

Transportation Policy Brief #1

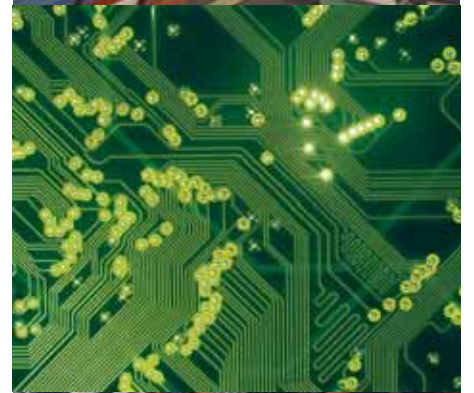
Texas's Manufacturing Competitiveness

Project Directors:

Michael Bomba, Ph.D., Adjunct Associate Professor
Lyndon B. Johnson School of Public Affairs
The University of Texas at Austin &
Associate Research Professor
Center for Logistics Education and Research
University of North Texas

Leigh B. Boske, Ph.D., Professor,
Lyndon B. Johnson School of Public Affairs,
The University of Texas at Austin

Robert Harrison, Deputy Director,
Center for Transportation Research,
The University of Texas at Austin



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SAMUEL BISCARO

MARTHA BOHRT

MAX KRUPP

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Project Directors:

Michael Bomba, Ph.D., Adjunct Associate Professor
Lyndon B. Johnson School of Public Affairs
The University of Texas at Austin &
Associate Research Professor
Center for Logistics Education and Research
University of North Texas



Leigh B. Boske, Ph.D., Professor
Lyndon B. Johnson School of Public Affairs
The University of Texas at Austin



Robert Harrison, Deputy Director
Center for Transportation Research (CTR)
The University of Texas at Austin



POLICY RESEARCH PROJECT PARTICIPANTS

Students

- Samuel Biscaro, B.B.A. (Business Administration), B.S. (Political Science), University of Hawaii
- Martha Bohrt, B.B.A. (Marketing), University of North Texas
- Tracy Del Bianco, B.A. (Political Science), Boston University
- Robert E. Dolan, B.A. (Political Science), The University of Notre Dame
- Maia P. Draper, B.A. (Comparative Literature, Psychology), Stanford University
- Callie Flynn, B.S. (Economics), B.A. (Sociology), University of Nebraska-Lincoln
- Beatrice Halbach, B.A. (Economics, Asian Studies), The University of Texas at Austin
- Jennifer Huffman, B.A. (Psychology), B.A. (Spanish), Texas Lutheran University
- Sarah Kline, B.S. (Economics), B.A. (Political Science, French), Texas Christian University
- Max H. Krupp, B.B.A. (Finance), The University of Texas at Austin
- Dylan Roberts, B.A. (Political Science), The University of Tennessee, Knoxville, M.A. (International Studies), Florida International University
- Avery Saxe, B.A. (International Studies, German), Butler University
- Maria Monica Villarreal, B.A. (Government, Latin American Studies), The University of Texas at Austin
- Victoria Wilson, B.A. (Philosophy, German), Colgate University

Project Directors

- Michael Bomba, Ph.D., Adjunct Associate Professor, Lyndon B. Johnson School of Public Affairs, The University of Texas at Austin;
Associate Research Professor, Center for Logistics Education and Research at the University of North Texas
- Leigh B. Boske, Ph.D., Professor, Lyndon B. Johnson School of Public Affairs, The University of Texas at Austin
- Robert Harrison, Deputy Director, Center for Transportation Research (CTR), The University of Texas at Austin

FOREWORD

The Lyndon B. Johnson School of Public Affairs at The University of Texas at Austin has established interdisciplinary research on policy problems as the core of its educational program. A major part of this program is the nine-month policy research project (PRP), in the course of which two or more faculty members from different disciplines direct the research of 10 to 20 graduate students of diverse backgrounds on a policy issue of concern to a government or nonprofit agency.

During the 2014–2015 academic year, the Texas Department of Transportation (TxDOT) supported a policy research project on manufacturing trends in Texas and Mexico, addressing six key policy issues. The project was a collaboration of the Center for Transportation Research (CTR) and the Lyndon B. Johnson School of Public Affairs at The University of Texas at Austin, and the Center for Economic Development and Research at the University of North Texas.

The research team interacted with TxDOT officials throughout the course of the academic year. Overall direction and guidance was provided by Mr. Marc Williams, Director of Planning for TxDOT. Mr. Williams participated in an October 10, 2014, workshop to determine the scope of the study. As a consequence, the following policy issues were selected for study:

1. Texas's Manufacturing Competitiveness;
2. Reshoring in Texas;
3. Nearshoring in Mexico;
4. Inland Ports and Logistics Hubs;
5. Intra-Industry Trade; and
6. Implications of the Trans-Pacific Partnership on Transportation in Texas.

The findings of each policy issue are presented within the context of separate transportation policy briefs. This particular policy brief, "Texas's Manufacturing Competitiveness," was researched and written by Samuel Biscaro, Martha Bohrt, and Max Krupp.

ACKNOWLEDGEMENTS

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- Joseph Mendiola, Business Development Specialist, Laredo Development Foundation
- Daniel B. Hastings III, Vice-President, Daniel B. Hastings, Inc.
- Fatima P. Perez, Exports Manager, Daniel B. Hastings, Inc.
- Gonzalo Prida, Executive Vice-President, Association of Laredo Forwarding Agents
- Lic. René González de La Hoya, Director of Promotion - Industry, Trade, and Services, Secretary of Economic Development – Nuevo Laredo
- Mario Maldonado, Bridge Manager, Laredo International Bridge Systems
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EXECUTIVE SUMMARY

Texas's manufacturers and their suppliers and customers depend heavily upon the state's transportation infrastructure to move raw materials, intermediate goods, and finished products. For this reason, the Texas Department of Transportation (TxDOT) has a significant impact and influence over the state's manufacturing competitiveness. For their part, manufacturers' locational decisions pair the most efficient use of their resources while attempting to maximize the profitability of their operations. This policy brief will discuss three important issues for Texas's manufacturing sector: locational decision factors; energy; and labor. Each of these issues also has a direct impact on the state's demand for freight transportation infrastructure and, by extension, TxDOT's responsibility for the state's transportation network.

The first section of this policy brief focuses on the key locational factors that manufacturers consider, which include a region's business climate, its regulatory and legal environment, the tax burden, its transportation or logistical network, the quality and productivity of its workforce pool, and access to raw materials and energy. Manufacturers consider each of these factors when making decisions to establish, relocate, or expand their operations. Texas's ability to rank highly on many of these factors explains its current economic success, but also underscores future challenges.

The second section of the policy brief examines Texas's energy sector and its relationship to the state's level of manufacturing competitiveness. The presence of a strong energy sector is one (and for some industries, the most important) factor that allows firms to operate in an increasingly competitive global economy. Texas's rich mineral resources and ability to process oil and derivative products has encouraged many existing manufacturers to remain in state, while also encouraging out-of-state manufacturers to consider relocating to Texas. Firms specializing in oil and gas, petrochemicals, semiconductors, and plastics have utilized cheap and readily accessible energy to their advantage in an ever-shifting global economy. This policy brief will detail the relationship between the Texas energy economy and Texas roadways. Although the overall economic benefit of hydraulic fracturing to the state has been unquestionably positive, TxDOT has had to deal with one of the significant consequences, that is, roadway damage. The State of Texas has an interest in supporting the oil industry not just for the positive economic impacts it creates, but to also support the growth of other areas in the economy, like manufacturing, that are intensive users of energy. TxDOT, as a government agency, has to balance competing interests—that is, economic expansion through energy access, and safety and stewardship of taxpayer investments—in order to further facilitate Texas's manufacturing competitiveness. The energy section will conclude with policy recommendations for TxDOT's consideration in the areas of economic expansion, safety, and investment. Acting proactively will not only allow TxDOT to address these three issues, but will also propagate the state's manufacturing competitiveness by helping sustain the long-term viability of the Texas energy economy.

