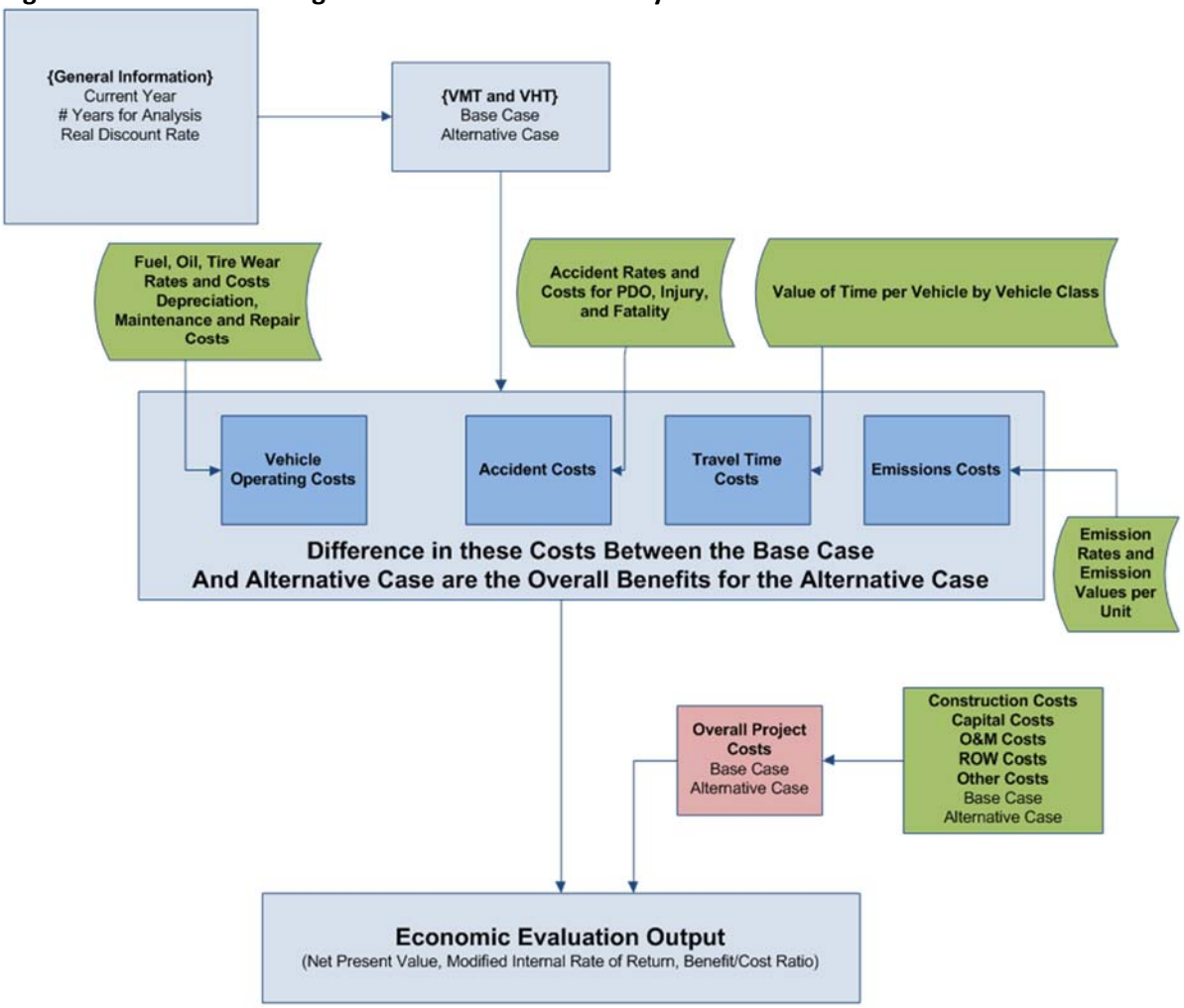
Discounting is a method used to convert future costs and benefits into a common year for comparison. It is a procedure to express future outcomes in their present value. The conversion typically requires the use of a discount rate: the annual percentage change in the present value of a future dollar.

The basic proposition underlying discounting is a very simple one – namely, that in general people attach less value to outcomes that occur in the future as compared to outcomes that occur in the present. In other words, discounting relates to the idea that, even with zero inflation, the value attached to $1 received one year from now is typically less than the value attached to $1 received today. This in turn, reflects a general preference for the present, for instant rather than delayed gratification. This is why interest rates exist on savings accounts: people need to be paid something in order to delay the enjoyment of their money.

The purpose of discounting is to level the playing field when comparing alternatives whose costs and benefits occur through time at different rates and in different amounts. It is standard practice to compare discounted benefits and costs when computing net present value (NPV) and benefit-cost ratio. Since transportation projects generally consist of up-front costs followed by long periods of benefits, if the NPV or BCR were computed using non-discounted costs and benefits would overstate the benefits of the project.

This can be illustrated using a simple numerical example. Suppose a project can be built today for $10 and generates $100 of benefits next year. Then comparing the undiscounted costs and undiscounted benefits yields a BCR of $100/$10 = 10. Now assume a discount rate of 5 percent. Then the $100 of benefits next year are actually valued at about $95, yielding a BCR of 9.5.

Figure 1. Structure and Logic for the Benefit-Cost Analysis



O&M operating and maintenance
PDO property damage only
ROW right-of-way
VHT vehicles hours traveled
VMT vehicle miles traveled

The specific methodology developed for this analysis is consistent with the United States Department of Transportation (USDOT) guidelines. The methodology involves:

- Establishing existing and future conditions under a Trend Scenario and two alternative scenarios: Interim and Full Build
- Measuring benefits in monetized terms, whenever possible, and expressing benefits and costs in a common unit of measurement
- Using USDOT guidance for the valuation of travel time savings, safety benefits, and reductions in air emissions, while relying on industry best practices for the valuation of other effects

Corridor Implementation Scenarios

The BCA has been configured around three scenarios in terms of the implementation strategy of the corridor, as follows:

- The Baseline or Trend scenario includes projects in both Arizona and Nevada that are funded in long-range transportation improvement plans. These projects have already been identified and prioritized by the respective public agency (state Departments of Transportation or regional Metropolitan Planning Organizations) for the sake of improving the regional transportation network. Other scenarios will be compared to this effective baseline to assess both costs and benefits of the scenarios.
- The Interim Scenario assumes implementation of the trend projects, plus additional targeted improvements as required to create an interim end-to-end corridor through both states. The goal of implementing this interim condition is to achieve a continuous I-11 and Intermountain West Corridor as quickly as possible and at the lowest cost.
- The Full Build Scenario builds upon the previous two scenarios to complete build-out of a multimodal transportation corridor that will match the needs of future demands for the movement of people and goods.

The two scenarios (Interim and Full Build) are each compared against the Trend Scenario. These investment strategies reflect costs and benefits for a highway-only corridor from Mexico to Las Vegas.

Benefit Categories

Travel Time Savings

Travel time savings captures the difference in time spent on the road network in the Trend and alternative (Interim or Full Build) scenarios for all drivers. Travel time savings include the cost to businesses of the time their employees spend on travel and the cost to people spending time on personal unpaid travel.

To calculate travel time savings, the average network speed is computed in the Trend and the alternative scenarios. Next, using the average speeds in each scenario, a change in travel time is calculated in terms of minutes per mile. Finally, the travel time savings can be calculated using the vehicle miles traveled (VMT) in the Baseline Scenario and alternative scenarios.

This travel time savings is monetized using USDOT-suggested values.

Vehicle Operating Costs

Vehicle operating costs (VOCs) are costs that change with vehicle use; for example, fuel, oil, tire wear, maintenance and repair, and depreciation. VOCs may increase or decrease as a result of a transportation improvement, depending on the difference in vehicle miles traveled and vehicle hours traveled (VHT) between the Trend and alternative (Interim or Full Build) scenarios.

To calculate VOC, the BCA uses estimates of VMT and VHT in the region along with consumption rates for fuel and oil and their unit costs. VMT and VHT are estimated on an annual basis for the Trend and alternative scenarios using data from the travel demand model. The annual VMT and VHT estimates are used with the corresponding consumption rates of fuel and oil (for vehicles in movement and vehicles idling) to estimate the annual number of gallons of fuel and oil used by border-crossing drivers in the Baseline and alternative scenarios. The annual number of gallons of fuel and quarts of oil consumed under each scenario are then monetized using the corresponding cost of fuel and oil to estimate the yearly total VOC estimates for the Trend and alternative scenarios.

Economic Value of Induced Trips

The I-11 and Intermountain West Corridor may result in new trips that would not have otherwise been made. For example, a resident of Phoenix may choose to drive on I-11 rather than fly to Las Vegas. These trips create both travel time and VOC impacts.

Safety Benefits

Safety benefits refer to the monetized value of crashes between an alternative scenario (either Interim or Full Build) and the Trend Scenario. The number of crashes on a road is generally a function of the number of cars that use the road as well as any safety enhancement measures that have been implemented on the road. For example, installation of rumble strips on a road may reduce the number of crashes on that road.

Using historical crash data for the roads that make up much of the I-11 Corridor, crash rates can be computed for crashes that result in a fatality, crashes that result in injury, and crashes that result in property damage.

The I-11 Corridor includes many types of projects such as roadway widening, median installation or widening, and interchange improvements. Using Federal Highway Administration crash reduction factors for these roadway improvements as well as VMT, accidents can be projected under the Trend and alternative scenarios.

These safety benefits are monetized using USDOT suggested values.

Emissions Benefits

Air pollution levels can increase or decrease as a result of a transportation infrastructure project. This analysis considers the total amount of volatile organic compounds, nitrogen oxides, fine particulate matter, sulfur dioxide, and carbon dioxide released into the atmosphere under the Trend and alternative (either Interim or Full Build) scenarios.

The emissions analysis for BCA purposes is not a predictor of future air quality—it is a comparative tool. The vehicle emissions calculated are a function of the level of VMT as well as the average speed on a network, whereas robust air quality analyses consider many other factors. This analysis uses MOVES, a nationally accepted emissions model, with customized rates from Maricopa County, to calculate emissions rates along the Corridor. These emissions levels are monetized using USDOT-suggested values.

Freight Logistics Benefits

Due to more reliable transport times and lower transport costs as a result of the I-11 and Intermountain West Corridor improvements, local manufacturers may choose to hold less inventory and reduce overhead costs. As a result, the manufacturing and machinery industries may become more competitive or profitable.

Using assumptions on business and consumer behavior, an estimate of how output changes with respect to travel time can be calculated. Next, using the value of freight transported on the I-11 and Intermountain West Corridor as well as changes in freight logistics benefits can be calculated. Note that the reductions in truck drivers' travel time are captured under the Travel Time Savings benefit category.

Project Cost Estimate

Table 1 gives a description of the planned improvements by scenario by segment. Three alternatives were developed for the Southern Nevada/Las Vegas segment: Alternative BB-QQ, Alternative Y, and Alternative Z.

Table 1. Descriptions of the Trend and Alternative Scenarios

Segment	Trend (Baseline) Description	Interim Description	Full Description
Southern Arizona - Nogales to Casa Grande			
I-19 to I-10/I-8 (Casa Grande)	• Widen portions of I-19 to 6-lanes (Continental Rd to El Toro Road, El Toro Road to Valencia Road, San Xavier to Ajo Way) • Construct frontage road • Reconstruct six interchanges and bridge over Santa Cruz River • Widen I-10 to 8-lanes (Prince Road to Pima County Line), • Construct 11 traffic interchanges, railroad grade separation at two locations	• Widen remainder of I-19 to 6 lanes from Nogales to I-10 • Reconstruct Cortaro traffic interchange	• Major transportation enhancements that could include port-of-entry improvements, improvements to existing rail or highway corridors, developing new rail or highway corridors, or other concepts to be evaluated in future study(s)
Phoenix Metropolitan Area			
I-10/I-8 (Casa Grande) to, and including, I-10 (Buckeye)	• SR 85: Construct Warner Street bridge • I-10: Widen roadway • SR 30: Construct new 4-lane highway	• SR 85: Upgrade to freeway, construct SR 85/I-10 and SR 85/I-8 system interchanges • I-8: Widen to 6-lanes, construct I-8/I-10 system interchange	• Construct new 6-lane freeway with full interchange build-out and related features/upgrades (alignment to be determined in future study)
I-10 (Buckeye) to US 93 (Wickenburg)		• Construct new 4-lane parkway (alignment to be determined in future study)	• Construct new 6-lane freeway with full interchange build-out and related features/upgrades (alignment to be determined in future study)
Northern Arizona/Southern Nevada			
US 93 (Wickenburg) to I-40	• Upgrade to 4-lane divided highway	• Construct Wikieup Bypass	• Upgrade to 4-lane freeway, full interchange build-out, and related features/ upgrades
US 93 co-location with I-40		• Construct East Kingman and Rattlesnake traffic interchanges	• Widen to 6 lanes with related features/upgrades
US 93, Kingman/I-40 to Pat Tillman/Mike O'Callaghan Bridge	• Construct 10 miles of shoulders and rumble strips from Willow Beach Road to White Road	• Construct West Kingman traffic interchange	• Upgrade to 4-lane freeway (from SR 68 to Kingman Wash) and 6-lane freeway (SR 68 to I-40), full interchange build-out, and related features/upgrades

