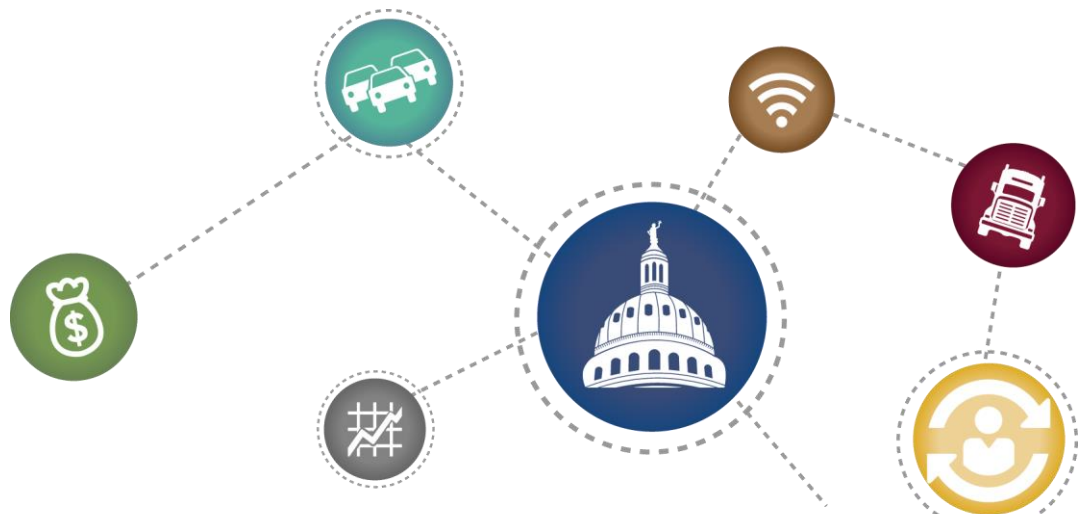


Oil and Gas Freight Transportation Alternatives *Final Report*

PRC 15-50 F



Oil and Gas Freight Transportation Alternatives

Texas A&M Transportation Institute

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Executive Summary

Editor's Note: At the time of this writing (fall 2016), oil prices are rising from recent lows. The effect of the price drop has been to reduce oilfield activity and limit, but not eliminate, additional damage being done to energy-impacted roads. Experience and observation suggest that prices may again rise to a point that repeats the magnitude of damage seen in the period leading up to this report.

After 2007, the application of hydraulic fracturing (or fracking) and horizontal drilling techniques led to rapid new development in the oil and natural gas (O&G) industries in many areas of Texas and in other shale formation areas across the United States. Between 2007 and 2014, an increasing demand for O&G products in a favorable market (high prices for Texas O&G products with favorable marginal prices compared to worldwide benchmarks) resulted in dramatically increased drilling activity and associated freight traffic on Texas roadways in energy production areas moving drilling equipment, fracking sand, water, and other energy-development-related freight.

The Texas A&M Transportation Institute (TTI), in Texas Department of Transportation (TxDOT)–sponsored research and in Transportation Policy Research Center (PRC) reports, has offered a thorough background on the recent O&G drilling activity in Texas and the effects of that activity on the condition and use of state and local roadway infrastructure. The policy project discussed in this report examined potential options regarding the use of rail and pipeline infrastructure to address the growing costs of roadway rehabilitation in the energy production areas of Texas.

Freight Railroads and Pipelines

Despite the recent downturn in O&G prices, energy development in its various forms (e.g., oil, coal, natural gas, and related products) is expected to remain a key driver of future demand on the multimodal Texas transportation system (e.g., rail, truck, and pipeline) and, in the long run, increase its maintenance and operating costs. Throughout the recent energy boom, private rail and pipeline companies have independently and collectively improved and extended networks or built expanded rail yards or pipeline collection hubs at the closest points on their network to energy production areas. Figure 1 is a map of freight railroads, pipelines, and major transloading facilities that move crude oil in railroad tank cars.

Freight railroads, large and small, offer O&G producers access to equipment and supplies used in drilling and fracking, including pipe, fracking sand, chemicals, and cement. Railroads can also transport crude oil and petroleum by-products in production regions not served by pipelines. These transportation services can be provided within the existing freight railroad network, through expansion of third-party transloading facilities along the rail network, or through expansion of rail capacity or new rail lines.

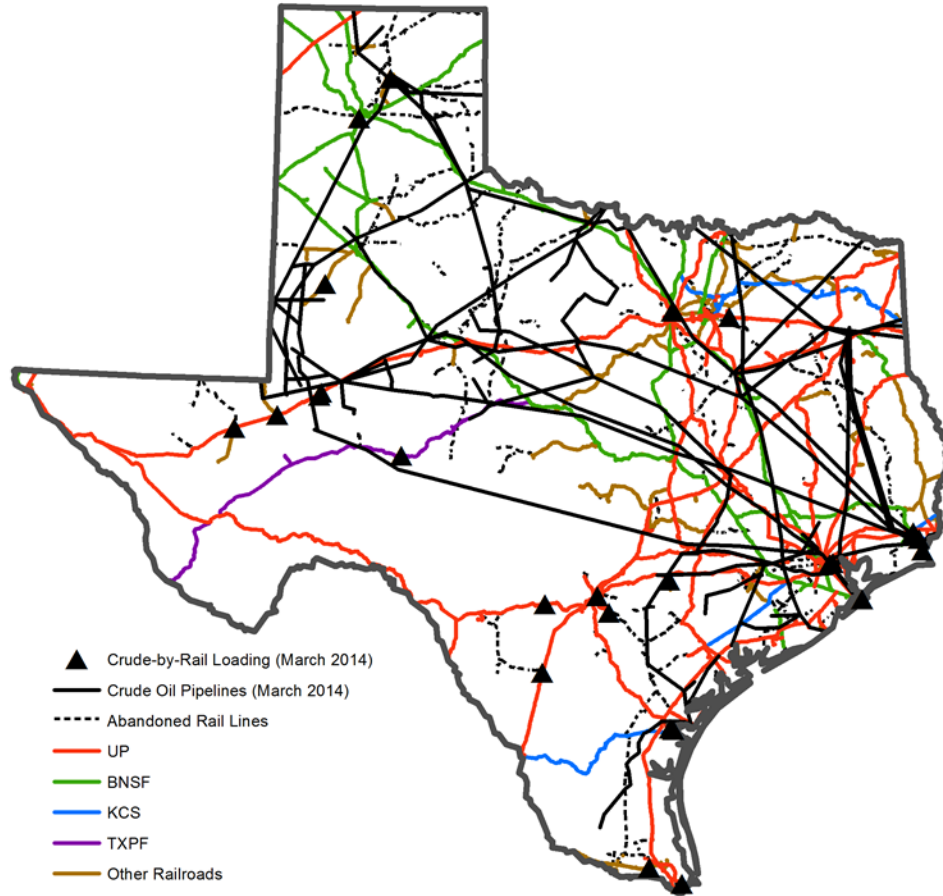


Figure 1. Location of Oil and Gas Wells in Relation to Rail Infrastructure.

Pipeline companies build and maintain an extensive network of liquid petroleum and natural gas pipelines in Texas, with more than 431,997 miles in 2015 according to the Texas Railroad Commission (1). Pipelines allow the safe and efficient movement of large quantities of O&G to storage centers and refineries while minimizing interactions with urban centers. They have delivered O&G products reliably, safely, efficiently, and economically for almost a century. It would take a constant line of tanker trucks, about 750 per day, loading up and moving out every two minutes, 24 hours a day, seven days a week to move the volume of even a modest pipeline. The railroad equivalent of this single pipeline would be a train of 75 2,000-barrel tank railcars every day. Almost all natural gas is moved by pipeline.

Public-Sector Energy Development Responses

Since O&G production in shale formations is occurring throughout the United States (as discussed in Chapter 1 of this report), a number of states are responding to the effects of increased energy development through a variety of funding mechanisms. According to a prior study done by TTI, states have charged O&G production through different types of fees, taxes, and exercises, applying the collected capital among several sectors, including transportation

programs. The study reveals that these taxes have aided in matching needed funds in the transportation area in important producer states (2).