The last section of the paper explores the current state of manufacturing labor in Texas. A

brief analysis of the state's wages and productivity provides useful insights into the potential for growth of the manufacturing industry as well as its labor force. Texas's manufacturing jobs are currently concentrated in the state's most densely populated areas. As the state's manufacturing competitiveness improves, an increased number of firms are expected to move to the state, which will lead to further employment and population growth. Under this scenario, the problems concerning TxDOT relate to connectivity and congestion and how both factors will impact commuter and freight transportation within the state and along the Texas-Mexico border.

BACKGROUND

For many manufacturing firms, Texas provides an optimal business environment when compared to other states. Texas prides itself on its competitiveness and its ability to attract new industry. The state's government diligently promotes an environment that is friendly to manufacturers and provides an array of services that help companies to establish a presence, relocate, or expand. In certain instances, firms may even benefit from tax or financial incentives, but most of the firms benefit from the state's permissive regulatory environment. This business-friendly climate has contributed to Texas becoming the top goods exporter in the nation and home to more than 10 percent of the nation's Fortune 500 companies.¹ As the state's economy has grown, by extension, its manufacturers have created new demands for transportation infrastructure and capacity. This demand, in turn, has directly impacted the Texas Department of Transportation (TxDOT) and, as future demand for freight transportation infrastructure increases along with Texas's economic competitiveness, these impacts will grow over time.

The strategies for business attraction and facilitation implemented by state government have strongly contributed to Texas being rated the top U.S. state for job growth in 2014.² Texas also experienced the largest overall net employment increase in the nation between 2009 and 2014.³ During that five-year period, Texas ranked second in job creation by percentage growth and first in net job growth, with more than 1.3 million new jobs. TxDOT plays an active role supporting the strength of the Texas economy and is currently finalizing the Texas Freight Mobility Plan to improve transportation linkages and mobility that will further improve the state's competitiveness. Collectively, state government's efforts demonstrate a holistic understanding of the factors that drive, support, and cultivate the manufacturing sector.

The locational decisions of manufacturers focus on the most efficient use of their resources while maximizing the output or productivity of their operations and profitability. Key locational factors that manufacturers consider include the business climate of a region, regulatory and legal environment, tax burden, the transportation or logistical network, quality and productivity of the workforce pool, and access to raw materials and energy. Manufacturers consider each of these factors during their decisions to establish, relocate, or expand their operations.

BUSINESS CLIMATE AND INCENTIVES

"Business climate" is a frequently used but vague term used primarily by elected and agency officials. Despite its ambiguity, it encapsulates the major attributes that are important for locational siting, which include the tax climate, opportunities for financial assistance or other incentives, and the regulatory environment. Numerous trade publication studies have cited Texas's favorable business climate as the primary factor for

¹ Official Texas Economic Development Corporation.

² Ibid.

³ "Ranking U.S. States by Job Creation in Past 5 Years."

corporate and small business relocations. *Site Selection* magazine, perhaps the most influential trade publication that focuses on corporate real estate strategy and regional economic development, named Texas the winner of its 2013 Governor's Cup for the most new and expanded corporate facilities within the 54 U.S. states and territories.⁴ It was Texas's fifth "Governor's Cup" award in a decade, demonstrating the consistent, comprehensive, and sustained effort by state and local governments to set positive conditions for business migration, growth, and expansion.⁵ In 2014, corporations responding to the *Winning Strategies in Economic Development Marketing* survey ranked Texas as the best state for the sixth year in a row. This survey, administered by Development Counselors International, overlaps many of the categorical industrial siting factors that are important to corporate executives with site selection responsibilities.⁶

Public incentives for industry have been an essential element of the state's success. The Texas Enterprise Fund (TEF) is the state's financial incentive tool that offers cash grants. The TEF has awarded over 100 grants totaling more than \$500 million to outcompete other states with "deal closers."⁷ The Texas Legislature also created the Texas Emerging Technology Fund (TETF) in 2005, at the request of Governor Rick Perry. The TETF was designed to give Texas an advantage in the development, research, and commercialization of fledgling technologies. In addition to TETF's \$220 million in matching grants to Texas's universities, over \$2.2 billion has been awarded to non-state requests under TETF's guidelines. Texas also provides financing for firms that wish to relocate or expand within the state through the Texas Capital Access Program. This program provides financing for companies that cannot access traditional lending sources or that face other challenges when accessing capital. The guidelines are flexible to meet the needs of firms, with proceeds available for various uses ranging from construction, acquisition of capital assets, or residential housing for employees.⁸

Texas's usage of discretionary funds has inspired other states to offer similar incentives out of a necessity to compete. Texas created half of the new jobs in the United States between June 2009 and June 2011.⁹ This growth can be attributed, in part, to its generous corporate incentives, low labor and land costs, and a limited regulatory environment. While other states may imitate Texas's incentive-based programs, Texas continues to leverage its other assets to aggressively pursue new companies and industries.

Texas is also one of the few states that provides manufacturers and other firms with locational siting tools. The Texas Site Search gives prospective firms the ability to analyze geographic locations in terms of existing business footprint, available commercial real estate, and labor force statistics (e.g., wages and education attainment).¹⁰ This tool serves

⁴ "Texas is in the Money."

⁵ "Texas, Houston Rank High on Development Counselors International's 'Winning Strategies in Economic Development Marketing' 2014 Survey."

⁶ "Winning Strategies in Economic Development Marketing."

⁷ "Texas Enterprise Fund as of January 31, 2015."

⁸ "Capital Access Program."

⁹ "Tax Policy: The Land of Sweet Subsidy."

¹⁰ "State of Texas Industrial and Commercial Sites and Buildings."

as a “one-stop shop” that allows businesses to gain a general situational awareness using generic locational siting characteristics. Dynamic mapping tools, demographic analysis, and existing industry reports allow firms to quickly determine geographic locations that could meet their requirements for future analysis.

Texas’s pro-business environment is the result of many locational siting factors. Its favorable business climate involves the intersection between the state’s economy, regulatory environment, tax burden, labor force, and access to materials and energy. Each of these factors will be discussed in subsequent portions of this policy brief to fully explore the factors that have created Texas’s status as a leading venue for attracting, growing, and expanding manufacturing activities.