Table 1. Descriptions of the Trend and Alternative Scenarios

Segment	Trend (Baseline) Description	Interim Description	Full Description
US 93/Boulder City Bypass, Pat Tillman/Mike O'Callaghan Bridge to I-515/Foothills grade separation	• Construct new 4-lane freeway with related interchanges and features		
Southern Nevada - Las Vegas Metropolitan Area			
Alternative BB-QQ			
New Eastern Corridor (Boulder City Bypass [I-515 and Foothills grade separation] to I-15)		• Construct new 4-lane highway	• Construct new 4-lane freeway with 3 new interchanges
I-15, Eastern Corridor to CC 215/Northern Beltway		• Widen from 4 to 6 lanes	• Widen from 6 to 8 lanes
CC 215/Northern Beltway, I-15 to US 95	• Upgrade to 6-lane freeway • Upgrade traffic interchanges to system interchanges at I-15 and at US 95 • Construct 2 service interchanges		• Widen from 6 to 8 lanes
US 95, CC 215 Northern Beltway to SR 157 (Kyle Canyon)	• Widen from 4 to 6 lanes, Durango Drive to SR 157 (Kyle Canyon)		• Widen to 6 to 8 lanes, CC 215 to SR 157
Alternative Y			
I-515/US 93, Foothills Grade Separation to I-215		• I-515: Widen from 6 to 8 lanes	• I-515: Widen from 8 to 10 lanes
I-215, I-515 to I-15	• I-215: Widen from 6 to 8 lanes from I-515 to Warm Springs, System-to-system direct connector HOV ramps (at I-215 Southern Beltway), Upgrade Interchange at Airport Connector		• I-215: Widen from 8 to 10 lanes
CC 215, I-15 to future Sheep Mountain Parkway	• CC-215: Upgrade to 6-lane freeway (Craig Rd to Hualapai Way North), with interchanges at Lone Mountain Rd & Ann Rd, & an overpass at Centennial Pkwy • Upgrade to system-to-system interchange (at Summerlin Pkwy)	CC 215: Widen from 6 to 8 lanes, I-15 to future Sheep Mountain Parkway	• CC-215: Widen from 8 to 10 lanes, I-15 to future Sheep Mountain Parkway
Future Sheep Mountain Parkway, CC 215 to US 95	• Future Sheep Mountain Parkway: Construct 4-lane highway with interchanges (I-215 Western Beltway to SR 157 west of US 95)	Future Sheep Mountain Parkway: Widen from 4 to 6 lanes	• Future Sheep Mountain Parkway: Widen from 6 to 8 lanes

Table 1. Descriptions of the Trend and Alternative Scenarios

Segment	Trend (Baseline) Description	Interim Description	Full Description
Alternative Z			
I-515/US 93, Foothills Grade Separation to I-215		• I-515: Widen from 6 to 8 lanes	• I-515: Widen from 8 to 10 lanes
I-515, I-215 to I-15 (including Spaghetti Bowl)	• I-515: Widen to 10 lanes to include HOV lanes, & add new interchanges at Pecos Rd, & 'F' Street (PE, ROW, Const) (from Charleston Blvd to I-15/US 95 Interchange - Spaghetti Bowl)	• I-515: Widen 6-8 lanes from I-215 to Charleston • Spaghetti Bowl improvements to accommodate 10 lanes • Reconstruct pavement • Reconstruct existing service interchanges at Boulder Hwy and Flamingo Rd	• I-515: Widen 8 to 10 lanes from I-215 to Charleston.
US 95, I-15 to CC 215/Northern Beltway	• US95: Widen from 6 to 8 lanes, Ann Rd to Durango Drive.	• US 95: Widen to 10 lanes, I-15 to Rancho • Reconstruct MLK and Rancho Interchanges	• US 95: Widen to 10 lanes, Rainbow to I-215
US 95, CC-215 Northern Beltway to SR 157 (Kyle Canyon)	• US95: Widen from 4 to 6 lanes, Durango Drive to SR157 (Kyle Canyon).		• US 95: Widen to 6 to 8 lanes, CC-215 to SR157

Note: The projects listed under the Interim and Full Build Scenarios are only for the purposes of the BCA to provide specific projects to cost for the analysis. Actual improvements might vary after more detailed project development.

Table 2 shows the capital, O&M, and total costs by scenario. Costs are presented in both discounted and non-discounted terms, in billions of 2013 dollars. The scenarios can be viewed as building upon each other; that is, the Interim Scenario contains all of the improvements slated to occur under the Trend Scenario as well as some additional improvements. Similarly, the Full Build Scenario builds on the Interim Program. Due to the three current alternatives for the I-11 and Intermountain West Corridor near Las Vegas, a range of costs is presented.

Table 2. Descriptions of the Trend and Alternative Scenarios, Billions of 2013 Dollars

	Cost Category	Trend Total Cost	Interim Incremental Cost	Full Build Incremental Cost	Full Build Total Cost*
Not Discounted	Capital Cost	4.1 - 5.2	3.2 - 3.9	7.5 - 7.5	10.7 – 11.4
	O&M Cost	0.5 - 0.7	0.4 - 0.5	0.9 - 1	1.3 – 1.5
	Total Cost	**4.6 - 5.8**	**3.6 - 4.4**	**8.4 - 8.5**	**12 – 12.9**
Discounted	Capital Cost	2.2 - 2.8	1.7 - 2.2	4.1 - 4.1	5.8 – 6.3
	O&M Cost	0.2 - 0.2	0.1 - 0.2	0.3 - 0.3	0.4 – 0.5
	Total Cost	**2.4 - 3.1**	**1.9 - 2.3**	**4.4 - 4.5**	**6.3 - 6.8**

** Full Build Total Cost includes Interim Incremental Cost and Full Build Incremental Cost, but not the cost of the Trend, as that is considered baseline.*

Key Assumptions

This analysis assumes that construction will begin in 2024 for both the Interim and Full Build scenarios, with construction lasting 10 years in each scenario. Construction spending is divided evenly across the construction

duration. O&M costs are assumed to be 0.5 percent of the total project cost per year. This analysis considers benefits accrued during the construction period as well as for 20 years after the construction completion date. The benefits accrued during the construction period are proportional to the total project costs spent; for example, this analysis assumes that 40 percent of the 2035 project benefits are realized during year 4 of the construction period. An annual discount rate of 4 percent is used. This analysis also assumes no growth in traffic following 2035, which is the forecast year for the travel demand model.

This BCA relies heavily on the outputs of the travel demand model, and results were produced on a segment-level. The segmented analysis divides the corridor into four regions: Southern Arizona, the Phoenix Metropolitan Area, Northern Arizona, and Southern Nevada. The results for these four segments are also aggregated and presented as corridor-wide results.

These results were based on the AZTDM2 model and the Regional Transportation Commission of Southern Nevada (RTC) model for southern Nevada. The AZTDM2 model is the second generation of the Arizona Statewide travel demand model. This model uses 2008 data as the existing conditions and forecasts conditions for 2035. AZTDM2 is a statewide model with an extended zone system covering all of North America. Given the high volume of through traffic to and from California and the rest of the country, capturing this long distance person and truck travel is critical to understanding the demand for highway facilities in Arizona.[1] AZTDM2 uses traffic analysis zones to describe trips. Specifically, using AZTDM2 allows for modeling intra-Arizona trips, Arizona-Nevada trips, and intra-Nevada trips. The RTC model also uses traffic analysis zones to describe trips, but it is a regional, rather than national, model.

For the three Arizona segments, the results focus only on the counties adjacent to the I-11 and Intermountain West Corridor: Pima and Santa Cruz counties in Southern Arizona, Maricopa and Pinal counties in the Phoenix Metropolitan Area, and Mohave and Yavapai counties in Northern Arizona. In Southern Nevada, travel demand results were produced for the entire network covered by the RTC model.

Table 3 shows the VMT and VHT for the entire network in the AZTDM2 model for the base year of 2008 and the forecast year of 2035. All scenarios show significant growth over existing conditions in 2008. For Southern Arizona and Northern Arizona, the VMT is the highest in the Interim Scenario. In the Phoenix Metro area and Southern Nevada, VMT is highest under the Full Build Scenario. Overall, Alternative BB-QQ results in the highest Southern Nevada VMT in the Interim Scenario, while Alternative Y results in the highest Southern Nevada VMT in the Full Build.

Table 3. AZTDM2 and RTC Model Segment-Level Outputs

Segment	2008 Existing Condition	2035 Trend Scenario	2035 Interim Scenario	2035 Full Build Scenario
Daily Vehicle Miles Traveled (thousands)				
Southern Arizona	19,301	26,925	26,937	26,921
Phoenix Metro	93,167	150,056	150,158	150,276
Northern Arizona	10,290	16,334	16,339	16,321
Southern Nevada - Alternative Y	35,625	56,352	56,454	56,561
Southern Nevada - Alternative Z	35,625	56,379	56,394	56,443
Southern Nevada - Alternative BB-QQ	35,625	56,410	56,496	56,516

[1] From "Development of the Arizona Statewide Travel Demand Model: Phase 2 (AZTDM2)." Prepared for the Arizona Department of Transportation, September 2011. Pages 11-13.

Table 3. AZTDM2 and RTC Model Segment-Level Outputs

Segment	2008 Existing Condition	2035 Trend Scenario	2035 Interim Scenario	2035 Full Build Scenario
Vehicle Hours Traveled (thousands)				
Southern Arizona	530	810	806	807
Phoenix Metro	2,935	4,383	4,380	4,351
Northern Arizona	220	374	374	373
Southern Nevada - Alternative Y	1,067	2,116	2,076	2,047
Southern Nevada - Alternative Z	1,067	2,097	2,086	2,070
Southern Nevada - Alternative BB-QQ	1,067	1,800	1,775	1,748

Note: The Southern Arizona results include VMT and VHT for all roadways within Pima and Santa Cruz counties, the Phoenix Metropolitan Area results include VMT and VHT for all roadways within Maricopa and Pinal counties, the Northern Arizona results include VMT and VHT for all roadways within Mohave and Yavapai counties, and the Southern Nevada results include network-level results for the RTC model.

Key Results and Conclusions

This section presents key BCA results and findings. Results are shown for each alternative, Interim and Full Build, as compared to the Trend Scenario. For example, the costs presented in **Table 4** are the costs of the Interim Scenario less the cost of building the Trend Scenario. Results are shown in both discounted and non-discounted terms; however, the concepts of Net Present Value and Benefit/Cost Ratio are only presented for the discounted results.

Results are also presented for each segment of the project. These results should *not* be interpreted as the benefits and costs of developing any single segment in isolation as these segmented results assume that all improvements are completed within the same 10-year construction period beginning in 2024. Calculating a benefit-cost ratio for any individual segment would overstate the benefits of that segment; this is because the level of traffic estimated in the travel demand model assumes that all improvements are made concurrently. Instead, the segmented results illustrate the relative benefits that accrue to the various segments by developing the entire I-11 and Intermountain West Corridor.

Table 4 shows the discounted benefits and costs by category for the Interim Scenario relative to the Trend Scenario.

On the Southern Arizona Segment, travel time savings is the largest benefit category with $317.8 million in benefits, followed by $122.1 million in freight logistics benefits and $80.2 million in safety benefits. In Phoenix, safety benefits are the largest category with $442.6 million, followed closely by $436.0 million in travel time savings benefits. In Northern Arizona, safety benefits are the largest category, while travel time savings is the largest benefit category in Southern Nevada.

Table 4. Benefits and Costs By Category for the Interim Scenario, Discounted, Millions of 2013 Dollars

Benefit Cost Analysis Summary	Interim Southern AZ	Interim Phoenix Metro	Interim Northern AZ	Interim Southern NV	Interim I-11 Corridor
Discounted Total Benefits, $2013 Million	**524.0**	**898.1**	**62.7**	**1,291 – 4,130**	**2,776 – 5,615**
Travel Time Savings	317.8	436.0	8.3	866 – 3,177	1,628 – 3,939
Vehicle Operating Cost Savings	5.4	1.2	-0.4	100 - 325	106 - 331
Economic Value of Induced Trips	0.1	0.1	0.0	0 - 3	0 - 3
Safety Benefits	80.2	442.6	48.4	160 - 182	731 - 753
Emissions Cost Savings	-1.5	-12.6	-0.5	-13 - -2	-28 - -17
Freight Logistics Benefits	122.1	30.8	6.9	130 - 478	289 - 638
Discounted Total Costs, $2013 Million	**158.5**	**1,319.4**	**229.4**	**168 - 630**	**1,875 – 2,337**
Capital	146.4	1,218.9	211.9	155 - 582	1,732 – 2,159
O&M	12.1	100.5	17.5	13 - 48	143 - 178
Summary Metrics					
Net Present Value	**365.5**	**-421.3**	**-166.7**	**662 – 3,962**	**439 – 3,740**
Benefit/Cost Ratio	**3.3**	**0.7**	**0.3**	**2.1 - 24.7**	**1.2 – 3.0**

Note: All benefits and costs were estimated relative to the Trend Scenario.