In Texas, O&G production is charged on severance taxes according to the market value of the product (7.5 percent for gas and 4.6 percent for O&G condensate). The allocation of budget relies on the Economic Stabilization Fund needs, as determined by House Bill 1 (83rd Legislature) approved in November 2014. From the total of O&G severance taxes, 37.5 percent is designated to the Environmental Response Fund, and the remainder is allocated to the State Highway Fund, aiming to fund unmet financial needs in the transportation sector. Fifteen percent of the revenue allocated to the State Highway Fund is statutory, allocated to road construction and maintenance related to O&G activities.

Other states have O&G-related funding programs, such as the following:

- The Colorado O&G severance tax allocates funds for state and local transportation projects.
- West Virginia allocates \$24 million in O&G severance taxes for infrastructure debt amortization. West Virginia also requires well operators to post revenue bonds with the state in anticipation of damage to state and local roads.
- North Dakota allocates O&G severance taxes into a state Oil Impact Fund and to producing counties for transportation projects.
- Pennsylvania distributes revenues from its unconventional gas well fees to fund rail freight assistance grants and to fund bridge repairs in producing counties. Pennsylvania also requires oversize/overweight oilfield motor carriers to execute excess maintenance agreements for use of state and local roads.

A number of states also maintain grant programs that offer funding for rail infrastructure improvements. Thirty-three states have programs that fund rail spur lines or industrial leads (rail connections from mainline track to industrial facilities), and nine state programs support economic development activities that can include rail improvements.

Texas has also authorized rural rail transportation districts (RRTDs), subdivisions of the Texas state government created at the county level. RRTDs have the authority to purchase, operate, and/or build new railroad and intermodal facilities; the right of eminent domain; and the ability to issue bonds based on projected revenues that may be generated by the rail improvements. As of June 2013, 42 RRTDs have been identified as being officially formed in Texas, with 95 of the state's 254 counties participating in at least one RRTD. Counties forming RRTDs generally do so to preserve rail access or prevent abandonment of the rail lines, foster local economic development through short-line rail access, or improve passenger rail service.

Private-Sector Oil and Gas Improvements in Rail and Pipeline Networks

This project also gathered illustrative examples of new rail facilities funded and constructed by the private sector in O&G production areas. Dozens of new pipelines are under construction in Texas, and many more have been built during the last decade. Examples of rail-served facilities include the following:

- Mission Rail Park in San Antonio, along Union Pacific (UP), offers storage and transloading of crude oil and hazardous materials, fracking sand, and other commodities.
- Alamo Junction Rail Park in San Antonio, served by Burlington Northern Santa Fe (BNSF) Railway and UP, offers railcar handling, storage, and switching.
- Gardendale Railroad in La Salle County reconstituted 29 miles of abandoned track into Crystal City and offers railcar storage and transloading of fracking sand, pipe, and crude oil.
- Live Oak Railroad between Three Rivers and George West in Live Oak County offers connections to UP and four pipelines at the facility.
- Texas Pacifico Transportation, the railroad operator on the state-owned South Orient Rail Line between Coleman and Presidio, has seen extensive traffic growth with O&G production.
- The BNSF Logistics Center in Sweetwater offers unit train terminals for sand, agricultural commodities, and aggregates that serve the Permian Basin fields.

State Policy Implications

While increased O&G drilling and production activity creates significant benefits for the state's economy, particularly in spreading job and income growth into rural areas outside the Texas Triangle, this O&G activity increases truck activity, which then affects infrastructure conditions and commercial motor vehicle safety. These effects in turn have real monetary costs for the state.

The private sector is already responding to the new energy development business opportunities by expanding pipeline capacity and offering more rail transloading facilities, as described in Chapter 4 of this report. Both the expansion of pipelines (particularly pipelines that collect O&G from wells, pipelines that transport liquids and gas to injection wells, and pipelines that distribute water to wells) and the addition of new rail lines and facilities to serve O&G production areas may reduce commercial motor vehicle mileage and the associated public costs. Some of these new rail facilities are being developed with the participation of local economic development corporations and other public investments.

Texas O&G severance taxes are now being allocated into the State Highway Fund as a result of Proposition 1 adopted in 2013, but these funds appropriated for energy development areas are limited to state highways. Texas may wish to consider the capitalization of a new multimodal State Infrastructure Bank—a revolving loan fund to leverage private investments in rail, pipeline, and port infrastructure projects that can reduce energy-development-related truck trips.

Chapter 1. Introduction and Background

The policy project discussed in this report examined potential options regarding the use of rail and pipeline infrastructure to address the growing costs of roadway rehabilitation in the energy production areas of Texas. This project studied whether offering state incentives for expansion of rail or pipeline infrastructure along with roadway improvements might be an effective approach to address the increased freight transport needs of energy development and subsequently provide longer-term economic development opportunities in Texas shale energy regions. Specific rail and pipeline improvements have the potential to divert some heavy-truck traffic from energy production area roadways and thereby decrease roadway rehabilitation costs and increase traffic safety for roadway users on state and local roads.

Oil and Gas Drilling Activity in Texas

After 2007, the application of hydraulic fracturing (or fracking) and horizontal drilling techniques led to rapid new development in the O&G industries in many areas of Texas and in other shale formation areas across the United States. Between 2007 and 2014, an increasing demand for O&G products in a favorable market (high prices for Texas O&G products with favorable marginal prices compared to worldwide benchmarks) resulted in dramatically increased drilling activity and associated freight traffic on Texas roadways in energy production areas moving drilling equipment, fracking sand, water, and other energy-development-related freight. By late 2014, the Texas O&G industry was producing 31 percent of the natural gas consumed in the United States and accounted for 45 percent of total U.S. crude oil production (3). At that time, more than 15 million Americans lived within a mile of an oil or gas well—with 6 million of those located in Texas.

TTI, in TxDOT-sponsored research and in PRC reports, offers a thorough background on the recent O&G drilling activity in Texas and the effects of that activity on the condition and use of state and local roadway infrastructure. Because those reports offer both a valuable historical overview of the implementation of fracking and horizontal drilling in Texas and a detailed assessment of how this energy development activity affects state and county roads, that information will not be replicated in this report. Additional background can be found in the following TTI reports:

- *Energy Developments and the Transportation Infrastructure in Texas: Impacts and Strategies* (4).
- “Work Order 24: Estimation of Additional Investment Needed to Support Energy Industry Activity in Texas,” in *TxDOT Administration Research: Tasks Completed FY 2012* (5).
- *Oil and Gas Energy Developments and Changes in Pavement Conditions in Texas* (6).
- *Oil and Gas Energy Developments and Changes in Crash Trends in Texas* (7).

Despite the recent downturn in O&G prices, energy development in its various forms (e.g., oil, coal, natural gas, and related products) is expected to remain a key driver of future demand on the multimodal Texas transportation system (e.g., rail, truck, and pipeline) and, in the long run, increase its maintenance and operating costs. TxDOT has partnered with the Texas Legislature to seek new funding sources to address the acute needs for improved roadways in production areas, authorizing and getting voter approval for two separate funding propositions to address energy-sector needs following the 2013 and 2015 legislative sessions; however, the increased funding provided by these propositions still falls short of identified needs.