REGULATORY/LEGAL ENVIRONMENT

Cumbersome or misguided regulations can create unfavorable conditions that curtail innovation and hinder business growth. In the extreme, they can cause an exodus of firms to more business-conducive states or countries, even when those regulations are offset by the advantages of a booming economy and a large labor force. Complying with complex regulations, permitting, licensing, as well as other assorted start-up costs, can easily dissuade a firm. Texas remains aware of these risks and its legislature has passed measures to protect businesses and create a climate that attracts and bolsters industry. Thumbtack, a business-oriented website, in conjunction with the Kauffman Foundation, rates business-friendliness annually by assessing a diverse number of regulatory-based metrics. Specifically, Kauffman assesses the regulation-based characteristics of zoning, licensing, environmental prohibitions, and health and safety standards. Texas is consistently rated an “A+” on the majority of the 11 categories. In comparison, California (which has similar workforce characteristics and GDP) is consistently rated in the “F” range.¹¹

Serving as a cautionary tale, California’s regulatory framework is riddled with obstacles when it comes to developing land or energy resources. The U.S. Chamber of Commerce regularly publishes a report called *Enterprising States* that ranks states according to a variety of metrics, heavily weighting their regulatory environment. Texas continually ranks in the top 10 of all states when averaging all the factors, with particularly strong rankings in business birthrate and the low regulatory overhead that fosters growth.¹² One of the starkest contrasts between California and Texas remains labor costs in comparison to productivity; this factor essentially discourages business from expanding in California with other factors held constant. Texas is also a “right to work” state, which prohibits unions from making membership a condition of employment. Texas has some of the lowest unionization rates in the country, whereas California has one of the highest.¹³

The economic success of Texas is due not only to its permissive regulatory environment but also to its industry-friendly legal system. The Texas Legislature initiated tort reform in 2003, which effectively lowered insurance premiums for businesses and medical providers

¹¹ “United States Small Business Friendliness.”

¹² “Enterprising States Dashboard, US Chamber.”

¹³ Batheja, “Texas Touts Light Regulations Wooing California Firms.”

by capping the awarded damages. In the last decade, this initiative resulted in fewer lawsuits and lower payouts,¹⁴ which sustained business growth and expansion. The U.S. Tort Liability Index ranks Texas second in the nation (behind Oklahoma) in overall tort inputs, reflecting the reforms adopted over the previous decade.¹⁵ Oklahoma's favorable tort climate is not surprising. The Oklahoma Legislature instituted similar sweeping tort reforms following Texas's lead, fearful of business and capital flight to a more accommodating atmosphere. California ranks in the bottom half of the nation in tort reform, with the large states of New York, Pennsylvania, and Illinois occupying the bottom five.

Since 2003, Texas has reinforced tort reform, passing several laws to limit frivolous lawsuits in 2005 and 2011. Under these laws, civil plaintiffs who sue and lose may be required to pay not only their court costs but the court costs of the defendant. Judges are permitted the latitude to dismiss baseless lawsuits early in the legal lifespan, expediting civil cases that are legitimate.¹⁶ The curtailment of potentially frivolous lawsuits has had a reassuring effect on employers seeking to relocate. Texas instituted caps for expedited actions that include all damages, including attorney fees. These reforms streamlined caseload, discouraged multiple filings, and expedited resolution.¹⁷

Texas has gone to great lengths to protect employers from frivolous lawsuits while maintaining a regulatory environment that favors industry and small business. Low tax burdens for individuals and corporations are another appealing advantage of the state, although at times it prevents state and local governments from providing the level of services demanded by the public. From an industrial siting perspective, these conditions are generally attractive and are enhanced when complimented by a qualified labor pool.

TAXATION

Texas is one of seven U.S. states that levy no individual income tax and one of three states that have no corporate income tax. Additionally, Texas has no state-level property tax. The Tax Foundation, a think tank that publishes research studies on tax policies, gave Texas the fourth lowest overall tax burden for 2014.¹⁸ Governor Sam Brownback of Kansas has noted that California, with the highest personal income tax, is losing qualified workers to Texas. He is actively reforming his state's tax design to model Texas, to remain competitive in the national and global economy. He believes that low-tax states with less regulation grow jobs faster by generally attracting firms and increasing their revenues.¹⁹ Texas's viewpoint toward corporate taxation may be counter to national policies, but is akin to countries that have reformed their tax regime to remain competitive in the global economy. Since 2005, 63 countries have cut their statutory corporate tax rate. This has lowered the average

¹⁴ "10 Years of Tort Reform in Texas Bring Fewer Suits, Lower Payouts."

¹⁵ "2010 Tort Liability Index."

¹⁶ "Perry Signs 'Loser Pays' Lawsuit Reform into Law."

¹⁷ "Texas Judiciary Adopts New Rules Expedited Rules for Small Controversies."

¹⁸ "Tax Burden Map."

¹⁹ "America's Competitiveness."

statutory tax rate to 24 percent, while the United States has stagnated above 39 percent.²⁰ A high tax burden (whether individual, corporate, or both) undermines productivity and encourages capital flight either to other states or offshore.

There is a direct correlation between the performance of a state's economy and the tax and regulatory burden imposed on its workers and employers. The American Legislative Exchange Council, a non-partisan organization of state legislators, analyzed how fiscally responsible states with low tax burdens outcompete their high-tax peers. They stress that high-tax states, such as Illinois, California, and New York (historically considered "economic powerhouses") have continued to decline in economic metrics due to their high tax burdens.²¹ Consider that eight of the top 20 and 17 of the top 50 metropolitan areas in employment growth are in Texas. Conversely, three of the bottom 10 are in California, with Los Angeles being the worst performer in absolute terms.²²

The goal of Texas's political leadership is to continue with its efforts to incentivize business growth and expansion, but particularly in the realm of taxation. In 2008, Texas changed its franchise tax to a broader, lower-effective, and fairer margin tax. These changes reward businesses by decreasing the overall tax liability for each employee they hire. The rationale is that Texas should reciprocate if a business is putting a Texan to work, funding that pension, or covering costs associated with an employee's healthcare. Texas also uses penalties to discourage firms that hire undocumented workers.²³

Texas levies a 6.25 percent sales tax on retail sales that, when coupled with other taxing jurisdictions, effectively becomes 8.25 percent in many areas. This rate is average, when compared to the rest of the United States. However, Texas makes special concessions for sales taxes and for firms that deal primarily in manufacturing. State sales and use tax exemptions are offered on tangible personal property that is purchased by a company for predominantly manufacturing purposes.²⁴ Toyota moving its North American headquarters from Southern California to Texas is an example of a large manufacturing firm choosing to forgo an oppressive business climate for a more accommodating one. California was once the North American headquarters for Japan's "Big 3" auto makers. All three will have departed by 2016, including Toyota's dislodgement after more than 50 years.²⁵ Governor Rick Perry stated after the announcement that "Toyota understands that Texas's employer-friendly combination of low taxes, fair courts, smart regulations, and world-class workforce can help business of any size succeed and thrive."²⁶

The locational decisions of manufacturers center on the most efficient use of their resources while maximizing the productivity of their operations. The factors of business climate, regulatory and legal environment, and tax burden cannot be understated, but firms

²⁰ "U.S. Corporate Taxation: Prime for Reform."

²¹ "Take a Cue from the Best States for Business."

²² "27th Annual Corporate Executive Survey Results."

²³ "Low Taxes (Official Texas Economic Development Corporation)."

²⁴ Texas Comptroller of Public Accounts, "Manufacturing Exemption."

²⁵ Woodyard, "Toyota Moving U.S. Headquarters to Texas."

²⁶ Ibid.

still require transportation infrastructure to support their vision and to get their goods to the global market. Texas recognizes the criticality of a robust multimodal freight transportation system to support commerce and economic growth. Texas's transportation network also provides opportunities for firms to establish, relocate, or expand in pursuit of optimizing their operations.