Overall, the project has a net present value between $425 million and $3.7 billion depending on the Las Vegas alternative selected. The benefit-cost ratio for the project is estimated between 1.2 and 3.0. Standard BCA methodology dictates that BCRs are calculated using discounted costs.

Table 5 shows the non-discounted benefits and costs by category for the Interim Scenario relative to the Trend Scenario. Overall, the Interim Scenario will generate between $8.5 billion and $17.2 billion in benefits, at a cost between $3.6 billion to $4.4 billion more than the Trend Scenario.

Table 5. Benefits and Costs By Category for the Interim Scenario, Not Discounted, Millions of 2013 Dollars

Benefit Cost Analysis Summary	Interim Southern AZ	Interim Phoenix Metro	Interim Northern AZ	Interim Southern NV	Interim I-11 Corridor
Non Discounted Total Benefits, $2013 Million	**1,606.1**	**2,723.5**	**189.4**	**3,946 – 12,644**	**8,465 – 17,163**
Travel Time Savings	967.9	1,327.4	25.4	2,644 – 9,706	4,965 – 12,026
Vehicle Operating Cost Savings	16.6	2.1	-0.9	300 - 961	318 - 979
Economic Value of Induced Trips	0.2	0.4	0.0	0 - 9	1 - 10
Safety Benefits	237.4	1,313.6	143.8	474 - 539	2,169 – 2,234
Emissions Cost Savings	-2.1	-17.4	-0.7	-18 - -3	-38 - -23
Freight Logistics Benefits	386.0	97.4	21.8	409 – 1,512	915 – 2,018
Non Discounted Total Costs, $2013 Million	**301.3**	**2,508.1**	**436.1**	**318 – 1,197**	**3,564 – 4,442**
Capital	267.2	2,224.5	386.8	282 – 1,061	3,161 – 3,940
O&M	34.1	283.6	49.3	36 - 135	403 - 502

Table 6 shows the discounted benefits and costs by category for the Full Build Scenario relative to the Trend Scenario.

Overall, the project has a net present value between $1.7 billion and $6.4 billion depending on the Las Vegas alternative selected. The benefit-cost ratio for the Full Build Scenario is estimated between 1.3 and 2.0. Standard BCA methodology dictates that BCRs are calculated using discounted costs.

Table 6. Benefits and Costs By Category for the Full Build Scenario, Discounted, Millions of 2013 Dollars

Benefit Cost Analysis Summary	Full Build Southern AZ	Full Build Phoenix Metro	Full Build Northern AZ	Full Build Southern NV	Full Build I-11 Corridor
Discounted Total Benefits, $2013 Million	**560.9**	**4,437.0**	**249.5**	**3,234 – 7,550**	**8,482 – 12,798**
Travel Time Savings	210.0	2,800.0	51.0	2,152 – 5,566	5,213 – 8,627
Vehicle Operating Cost Savings	2.9	-7.9	-6.8	182 - 604	170 - 592
Economic Value of Induced Trips	0.0	2.0	0.0	1 - 11	3 - 13
Safety Benefits	267.0	1,470.7	161.4	525 - 553	2,424 – 2,452
Emissions Cost Savings	$0.5	-27.1	1.3	-27 - -8	-52 - -34
Freight Logistics Benefits	$80.5	199.3	42.5	325 - 851	647 – 1,174
Discounted Total Costs, $2013 Million	**971.7**	**3,433.0**	**1,516.9**	**403 - 834**	**6,324 – 6,756**
Capital	897.7	3,171.4	1,401.3	372 - 771	5,842 - 6,241
O&M	74.0	261.6	115.6	31 - 64	$482 - 515
Summary Metrics					
Net Present Value	**-410.9**	**1,004.0**	**-1,267.4**	**2,400 – 7,148**	**1,726 – 6,474**
Benefit/Cost Ratio	**0.6**	**1.3**	**0.2**	**3.9 - 18.8**	**1.3 – 2.0**

Note: All benefits and costs were estimated relative to the Trend Scenario.

Table 7 shows the non-discounted benefits and costs by category for the Full Build Scenario relative to the Trend Scenario. Overall, the Full Build Scenario will generate between $25.7 billion and $39.0 billion in benefits, at a cost between $12.0 billion to $12.9 billion more than the Trend Scenario.

Table 7. Benefits and Costs By Category for the Full Build Scenario, Not Discounted, Millions of 2013 Dollars

Benefit Cost Analysis Summary	Full Build Southern AZ	Full Build Phoenix Metro	Full Build Northern AZ	Full Build Southern NV	Full Build I-11 Corridor
Non Discounted Total Benefits, $2013 Million	**1,694.4**	**13,458.1**	**750.4**	**9,871 – 23,112**	**25,774 – 39,014**
Travel Time Savings	639.4	8,524.7	155.6	6,573 – 17,001	15,893 – 26,321
Vehicle Operating Cost Savings	8.9	-30.7	-20.4	544 - 1804	502 - 1762
Economic Value of Induced Trips	0.0	6.1	0.0	4 - 34	10 - 40
Safety Benefits	790.8	4,365.5	479.1	1,558 – 1,640	7,194 – 7,275
Emissions Cost Savings	0.7	-37.5	1.8	-37 - -12	-72 - -47
Freight Logistics Benefits	254.5	630.0	134.3	1,026 – 2,691	2,045 – 3,710
Non Discounted Total Costs, $2013 Million	**1,847.2**	**6,525.7**	**2,883.5**	**765 – 1,586**	**12,022 – 12,842**
Capital	1,638.3	5,787.8	2,557.4	679 – 1,407	10,662 – 11,390
O&M	208.9	737.9	326.1	87 - 179	1,359 – 1,452

Appendix B
Technical Memorandum
Impacts of a New Highway or Highway Improvements on Economy

I-11 and Intermountain West Corridor Study

Technical Memorandum: Impacts of a New Highway or Highway Improvements on Economy

Prepared for

Nevada DOT and ADOT

August 2013

Contents

Figure

Tables

1. General Impact of Interstate 11

The purpose of this technical memorandum is to review the available literature on the regional impacts of a new highway or highway improvements in terms of economic growth, economic development, reduced commuting times and costs, and other benefits. In the past, transportation agencies decided on transportation project priorities and investments, based on traffic needs, safety, and quality of life; today, however, agencies are more sensitive to the economic development potential of increased transportation investments. These investments can enhance job growth, income, and a region's tax-base.

Multiple methodologies exist for measuring these impacts; some of the most popular are discussed in this technical memorandum. Common methodologies include Cost-Effectiveness, Benefit-Cost Analysis, Lifecycle Cost Analysis and Multiple Accounts Analysis.

It is important to consider multiple cost and benefit components in conducting these studies. Some costs include downstream congestion (increased capacity may increase volume), parking costs (better capacity creates additional trips, which may increase parking demand), roadway impacts (larger vehicles require additional roadway services and damage roads), traffic impacts on non-motorized vehicles (discomfort and safety of pedestrians and cyclists), vehicle depreciation (increased trips may increase the vehicle maintenance costs), , land use objectives (reducing or creating sprawl, fit with existing strategic land use objectives), and construction delays and impacts. Benefits of transportation investments may include shifts in vehicle ownership (improved transportation can reduce demand for multiple vehicles per family), environmental impacts (benefits from reduced idling and costs of development of open space and noise pollution), other consumer benefits (reduced commuting times and savings on gas, vehicle maintenance and depreciation), and economic benefits (increased productivity and reduced transportation costs) ((Litman 2006).

A study of a proposed 200-mile-long, four-lane highway across north-central Wisconsin (Weisbrod and Beckwith 1992) involved creating a computerized traffic simulation model of the entire state, an economic forecasting and simulation model sensitive to business growth impacts due to changes in transportation costs, an industry screening analysis for identifying new business attraction impacts due to changes in inter-industry sales and supply patterns, and a tourism market forecasting model incorporating relative differences in travel time among surrounding tourist locations. The study considered five transportation improvement scenarios, ranging from road improvements to meet existing traffic to a full-service highway spanning the entire proposed distance.

The Wisconsin study found multiple quantitative benefits resulting from each proposed improvement scenario. The highest benefits came from the full-service highway scenario, with the current value of total benefits estimated at $846 million (1987 dollars). This estimate included business expansion due to truck transportation cost savings ($164 million), additional industry attraction ($218 million), increased tourism ($56 million), value of auto travel time savings net of operating costs ($270 million), and value of auto accident reduction ($138 million). Most importantly, the study found that improving the transportation in the area through improved infrastructure, such as the freeway, increased the region's economic development potential by attracting new industries and tourism to the area.

A paper prepared by the Washington State Department of Transportation reviewed multiple transportation studies and concluded that improvements to surface transportation systems increase economic output, reduce prices, and raise incomes and profits. The study found that transportation contributes economic returns for virtually every person and business in the impacted region. Other studies show that state and national investments in transportation have measurable benefits to the economy. One finding is that each $1 billion of federal highway investment generates 47,500 jobs: 26,500 jobs as roads and bridges are built and an additional 21,000 jobs as those who earn their money directly from transportation activity buy goods and services (Poor et al. 2008).

A paper by Weisbrod and Treyz (1999) found that highway system improvements can reduce business costs of current operations or provide new opportunities for production economies associated with expanding operations. Under either scenario, the region will benefit from increased income and higher levels of business activity through reduced travel costs for existing trips, reduced inventory and logistic costs, and greater operating scale and accessibility economies.

A study by Weisbrod and Grovak (1998) compared the impacts of an expansion of an existing highway segment using different economic methodologies.

- Using the System Efficiency (User Benefit) Analysis, they found the greatest benefits came in terms of improved safety, with modest benefits from reduced travel time and vehicle operating costs. Trips originating in the study area were found to have a reduction of 60 percent in terms of travel distance and 55 percent in terms of travel time savings. Total annual user benefits were estimated at $13 million.
- Using the Macro-Economic Simulation Modeling methodology, Weisbrod and Grovak found the highway would help create more than 400 jobs once the project was completed, growing to 500 jobs by year 25. Associated with the job growth was an increase in personal income of up to $20 million per year.
- Using the Productivity Analysis methodology, Weisbrod and Grovak found that if the project were to add $129 million of highway capital (project construction cost) with a typical return on investment, the marginal benefit on national businesses can be estimated at $11.6 million per year.

In another paper, Weisbrod (1996) focused specifically on business impacts of transportation investment. The impact estimates and forecasts summarized in this paper are in terms of estimates of the shifts in business sales volumes and employment by type of business (SIC codes). The two business types expected to benefit from transportation investment are passenger-related commercial businesses and freight-related businesses.

A report summarizing discussions and presentations from the Transportation Improvement Program Development Committee (Michigan) meetings in 2004 and 2005 discussed a number of issues associated with lack of transportation investment. The report noted that congestion reduced business accessibility to skilled employees, to parts for manufacturing final goods and for shipping goods to a wide array of markets. Congestion translated to extra costs in terms of both time and opportunity. Higher production and operations costs reduced schedule reliability and reduced access, making businesses less competitive when compared to regions with better transportation networks, reducing the location's attractiveness and competitive advantage in the area of economic development.

Congestion also impacts a business' bottom line. Production costs can rise due to high transportation costs of raw materials. Transportation reliability problems can lead to increased inventory costs, with businesses forced to carry additional inventory to meet customer demand for products. Labor costs may also go up to attract competitive employees to the area. Finally, congestion can add to commuting costs. According to a report by the Southeast Michigan Council of Governments (SEMCOG), congestion cost about $63.1 billion for travelers in the nation's 85 largest urban areas in 2003. The average annual cost to a traveler in these areas was about $794 for wasted fuel and time stuck in peak-hour traffic. Travelers in the Detroit area had an added cost of about $499, eighth in the country, due to congestion (SEMCOG 2006).

A study by the Eno Center for Transportation (2012) found that the principal economic benefits of transportation investment were as follows:

- Creates jobs while boosting industrial competitiveness and productivity
- Enhances household wellbeing
- Strengthens local, regional, and state economies
- Boosts state tax revenues
- Facilitates business and leisure travel
- Reduces economic losses associated with crashes

- Reduces economic losses associated with congestion

A study by Hodge et al. (2003) also discussed the importance of the transportation infrastructure on businesses. According to their study, the literature on industrial site location commonly cites transportation infrastructure and access to markets as key determinants of business location. Their study, which examined the potential for business attraction to the region due to infrastructure improvements, found that:

- The economy of the study region (North Country, New York) is and has been struggling relative to the economy of the rest of New York and other nearby regional economies.
- A lack of strong transportation access inhibits its chances for economic vitality.