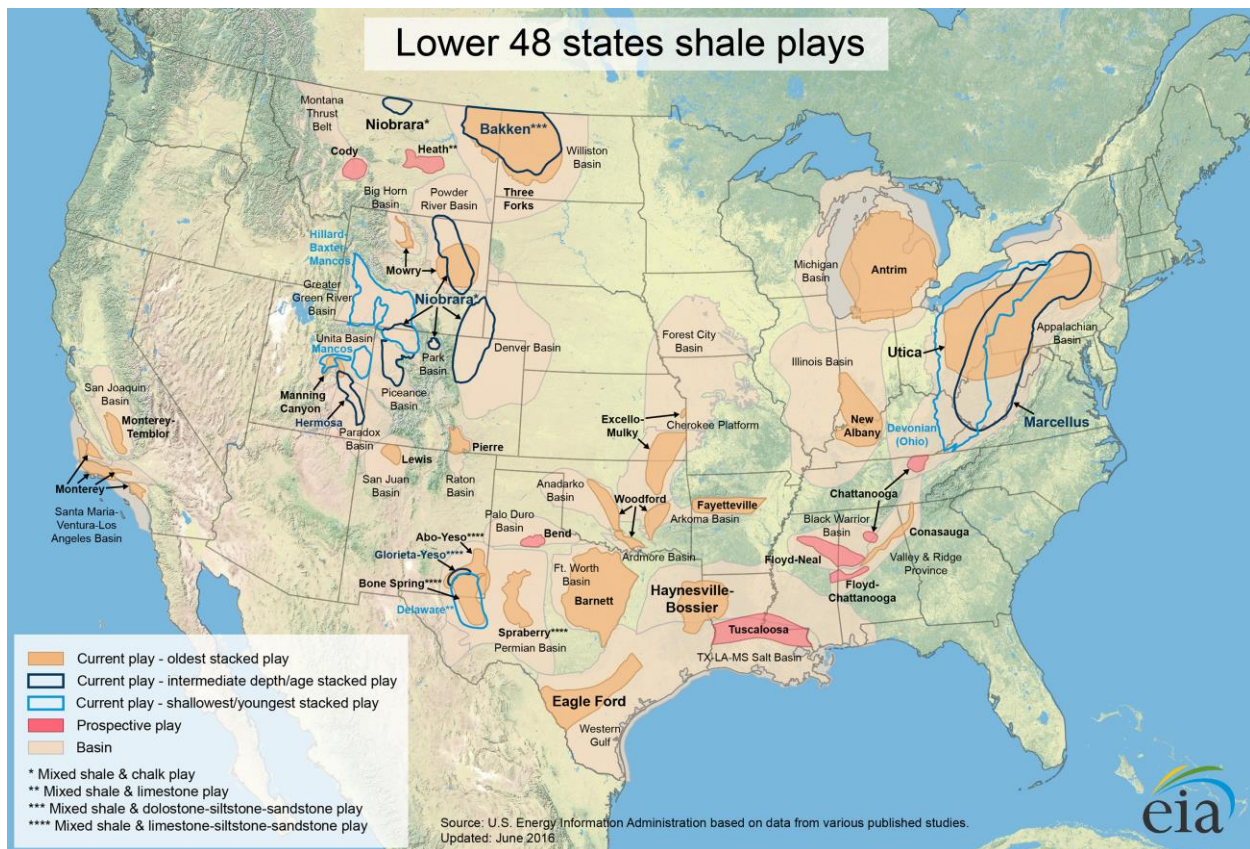
Throughout the recent energy boom, private rail and pipeline companies have independently and collectively improved and extended networks or built expanded rail yards or pipeline collection hubs at the closest points on their network to energy production areas. Unfortunately, new rail capacity improvements have not grown quickly enough to slow the growth of truck traffic on rural roadways servicing wells with sand, drilling equipment, and water. In fact, many distant rail yard/pipeline hub facilities can act as truck traffic generators from which truck-to-well operations originate to service an expanse of well sites. Unfortunately, several abandoned former rail lines within current energy production areas have been lost over the past 3.5 decades since rail deregulation, and existing pipeline infrastructure is only now being built to serve many of these now-economical energy production areas of the state.

Oil and Gas Energy Production Activity Clusters in Texas

Texas is home to several O&G shale plays including some of the most significant nationwide. Figure 2 shows that the energy production activity in the state extends to areas beyond just the Eagle Ford Shale Play and Permian Basin, although these two are the most well known. In September 2014, Texas accounted for 897 active rigs of the 3,683 active oil rigs worldwide—nearly 25 percent of the oil rigs around the globe (8, 9). Texas led the United States with 46 percent of active oil rigs at that time. Each of the state’s shale plays within a larger petroleum basin area has varying regional characteristics of the depth of the formation and the type of oil or gas products produced.

In Texas, the major basins and their associated shale plays include:

- Anadarko Basin—Granite Wash and the Cleveland Formation.
- East Texas Basin—Bossier, Cotton Valley, and Haynesville-Bossier.
- Fort Worth Basin—Barnett.
- Western Gulf Coast Basin—Eagle Ford and Pearsall.
- Permian Basin—Avalon, Bone Spring, Cline, Spraberry, Yates, Yeso, and Wolfcamp.
- Palo Duro Basin—Bend.



Source: (10).

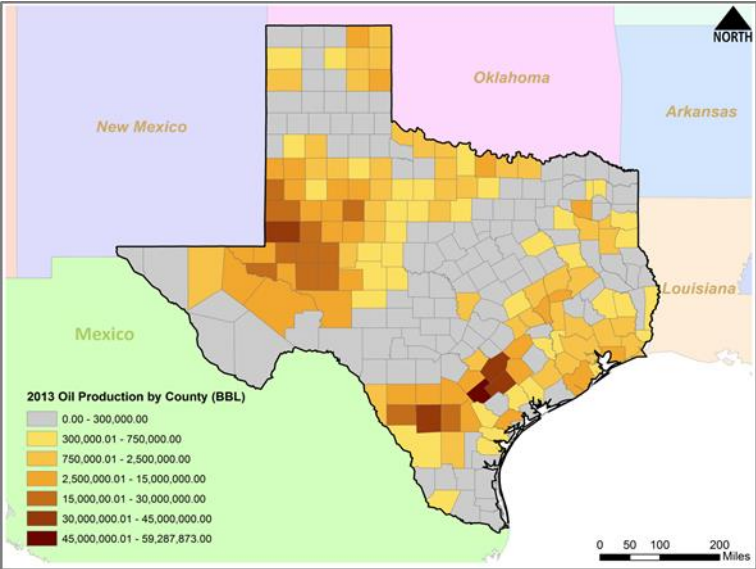
Figure 2. Contiguous U.S. State Shale Plays.

Some of the listed Texas shale plays have active production, while others are relatively untouched—awaiting future energy development once market prices rise. The TTI energy development reports listed previously focus on the three shale plays with the greatest drilling activity: Barnett, Permian, and Eagle Ford.

According to a 2014 U.S. Energy Information Administration (EIA) study, the six basins in Texas represented 90 percent of the growth in O&G production in the United States. The objective of the 2014 study was to measure the growth and impact that the O&G industry may have on residents near production areas. The EIA study focused on the impact of the drilling operations in the Permian Basin, which is classified as one of the O&G basins with the highest production growth rates in Texas. The research focused on only 10 of the basin’s counties: Fisher, Glasscock, Howard, Irion, Martin, Mitchell, Nolan, Reagan, Scurry, and Sterling. Findings included an expected total impact for the year 2022 of \$20 billion in the moderate scenario, creation of 30,540 jobs, and revenues of \$664 million for the local governments and \$701 million for the state government at the time the report was completed (11).

The Permian Basin region and Eagle Ford Shale region are the highest oil-producing regions in the state, while the other basin areas, though producing some oil, primarily produce either

various forms of natural gas or associated natural gas liquids (NGLs). Figure 3 shows that these two regions produce high values of oil based on 2013 volumes produced per county (6).



Source: Adapted from (6).

Figure 3. Texas Oil Production by County in 2013.

Chapter 2. Modal Alternatives for Oil and Gas Freight

This chapter describes the transportation alternatives and the effectiveness of each mode (i.e., truck, rail, and pipeline) to handle freight related to Texas shale O&G exploration. Table 1 gives an overview of advantages, disadvantages, benefits, and implementation hurdles associated with the use of highway, rail, and pipeline modes to serve O&G industry freight needs.

Table 1. Modal Comparison Table.