MULTIMODAL TRANSPORTATION

Manufacturers benefit from Texas's comprehensive transportation network, its central location in the United States, and its multimodal approach to serving domestic and global markets. Business services and manufacturing firms realize the positive benefit of public infrastructure more so than any other type of firm.²⁷ Texas has 313,210 miles of public roads, more than any other state. The roadway network includes 11 primary interstate highways that consist of international, coast-to-coast, and intrastate routes between some of the United States' largest metropolitan areas. Texas also possesses the most miles of railroad track, with 46 railroad operators that carried 379.3 million tons of freight in 2011.²⁸ Additionally, Texas has 26 commercial airports and approximately 300 general aviation airports—the second-largest state airport system in the United States. Dallas and Houston are among the largest international airports in the nation and serve as major hubs, domestically and internationally. The Dallas metropolitan area is also headquarters to two of the largest U.S. airlines, American Airlines and Southwest Airlines. Texas has 624 miles of coast and 16 deep and shallow draft seaports handling commercial cargo. The Gulf Intracoastal Waterway has its longest stretch through Texas, handling over 90 million tons of freight annually and serving a critical role in the state's multimodal transportation infrastructure.²⁹

Texas also boasts two master-planned logistics inland ports: Port San Antonio, in the south central portion of the state, and the Alliance Global Logistics Hub located to the north in Fort Worth. Each logistical complex integrates Class I rail terminals with high-capacity industrial airports in close proximity to interstate highways. Alliance is the world's first purely industrial airport. Together, Alliance Global Logistics Hub and Port San Antonio shipped more than 10.9 million tons of intermodal freight in 2011.

The 2013 Corporate Site Survey, which studied the locational decisions of businesses, pointed out that 11 of the top 26 site selection factors were directly related to transportation or infrastructure.³⁰ Texas has gone to great lengths to incentivize business migration through incentives and tax breaks, but survey respondents are shifting their preferences towards highway accessibility and transportation infrastructure. Incentives may reduce start-up costs, but long-term cost savings cannot be truly realized without appropriate transportation infrastructure.

²⁷ Cohen, "The Economic Impact and Financing of Infrastructure."

²⁸ "Texas Infrastructure."

²⁹ "Gulf Intracoastal Waterway."

³⁰ "27th Annual Corporate Executive Survey Results: Noted Changes in Site Selection Priorities."

Ultimately, transportation costs and infrastructure can be a factor that determines whether a manufacturer relocates its operations to Texas. The state's unrivaled multimodal transportation hubs and inland logistics ports are of great importance to locational decision-makers. Texas's business climate, permissive regulatory environment, and low tax burden can also be enticing factors when coupled with the state's freight transportation system. Two more major locational siting factors attract industry to the state—Texas's access to vast energy resources and the productivity of its labor force—will now be discussed.

ENERGY AND MANUFACTURING COMPETITIVENESS

This portion of the policy brief will provide a review of Texas's energy economy. It will examine how access to inexpensive and abundant energy has become a "force multiplier" for Texas's manufacturing competitiveness. Although energy has had an enormous positive impact, its wealth has not come without costs. Chief among these costs is the damage that the energy sector has caused to Texas's highway infrastructure. While TxDOT has recognized these concerns, it has struggled to ameliorate the roadway damage. Finally, this section concludes by offering policy-related solutions to address the problem.

Texas's current manufacturing capacity exists, in large part, because of the state's production of energy. With the advent of horizontal drilling, Texas has seen a resurgence in its overall energy production over the last 10 years. This expansion has been an important source of economic strength for the Texas economy and boon for state government coffers, adding upwards of \$15.7 billion in state and local taxes and royalties in 2014 alone.³¹ However, it is important to realize that energy production in Texas is not an isolated economic event. New forms of oil and gas production have created a cheap, easily accessible factor of production for many manufacturing firms throughout Texas—a veritable "force multiplier" for the economy. Access to this energy has likely induced many Texas firms to remain in Texas, while outsiders have come to Texas to take advantage of lower energy costs. For these and other reasons, the state has a clear interest in supporting its petroleum industry.

Although the recent surge in energy production is unquestionably a net positive for the state, there are costs associated with its rapid development. For TxDOT, these costs have manifested in deterioration of Texas's rural highways. Energy extraction has put enormous stress on the state's rural roadways and much of this damage has gone largely unrepaired. Without a concerted effort to ameliorate this issue, the Texas energy economy will find accessibility to fields increasingly difficult. At the same time, TxDOT has a statutory obligation to protect Texas's investment in transportation infrastructure, promote economic development, and ensure the safety of its citizenry on public roadways. Therefore, energy exploration/production and manufacturing are not unrelated, and the symbiosis of these two economic drivers requires the state to invest heavily in their sustainability and competitiveness. For these reasons, TxDOT finds itself at the nexus of energy production and infrastructure in Texas.

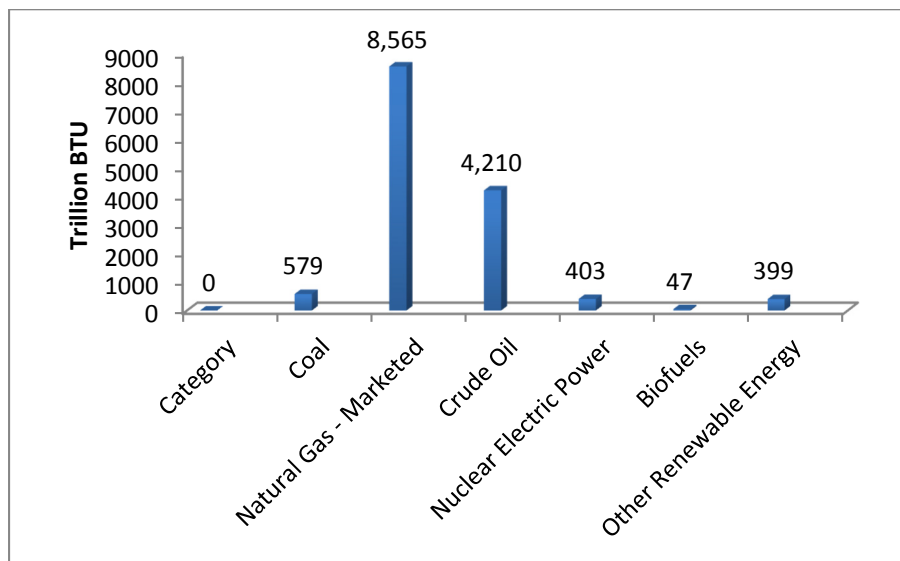
³¹ "Despite Low Prices, Texas Oil Group Stays Optimistic."

TEXAS ENERGY

For over 100 years, Texas has been known as a global leader in the production of oil and natural gas. However, to consider only oil and gas ignores the other critical sources of energy that are part of the Texas story. This section provides an overview of the energy industry's characteristics, based upon news media publications, government documents, and interviews with experts. This foundation will help answer the question: *Where is the modern energy sector today?*

According to the United States Energy Information Administration, Texas leads the United States in total energy production with 14,201 trillion BTUs produced in 2012 (see Figure 1).³² Texas is the nation's leader in oil and natural gas production, but the state has made significant inroads and, indeed, leads many emerging energy markets. Texas's wind, offshore oil and gas, solar, and biofuel energy production all demonstrate the state's ability to produce enormous amounts of energy at a low cost.

Figure 1. 2012 Texas Energy Production



Source: "Texas: State Profile and Energy Estimates." U.S. Energy Information Administration.

CRUDE OIL

The Texas economy is best known as the largest producer of crude oil in the nation, with a daily production of 923,682³³ barrels in 2013. This volume accounts for approximately one-third of U.S. production (2,718,571 barrels in 2013), outpacing the total production of offshore (405,618 barrels), North Dakota (313,905 barrels), and California (198,754 barrels), combined. The advent of hydraulic fracturing significantly increased Texas's oil production, which reached a 40-year high in 2013. In addition to providing a huge source of

³² "Texas: State Profile and Energy Estimates."

³³ "National Crude Oil Production."

income for the private sector and state government, the oil is used in manufacturing sectors throughout Texas as an input, making crude oil a multiplier industry. Crude oil extraction has long been a staple in the northern and western regions of the state, as well as South Texas.