The study also found that a transportation project may have job growth benefits ranging from roughly 750 to 4,000 new jobs, depending on the alignment and highway design, as well as improve the competitiveness of area businesses. The study recognized that the actual project impact will vary due to a number of factors such as the project design and ability of local industrial developers, corresponding investments in other infrastructure (for example, water and sewer, building space, and telecommunications), and labor force training. The study's main finding was the importance of improving the connections to labor, customers, tourism, and to buyer and supplier markets.

Another study (Wisconsin 2007) found that transportation projects can impact economic development in four ways, both short- and long-term:

- Construction benefits from the purchase of materials and hiring of workers directly caused by the construction project.
- Business expansion resulting from reduced business costs because of improved travel times and vehicle operating costs; this also includes the increased household buying ability due to time and cost savings on travel.
- Business attraction from capturing the effects of expanded market size for labor and suppliers beyond direct business cost benefits; it may also cause geographic shifts in population and employment.
- Tourism impacts that primarily refer to the increase in visiting trips due to improved transportation access and the rise in business sales due to higher visitor spending.

A study conducted for the Port of Portland and the Portland Business Alliance (EDRGI 2008) focused on the types of impacts generated by transportation investments by the freight system needs of an area. For example, regions with "just-in-time" manufacturing facilities will benefit from transportation infrastructure improvements in the following ways:

- Freight cost changes due to time savings and enhanced reliability
- Freight and passenger operating cost changes
- Truck concentration serving the industrial area
- Time and cost impact of size and weight restriction
- Accident cost impact
- Local airport connectivity
- Interstate highway connectivity
- Overseas air gateway connectivity

Having an improved transportation infrastructure will make a region more attractive to a business participating in just-in-time manufacturing. Positive impacts are similar for a distribution center with the addition of the importance of connectivity to rail, international borders, and overseas sea gateways. An employment center will also see benefits in the passenger value of time savings and enhanced reliability.

In less general terms, a study of the results of completing the Appalachian Development Highway System (ADHS) found impacts in terms of time, user, and accessibility benefits. For time benefits, the study found that vehicle hours traveled (VHT) (travel-time measure) forecasted across all vehicles types is estimated to be approximately 303,000 per day in 2020 and 758,000 per day by 2035. In annual terms, this corresponds to approximately 212 million fewer VHTs in 2035 as the growth in travel time savings from 2020 to 2035 reflects savings compared to traffic volumes and congestion without the completed corridors.

A significant share of the total VHT savings is for freight truck trips due to the long-distance nature of the trips, strong annual growth in freight truck tonnage (2.5 percent per year), and strong diversion to significantly faster and/or more direct routes.

Over the same period, total vehicle miles of travel (VMT) (miles-traveled measure) across the entire highway network is projected to increase slightly by 2035 after an initial decline in 2020. This increase is driven by growth in VMT for the automobile trip category. Route diversion for auto trips onto the ADHS corridors is projected to substantially increase projected VMT on ADHS highways. The increase in VMT on ADHS completed corridors is 124 percent in 2020 and 142 percent in 2035, indicative of improved travel performance on these routes. Changes in VMT due to ADHS completion can stem from two dynamics: reductions in VMT based on the use of more direct routes offered by ADHS corridors and increases in VMT as some trips divert from more direct but slower local roads to faster but less direct ADHS corridors.

In terms of user benefits due to highway improvements, the study focused on the following areas: travel time savings, operating costs, emissions cost, and safety. The study estimated approximately $1.4 billion in user benefits with a significant share of benefits accruing to the non-freight truck categories. According to the study, in 2020, freight trucks would benefit through savings of $376 million; non-freight trucks, $511 million; business automobiles, $79 million; and non-business automobiles, $392 million.

In addition to the traditional user benefits, the impacts from improved reliability of transportation as a result of the project were estimated. Reliability benefits are based on the concept that extra time needs to be planned to be on time at least 95 percent of the time. For the entire ADHS region, reliability benefits were estimated as equal to between $2.2 billion and $2.4 billion in 2020 and figures roughly five times as large in 2035. The majority of these reliability benefits in 2035 accrued to freight trucks.

An important benefit of transportation investments, and one of importance to economic development, is accessibility. As noted, transportation investments increased a region's accessibility to workforce, employment centers, transportation facilities (airports and rail system), markets, and other points of significance. The ADHS study found that by reducing travel times, the completion of a highway system will effectively enlarge the catchment areas on which businesses can draw labor, customers, and suppliers. Specifically, population accessibility increased by 3.7 percent as a result of ADHS completion, while employment accessibility increased by 4.6 percent (CSI 2008).

A study of increasing investment in the Wisconsin State Truck Highway (WSTH) System (CSI 2003) identified the following benefits:

- $7.0 billion in savings for everyday personal trips such as driving to work, doing errands, or visiting friends.
- $1.5 billion in savings by business persons and truckers while on the clock. The on the clock portion of the benefits (the $1.5 billion) would allow Wisconsin businesses to increase output, hire additional workers, and eventually increase Wisconsin residents' disposable personal income by $2.7 billion.

Therefore, the total benefits of the additional investment are the sum of the $7 billion for personal trips, plus the $2.7 billion of benefits (macroeconomic impacts) created from greater business efficiencies for a total of $9.7 billion. The benefits ($9.7 billion) of additional investment ($3.2 billion) translate into measurable and significant results. For every dollar of additional investment in the WSTH System beyond that needed to maintain current conditions, Wisconsin would enjoy $3 of benefit.

The study also demonstrated that additional highway investment leads to an increase in permanent new jobs. On an average annual basis, 4,800 more jobs would exist in Wisconsin if the additional investment were made because highway investment reduces the cost of doing business in Wisconsin.

The Best Investment A Nation Ever Made (Cox 1996) provides a comprehensive look at the benefits of infrastructure investment. The report discusses the impact of the Dwight D. Eisenhower System of Interstate and Defense Highways at its 40th anniversary as of 1996. Interesting report findings are that the road system has:

- Saved the lives of an estimated 187,000 people and prevented injuries to another 12 million
- Returned more than $6 in increased economic productivity for each $1 spent on construction
- Had numerous intangible impacts such as increased international competitiveness, personal mobility, and international security

The report discusses these impacts by state. For Nevada, the report estimates the number of roadway fatalities was reduced by 80 in 1994, and by 1,600 over the 40-year period, by the use of the Interstate Highway System. This resulted in the fatalities-avoided ratio per 1,000 population of 2.13, compared to the national ratio of 0.86. Additionally, injuries in Nevada were reduced by an estimated 3,800 in 1994 and 70,000 over the 40-year period. In Arizona, the use of the Interstate Highway System reduced the number of roadway fatalities by 170 in 1994 and by 4,200 over the 40-year period, resulting in a fatalities-avoided ratio per 1,000 population of 1.7. Injuries in Arizona were reduced by an estimated 4,800 in 1994 and 103,000 over the 40-year period.

Finally, the report estimated the economic loss attributable to the use of the Interstate Highway System was reduced by $180 million in Nevada and $300 million in Arizona in 1994 (in 1996 dollars) and quality of life was improved by $580 million in Nevada and $950 million in Arizona in 1994. Between 1957 and 1996, economic loss in Nevada was reduced by $2.6 billion, the equivalent of $3,500 per capita and in Arizona the economic loss was reduced by $5.2 billion, the equivalent of $2,100 per capita. These figures are greater than the national per capita amount of $1,700.

Overall, infrastructure investment has been shown to have a positive impact on economic growth, productivity and return on investment. According to the Eno Transportation Foundation, Inc. 1996 report, *Economic Returns From Transportation Investment*, that discusses various infrastructure studies, social rates of return on infrastructure investment are significant and positive, and infrastructure investment has helped raise the nation's productivity and reduce its costs of doing business.

An important conclusion of the Eno Transportation Foundation, Inc. study is that an increase in infrastructure investment reduces costs (shown as Price Changes) in almost all manufacturing industries and in many service industries (as shown in **Table 1)**, which also shows a corresponding increase in productivity.

Table 1. Contributions of Highway Capital and Other Factors to Productivity

	Annual Growth Rates				
	1952-1989	1952-1963	1964-1972	1973-1979	1980-1989
Total Factor Productivity	0.68%	0.94%	1.03%	0.13%	0.42%
Exogenous Demand	0.60	0.30	0.60	0.75	0.84
Highway Capital	0.17	0.30	0.26	0.03	0.03
Price Changes	-0.06	-0.06	-0.10	-1.70	0.07

Source: Eno Transportation Foundation, Inc. 1996

[1] Exogenous demand for goods and services is a function of changes in population and aggregate income on the demand side

[2] Price Changes are the change in relative prices of such key inputs for an industry as raw materials and intermediate products

The report also found, however, that the impacts of transportation vary widely from time to time and from place to place. Social rates of return have fallen rapidly in the past and vary according to place and the economic environment. The construction of new roads has a significant impact on the regions, but eventually new roads are merely substitutes for older ones as areas mature. To maximize the positive economic impacts of transportation investments, the report recommends an examination of how and when this effect is likely to occur.

Summary

Investment in transportation infrastructure is shown to generate significant benefits for a region's economy. Improved transportation networks save time and money for area residents and businesses, provide additional accessibility to commercial markets, make the region more attractive to employees and businesses and improve business operations. Industries most directly impacted by transportation investment are transportation, warehousing/logistics, and manufacturing.

References

Cox 1996. The Best Investment a National Ever Made: A Tribute to the Dwight D. Eisenhower System of Interstate and Defense Highways. Diane Publishing Company. May.

CSI 2003. Cambridge Systematics, Inc. (CSI). "Transportation Improvements Grow Wisconsin's Economy: The Economic Benefits of Transportation Investments." Prepared for Transportation Development Association of Wisconsin. February.

CSI 2008. Cambridge Systematics, Inc. (CSI)/Economic Development Research Group, Inc./HDR Decision Economics. "Economic Impact Study of Completing the Appalachian Development Highway System." June.

EDRGI 2008. Economic Development Research Group, Inc. (EDRGI) "Use of Freight and Business Impact Criteria for Evaluating Transportation Investments." Prepared for Port of Portland and Portland Business Alliance. August.

Eno 2012. "Better Use of Public Dollars: Economic Analysis in Transportation Decision Making." Eno Center for Transportation. June.

Eno Transportation Foundation, Inc. 1996. "Economic Returns From Transportation Investment." April 5.

Hodge et al. 2003. Hodge, Daniel J., Glen Weisbrod, and Arno Hart. "Do New Highways Attract Businesses? Case Study for North Country." Transportation Research Record 1839, Paper No. 03-4148.

Litman, Todd. 2006. "What's It Worth? Economic Evaluation for Transportation Decision-Making." Victoria Transport Policy Institute. July.

Poor et al. 2008. Poor, Aaron, Kathy Lindquist, and Michel Wendt. "Transportation's Link to the Economy: Synthesis." Prepared as a Transportation Synthesis Report. April 18.

Southeast Michigan Council of Governments (SEMCOG) 2006. "Transportation Funding: A Critical Economic Issue for Southeast Michigan." Proceedings of the Transportation Funding Discussion Series. June.

Weisbrod, Glen. 1996. "Distinguishing the Broad and Local Impacts of Transportation Investments." Transportation Research Board Annual Meeting. January.

Weisbrod, Glen and James Beckwith. 1992. "Measuring Economic Development Benefits for Highway Decision-Making: The Wisconsin Case." Transportation Quarterly, Volume 46, Number 1. January.

Weisbrod, Glen and Michael Grovak. 1998. "Comparing Approaches for Valuing Economic Development Benefits of Transportation Projects." Transportation Research Board 77th Annual Meeting, January.

Weisbrod, Glen and Frederick Treyz. 1999. "Productivity and Accessibility: Bridging Project-Specific and Macroeconomic Analyses of Transportation Investments."

Wisconsin 2007. “An Evaluation of the Business Attraction Module in Montana’s Highway Economic Analysis Tool-Project 07-03.” Midwest Regional University Transportation Center, College of Engineering Department of Civil and Environmental Engineering. University of Wisconsin, Madison. November.

2. Impact on Nevada

Given the benefits of transportation investments, as summarized in Section 1, the benefits of the investing in the extension of I-11 through Nevada is expected to be significant in terms of industry diversification, economic development, and benefits to local firms' supply chain and logistics practices. The analysis in this section looks at the existing make-up of the Nevada economy, by industry employment, and discusses import gaps, especially those in the industries directly affected by transportation investments (transportation, warehouse/distribution, and manufacturing) to determine whether and how additional investment in Nevada's transportation infrastructure can impact the state's economy.

Transportation Inventory

Nevada has a diverse geography, spanning 110,567 miles, making it the nation's 7th largest state.[1] It is bordered by Oregon and Idaho on the north, California on the west, Utah on the east, and Arizona to the south. Nevada has two main airports: one in the north (Reno) and one in the south (Las Vegas).