Mode	Modal Advantages	Modal Disadvantages	Modal Benefits	Implementation Hurdles
Highway	<ul style="list-style-type: none"> • Flexibility for short- or long-distance transportation • Direct access to well sites • Easy movement of specialty equipment 	<ul style="list-style-type: none"> • Certain cities have restrictions on truck dimensions and weights • Operations and maintenance costs related to heavy loads are higher compared to rail and pipeline 	<ul style="list-style-type: none"> • Increased road maintenance and repair • Roadside management/ inspection 	<ul style="list-style-type: none"> • Limited available funding sources for reconstruction and rehabilitation of rural roadways • Hazardous materials involved in highway accidents
Rail	<ul style="list-style-type: none"> • Flexibility to transport where pipeline is unable • Shorter contracts than pipelines • Faster movement than pipelines • Able to bring supplies and carry commodities closer to drilling operations—reduces truck trip length 	<ul style="list-style-type: none"> • Faster but less dependable than pipeline • Cannot directly connect all drill sites 	<ul style="list-style-type: none"> • Able to provide services not possible with pipeline and cheaper than truck • Continued expansion and development of rail parks located adjacent to or within the O&G exploration areas • Potential restoration of abandoned rail lines 	<ul style="list-style-type: none"> • Pipelines that are adjusting and realigning network in Texas to capture crude from Texas fields • New safety regulations that limit crude-by-rail speeds • Negative public opinion
Pipeline	<ul style="list-style-type: none"> • Safe and efficient movement of large quantities of O&G products • Cost-effective transportation of large quantities of liquid freight products • 500,000 miles of U.S. pipeline network 	<ul style="list-style-type: none"> • Speed of movement • Flexibility of movement • Slow response in case of pipeline damage 	<ul style="list-style-type: none"> • Potential flexibility to expand in the future • Eliminates additional transportation cost • Flexibility to connect from origin to destination 	<ul style="list-style-type: none"> • Nearby fire or explosion that can impact the pipeline system • Potential for vandalism/ disturbance of O&G flow • Negative public opinion

Highway

Effectiveness

The drilling of new O&G wells calls for the movement of heavy equipment to transport fracking sands, water, and other supplies to rural locations with roads and bridges unequipped for heavy traffic. While the highway system tends to offer flexible short- and long-distance transportation, direct access to drill sites, flexible transportation schedules, and easy movement of specialty equipment, the energy sector is placing significant financial and operational demands on state and local transportation systems (12).

An oil or gas well's development typically takes more than 20 days to construct and about three months to drill (13). A previous study conducted by TTI provided an estimate of the average daily truck traffic of approximately 27 truck arrivals per day during a well's construction phase. This development results in a total two-way traffic estimate of 1,054 truck trips per well during construction. Flatbed trucks move drilling rigs to the site; gravel trucks supply materials for the construction of site access roads; and tankers deliver cement, sand, mud, and water to the site and take waste water from the site (14). Rural roads and bridges were designed to provide land access for agricultural uses, not to withstand such high traffic levels or heavy loadings. Transportation agencies are challenged to address the increased damages resulting from energy-development-related traffic (12). Cooperative relationships between individual counties and TxDOT have been developed as one means to maintain roadways through the energy development period (14).

Current Capacity

TxDOT maintains over 80,260 centerline miles of roadway, with almost 41,000 centerline miles being farm-to-market system roads and spurs (15). Numerous segments of Texas's transportation system are experiencing deterioration and congestion, lack some desirable safety features, and do not have adequate capacity to provide reliable mobility, creating challenges for Texas's residents, visitors, businesses, and state and local governments (16).

From 1990 to 2013, Texas's population increased by 55 percent, from approximately 17 million to approximately 26.4 million. Texas's population is expected to increase to 45 million by 2040. From 1990 to 2015, annual vehicle miles of travel (VMT) in the state increased by 50 percent, from approximately 162.2 billion VMT to 243 billion VMT. Based on travel and population trends, the Road Information Program estimates that vehicle travel in Texas will increase another 25 percent by 2030, reaching approximately 304 billion VMT (16).

According to 2013 numbers, \$1.167 billion in goods is shipped from sites in Texas, and another \$1.246 billion in goods is shipped to sites in Texas, mostly by trucks. Sixty percent of the goods shipped annually from sites in Texas are carried by trucks, and another 9 percent are carried by parcel, U.S. Postal Service, or courier services, which use trucks for part of their deliveries (16).

Rail

This section assesses railroads as an alternative for expanding capacity for the movement of freight related to the O&G production in Texas. For O&G extraction, rail transportation could potentially be used throughout the entire process, from delivering vital components for extraction to transporting crude oil and other products and by-products. Typically, only the first- and last-mile deliveries from the nearest rail yard or line must be delegated to truck transport.

Effectiveness

The effectiveness of railroads in the transport of products used in O&G extraction revolves largely around the flexibility that rail can provide. The U.S. national rail network is already connected to the major O&G origins and destinations, such as refineries and fracking sand mines. This connection has allowed rail to facilitate greater shipments without the need to extend the current rail network; however, expansion of yards at loading and unloading transfer points along the network has been required. Such rail facilities can be expanded or developed along the existing rail network quickly by private rail companies and energy production companies. Expanded capacity can be more complicated due to extensive regulatory requirements for building new lines. As a result, most freight moves to trucks at the nearest yard or hub facility.

Supplying drill sites with the necessary equipment and supplies is handled by trucks; however, railroads transport many of these commodities to the nearest facilities within the drilling regions. For example, much of the premium U.S. fracking sand preferred by energy producers originates in Wisconsin and is delivered by rail to locations within the Texas drilling regions, where final delivery is provided by trucks. Locating additional rail facilities near the drilling sites could potentially reduce the distances that heavily loaded trucks would need to drive and the roadway damage impacts associated with such movements. Rail has proven to be a vital component in the shipment of crude oil as well. The Association of American Railroads (AAR) indicates that railroads originated 9,500 carloads of crude oil in 2008 and exceeded 207,700 carloads in 2013 (17). A 2014 report by the Congressional Research Service summarizes the flexibility railroads offer in terms of shipping crude oil (18):

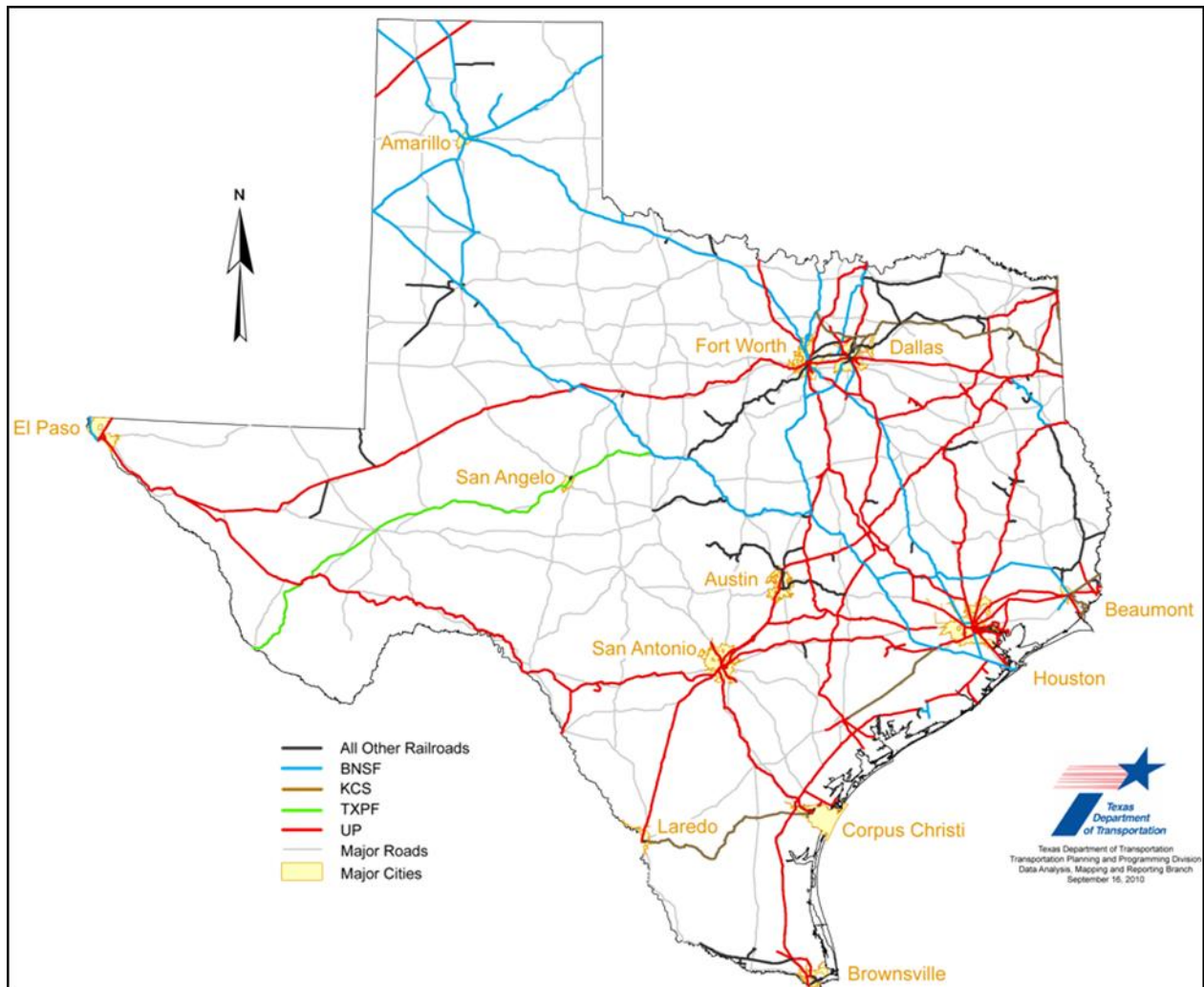
The geographic flexibility of the railroad network compared to the oil pipeline network can be especially beneficial for a domestic market in flux. Railroads can increase capacity relatively cheaply and quickly by upgrading tracks and roadbeds to accommodate higher train speeds, building passing sidings or parallel tracks, increasing the frequency of switchovers from one track to the other, and upgrading signal systems to reduce the headway needed between trains. Although railroads need approval from the federal Surface Transportation Board (STB) to build new lines, they do not require STB approval to make improvements to existing lines. Moreover, even without capacity improvements, railroads can offer routings not served by pipelines.