GAS

Texas is the nation's leader in natural gas production, accounting for 23 percent of overall U.S. production.³⁴ In addition to its uses for fuel and heat, natural gas is also used to manufacture plastics, medicines, fertilizers, and dyes—making natural gas another multiplier industry. Produced mainly in the Barnett, Permian, and Eagle Ford Shale plays, natural gas extraction has had a huge economic impact throughout the state. Natural gas and oil are found using the same processes, and increased exploration of oil has led to similar increases in (relatively cheaper) natural gas extraction. Future extraction of natural gas is likely to increase due to the continued proliferation of hydraulic fracturing and because natural gas is more economical and environmentally friendly than oil consumption.

OFFSHORE OIL

Offshore oil production is one of the most important sources of energy for the nation. Not only is Texas a hub for offshore oil production in the Gulf of Mexico, the state serves as a center for the entire Western hemisphere. Over 17 percent of total U.S. crude oil production is from the Gulf Coast's offshore drilling facilities.³⁵ In order to process this crude oil and natural gas, the Gulf Coast is home to over half of all oil and natural gas refining capabilities in the United States. Texas facilities account for half of this production, with the capacity to produce 4,502,626 barrels of gasoline per day.³⁶

WIND

Wind power is crucial in Texas, accounting for nearly 70 percent of all renewable energy production. There are more than 8,500 wind turbines in Texas, which produce an estimated 14,098 MW of electricity, making Texas the indisputable national leader in wind-harnessed energy.³⁷ In 2013, Texas wind power was able to produce over 8 percent of the state's electricity.³⁸ Located mainly in the Texas Panhandle and in West Texas, wind farms have provided approximately 9,000 direct and indirect jobs, including operations, construction, and transportation. Texas's independent power grid means that all (or nearly all) of the wind power produced in Texas remains in the state for Texas consumers. Additionally, Texas is the clear national leader in the manufacture of wind turbines and component parts (clustered largely around the Gulf and Dallas regions). Environmental

³⁴ "A Look at Natural Gas Production In Texas."

³⁵ "Gulf of Mexico Energy Data."

³⁶ *Ibid.*

³⁷ "Texas Wind Energy."

³⁸ "The Texas Renewable Energy Industry."

sustainability, scalability, and a tax-friendly state policy³⁹ ensure that wind power will continue to grow into the future.

BIOFUELS AND BIOMASS

The biofuels and biomass industries account for over 30 percent of renewable energy consumption in Texas.⁴⁰ Used primarily for transportation and industrial sectors, ethanol and biodiesel serve as alternatives for petroleum-based fuels and are crucial components of the state's energy sources. In addition to being environmentally friendly, biofuels are a key source of Texas innovation and jobs. Biomass energy production inherently creates local jobs because the fuel production occurs in close proximity to where the crops are grown.⁴¹ These production sites can be found throughout Texas, particularly in the Dallas-Fort Worth region. Though it is still considered a burgeoning industry, biofuel and biomass energy production is expected to develop substantially in the coming years.

SOLAR

To date, solar energy has been unable to compete with more cost-effective renewable energy sources in Texas, namely wind and bio energy. However, as the cost of solar panels continues to fall, solar energy is fast becoming economically viable. Going forward, Texas ranks first nationally in solar energy potential. The established electricity infrastructure, skilled workforce, and abundant sunlight ensure Texas's solar power production will continue to grow in the next decade.

MANUFACTURING AND ENERGY

In addition to oil and gas production, Texas leads the nation in the refinement, storage, marketing, and transportation of oil and oil-derivative products.⁴² However, there are many other manufacturing sectors associated with Texas's energy economy. Proximity to oil and gas supplies, as well as transportation and pipeline infrastructure, have greatly enhanced Texas manufacturing competitiveness. Firms that require easy access to Texas's diverse natural resources are likely to be clustered in energy producing areas in the state. Ultimately, this ability to produce energy gives Texas a clear advantage in attracting firms with diverse energy requirements. It is important to note that over half of Texas's energy consumption is directed towards industrial use, chiefly manufacturing. Clearly, there is a symbiotic relationship between Texas's energy resources and its manufacturing competitiveness. Outlined below are some industries that have located close to the Texas energy hubs—namely the Permian Basin, North Texas, and Gulf regions.

³⁹ Electric Reliability Council of Texas (ERCOT) ensures the wind energy in Texas stays in Texas. Texas is the only state with its own wind energy grid, allowing it to reap the benefits of wind energy while simultaneously avoiding federal taxation. In addition, recent completion of the Competitive Renewable Energy Zone (CREZ), a \$6.9 billion electricity grid, will ensure energy is able reach population-dense Eastern Texas.

⁴⁰ "The Texas Renewable Energy Industry."

⁴¹ "Biomass Energy."

⁴² McFarlane, "Texas' Oil Economy."

OIL REFINING

Oil refining is a chief driver of the energy extraction process in Texas. The refining industry transforms crude oil into various usable products, including gasoline, diesel, and jet fuel. This key sector accounts for nearly 25,000 jobs throughout the state and billions of dollars of investment. Proximity to raw inputs is a principle factor in a firm's location decision-making, making Texas the national leader in sector employment, value added, value shipped, and capital invested.⁴³ Given the current global energy dependence and the sustained production among heavy crude producing countries—namely, OPEC members—oil refining will continue to be a key component of Texas's manufacturing sector and subsequent export of gasoline, diesel, and jet fuel (despite the fluctuating price of oil).

OIL AND GAS FIELD EQUIPMENT

This sector manufactures tools and equipment for oil and gas production, transportation, and refining. Products include derricks and drilling equipment for oil and gas fields, rock drill bits, and water well drilling machinery.⁴⁴ Much of this industry is located in energy producing and refining areas in the state, including Houston, Midland-Odessa, and Amarillo. As this industry's success is heavily correlated to the price of oil and natural gas, expansion and contractions are to be expected. However, due to the United States'—and, especially, Texas's—dominance of this sector, it is likely that Texas's oil and gas field equipment sector will continue to be competitive, both domestically and globally.

PLASTICS AND RUBBER

The plastics and rubber manufacturing industry is another key manufacturing sector in Texas. It includes firms that manufacture plastic bags, packing materials, films, pipes, foam, and bottles, as well as rubber tires, hoses, belts, and other products. Texas ranks third nationally in the number of production employees, value added, and overall shipment value. There are approximately 700 firms and a workforce of nearly 40,000 employees in this industry alone.⁴⁵ Although plastic and rubber manufacturing can be found throughout the Gulf Coast and North Texas, the highest concentrations are in Victoria, Killeen, and Wichita counties. Plastics and rubber require vast amounts of liquid petroleum gases (LPG) and natural gas liquids (NGL) as feedstock for manufacturing. In 2010 (the last year for which data is available), the plastic manufacturing industry in the United States utilized about 191 million barrels of LPG and NGL to make plastic products—amounting to about 2.7 percent of total U.S. petroleum consumption.⁴⁶ In addition to liquefied natural gas requirements, the plastics and rubber industry consumes enormous amounts of electricity during its manufacturing processes—nearly 65 billion kilowatt-hours in 2010, equal to about 1.7 percent of total U.S. electricity consumption.

⁴³ "Petroleum Products Manufacturing."

⁴⁴ "Oil and Gas Equipment Industry Assessment 2007."

⁴⁵ "Plastics and Rubber Manufacturing."

⁴⁶ "How Much Oil Is Used to Make Plastic?"