According to the Nevada Department of Transportation, Nevada has 5 interstate routes (15, 80, 215, 515, and 580), 7 US routes (6, 50, 50A, 93, 93A, 95, and 95A), 193 state routes and numerous frontage roads.[2] A map of the state's major highways is shown on **Figure 1**.

Industry Concentration

Nevada's economy is highly concentrated in the services industries, with 25.3 percent of total 2012 employment in the Accommodation and Food Services industry and another 12.1 percent in the Retail Trade industry. **Table 2** shows the number of establishments, average number of employees and average annual wage, by industry, for the state as of 4th Quarter 2012.[3] With average annual wages of $30,782 and $28,874, respectively, these two industries pay wages well below the state average of $45,632.

1 Netscape.com.

2 "State Maintained Highways of Nevada-Descriptions and Maps." Nevada Department of Transportation, January 2013.

3 Department of Employment, Training and Rehabilitation.

Figure 1. Nevada Highway Roadmap[4]

[4] Geology.com

Table 2. Nevada Establishments, Employees, and Wages, by Industry–4th Quarter 2012

NAICS Code	NAICS Definition	No. Of Establishments	Average Employees	Empl. % of Total	Average Annual Wage ($)
11	Agriculture, Forestry, Fishing, and Hunting	296	2,194	0.19	39,644
21	Mining, Quarrying, and Oil and Gas Extraction	298	15,596	1.36	83,824
22	Utilities	146	5,304	0.46	85,122
23	Construction	5,866	54,635	4.76	55,052
31-33	Manufacturing	1,887	39,586	3.45	56,953
42	Wholesale Trade	4,993	32,785	2.86	69,946
44-45	Retail Trade	8,086	138,358	12.06	28,874
48-49	Transportation and Warehousing	2,080	53,428	4.66	42,862
51	Information	1,331	14,527	1.27	58,822
52	Finance and Insurance	4,512	31,029	2.70	64,664
53	Real Estate and Rental and Leasing	4,109	22,134	1.93	42,900
54	Professional, Scientific, and Technical Services	10,412	48,520	4.23	80,474
55	Management of Companies and Enterprises Administrative and Support and Waste	1,926	19,768	1.72	116,636
56	Administrative and Support and Waste Management and Remediation Services	5,562	79,130	6.90	30,788
61	Educational Services	978	74,750	6.51	43,087
62	Health Care and Social Assistance	6,965	107,892	9.40	55,178
71	Arts, Entertainment, and Recreation	1,655	27,593	2.40	35,477
72	Accommodation and Food Services	5,936	290,661	25.33	30,782
81	Other Services (except Public Administration)	4,641	29,115	2.54	33,780
92	Public Administration	831	59,466	5.18	62,018
99	Unclassified	884	1,000	0.09	75,402
Total		**73,394**	**1,147,471**		**$45,632**

Source: Nevada Department of Employment, Training and Rehabilitation.

The industries shown to be most impacted by transportation investments (manufacturing, transportation, and warehousing/distribution) make up a small share of total state employment at 3.5 percent for Manufacturing and 4.7 percent for Transportation and Warehousing. However, Manufacturing wages exceed the state average at $56,953, and Transportation and Warehousing wages are only slightly below the state average at $42,862. Attracting companies in these industries would provide a benefit to Nevada in terms of higher wages for its residents.

Geographic Markets

Nevada is an active participant in domestic and foreign imports and exports. According to data provided by the U.S. Department of Transportation, the highest number of inbound and outbound shipments outside of Nevada are to/from California, with 22.9 percent of the value of all shipments out of Nevada and 29.7 percent of the value of all shipments into Nevada (see **Table 3**). Other neighboring states also participate in imports and exports with Nevada. Utah makes up 11.6 percent of all value of shipments from Nevada, and Arizona accounts for 4.3 percent of all shipments into the state.[5]

5 "2007 Commodity Flow Survey: State – Nevada." US Department of Transportation, Bureau of Transportation Statistics. July 2010.

Table 3. State of Nevada Domestic Shipments

State	Outbound Value		Inbound Value	
	2007 (million $)	% of Total	2007 (million $)	% of Total
All States	53,126	100.0	77,230	100.0
Arizona	1,875	3.5	3,329	4.3
California	12,155	22.9	22,913	29.7
Idaho	432	0.8	358	0.5
Nevada	18,355	34.5	18,355	23.8
Oregon	1,416	2.7	826	1.1

Source: U.S. Department of Transportation, Bureau of Transportation Statistics

A highway system that facilitates transportation between Arizona, Nevada, and California will help enhance Nevada's ability to transport shipments through and outside the state, increasing its competitiveness in the export/import market.

Export Enhancement

As an important part of economic development, export enhancement attempts to increase export sales to buyers outside a region. Export sales by Nevada's industries bring dollars into the economy to provide growth for future economic expansion. An effective economic development strategy seeks to expand the exports of specific sectors, which could enhance future and additional economic development.

Table 4 compares the top 25 industries in Nevada by value of exports, both domestic and foreign, by industry. The table shows Nevada businesses exported a total of $67.6 billion in 2011. Of the top 25 industries, by value of imports, the majority are exports from service-related industries. Of note is the $1.0 billion in exports by the transit and ground passenger transportation industry, indicating that the capacity for the creation and export of transportation services exists in the state; this potential has not been used to the same degree as other industries, such as mining and accommodations.

Table 4. Top 25 Industries by Value of Exports -Nevada[6]

Industry Code	Description	Domestic Exports ($)	Foreign Exports ($)	Total Exports ($)
411	Hotels and motels, including casino hotels	15,791,226,318	1,500,863	15,792,727,181
24	Mining gold, silver, and other metal ore	5,008,466,801	845,254,250	5,853,721,050
409	Amusement parks, arcades, and gambling industries	3,734,103,271	--	3,734,103,271
413	Food services and drinking places	3,482,440,106	13,281,137	3,495,721,243
381	Management of companies and enterprises	1,638,900,513	714,085,999	2,352,986,511
360	Real estate establishments	2,201,348,145	12,156,863	2,213,505,008
338	Scenic and sightseeing transportation and support activities for transportation	1,328,044,363	645,058,669	1,973,103,032
359	Funds, trusts, and other financial vehicles	1,897,653,809	--	1,897,653,809
319	Wholesale trade businesses	606,947,754	772,780,518	1,379,728,271
317	All other miscellaneous manufacturing	997,519,025	242,467,784	1,239,986,808
332	Transport by air	715,283,447	481,712,799	1,196,996,246
336	Transit and ground passenger transportation	1,019,346,191	--	1,019,346,191
389	Other support services	963,705,181	4,756,288	968,461,469

6 IMPLAN Model, 2011 data.

Table 4. Top 25 Industries by Value of Exports -Nevada[6]

Industry Code	Description	Domestic Exports ($)	Foreign Exports ($)	Total Exports ($)
327	Retail Stores - Clothing and clothing accessories	708,966,125	--	708,966,125
178	Nonferrous metal (except copper and aluminum) rolling, drawing, extruding and alloy	369,678,356	330,226,677	699,905,033
331	Retail Nonstores - Direct and electronic sales	698,434,143	--	698,434,143
32	Natural gas distribution	639,159,558	878,215	640,037,773
366	Lessors of nonfinancial intangible assets	101,743,408	447,547,943	549,291,351
30	Support activities for other mining	514,760,723	126,374	514,887,097
355	Nondepository credit intermediation and related activities	470,757,490	40,029,376	510,786,865
356	Securities, commodity contracts, investments, and related activities	313,332,766	191,120,132	504,452,898
10	All other crop farming	441,270,317	34,942,841	476,213,158
367	Legal services	380,609,131	80,432,175	461,041,306
133	Pharmaceutical preparation manufacturing	377,392,616	58,179,351	435,571,967
354	Monetary authorities and depository credit intermediation activities	175,829,544	250,522,934	426,352,478
	Other industries	14,644,064,555	3,218,968,157	17,863,032,712
	Total	**59,220,983,656**	**8,386,029,342**	**67,607,012,998**

Source: 2011, State of Nevada input-output model, IMPLAN.

Import Substitution

Import substitution is another important aspect of economic development because it attempts to stem the outflow of money from the state and provides information necessary to attract companies that produce imported goods and services. An important location consideration for many industries is the size of the local market for an industry's products. One measure of potential local market size is the dollar value of imports of an industry's product to Nevada. The potential to substitute for Nevada's imports may make the region an attractive location for companies.

The IMPLAN software estimates two types of imports. Non-competitive imports are imports for which there is no production in the Nevada economy. Competitive imports are imports of goods and services that are also produced locally. Import information provided by the IMPLAN model can be used to identify potential gaps and disconnects in the local economy that can serve as a starting point for economic development strategies. These gaps and disconnects can occur for two reasons. First, a given industry in Nevada may demand a certain good or service as an input into its production process. For some industries, certain inputs may not be available in the Nevada economy and must be imported into the state. This type of import can be classified as a gap in a local economy.

Second, the good or service that a given industry may demand is produced in Nevada, but is also imported for some reason. This type of import is often referred to as a disconnect in the local economy. An import substitution analysis can identify these disconnects, providing information for the economic development entities to investigate its causes.

While methods outlined in this technical memorandum serve as a starting point to identify specific industries, some gaps and disconnects are logical once they are further explored. In some instances, because of governmental, physical, or other limitations, a gap cannot be addressed. A disconnect may not be overcome, for example, if the quality of input required by a local business cannot be produced by the local input supplier. Additional research and analysis must be performed for the individual industries to determine the actual causes of the gaps and disconnects in the economy.However, an improved inter- and intra-state transportation system can facilitate both export enhancement, allowing local industries to ship their goods outside of the State, and import

substitution, allowing production to occur locally and create cheaper distribution of goods within the State, making the State more attractive to new firms.

Non-Competitive Imports

Table 5 shows all non-competitive import gaps for Nevada. Many of these are manufactured and agriculture-related products. These are products for which no local production is available and provide the first steps in identifying companies suitable for import substitution. The amount of imports for each product indicates the level of locally unmet demand for this product, an important piece of information for producers of these products considering locating in the state.

Table 5. Non-Competitive Commodity Imports for Nevada[7]

Commodity Code	Description	Intermediate Imports ($)	Institutional Imports ($)	Total Imports ($)
3433	Used and secondhand goods	28,214,304	387,684,235	415,898,529
3072	Wine and brandies	29,310,688	143,868,912	173,179,596
3265	Other major household appliances	10,444,997	40,345,612	50,790,607
3104	Wood pulp	46,222,576	-	46,222,576
3184	Cutlery, utensils, pots, and pans	6,259,037	27,489,336	33,748,371
3049	Refined sugar from sugar beets	16,127,968	16,701,235	32,829,201
3048	Raw and refined sugar from sugar cane	14,813,799	15,854,301	30,668,100
3259	Electric lamp bulbs and parts	5,829,622	23,208,889	29,038,511
3018	Wild game products, pelts, and furs	-	28,248,735	28,248,735
3001	Oilseeds	16,772,387	-	16,772,387
3165	Abrasive products	12,920,418	3,554,216	16,474,634
3158	Glass containers	14,509,158	1,525,284	16,034,443
3175	Copper	11,589,658	202,179	11,791,837
3274	Carbon and graphite products	8,071,214	17,166	8,088,380
3156	Flat glass	7,460,429	-	7,460,429
3124	Carbon black	6,074,525	-	6,074,525
3092	Tanned and finished leather and hides	2,995,650	191,582	3,187,232
3221	Rolling mills and other metalworking machine	2,606,245	-	2,606,245
3022	Iron ore	1,838,093	-	1,838,093
3008	Cotton	1,174,109	64,765	1,238,875
3007	Tobacco	238,405	-	238,405
3009	Sugarcane and sugar beets	140,118	-	140,118

Source: 2011, State of Nevada input-output model, IMPLAN.

[7] IMPLAN defines "intermediate imports" as the value of production purchased by industries within the study area. "Institutional imports" are defined as imports made by households and government entities.

It may be that some of these products are not produced locally due to transportation restrictions; if so, investments in the transportation infrastructure can help attract businesses to produce these commodities locally, increasing the positive economic impact on the state.

Competitive Imports

Products and services are often imported into the economy when similar products and services are available locally, creating a disconnect. Some of these disconnects may be permanent and impossible to fix, while others provide an opportunity for import substitution. **Table 6** summarizes the top 25 competitive imports for Nevada. These goods and services are purchased outside of the state even though some amount of these goods is produced locally.