AAR identifies many advantages of transporting crude oil by rail (17):

- Geographical flexibility—By serving almost every refinery in the United States and Canada, railroads offer market participants enormous flexibility to shift product quickly to different places in response to market needs and price opportunities.
- Responsiveness—Rail facilities can usually be built or expanded much more quickly than pipelines and refineries. Essentially, railroads are the only transportation mode that can expand capacity quickly enough to keep up with production growth in the emerging oil fields.
- Efficiency—Railroads promote unit train shipments, which use dedicated equipment and generally follow direct shipping routes to and from facilities designed to load and unload them efficiently.
- Underlying infrastructure—Hundreds of millions of dollars have been invested on tracks, locomotives, terminals, and more to enhance rail’s ability to transport crude oil.
- Product purity—Consumers of crude oil often desire a specific type of crude oil. Shipping crude by rail allows pure barrels to be delivered to destinations in ways that are not always possible with pipelines.

Current Capacity

Texas has 49 railroad companies that operate on almost 10,500 miles of rail line across the entire state, which ranks it first in total rail miles compared to other states (19). Most of the mileage and movements occur on the three Class I railroads: UP, BNSF Railway, and Kansas City Southern Railway (KCS). Figure 4 presents a Texas rail network map from the Texas Rail Plan with the color-coded lines representing the three Class I railroads, the state right-of-way-owned Texas Pacifico Railroad (TXPF), and all the other railroads.



Source: (20).

Figure 4. Texas Freight Rail Network.

The Texas rail network is the most extensive network in terms of mileage and ranks high in most key indicators, according to the most current publicly available 2012 data sheet compiled by AAR and as seen in Table 2. Texas's 10,469 miles of rail rank first among other states, and its 49 railroads rank second nationally. Including trackage rights, which is where one railroad operates over another railroad through an agreement, the state's rail miles are 14,687 miles. Texas ranks fifth in overall rail tons, with terminating tons ranking first, at over 206.6 million tons, and ranks second in total rail carloads, with over 9.1 million carloads (19).

Table 2. Texas Key Rail Indicators for 2012.

Key Indicator	Statistic	Rank
Number of freight railroads	49	2nd
Total rail miles		NA
Excluding trackage rights	10,469	
Including trackage rights	14,687	
Total rail tons	373.4 million	5th
Originating	92.9 million	3rd
Terminating	206.6 million	1st
Total rail carloads	9,151,800	2nd
Originating	1,902,200	4th
Terminating	3,117,400	3rd
Total rail employment	16,826	1st
Total wages by rail employees	\$1.3 billion	1st

NA = not applicable. Overall state rankings do not include trackage rights mileage.

Source: (19).

Figure 5 displays the locations of O&G wells constituted between 1977 and 2010, with the railroad network placed over them. The O&G well data come as processed data from the Texas Railroad Commission.

The rail network appears to have good coverage throughout the Texas Gulf Coast and East Texas, while patches of wells in the Texas Panhandle, west of Fort Worth, and in the Permian Basin are not as covered by the existing railroads. Several abandoned rail corridors traverse O&G activity areas, such as between Wichita Falls and Abilene.

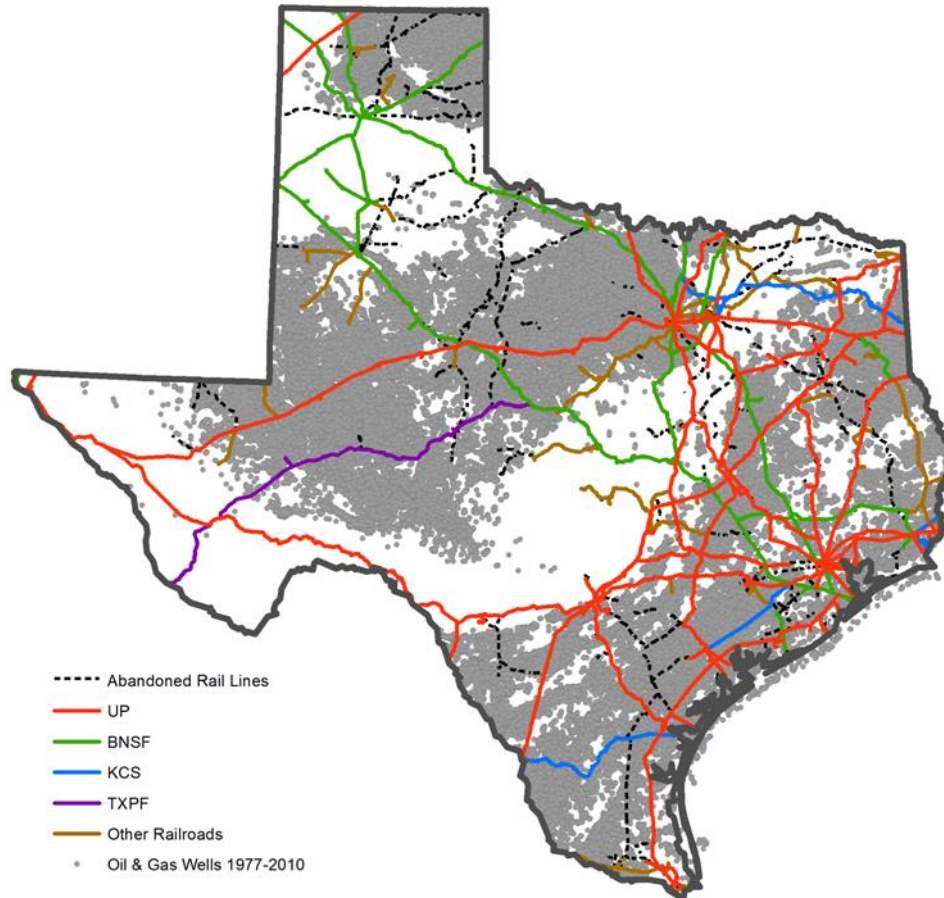


Figure 5. Location of Oil and Gas Wells in Relation to Rail Infrastructure.

Figure 6 displays the crude-by-rail facilities and crude oil pipelines. The crude-by-rail facilities are mostly concentrated in the Permian Basin and Texas Panhandle, with some additional facilities in the San Antonio area. The Permian Basin facilities exist despite the presence of crude oil pipelines. The San Antonio area facilities seem to be filling a need due to the lack of crude oil pipelines.