BASIC CHEMICALS

This sector includes petrochemicals, industrial gases, dyes and pigments, alcohol, and precursors for more complex chemicals (see below). The Texas chemical industry is the nation's leader in value added, production, value shipped, and capital investment.⁴⁷ Chemical manufacturing employs nearly 33,000 Texans, and is subsequently one of the state's largest industries. The petrochemical industry is exceedingly dependent upon access to natural gas and oil. The availability of cheap factors of production lowers marginal costs and increase economies of scale, thereby making the industry more competitive. The recent expansion of Texas's oil and natural gas sectors has improved chemical manufacturer's revenue, profitability, and ability to hire more skilled labor.

OTHER CHEMICALS

This sector is composed of various manufacturers of chemical products, including pesticides, fertilizers, agricultural chemicals, paints and coatings, soaps and cosmetics, and printing and film chemicals. Texas's complex chemical manufacturing sector is ranked fourth among all states in value added and employment. Advanced manufacturing in the chemical industry accounts for more than 23,000 high-paying jobs (\$77,103 average annual wage), among 581 firms. Chemical companies use oil and natural gas as feedstock; therefore, cheap, accessible energy is crucial for maintaining profitability. High concentrations of chemical manufacturing are found along the Gulf Coast, as well as in the Dallas-Fort Worth region.

SEMICONDUCTORS

Semiconductors and microchips are used as an intermediate component in all smartphones, computers, and (notably) solar panels. The semiconductor industry in Texas is one of the strongest in the nation. Despite a 24 percent employment decline in the semiconductor sector over the last five years,⁴⁸ the microchip industry employs nearly 39,000 people in Texas. Located mainly in the technology hubs of Austin and Dallas, the semiconductor industry relies less heavily on energy access and more on technically capable labor. However, Texas's energy sector is crucial for the future of semiconductor manufacturing. As the solar industry continues to grow, Texas semiconductor manufacturers will be forced to expand their manufacturing scale and efficiency. This symbiotic relationship makes Texas more competitive on two fronts: the state is able to drive down the price of solar energy and increase the size of an important manufacturing sector.

ENERGY AND TEXAS'S TRANSPORTATION CHALLENGES

Although the Texas economy has benefited greatly from energy production, these benefits have not come without costs. The costs have manifested themselves most visibly in the condition of the state's rural roadways (according to a recent study conducted by the Texas A&M Transportation Institute, roads that service Texas's energy industries incur \$2 billion

⁴⁷ "Basic Chemical Manufacturing."

⁴⁸ "Electronics Manufacturing."

a year in damages). In addition to the financial strain felt by TxDOT, these damaged roads have become a major safety and economic concern for commercial and private transportation. While each of the previously mentioned energy sources has been a boon for the economy, two in particular have had direct impacts on Texas’s roadways: hydraulic fracturing and wind power. The rapid growth in these industries has led to massive surges in roadway usage over the past 10 years, with the oil and gas sector having the greatest impact. The results of these activities have led to various forms of roadway damage, including road failures, surface ripples, and drainage problems.⁴⁹

Hydraulic fracturing is perhaps the greatest immediate threat to Texas’s rural highways. There are an estimated 4,000 upstream—i.e., part of the production process—truckloads per pad in the Permian Basin and Eagle Ford Shale. Because hydraulic fracturing activities expanded so rapidly, the roads in these regions had not been fortified to withstand the immense pressure from the equipment and consumables that are moved by the oil and gas industry. Already, there is a low-end estimate of \$1 billion in funds needed to fix roads damaged by the oil and gas drilling industry.⁵⁰ To date there have been some allocations of money from the oil and gas industry to repair these problems, but the response has been disproportionate to the damage and a significant amount of infrastructure remains in disrepair.⁵¹

Alternative sources of energy such as wind power may be more environmentally friendly than vertical and horizontal drilling, but are still damaging to Texas roads. Wind infrastructure requires thousands of pounds of concrete to build the 60x60x6 foot pads. Additionally, the massive towers and propellers must be moved using oversized trucks on Texas highways. Though wind platforms may be less impactful over time than the intense trucking required for hydraulic fracturing, the initial buildup of platforms has also had a negative impact on many of Texas’s rural roads.

ENERGY-RELATED PROBLEMS AND POLICY RECOMMENDATIONS

We have identified three energy-related challenges TxDOT will need to address to maintain Texas’s manufacturing competitiveness: safety, economic growth, and stewardship of taxpayer dollars. We will offer policy recommendations that may assist with addressing these areas of concern.

SAFETY

Chief among the problems facing TxDOT is passenger vehicle safety. Today’s drivers on rural county highways face more risks than they did 15 years ago. Drivers must constantly be aware of deteriorated roadway conditions while driving with high volumes of semi-trucks on narrow Texas highways that were not designed for the volume of trucks they are being required to handle. Occasionally, these commercial drivers are tired, inattentive, or

⁴⁹ “Energy Developments and Our Roadways: Impacts and Strategies.”

⁵⁰ “Why Oil and Gas Taxes Will Not Solve Texas Road Funding Shortfall.”

⁵¹ In a recent report, Dewitt County Judge Daryl L. Fowler estimates that ameliorating the truck damage from oil and gas industry in Dewitt County would cost an estimated \$432 million.

even untrained, which further increases the risks on the roadway.

Policy Recommendation: Continue to invest in building road infrastructure in rural counties affected by hydraulic fracturing. Road surfaces and safety structures (such as guardrails) should be continuously monitored. Additionally, truck drivers for the hydraulic fracturing industry should not be granted exemptions that allow them to work extended hours. TxDOT should consider working with other agencies that have authority in limiting the amount of legal driving time for truckers.

ECONOMIC GROWTH

While addressing roadway safety concerns is TxDOT's highest priority, TxDOT must be wary of policies that compound problems rather than resolve them. For example, truckers will often wear down roads to the point where they are no longer willing to drive on them. The truckers will then use alternate routes to reach drill sites, repeating the process. Ultimately, this leads to a three-fold concern. First, roads will be pushed to the brink of disrepair, due to upstream trucks serving the production process. Second, once these roads are unnavigable, truckers will find it increasingly difficult to reach drilling areas, thereby increasing transportation costs. Third, truckers will use the public good (i.e., roadway infrastructure) until depletion, without a mandate to repair the roads they damage. Oil and gas companies will continue to allow drivers to do so until they are required to contribute to road construction or rehabilitation (such as through usage taxes) or use privatized roads. In practice, some wells might not be profitable if the roadway infrastructure is included in the costs, so firms will simply move on to another location with better infrastructure rather than pay.

Policy Recommendation: Texas's pro-business environment is one of state's defining features, which has included low business tax rates. Rather than increasing the taxes on the energy sector to repair roads that will continue to handle high volumes of truck traffic, TxDOT could offer expedited clearance for new pipelines that run within its existing right-of-way, as an inducement to the private sector to build infrastructure that relieves the pressures on public roadways.

STEWARDSHIP OF TAXPAYER FUNDS

The third concern for TxDOT is prioritizing where roadway maintenance money is spent. The energy sector has created an enormous revenue stream for the state. However, most of the Severance Tax has been directed towards the Permanent School Fund and the Economic Stabilization Fund, leaving Texas roadways woefully underfunded.⁵² TxDOT is responsible for making the best possible investment in Texas's roadway infrastructure, given these limited funds. It must decide which roads are worth saving, which counties should receive funding, and where to draw the line between economic development for the oil and gas industry and the state's remaining roadway needs. In a 2012 hearing at the

⁵² In 2013, SB 1747 made counties eligible for funding authorized under HB 1025, which addresses the impact of energy sector activity. Though well intentioned, the \$225 million appropriated to repair country roads is not sufficient for the task.