Table 6. Top 25 Competitive Commodity Imports for Nevada

Commodity Code	Description	Intermediate Imports ($)	Institutional Imports ($)	Total Imports ($)
3115	Refined petroleum products	2,802,281,494	2,228,618,164	5,030,899,414
3357	Insurance	1,316,565,918	1,978,889,404	3,295,455,322
3133	Pharmaceutical preparations	282,418,640	1,760,873,779	2,043,292,480
3356	Securities, commodity contracts, investments, and related services	1,471,969,727	411,758,362	1,883,728,027
3397	Private hospital services	1,241,609	1,792,267,334	1,793,508,911
3319	Wholesale trade distribution services	372,573,853	1,410,376,221	1,782,950,073
3377	Advertising and related services	1,632,174,683	50,792,026	1,682,967,041
3031	Electricity and distribution services	829,066,589	666,046,753	1,495,113,281
3351	Telecommunications	798,343,384	636,952,026	1,435,295,410
3020	Oil and natural gas	1,116,345,703	--	1,116,345,703
3276	Automobiles	137,491	1,058,494,385	1,058,631,836
3392	Education from private junior colleges, colleges, universities, and professional schools	8,930,230	1,040,258,057	1,049,188,232
3398	Nursing and residential care services	--	940,734,253	940,734,253
3374	Management, scientific, and technical consulting services	775,718,262	87,155,571	862,873,840
3360	Real estate buying and selling, leasing, managing, and related services	467,779,785	349,292,480	817,072,266
3411	Hotels and motel services, including casino hotels	278,601,929	505,704,712	784,306,641
3277	Light trucks and utility vehicles	1,821,303	766,640,259	768,461,548
3283	Motor vehicle parts	532,209,473	196,695,587	728,905,029
3394	Offices of physicians, dentists, and other health practitioners	--	681,940,918	681,940,918
3060	Processed poultry meat products	89,580,444	523,359,314	612,939,758
3127	Plastics materials and resins	590,864,868	1,578,153	592,442,993
3423	Services from religious organizations	--	586,635,864	586,635,864
3234	Electronic computers	12,648,217	559,487,793	572,135,986
3059	Processed animal (except poultry) meat and rendered byproducts	112,376,099	426,658,722	539,034,790
3345	Software	63,328,564	467,369,354	530,697,937

Source: 2011, State of Nevada input-output model, IMPLAN.

Table 6 shows that one of the major imports by Nevada's businesses and institution is that of Wholesale Trade Distribution services (Commodity Code 3319), of nearly $1.8 billion in 2011. These services include the movement of goods and services between the wholesaler and retailer. Nevada's businesses produce approximately $6.0 billion worth of these services, of which $1.3 billion are exported. This results in net imports of $500 million, which remain unmet and a disconnect in the state economy, which provides an opportunity for economic development.

The reason for this disconnect requires further, more detailed study. However, as discussed above, expanded interstate highway systems help regions attract new businesses, especially those in the transportation and distribution (logistics) industries. The expansion of I-11 through the state can help Nevada attract such businesses, especially given a market of $500 million of unmet demand for Wholesale Trade Distribution services. These businesses will, in turn, attract additional customers and suppliers to the region, helping with the economic development of the state.

Cluster Value Chains

Industrial sectors supplying inputs to or purchasing outputs from the transportation-related industries (transportation and warehousing/distribution) may be positively impacted by transportation investments. Sectors linked to the transportation industries and those dependent on transportation for operation may find Nevada a preferred location if proximity to input supplies and products markets is desired.

For the purposes of this technical memorandum, transportation-related industries are defined using the following North American Industrial Classification Systems (NAICS) and IMPLAN codes. NAICS codes are used because they are the universal industry definition codes. IMPLAN codes are used because they correspond to the data provided by the IMPLAN model. These codes are as follows:

NAICS Code	IMPLAN Code	IMPLAN Definition
484	335	Truck transportation
485	336	Transit and ground passenger transportation
487, 488	338	Scenic, sightseeing, and support activities for transportation
492	339	Couriers and messengers
493	340	Warehousing and storage

The IMPLAN database was used to identify forward or backward linkages to and from the transportation industries. A backward link to a transportation industry is a sector that supplies the industry with products and services. Backward links are counted if a sector supplies at least 2 percent of the total value of purchases by the industry. A forward link to the transportation industry is a sector that purchases the industry's output. Forward links are counted if a sector purchases more than 1 percent of the total value of intermediates sales of the transportationindustry.

Using the IMPLAN database, top existing input suppliers and customers for the relevant transportation industries were identified and are summarized in **Table 7**. The table summarizes top sectors, by total linkages. For example, the Truck Transportation industry (IMPLAN 335) has four backward linkages. This means that it supplies goods and services to four of the above five industries. It also has four forward linkages, which indicates it purchases goods and services from four of the above highlighted industries. The most linkages an industry has to the highlighted industries, the more purchasing and selling activity occurs between these industries. The linkages analysis, however, does not indicate the magnitude of these activities, and an industry with just a single linkage to the highligted industries may have a significant impact on the State.

Understanding which industries purchase from or sell to transportation-related industries impacted by transportation investments will help understand which industries will benefit from the expansion of these transportation industries due to the improvement in the transportation infrastructure. One of the significantly

impacted industries is Wholesale Trade, which, though it represents only 2.9 percent of the state's total employment base, has an average annual wage of $69,900, much higher than the state average.

Table 7. Top Backward and Forward Linkages for Transportation Industries–Nevada

IMPLAN Code	Definitions	Backward Linkages	Forward Linkages	Total Linkages
335	Truck transportation	4.0	4.0	8.0
338	Scenic and sightseeing transportation and support activities for transport	4.0	4.0	8.0
319	Wholesale trade	3.0	5.0	8.0
339	Couriers and messengers	5.0	2.0	7.0
382	Employment services	5.0	1.0	6.0
381	Management of companies and enterprises	5.0	1.0	6.0
354	Monetary authorities and depository credit intermediation	5.0	1.0	6.0
340	Warehousing and storage	4.0	2.0	6.0
411	Hotels and motels, including casino hotels	1.0	5.0	6.0
388	Services to buildings and dwellings	5.0	0.0	5.0
360	Real estate	4.0	1.0	5.0
351	Telecommunications	4.0	1.0	5.0
356	Securities, commodity contracts, investments, and related activities	1.0	4.0	5.0
413	Food services and drinking places	0.0	5.0	5.0
39	Maintenance and repair construction of nonresidential maintenance	3.0	1.0	4.0
31	Electric power generation, transmission, and distribution	2.0	2.0	4.0
409	Amusement parks, arcades, and gambling industries	0.0	4.0	4.0
327	Retail - Clothing and clothing accessories	0.0	4.0	4.0
427	Postal service	3.0	0.0	3.0
115	Petroleum refineries	3.0	0.0	3.0
390	Waste management and remediation services	2.0	1.0	3.0
389	Other support services	1.0	2.0	3.0
397	Hospitals	0.0	3.0	3.0
320	Retail - Motor vehicle and parts	0.0	3.0	3.0
357	Insurance carriers	2.0	0.0	2.0
421	Dry-cleaning and laundry services	2.0	0.0	2.0
333	Rail transportation	1.0	1.0	2.0
374	Management, scientific, and technical consulting services	1.0	1.0	2.0
367	Legal services	1.0	1.0	2.0
161	Ready-mix concrete manufacturing	0.0	2.0	2.0
24	Gold, silver, and other metal ore mining	0.0	2.0	2.0
164	Lime and gypsum product manufacturing	0.0	2.0	2.0
394	Offices of physicians, dentists, and other health practitioners	0.0	2.0	2.0
386	Business support services	0.0	2.0	2.0
365	Commercial and industrial machinery and equipment rental and leasing	0.0	2.0	2.0
324	Retail - Food and beverage	0.0	2.0	2.0
329	Retail - General merchandise	0.0	2.0	2.0
331	Retail - Nonstore	0.0	2.0	2.0

Source: 2011, State of Nevada input-output model, IMPLAN

The expansion of Nevada's interstate highway network, represented by the I-11 project, and the resulting benefits to in-state transportation industries could make Nevada a more attractive location for linked economic sectors, thus reducing the efforts and incentives required to attract out-of-state businesses in the linked sectors and providing a more diverse economic-base for the state.

Summary

It was the conclusion of the studies summarized in Section 1 that highway transportation investments increase a state's or region's competitiveness, aid economic development, and benefit the region's residents. Section 2 applied these findings to Nevada to find that, given the highly concentrated nature of the state's economy, a new interstate highway (I-11) connecting Nevada to its neighbors will not only aid in tourism attraction, but also will help accelerate the economic development and diversification that is currently occurring. Such an investment would benefit new and existing businesses by providing additional access to in-state and out-of-state markets and to other regional labor sheds. As noted, transportation improvements reduce congestion and travel time and, thus, the cost of goods and services.

Interstate investments such as I-11 make Nevada attractive because visitors can reach their destinations faster and more easily, enhancing the state's major economic cluster-lodging and hospitality. It is also attractive to businesses (goods movement), because it reduces operating costs and facilitates reaching customers and suppliers. Though the exact benefits of the highway construction are difficult to measure, given the importance of transportation to Nevada's economy, the I-11 project is expected to enhance the state's ability to attract visitors, businesses, and residents, and accelerate its economic evolution and performance in a highly competitive world economy.

Appendix C
Technical Memorandum
I-11 Case Studies Summary

I-11 and Intermountain West Corridor Study

Case Study Summaries

Prepared for

Nevada DOT and ADOT

June 2014

Contents

Tables

I-11 Case Study Summaries

Introduction

This document summarizes three recent case studies with findings that are especially relevant to the expected outcomes of completing a high-capacity transportation corridor, including an Interstate-level highway between (and possibly beyond) the Phoenix, Arizona, and Las Vegas, Nevada, metropolitan areas. The purpose of this case study review is to identify completed or proposed improvements with outcomes that can be compared to those predicted for the I-11 and Intermountain West Corridor Study. The most important outcomes have been specified as economic benefits and other impacts, expressed in terms of monetary output value and/or new jobs; the net present value (benefits minus costs) of improvements over their lifetime; and the ratio of project benefits to project costs, with 1.0 representing the break-even point.

The case studies are meant to supplement the benefit-cost analyses (BCAs) that were conducted on the I-11 Corridor to help capture in quantitative terms the economic justification for building out the Corridor.

The case studies reviewed in this document emphasize:

- Multistate corridors
- Heavy, long-distance freight movement
- Overland international trade
- A mix of urban and rural environments
- Linkage of primary and secondary activity centers within states, provinces, or regions
- Areas of strong growth that will exceed the capacity of existing facilities
- Multiple modes, but with a prominent highway element
- Tourism
- The need for long-range, phased development of improvements
- Clear measurement (or forecasting) of outcomes
- Economic efficiency: evidence of benefits exceeding costs and positive net present value
- Before and after studies of actual investment impacts

The value of the first case study (World Trade International Bridge) lies in its findings from an actual border crossing improvement that in some ways constitutes the final component of a crucial international trade corridor (I-35) serving the U.S. Heartland. The second study (I-35 Trade Corridor) focuses on proposed alternatives for the full I-35 Corridor across six states, recommends a visionary alternative, and provides basic economic impact and BCA results. The third study (Northeast CanAm Connections) is more regional than corridor-specific, but holds great interest because of its international and multijurisdictional scope, its frank discussion of both challenges and opportunities, its broad consideration of strategies, and its detailed economic analysis of scenarios.

World Trade International Bridge

The World Trade International Bridge connects Laredo, Webb County, Texas, U.S., with Nuevo Laredo, Tamaulipas, Mexico. The Economic Development Research Group performed an economic impact study, published by the Transportation Research Board, Strategic Highway Research Program[1] to evaluate the economic impacts of a new, commercial-vehicle-only toll bridge connecting the U.S. and Mexico. The bridge was completed

[1] http://tpics.us/CaseSelected.aspx?case_study_id=7

in 2000 to alleviate severe congestion—with border crossing times of several hours, lines of commercial vehicles stretching several miles into the downtown business areas, and hazards created by commercial vehicles mixing with passenger vehicles and pedestrians. The 0.18-mile-long bridge was built over a 2-year period beginning in 1998 and ending in 2000. The capital cost of the U.S.-funded portion, in 2008 dollars, was $138.28 million.

The Laredo land port of entry (LPOE) lies at the south end of I-35, part of an international trade route that connects northern Mexico's manufacturing hub, Monterrey, with Duluth, Minnesota, through six U.S. states. By 2000, Laredo was the busiest inland port in North America, accounting for more than 40 percent of goods entering the U.S. by land, and it was by far the most heavily used LPOE from Mexico. The enactment of the North American Free Trade Agreement (NAFTA) and thriving economies in both nations strained border crossing infrastructure. As recently as 1999, only two Laredo bridges permitted commercial truck crossings, with the next closest crossing more than 80 miles away and lacking access to I-35.

The eight-lane World Trade International Bridge was built to end the long delays that imposed high costs on shippers, manufacturers, residents, and tourists. The bridge design includes Automated Vehicle Identification and Weigh in Motion technology, allowing vehicles to pass without stopping. The design also uses a queuing system and feeder roads to keep the approximately 350 vehicles lined up at a given time moving continuously. This international crossing accommodates commercial motor vehicles only, with no passenger cars, non-motorized traffic, or rail.