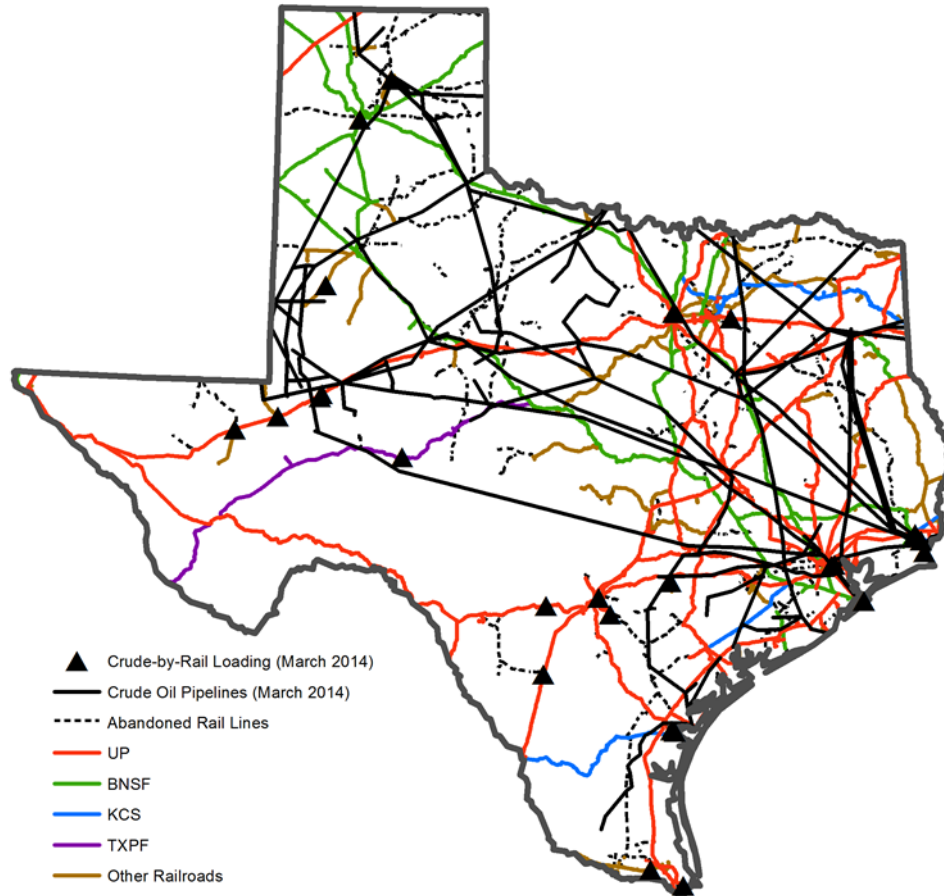
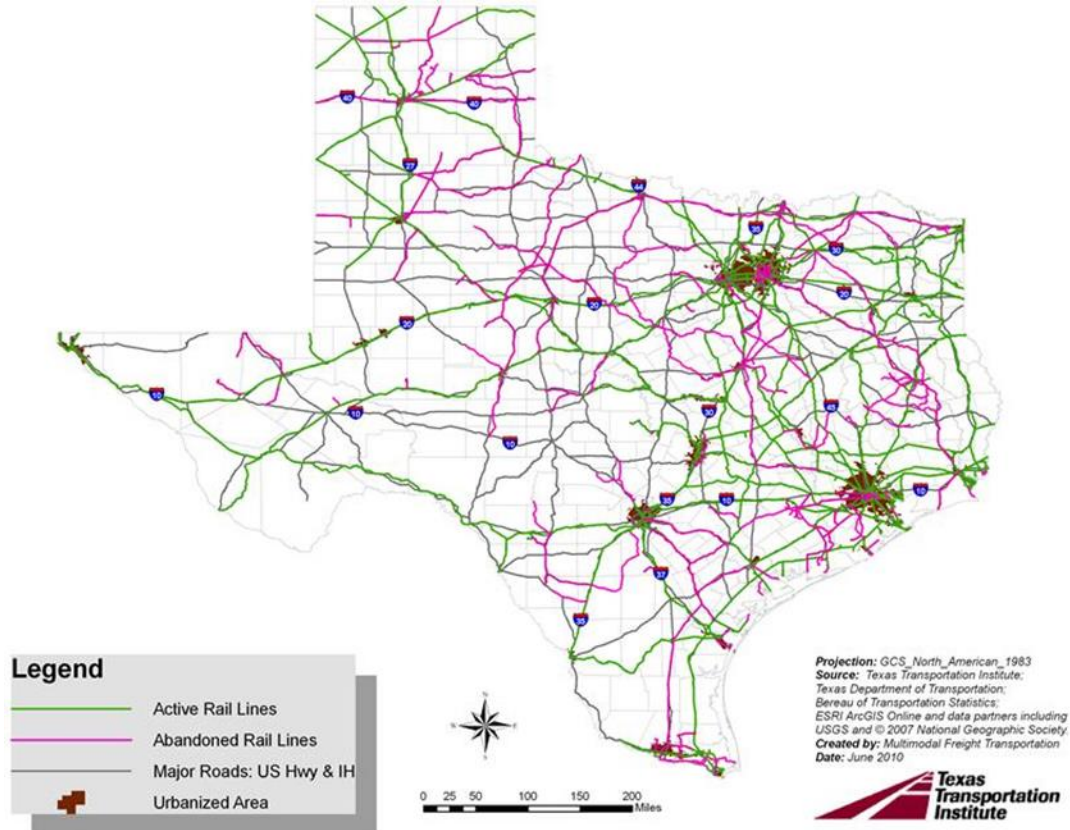


Figure 6. Location of Oil and Gas Wells in Relation to Rail Infrastructure.

Texas Abandoned Railroads

The peak of Texas railroad mileage was in 1932 with over 17,000 miles of track (21). That total has decreased over the years, with accelerated rates of decline beginning in the late 1970s and 1980s following the passage of the Staggers Act in 1980, which made it easier for railroads to abandon unprofitable rail lines.

A March 2011 TTI report calculated that as of 2008, over 9,000 miles of rail line track had been abandoned in the state (21). Some of those lines are now used for other purposes, such as roadways or pathways, while most of the remainder are used by the adjoining landowners, who reassumed ownership. Still other segments are still owned by the railroads and sit idle. Figure 7 provides a comprehensive view of the abandoned rail lines in Texas based on the findings of the 2011 TTI report. Several of the abandoned lines sit within the most active O&G exploration regions, with a few former lines being reconstructed or expanded for rail service to support O&G shipments.



Source: (21).

Figure 7. Comprehensive View of Abandoned Rail Lines in Texas.

Pipelines

This section presents an assessment of pipeline networks as an alternative for the movement of freight related to the O&G production in Texas. Almost 500,000 miles of pipelines in the United States have been used to transport O&G products—including interstate, intrastate, and intracompany. A typical trip through a pipeline is from a producing region (e.g., Texas, Wyoming, North Dakota, and Alaska) to a refinery. Pipelines also move oil that arrives from Mexico, Africa, the Middle East, and Latin America by tanker from U.S. seaports to refineries. Pipelines are privately owned assets for which transmission and distribution companies assume capital, operation, and maintenance costs in exchange for the opportunity to make a profit. This extensive infrastructure network is regulated and overseen by the Pipeline and Hazardous Materials Safety Administration, the National Association of Pipeline Safety Representatives, and the National Transportation Safety Board. In Texas, the Railroad Commission has regulatory authority over common carrier pipelines (22). However, lines located before the point of sale are not regulated and face no construction specification restrictions. In general, there are two types of energy pipelines: liquid petroleum pipelines and natural gas pipelines.

The liquid petroleum pipeline network is composed of five pipeline categories (23):

- **Crude oil gathering lines** are very small pipelines, usually from 2 to 8 inches in diameter, located primarily in Texas, North Dakota, California, Oklahoma, New Mexico, Louisiana, and Wyoming, with small systems in a number of other producing states.
- **Crude oil transmission lines** are larger cross-country trunk lines that bring crude from producing areas to refineries. There are approximately 55,000 miles of crude oil trunk lines in the United States, usually 8 to 24 inches in diameter. One of the largest is the Trans-Alaska Pipeline System, which is 48 inches in diameter.
- **Refined product lines** vary in size from relatively small, 8- to 12-inch-diameter lines, to much larger ones that go up to 42 inches in diameter. They transport products such as gasoline, jet fuel, home heating oil, and diesel fuel. Approximately 95,000 miles of refined product pipelines run throughout almost every state in the United States.
- **Highly volatile liquid lines** transport NGLs that turn to gas once exposed to the atmosphere (e.g., ethane, butane, and propane).
- **Carbon dioxide (CO₂) lines** allow CO₂ to be used to enhance oil recovery.