Texas Legislature, former TxDOT director Phil Wilson stated that road rehabilitation is up to seven times more costly than preventive road strengthening performed before damage is incurred. Clearly, Texas has a strong incentive to be proactive in its approach. However, for various reasons, TxDOT has found it difficult to respond to the problem. For one, the pace of the industry's expansion put stress on roads that were never intended for high-volume trucking. Second, it is difficult to forecast the future location of oil and gas drilling due to the industry's proprietary nature. Third, once roads are sufficiently fortified, they will require additional and unplanned maintenance, adding strain to an already severe budgetary reality. Fourth, recent drops in the price of oil and gas demonstrate (once again) that energy extraction is a boom-and-bust industry. TxDOT must be wary of investing too heavily in infrastructure that may eventually go unused.

Policy Recommendation: It is important for TxDOT to maintain an ongoing dialogue with energy firms so the agency knows which roads should be built, strengthened, or (in some cases) forsaken. Additionally, TxDOT could seek legislative authority to charge user fees before—not after—the roads have been used. The state of Ohio's "Road Use Maintenance Agreements" have required that oil and gas companies pay for roadway strengthening before obtaining drilling licenses.⁵³ This plan ensures that the firms using the roads will pay for their use, reducing the current 'free rider' problem.

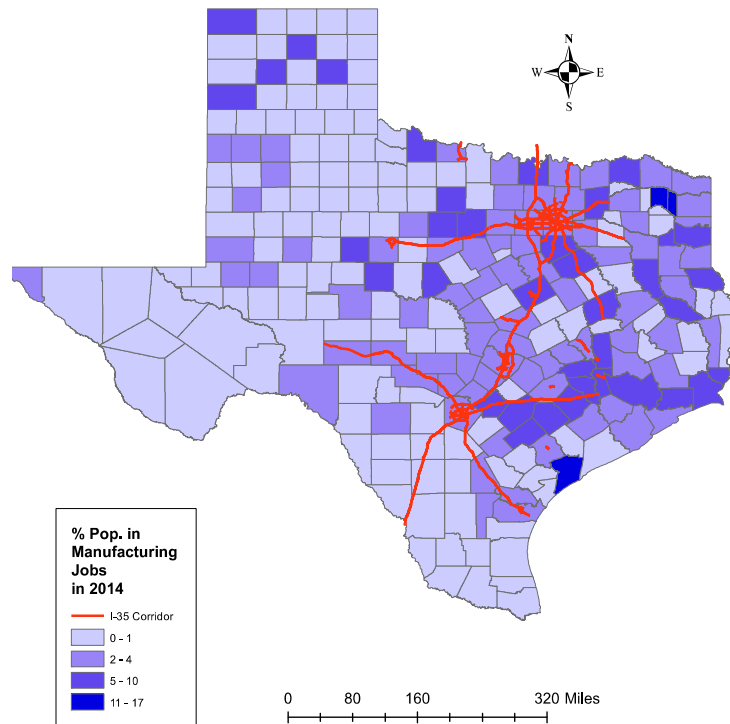
LABOR AND PRODUCTIVITY

The Texas Association of Manufacturers describes the state's manufacturing sector as "the engine that drives prosperity in Texas and across the nation. Manufacturing is central to the state's economic security—creating high quality jobs and benefits, and providing significant tax revenue for schools and other government services." Texas's manufacturing competitiveness in the global economy depends, in large part, on the quality of its labor force and labor's productivity. As the state's labor force grows, so do issues of mobility and congestion, especially as firms cluster in and around urban hubs and logistics centers. To put it simply, where the workers go, the freight goes, especially when the workers are employed in the manufacturing sector.

Figure 2 presents the percentage of total population in manufacturing jobs per county in 2014. As shown in Figure 2, manufacturing jobs in Texas are concentrated in the eastern half of the state, especially along the IH-10 corridor. Because manufacturing employment and population tend to be clustered, this situation negatively impacts traffic congestion, since it forces commercial and commuter traffic to share the same roads and highways. Changes to the distribution of the state's workforce, its skill set, its competitiveness in the global economy, etc., can affect the spatial allocation of freight activities, as well as the flow of goods across Texas and across its borders. This section will summarize the current state of Texas's manufacturing labor force, efforts underway to improve it, and the tangible implications of these conditions on the Texas transportation system.

⁵³ "Road Use Maintenance Agreement Clearing the Way in Harrison County - News - Top Stories." WTOV Steubenville-Wheeling.

Figure 2. Percent of Total Population in Manufacturing Jobs per County in 2014



Sources: Texas Association of Manufacturers and the U.S. Census Bureau

TEXAS LABOR FORCE

The manufacturing sector contributed \$211 billion of output, or 15 percent of the Texas economy in 2012.⁵⁴ Manufacturing labor statistics include all jobs created by manufacturing firms, whether production, sales, or distribution (transportation of goods falls under a different category within the labor force). Two factors used to evaluate the competitiveness of a labor force are its wages and its productivity. Wages refer to the hourly rate paid to workers. Wages are of special importance to manufacturers, since they are a significant expense in any labor-intensive industry. The U.S. Bureau of Labor Statistics divides wages into 23 occupations. The category of “production occupations” most closely captures the wages of jobs in the manufacturing industry. Currently, the mean hourly wage for production occupations in Texas is \$16.68 per hour, very close to the national average for this category (\$16.79). In total, there were over 893,000 manufacturing employees in Texas at the end of 2014.⁵⁵

Productivity is the value of goods produced per worker over a period of time. Texas’s manufacturing productivity was at least 22 percent higher than the U.S. average between 2007 and 2011. During this period (and with the exception of 2010), Texas’s

⁵⁴ Texas Association of Manufacturers.

⁵⁵ Bureau of Labor Statistics.

manufacturing productivity ranked first among nine states with similar industries: Alabama, Arizona, Connecticut, Georgia, Kansas, Missouri, Washington, and Utah.⁵⁶ This measure of labor productivity is based upon the value added per hour worked by production workers. Between 2007 and 2009, the productivity of Texas workers declined by about \$7.59 per hour. However, productivity increased by \$54.12 per hour between 2009 and 2011.⁵⁷

The Texas Legislature has supported employment growth in the manufacturing sector and the state's overall industrial competitiveness through the various policies and pieces of legislation. Figure 3 shows that these efforts have paid off. Despite the economic downturn experienced by most states during the 2008–2009 recession, several Texas counties experienced employment growth in the manufacturing sector. Similarly, Texas's manufacturing employment was quick to recover after the recession. Figure 4 shows the change in manufacturing jobs per county from 2010 to 2014. Although some counties continued to lose jobs, the number of counties with manufacturing employment growth dramatically increased from the previous period.

Local governments and non-profit organizations, along with educational institutions, are also promoting workforce development within their regions. Their efforts focus on technical training and preparedness of the state's labor pool, as a means of attracting and retaining employers. Understanding of these initiatives is important to identify the aspects of Texas's labor force that still need improvement, to maintain future employment growth.

⁵⁶ The recession started in December 2007 and ended in June 2009.

⁵⁷ Wichita State University.