The City of Laredo owns the U.S. half of the bridge, while the Mexican portion is owned by the federal government of Mexico. The U.S. share of the capital cost was split 65/35 between the federal government and the State of Texas. The federal contribution consisted of a discretionary grant from the Federal Highway Administration (FHWA) National Corridor Planning and Development Program, and of State Infrastructure Bank loans.

While only a bridge rather than a complete corridor, this project removed a bottleneck to international trade and greatly reduced delays at a critical crossing. Similar to the Intermountain West region, much of south Texas has experienced a high growth rate. However, the bridge does not directly serve any large metropolitan area in the U.S., and it accommodates only one mode (trucks). No evaluation has been made of cumulative effects of the World Trade International Bridge plus proposed investments along I-35 (see the I-35 Trade Corridor case study), or of economic impacts of the bridge outside Webb County. Also, no BCA is provided, and the methodology for calculating the economic development impacts is not shown.

Impacts of the Investment

Transportation benefits of the World Trade International Bridge include elimination of the miles-long backups on I-35, ending the dangerous mix of truck/car/pedestrian traffic near other border crossings in the area, and reducing commercial crossing times so that drayage trucks (short-haul shuttles serving the border) can make several more trips each day. The typical commercial crossing that previously took 2 to 3 hours now takes 5 minutes from the time a truck leaves I-35 in Laredo to the time it crosses into Mexico. The Texas Department of Transportation (TxDOT) reports that in a typical year, 1.3 million trucks cross southbound to Mexico and 1.1 million cross northbound to the U.S.

Economic impacts include:

- From 1999 to 2001, Laredo gained 4,400 jobs. According to a 2001 FHWA economic development study, 1,600 of these jobs in the transportation and public utility sectors resulted from the World Trade International Bridge opening.
- The study authors estimate that an additional 1,500 jobs were created as an indirect result of the bridge; this brings the direct and indirect employment benefits to 3,100 jobs in Webb County.
- The bridge increased direct income (wages) by $55 million and indirect income by $53 million, for a total of $107 million (after rounding) in Webb County.

- The resulting direct and indirect increases in economic output were $130 million and $125 million, or $256 million (after rounding) in Webb County.
- Also from 1999 to 2001, unemployment in Laredo declined from 7.9 percent to 6.5 percent, even as the Texas and national economies began to slow and their unemployment rates rose.
- In 2005, the bridge generated more than $38 million in toll revenue for the City of Laredo. The proceeds are used to provide various city services, as well as to operate and maintain the bridge.

Overall, high local population and employment growth make it difficult to isolate the impact of the World Trade International Bridge. Fluctuations in international trade and large-scale economic changes in both countries likely had a larger effect than the bridge on economic growth in the region. Without the bridge, however, the region would not have been as well positioned to take advantage of these broader changes, and the cost of exploiting them would have been higher.

I-35 Trade Corridor

The I-35 Trade Corridor covers the entire length of I-35 from the U.S.-Mexico border at Laredo, Texas, to Duluth, Minnesota, a distance of 1,568 miles. The *I-35 Trade Corridor Study*[2] evaluated the need to improve local, intrastate, and interstate service on I-35, developed feasible alternatives, and spelled out a general improvement plan to meet the needs. The study says that I-35 "...is the only interstate highway connecting Mexico, the U.S. and Canada through the Heartland, and it carries a greater percentage of U.S.-Mexico trade among the NAFTA partners than any other U.S. interstate highway." Major cities along the corridor are San Antonio, Austin, Dallas/Fort Worth, Oklahoma City, Wichita, Kansas City, Des Moines, and Minneapolis/St. Paul. I-35 was constructed and improved in segments, beginning in the 1950s and ending in approximately 1990. The estimated capital cost of the improvements constituting the recommended alternative is approximately $10.9 billion in 1996 dollars. TxDOT led the study and five other states (Oklahoma, Kansas, Missouri, Iowa, and Minnesota) participated along with the FHWA.

The Base Case or "Do Little" alternative included maintenance, committed improvements, and other planned activities only. The three "most viable" Build alternatives all included the Base Case improvements, assumed maximum added lanes to I-35 within the existing right-of-way, and added comprehensive Intelligent Transportation Systems. Because the maximum added lanes are insufficient to meet the year 2025 traffic projections, each of the three final alternatives included additional improvements beyond this "Maximum Upgrade." Alternative 1 consists of Relief Routes in urban areas and/or double-decking I-35 in selected areas. Alternative 2, Trade Focus Strategy, consists of a partial NAFTA truckway, allowing larger truck sizes and weights in the southern portion of the corridor between Dallas-Fort Worth and Laredo, where truck traffic projections are highest. This alternative also includes the improvements in Alternative 1, except for additional lanes that are not needed because of the truckway. Alternative 3, Combination Strategy, contains selected elements of the first two alternatives, although not the truckway from Alternative 2. Additional lanes would be provided between Kansas City and Duluth by means of right-of-way purchases, and cooperative rail freight services would be promoted between Kansas City and Laredo, cities that the Union Pacific and Kansas City Southern railroads currently connect.

Alternative 2, Trade Focus Strategy, was selected as the recommended option for several reasons: good overall movement of traffic, the best reduction in travel time on I-35, the best reduction in crashes and their costs, the fewest environmental impacts, the special accommodations for heavy truck traffic from Dallas-Fort Worth to Laredo, and the best economic benefits and benefit-cost relationship.

Similar to I-11, the I-35 Corridor is a multistate, international trade corridor for which planners have formulated a multimodal vision, although in the case of I-35, the Interstate highway is already in place. Also similar to I-11, I-35 is a key NAFTA corridor from Mexico to Canada, although additional travel is required to reach the Canadian

[2] http://www.iowadot.gov/i35final.pdf

border by road from Duluth. Both I-35 and I-11 serve (or would serve) large cities and other activity centers, but also long rural segments with limited local travel demand. In both cases, too, ambitious new investments may require the use of innovative funding sources. Both corridors do or could extend to a Mexican LPOE. Conversely, for I-35, but not I-11, the existing access-controlled facility largely fixes the location of the alignment. I-35 has significantly different land use and topography from I-11, traversing a higher proportion of private and agricultural land. Another difference is that I-35, unlike I-11, serves a major seaport, which serves as the main port of entry to and from Canada.

Impacts of the Investment

Because the I-35 Trade Corridor recommended improvements are not yet fully implemented, estimated annual transportation benefits of implementing the recommended option (Alternative 2) consist of $1.15 billion in vehicle operating cost savings, $1.08 billion in travel time cost savings, and $0.15 billion in accident cost savings.

In addition, several types of economic benefit, in 1996 dollars, were estimated over the construction and operational life of the project. These benefits include approximately 43,000 permanent new jobs, value added of $20.90 billion, added personal income of $30.80 billion, and added wages of $18.40 billion. The estimated benefit to cost ratio of the recommended alternative is 1.86, while the net present value of the improvements over their lifetime is $5.76 billion.

Northeast CanAm Connections

The northeast border area is a broad, cone-shaped swath expanding from west to east, spanning parts of New York, New Hampshire, Vermont, Maine, Ontario, Quebec, and the four maritime provinces of New Brunswick, Nova Scotia, Newfoundland, and Labrador, and Prince Edward Island. Several efforts have been conducted to assess transportation deficiencies in the Northeast Border Corridor, to formulate scenarios to mitigate them, and to recommend strategies benefitting economic development, thereby making the region more competitive in the global economy.

A large study effort was undertaken to assess this region due to concern that much of the Northeast CanAm region (except the two largest metropolitan areas in Canada) has suffered from an above-average number of indicators of economic distress. Worker income, employment growth, and international trade growth are either stagnant or lagging behind other regions of North America. The region's multimodal transportation network has not kept up with recent shifts in international trade patterns. Elements of the CanAm study include existing conditions, strategic directions for economic growth, economic and transportation impacts, benefits and costs, financing options, and recommendations.

Several transportation-related conditions impede the economic vitality and competitiveness of the region. These conditions include truck freight costs averaging 45 to 65 percent higher than the national average, low freight efficiency (a high rate of backhaul miles) on the U.S. side, long freight haul distances, few and costly air travel options (which discourage tourism), sparse transportation infrastructure in many parts of the region, and a lack of multimodal crossroads outside a few areas, such as Montreal.

The study identifies 6 strategic directions, along with the following 11 classes of short-, medium-, and long-term actions for pursuing them:

1. Invest in a northern east-west highway connecting Nova Scotia, New Brunswick, Maine, and Quebec (determine feasibility in the short term).
2. Invest in southern east-west highways connecting Nova Scotia, New Brunswick, Maine, New Hampshire, Vermont, New York, and Ontario (in the long term).
3. Improve efficiency at border crossings by investing in infrastructure and modifying operational and institutional processes (improve cross-border transport and economic data in the short term).
4. Harmonize truck weight regulations regionally on both sides of the border (pilot study in the short term).

5. Develop a radial network in the region.
6. Invest in an Atlantic Gateway supporting the maritime provinces (in the short term).
7. Invest in a Continental Gateway supporting Montreal and Toronto (in the short term).
8. Invest in improved rail connections at ports targeting container traffic.
9. Develop inland port facilities (strategic analysis in the medium term).
10. Invest in a regional east-west rail network with good connections to Class 1 railroads (develop interim plan in the medium term; invest in a corridor in the long term).
11. Integrate economic development, land use, and transportation planning efforts (continuing in all timeframes).

The CanAm study area, although not a true corridor, exhibits many similarities to the I-11 Corridor. It covers an area with extensive interstate and international trade flows and it has a challenging climate for much of the year. Highways are the dominant mode of freight transportation and tourism is a mainstay of the economy, although with substantial seasonal variations. Both areas perceive a lack of needed freight infrastructure, such as inland ports and logistics centers. The study areas are large, with a clear need to phase and prioritize improvements over many years or even decades. Also, both studies are multimodal in scope, with serious consideration of rail options.

Differences include the high proportion of maritime trade in the CanAm region (both within Canada and internationally). The two nations were equal partners in the CanAm study, whereas I-11 is predominantly an effort of two U.S. states. Moreover, in the case of CanAm, the two dominant cities and economic activity centers (Toronto and Montreal) are outside the U.S. Except for these two large metro areas, socioeconomic growth rates are generally much lower in the CanAm area than in the I-11 Corridor. There are also differences in study method and approach, with the CanAm evaluation process oriented less toward geographically based segments than toward broad-brush strategic options. The CanAm effort, while a planning analysis, has a stronger economic focus than the current I-11 and Intermountain West Corridor Study. The CanAm evaluation of alternatives emphasizes projected economic outcomes more than planning criteria. A related consideration is that the CanAm investigators had no travel demand model available and therefore used alternative methods.

Estimated Impacts of Proposed Alternatives (Including Benefit to Cost Ratio and Net Present Value)

The CanAm report[3] provides detailed transportation benefits from several classes of actions (for example, northern and southern east-west highways) to the year 2035. These benefits include highway and railroad travel time savings for all types of traffic, potential diversion of trade from other regions, gains from harmonizing trucking regulations internationally, and direct job creation from inland port/logistics and distribution centers.

To estimate economic development impacts, the study team translated travel time and distance impacts by mode into dollars, which were then used in economic impact and the BCA. Other direct economic effects, such as induced trade flows and inland port logistics activity, were also taken into account. The aim was to evaluate how the Northeast CanAm scenarios would improve economic competitiveness in the region by changing travel patterns. Impacts could result from increased travel efficiency, increased access to markets, and improved connectivity.

Low (worst case), medium, and high (best case) impact estimates were reported for the six final investment scenarios: North Highway, South Highway, Rail Improvement, Truck Harmonization, Radial Highway Network, and a hybrid Seamless Movement scenario incorporating elements of all the others. The Seamless Movement scenario consistently shows the greatest positive impact (compared with the Base Case), but every investment scenario would have some positive impact on total jobs, output, gross domestic product, and wages, as Table 1 shows. All monetary values are in 2007 dollars.

[3] http://www.edrgroup.com/library/multi-modal/northeast-canam-connections-integrating-the-economy-a-transportation.html

Table 1: Range of Annual Impacts (Low-High) of Proposed CanAm Improvement Scenarios, by 2035

Scenario	Additional Jobs (thousands)	Increased Output ($billion 2007)	Increased Gross Domestic Product ($billion 2007)	Increased Wages ($billion 2007)
Seamless Movement	59-141	$8.2-$19.4	$4.6-$10.9	$2.5-$5.9
North Highway	12-39	$1.7-$5.4	$0.9-$3.0	$0.5-$1.6
South Highway	23-51	$3.2-$7.0	$1.8-$3.9	$1.0-$2.1
Rail Improvement	33-75	$4.5-$10.4	$2.5-$5.8	$1.4-$3.1
Truck Harmonization	18-36	$2.5-$5.0	$1.4-$2.8	$0.7-$1.5
Radial Highway	14-31	$1.9-$4.3	$1.1-$2.4	$0.6-$1.3

The BCA, performed using the proprietary TREDIS software, attempted to identify all costs and benefits to society, including those accruing outside the region. Table 2 shows the estimated range (from low to high estimate) of the benefit to cost ratio for each transportation investment scenario. Under every scenario, the ratio exceeds 1.0 with at least the medium and high estimates. The right-hand column of Table 2 shows the net present value (the net value to society, after costs are subtracted) of each investment, under the medium estimate. The net value varies greatly by investment scenario, but consistently exceeds zero. (The report points out, however, that the costs of supportive policies, programs, and investments necessary to realize the full benefit are not included.)