The U.S. natural gas pipeline network consists of more than 2.4 million miles of transmission and local utility natural gas lines (24). Natural gas pipeline systems can contain NGLs, water, and impurities (i.e., rich or wet) from the extraction stream. NGLs, water, and impurities are minimized or removed for commercialization (i.e., lean or dry). Natural gas and NGLs then travel on separate types of pipeline systems:

- **Gathering pipeline systems** collect raw natural gas from production wells and transport it to large cross-country transmission pipelines.
- **Transmission pipeline systems** transport natural gas thousands of miles from processing facilities across many parts of the continental United States.
- **Natural gas distribution pipeline systems** can be found in thousands of communities from coast to coast and distribute natural gas to homes and businesses through large distribution lines' mains and service lines.

The density of gathering networks has a critical influence on the transportation demands in a region. Gathering networks are used to collect emulsion (i.e., the oil and water mix extracted from wells) and to bring water for injection. Often, new wells are not connected to gathering pipeline networks, generating more tanker truck trips. As production levels increase, it makes more economical sense to develop the gathering pipeline network, reducing truck trips.

Effectiveness

Pipelines allow the safe and efficient movement of large quantities of O&G to storage centers and refineries while minimizing interactions with urban centers. Pipelines have delivered O&G

products reliably, safely, efficiently, and economically for almost a century. Although marine tankers, trucks, and railroads are alternative transportation modes to move O&G products, on a ton-mile basis, 71 percent of crude oil and refined products are carried by pipeline, 22 percent are carried by marine tankers, 4 percent are carried by trucking, and 3 percent are carried by rail. Of the dry natural gas recovered in the United States, 100 percent is shipped by pipeline to end users (24). For the movement of crude oil over long distances, pipelines represent the most cost-effective transportation mode. Without pipelines, streets and highways would be overwhelmed by trucks trying to keep up with the nation's demand for petroleum products.

It would take a constant line of tanker trucks, about 750 per day, loading up and moving out every two minutes, 24 hours a day, seven days a week to move the volume of even a modest pipeline. The railroad equivalent of this single pipeline would be a train of 75 2,000-barrel tank railcars every day. Almost all natural gas is moved by pipeline. Natural gas can be liquefied and moved by ship or truck, but few truck shipments of liquefied natural gas occur in the United States (24). According to statistics from EIA, as of December 2012, the United States produces over 10.6 million barrels of petroleum per day (24). This figure is projected to rise to 27 million barrels of petroleum per day by 2020.

Current Texas Pipeline Capacity and Routing

The 2013 EIA report *Short-Term Energy Outlook Supplement: Key Drivers for EIA's Short-Term U.S. Crude Oil Production Outlook* provides an overview of existing and planned pipeline capacity in Texas's Permian Basin region (25). According to this report, in 2013, two pipelines transported crude from the Permian Basin to the main pipeline collection point for crude oil in the United States at Cushing, Oklahoma. Those two pipelines were the Plains All American pipeline and the Oxy Centurion pipeline. The Plains All American pipeline had a current capacity of 450,000 barrels of petroleum per day (expanded from 400,000 barrels of petroleum per day in 2012), and the Oxy Centurion pipeline had a capacity of 175,000 barrels of petroleum per day. A third pipeline from the Permian Basin moved crude oil to Longview, Texas, where it connected to another transmission pipeline to the U.S. Midwest with a capacity of 300,000 barrels of petroleum per day.

The EIA report further stated that all three of these pipelines were approaching full capacity in early 2013 and that all three serviced the U.S. Midwest refinery region, which was effectively overserviced at the time of the report. As a result, and due to increased production in the Permian Basin occurring at the time of the report, six pipeline projects were underway to increase pipeline capacity from the region—all of which served the Texas Gulf Coast. The list of planned pipeline projects in 2013 included reversals and expansions of existing pipelines as well as construction of new pipelines. Projected pipeline capacity increases from these projects were forecast to provide an additional 355,000 barrels of petroleum per day in 2013 and 478,000 barrels of petroleum per day in 2014, if completed as planned (25).

Chapter 3. Public-Sector Energy Development Efforts

Recent investigations have focused on other state activities related to managing the rapidly increased levels of truck activity in and around well locations. Most of these activities involve efforts to maintain roadway conditions, upgrade roadway sections in poor condition, and fund these infrastructure improvements. Little research has investigated how rail and pipelines can assist in the management of truck activity or how these modes can play a larger role in supporting mining activities. The PRC report *Energy Development Impacts on State Roadways: A Review of DOT Policies, Programs and Practices across Eight States* found that “Colorado, North Dakota, Pennsylvania, and Utah reported engaging in long-term energy corridor planning involving important roads or other modes such as pipeline and rail” (2).

This project found that those states with potential rail options typically have an existing state-level rail funding program or programs (i.e., loans, grants, or a combination of loans and grants) that could be used for rail infrastructure projects. In almost all cases, the scoring/selection process for these funds is based largely on economic development criteria rather than transportation benefits. With that said, rail-based infrastructure associated with O&G activity would be eligible because of the local economic development benefits. Examples of such infrastructure include loading facilities and loop tracks within local industrial parks and staging facilities for interchange of energy equipment and products between Class I and short-line railroads.

State Congestion and Safety Responses

In a National Cooperative Highway Research Program study on energy development impacts on U.S. roads and bridges, states reported traffic conflicts with other modes (e.g., pedestrians and bicycles), along with increases in the number of head-on collisions and run-off-the-road incidents, as safety-related issues for increased O&G-related traffic. Both the North Dakota Department of Transportation (NDDOT) and TxDOT reported increases in fatality crashes and rear-end collisions. The leading causes of these crashes, according to law enforcement in Texas, were the failure to control speed and driver inattention. Table 3 summarizes the effective measures reported to address the identified safety issues. Two safety measures reported as very effective were modifications to roadway geometric features and use of detours or alternate routing for heavy trucks (12).

Table 3. Safety Strategies Used and Rated Effectiveness.

Measures Reported	States	
	Measure Rated as Very Effective	Measure Rated as Somewhat Effective
Reinforcement of roads (e.g., use of geotextiles, stabilization of aggregates or subgrade)	West Virginia	Iowa, Nebraska, Pennsylvania, Utah
Roadway geometric feature modifications (e.g., widening paved shoulder, horizontal curve re-alignment, etc.)	Arkansas, Colorado, Iowa, Kansas, Texas	Alabama, Montana, North Dakota, Pennsylvania, Utah
More frequent use of law enforcement (e.g., limit traffic, especially during periodic heavy rainfall)	Colorado	Arkansas, Montana, Pennsylvania, Texas, Utah
Encourage or require use of detours and alternate routing for heavy trucks	Colorado, Iowa, West Virginia	Minnesota, Nebraska, Pennsylvania, South Carolina, Utah
Install additional signage to warn motorists of heavy truck traffic volumes in the area	West Virginia	Alabama, Pennsylvania, Utah
Lower the posted speed limit		Colorado, Montana, Pennsylvania
Specific state or local legislation or regulations that apply to specific energy development industries (e.g., adequate public facilities ordinances, specific road and bridges design standards, etc.)	Colorado	Alabama, Pennsylvania
Temporary measures such as roadway embankments	Kansas	Pennsylvania
Campaigning and public outreach (e.g., ProgressZone in state of North Dakota)	North Dakota	Colorado, Pennsylvania, Texas, Utah
Use of intelligent transportation systems (e.g., advance warning systems)	Alabama, Colorado	Pennsylvania, Utah

Source: (12).

NDDOT and TxDOT indicated that the increase in crashes with incapacitating injuries and fatalities was attributable to the effects of energy development in the area. Twelve states noted that the congestion level on public roads with heavy-truck volumes could be primarily attributed to roadway geometric issues. Congestion on adjacent roads and conflicts with infrastructure (vertical clearance issues) were reported as other noticeable congestion patterns. Even though congestion resulting from the increased truck traffic from energy development activities was observed in Montana and South Dakota, those departments of transportation (DOTs) reported that the congestion was manageable under current roadway capacity (12).