Figure 3. Percentage Change in Manufacturing Jobs per County from 2008 to 2010

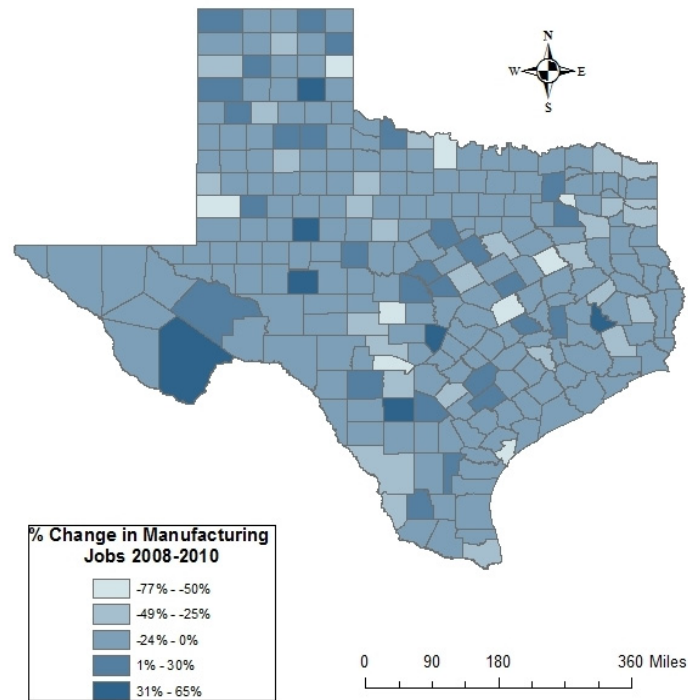
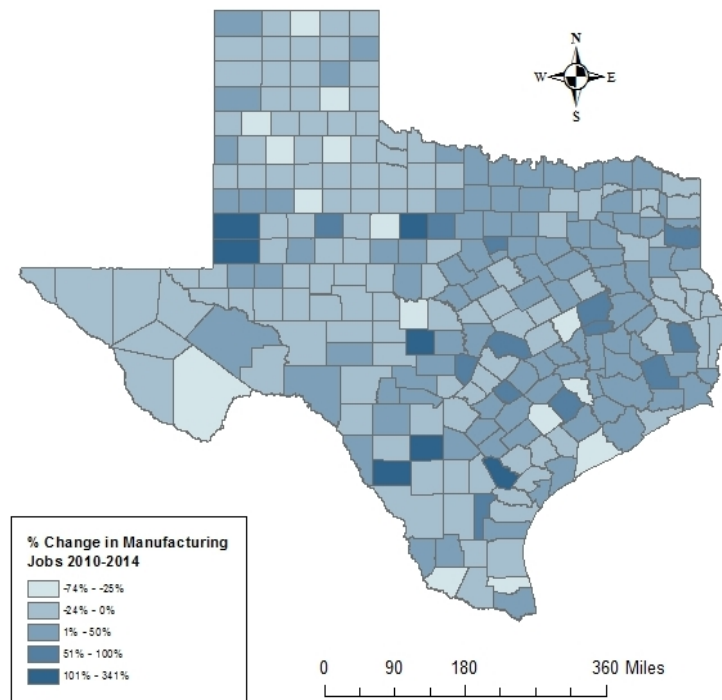


Figure 4. Percentage Change in Manufacturing Jobs per County from 2010 to 2014



Sources: Texas Association of Manufacturers and the U.S. Census Bureau.

IMPROVING TEXAS'S LABOR FORCE COMPETITIVENESS

The Texas Workforce Commission (TWC) invests in manufacturing workforce development through grants from its Skills Development Fund. In 2015, the TWC funded a \$1.3 million project for McLennan Community College (MCC) in Waco, TX. The funds allow MCC to partner with a manufacturing consortium composed of Aramark, Behlen Manufacturing Co., Caterpillar Logistics Services Inc., Caterpillar Work Tools Inc., Romark Logistics of Texas Inc., and Sonoco Flexible Packaging Co. Inc. The partnership will provide customized training for 916 consortium employees, both new and current, on safety procedures, first aid, machinery maintenance, and manufacturing operator skills. Upon completion of training, the workers expect to receive an average wage of \$18.93, more than \$2 higher than the Texas and the national averages.

This program reflects a larger national trend of promoting trade careers. After the 2008–2009 recession, economists saw increased differences between people with a high school diploma and those with a college degree. The unemployment rate for those who graduated with a high school diploma was almost twice as high as workers with a college degree. Another trend noticed by economists was an increase in the number of higher-paying jobs opening up in the trades, some of which pay better than the average college graduate wage. Georgetown University's Center on Education and the Workforce estimates that roughly two million U.S. jobs go unfilled because of shortfalls in skills, training, or education. Among those unfilled jobs, roughly 600,000 of them require more than a high-school diploma but less than a bachelor's degree. The center predicts roughly one-third of U.S. job openings through 2020 will require such middle skills—vocational certificate, industry-based certification, some college credits, or an associate degree, but not a classic four-year college degree. Based on the research and observations, TWC and their counterparts around the country began providing financial support to organizations interested in developing trade programs.

LABOR POLICY RECOMMENDATIONS

Texas's manufacturing jobs are currently concentrated in the state's most densely populated areas. As the state's manufacturing competitiveness improves, it is expected to lead to an increased number of firms moving to the state, which will lead to further employment and population growth. Under this scenario, the problems concerning TxDOT relate to connectivity and congestion and how both factors will impact commuter and freight transportation within the state and along the Texas-Mexico border. From this perspective, we offer the following recommendations for TxDOT's consideration:

Recommendation 1: The high concentration of the state's manufacturing jobs in densely populated areas increasingly contributes to congestion in the Texas triangle, which is also heavily transited by freight carriers. TxDOT should continue to consider both the freight and workforce mobility implications of each project it funds and seek opportunities to leverage private sector investment.

Recommendation 2: TxDOT should continue to evaluate the potential of existing technologies to alleviate congestion for commuters and freight carriers. Creating a smart phone app that would make the DriveTexas.org website easier for commuters to use is one possibility. While there are existing apps that provide traffic information, TxDOT is in a unique position to provide up-to-date information for features like a “rush-hour alert” for defined routes set up by users. Because TxDOT is in charge of defining these statistics, they can incorporate them into an app that encourages or deters drivers from getting on the road at specific times. A voice-controlled feature could ensure compliance with hands-free operation. Data-gathering technology can also be considered to address freight congestion. One such technology is the Freight Advanced Traveler Information Systems (FRATIS). FRATIS is a dynamic mobility program providing real-time information on traffic, weather, congestion, and construction to commercial trucks.⁵⁸ The program is not available statewide. Increasing its availability to the whole state could also help diminish freight congestion. Similarly, the information gathered by TxDOT’s Transportation Management Centers (TCMs) remains within its service area. Coordinating information between TCMs to provide information about the areas between them can be helpful for commuters and commercial truck operators.

CONCLUSIONS

When it comes to transportation, the allocation of economic activities matters. Locational siting factors, energy, and labor all directly influence the spatial distribution of employers (especially manufacturers) in our state. In the case of freight transportation, the allocation of economic activity is particularly influential when it comes to congestion and bottlenecks. This allocation is equally important for commuter patterns. The purpose of this policy brief has been to reiterate this common understanding of geography’s importance and to also highlight the connection between economic issues and the state’s transportation needs. Seemingly unconnected topics, such as tax incentives or workforce training programs, can and do have significant, spatial impacts on the state’s freight and commuter transportation networks. Thus, macroeconomic issues should not be viewed as unrelated, tangential, or too broad for a specific effect, since examples to the contrary are demonstrated on a daily basis. Additionally, planners and policymakers who incorporate this broader perspective will be better able to improve Texas’s transportation system and promote a stronger Texas economy.

⁵⁸ “Talking Freight: Freight Advanced Traveler Information System (FRATIS).”

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