The study concludes that, if funding is not constrained, the Seamless Movement scenario is preferable because it provides the greatest net benefit (net present value). If the budget is limited, then it becomes desirable to select the option with the greatest public return on investment (the highest benefit to cost ratio): either the Truck Harmonization scenario (according to the low estimate) or the North Highway scenario (according to the medium and high estimates).

Table 2: Benefit to Cost Ratio of Proposed CanAm Improvement Scenarios

Scenario	Benefit to Cost Ratio			Net Present Value ($billion, medium estimate)
	Low Estimate	Medium Estimate	High Estimate	
Seamless Movement	0.9	2.6	6.1	$9.4
North Highway	3.4	12.9	43.9	$7.8
South Highway	0.5	1.4	4.7	$0.9
Rail Improvement	1.0	1.8	2.8	$2.6
Truck Harmonization	4.7	10.4	27.9	$1.5
Radial Highway	1.0	1.5	2.1	$0.5

Note: Shading represents scenarios in which costs equal or exceed benefits.

Additional Proposed Trade Corridors: Interstate 69 (I-69)

Like I-35, I-69 would be a fully access-controlled highway running generally southwest-northeast from Mexico to Canada. I-69 would connect Laredo, Texas, with Port Huron, Michigan over an approximately 1,656-mile route through six intermediate states: Louisiana, Arkansas, Mississippi, Tennessee, Kentucky, and Indiana. Cities served might include Houston, Shreveport, Memphis, Evansville, Indianapolis, and Lansing. Unlike I-35, I-69 currently exists only in segments, some of which have full access control while others do not. Final alignments for much of I-69 from Indianapolis to Laredo will be selected in future environmental and design studies.

Highlights of the corridor's planning history are:

- 1944: "Interregional Highways" report suggested route between Indianapolis and Angola, Indiana.
- 1958: "National System of Interstate Highways" report included I-69 between Indianapolis and Marshall, Michigan; later extended to Flint and Port Huron.
- I-69 complete to Marshall (1968) and Canadian border at Port Huron (1988).

- 1991: Intermodal Surface Transportation Efficiency Act designates High Priority Corridors, including portions of proposed I-69 from Indianapolis to Memphis (Corridor 18) and in Texas (Corridor 20).
- Congress extends Corridor 18 to Houston, linking to Corridor 20 (1993) and combines the two corridors (1995).
- 1998: Transportation Equity Act for the 21st Century (TEA-21) designates the route as I-69 and adds connector routes.
- 2000: I-69 Steering Committee completes Special Environmental Study dividing the route into 32 sections of independent utility.
- States have begun the National Environmental Policy Act process for each Segment of Independent Utility as funding becomes available.

The Texas portion of I-69 has received particular attention, in part because it would serve as an alternative and a reliever for I-35 from the state's principal LPOE at Laredo. In Texas, the proposed corridor extends from Texarkana/Shreveport to the Mexican border. According to a presentation on "Insights from Other Trade Corridors" that CH2M HILL delivered in December 2012, completion of I-69 within Texas would cost from $12 billion to $15 billion in 2008 dollars. The corridor contains 230 miles already at Interstate standards and 500 miles that need to be improved to such standards.

Goals and objectives of building out I-69 in Texas include:

- Communities located on or near I-69 will capture value from the commerce flowing in their regions.
- Businesses and industries throughout the state will benefit from improved connectivity to and from Texas LPOEs.
- Benefits such as creation of new jobs, more funding for local transportation projects, an increase in economic development opportunities, increased tourism, improved mobility, safety and air quality, and an additional hurricane evacuation route.

Themes especially relevant to the I-11 Corridor include:

- Develop alternatives to the West Coast for freight movement.
- Serve inland ports for trade with Mexico.
- Provide infrastructure to handle increasing cargo and containers.
- Build incrementally, project by project, as the cost to complete in one project is prohibitive.
- Find alternatives to insufficient federal funding.
- Build and maintain local support and engagement.
- Meet local needs, but create an integrated system that can serve business.
- Use existing highway rights-of-way wherever possible to reduce impacts.
- Spend available funds on projects with a high benefit to cost ratio and good performance on other measures.
- Use innovative project delivery and financing to complete high-priority projects faster.

Estimated Impacts of I-69 in Texas

Gregory Jason Pettibon wrote a paper, "The Development and Economic Impacts to the State of Texas from the Construction of Interstate 69"[4] that was approved in lieu of a thesis for a Master of Science degree at the University of North Texas in December 2002. The author used an interrupted time series model to test for the

[4] http://digital.library.unt.edu/ark:/67531/metadc3325/m1/1/

development impact in job creation to the counties affected by I-27 in west Texas after its completion in 1992. Five test counties along proposed I-69 were compared to a control group of five counties along I-27 that were chosen for their economic similarities to the test group in the "before" condition. Mr. Pettibon's paper thereby compares the observed job creation development impact to that which can be expected as a result of the construction of I-69.

Five economic impacts were estimated with IMPLAN, an economic impact software that forecasts direct, indirect, and induced impacts, as well as total impacts on output, value added, employee compensation, indirect business taxes, and employment. The resulting estimates of economic impact to the counties along I-69 are:

- Economic output: $4.23 billion (57 percent direct, 21 percent indirect, 22 percent induced)
- Value added: $2.03 billion (45 percent direct, 24 percent indirect, 32 percent induced)
- Employee compensation: $1.21 billion (50 percent direct, 23 percent indirect, 26 percent induced)
- Indirect business taxes: $112 million (17 percent direct, 31 percent indirect, 52 percent induced)
- Employment/job creation: 39,100 jobs (49 percent direct, 22 percent indirect, 30 percent induced)

Additional Proposed Trade Corridors: Ports-to-Plains Corridor

The Ports-to-Plains (PTP) Corridor is a proposed 1,400-mile freight and passenger transportation corridor extending from Laredo to Denver. The ultimate facility will be a continuous, four-lane divided highway covering the entire route. In its I-11 Business Case Workshop in December 2012, CH2M HILL estimated the cost at approximately $3 billion in 2004 dollars. According to the PTP Alliance, an advocacy group for the route, the highway would generally follow the alignment of US 87, along with portions of US 83, US 277, I-27 in north Texas, US 287, and I-70 east of Denver. A spur northwest from the Texas panhandle to Raton, New Mexico, is also envisioned. In a few areas, existing Interstate highways could be used with little or no change. In others, existing highways would be upgraded to four-lane divided. Fifteen relief routes totaling 113 miles are part of the concept. The corridor is intended to connect directly or indirectly to the proposed Heartland Expressway, Theodore Roosevelt Expressway, and Eastern Alberta Trade Corridor, and to link up with routes to Mexican cities and ports such as Monterrey, Matamoros, and Mazatlán.

In 1994, enactment of NAFTA raised the importance of PTP as an international trade corridor. Four years later, TEA-21 designated PTP as a High Priority Corridor, making it eligible for additional federal funding. The 2005 Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users allocated additional funds for projects in Oklahoma and Colorado. The PTP Corridor also intersects 5 of the 45 High Priority Corridors: 3 (East-West Transamerica near the Texas/Oklahoma border), 14 (proposed Heartland Expressway in Colorado), 20 (US 59 in Laredo), 23 (I-35 in Laredo), and 27 (Camino Real in Raton and Denver). The Texas portion of the corridor is on the planned Texas Highway Trunk System.

The mainline of this north-south corridor passes through Texas, the western tip of the Oklahoma panhandle, and southeastern Colorado. Substantial recent construction activity has occurred in Texas, with $213 million in projects in 2012 and 2013. These projects include the Big Spring Relief Route in west central Texas, a new loop route serving Amarillo, and several two-lane segments upgraded to add intermittent passing lanes, known as "Super 2" sections. Other key accomplishments in 2012 included widening of portions of US 87 to four lanes and relief routes at Del Rio, Texas, and Boise City, Oklahoma. Work is expected to continue one project at a time as funds become available in each state, with safety improvements receiving special priority. According to the PTP Alliance, completion of PTP would reduce crashes by rates ranging from 28 percent in Colorado to 47 percent in Texas (the state that contains most of the route).

Additional PTP Corridor goals and objectives are to:

- Reduce congestion at LPOEs at the international border with Mexico.
- Provide alternatives to congested corridors that run through major metropolitan areas.

- Increase and expedite trade between the three North American nations.
- Improve the region's ability to attract business and commerce.
- Help ease congestion affecting commercial activity.

As the improvements proceed, PTP will provide an increasingly competitive alternative to the existing route from Denver to Texas population centers via I-25. The Alliance is promoting PTP and associated corridors for their expected economic development and commercial benefits, especially to the agriculture and energy industries. The energy benefits would apply to traditional fossil fuels, new sources such as oil sands from Canada, and even such non-traditional sources as wind power. According to the Alliance, "PTP [with its associated corridors] is North America's Energy Corridor," serving 5 of the top 6 gas producing states, 6 of the top 10 oil producing states, and 7 of the top 8 states for potential wind power. Canada is the largest supplier of oil to the U.S., and oil sands development is projected to add $700 million to $1.5 billion to the Texas economy between 2010 and 2035. More than 170 Texas companies supply equipment, parts, and services being used in the development of Alberta's oil sands, making PTP part of a logical trade route between the three North American nations. Wind power is particularly abundant in the plains of north Texas, Oklahoma, and eastern Colorado, as well as in the Great Plains states to the north. As renewable energy sources grow in economic importance, the advantage of locating manufacturing facilities near wind farms will increase, while the generated power will need to be sent to population centers.

Themes especially relevant to the I-11 Corridor (many of which are the same for I-69) are to:

- Create a corridor-wide strategic plan for economic development.
- Organize economic development strategies by segment.
- Pursue projects to attain clear economic development objectives, not as individual communities striving to get more money.
- Unite as a corridor around a limited set of high-priority projects and provide a rationale for pushing these priorities.
- Develop alternatives to the West Coast for freight movement.
- Serve inland ports for trade with Mexico.
- Provide infrastructure to handle increasing bulk and containerized cargo.
- Build incrementally, project by project.
- Find alternatives to insufficient federal funding.
- Build and maintain local support and engagement (for example, through the active PTP Alliance).
- Use existing rights-of-way where possible, but consider relief routes to bypass bottlenecks.
- Consider whether allowing counties and cities to form Regional Mobility Authorities, as in Texas, might benefit Arizona, Nevada, and the I-11 and Intermountain West Corridor (Table 3).

Trans-Texas Corridor Rural Development Opportunities: Ports-to-Plains Case Study

This study, published by the TxDOT, Government and Business Enterprises Division in April 2007[5] sought to identify rural development opportunities in the Texas portion of the PTP Corridor and reached six principal conclusions in answer to the following questions:

- What are the opportunities for developing Trans-Texas Corridor infrastructure in the corridor?

[5] http://www.camsys.com/pubs/ttc_ptp_report.pdf

- What financial and institutional actions are likely to lead to construction and continued maintenance of new infrastructure in the corridor?
- What types of development/financing opportunities exist for other rural Texas corridors, and what is the framework for analyzing feasibility?

Table 3 shows the conclusions, along with policy and planning recommendations associated with each.

Table 3: Texas Department of Transportation Case Study Conclusions and Recommendations

Conclusions	Policy and Planning Recommendations
1. Additional rail terminals and connectivity could increase rail efficiency in the Ports-to-Plains Corridor.	• Pursue intermodal terminal development. • Support rail needs of emerging ethanol industry. • Encourage rail connectivity.
2. West Texas wind power could be transmitted to Texas urban areas through Trans-Texas Corridor (TTC) facilities.	• Consider development of electric transmission lines as a TTC facility. • Define the state's role in providing the transmission facilities.
3. Highway development opportunities exist but are limited.	• Not applicable.
4. Define the benefits and beneficiaries of TTC development to structure financial participation.	• Conduct economic and financial analyses to determine cost-sharing roles of investors.
5. Allowing cities to establish Regional Mobility Authorities could aid rural TTC development in West Texas.	• Allow cities to participate in regional mobility authorities.
6. Similar (TTC) development opportunities exist in other rural Texas corridors.	• Evaluate the TTC development opportunities in other rural corridors.

General Thoughts on Proposed Trade Corridors

- Near-term benefits of investments may not exceed costs.
- Long-term economic benefits may be difficult to quantify.
- The balance between qualitative and quantitative assessment of benefits varies.
- The emphasis on federal funding has declined and interest in alternative methods has grown.
- Tapping the value created by these projects to pay for them presents difficulties.
- Strong advocacy groups sustain momentum over decades-long implementation periods.