Table 4 describes and ranks the effective safety measures reported by DOTs to address observed congestion issues (12).

Table 4. Strategies to Address Observed Congestion Issues.

Measures	States	
	Measure Rated as Very Effective	Measure Rated as Somewhat Effective
Encourage use of detours or alternate routing for heavy trucks	Iowa	Pennsylvania, South Carolina
Install increased signage to warn motorists of heavy truck traffic volumes	Utah	Alabama, Pennsylvania, Texas
Use of intelligent transportation systems (e.g., advance warning system)	Utah	Alabama, Colorado, Pennsylvania
Collaborate with energy development companies to adjust the timing and logistics of truck movements (e.g., staged truck routing schedule)	Iowa, West Virginia	Colorado, Pennsylvania, South Carolina

Source: (12).

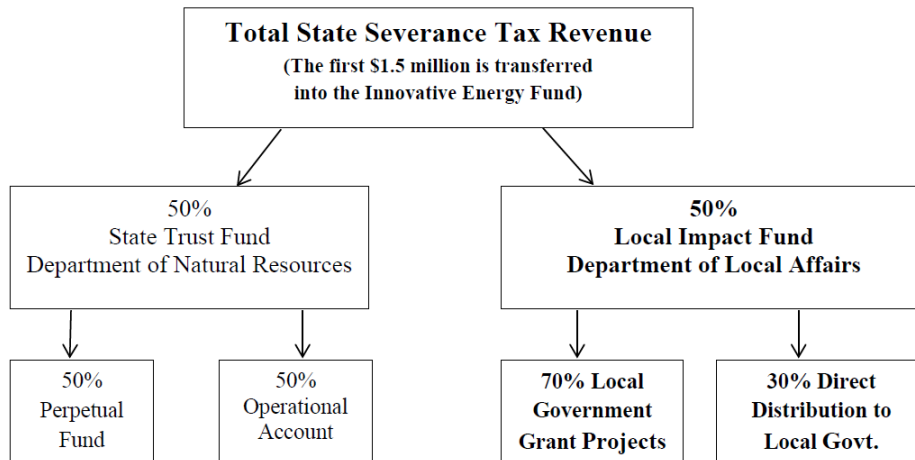
State Funding Programs for Energy Development Areas

Since O&G production in shale formations is occurring throughout the United States (as discussed in Chapter 1), a number of states are responding to the effects of increased energy development through a variety of funding mechanisms. According to a prior study done by TTI, states have charged O&G production through different types of fees, taxes, and exercises, applying the collected capital among several sectors, including transportation programs. The study reveals that these taxes have aided in matching needed funds in the transportation area in important producer states (2).

In Texas, O&G production is charged on severance taxes according to the market value of the product (7.5 percent for gas and 4.6 percent for O&G condensate). The allocation of budget relies on the Economic Stabilization Fund needs, as determined by House Bill 1 (83rd Legislature) approved in November 2014. From the total of O&G severance taxes, 37.5 percent is designated to the Environmental Response Fund, and the remainder is allocated to the State Highway Fund, aiming to fund unmet financial needs in the transportation sector. Fifteen percent of the revenue allocated to the State Highway Fund is statutory, allocated to road construction and maintenance related to O&G activities.

These revenue sources and funding programs include the following examples from other states:

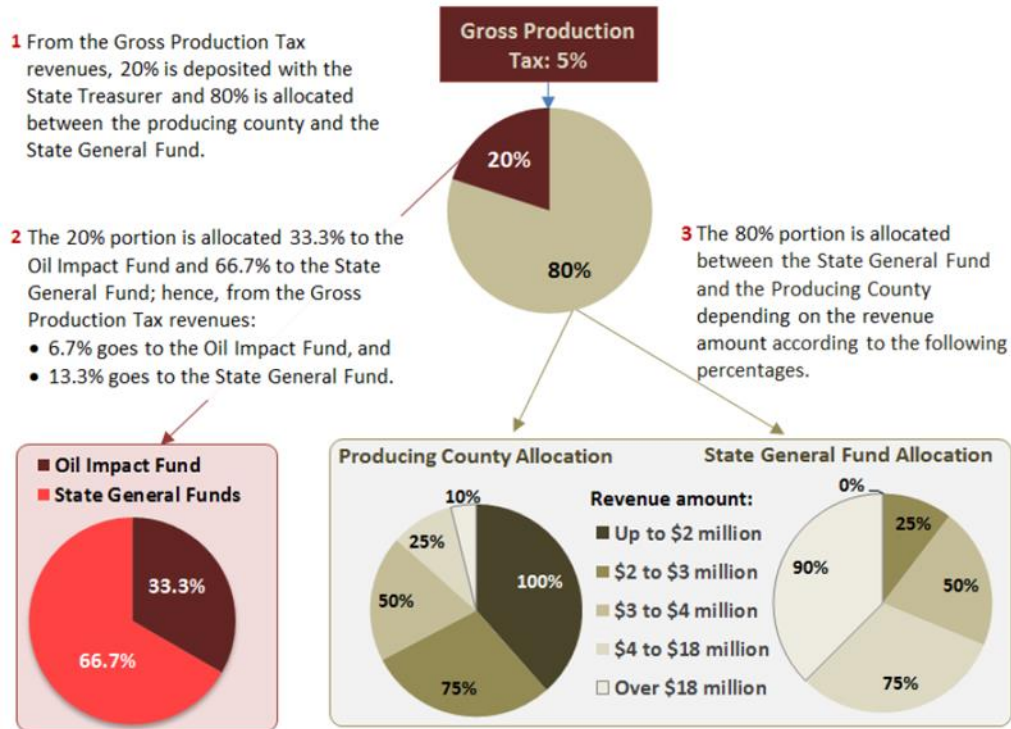
- Colorado oil and gas severance tax—Colorado, the seventh largest oil producer in the United States (26), has transferred revenues from O&G severance taxes allocated to the General Fund to aid transportation projects statewide. From the total revenue, \$1.5 million is transferred into the Innovative Energy Fund, and from the remainder, half is deposited into the State Trust Fund and the other half into the Local Impact Fund. The Local Impact Fund is devoted to financially aiding projects related to energy-sector activities. The fund is part of the Energy and Mineral Impact Assistance Program (see Figure 8), approved in 1977 by the Colorado Legislature (27).



Source: (27).

Figure 8. Colorado Oil and Gas Severance Tax Distribution.

- West Virginia oil and gas severance taxes—West Virginia has also adopted apportionments from the General Fund to mitigate infrastructure impacts caused by energy development activities. From the 90 percent portion of O&G severance taxes deposited into the General Fund, the first \$24 million collected is allocated to amortize debts in infrastructure bonds (28).
- North Dakota oil and gas production tax—According to North Dakota’s tax commissioner, of the 5 percent of the budget leveraged from the O&G gross production tax, 20 percent is allocated to the State Treasury. Of that portion, 33.3 percent is then transferred to the Oil and Gas Impact Fund, and 66.7 percent goes to state general revenues. The other 80 percent from the gross production tax is distributed to the State General Fund and the producing county, according to the total collected revenue (29). From the producing county allocation, local entities are required to fund transportation projects under penalty of forfeiting such revenues. Figure 9 shows the O&G gross production tax distribution in North Dakota in fiscal year 2012.



Source: (29).

Figure 9. Oil and Gas Gross Production Tax Allocation in North Dakota in Fiscal Year 2012.

- Pennsylvania unconventional gas well fee—Pennsylvania is the largest natural gas producer in the United States. According to the Pennsylvania Legislature Title 58, Section 2313(c)(1), from the total O&G fee revenues deposited into the Unconventional Gas Well Fund, \$1 million is applied directly to the state DOT for rail freight assistance. After other earmarks, 60 percent of the total O&G fee revenues go to producer counties, and 40 percent go to the Marcellus Legacy Fund. Through Act 13 of 2012, both funds were created to receive revenues from unconventional gas well fees and were aimed at mitigating adverse impacts of O&G production. While the Unconventional Gas Well Fund aids emergency responder training, unconventional wells, and rail freight projects, the Marcellus Legacy Fund has as one of its goals funding bridge repairs in producer counties (30).
- West Virginia bonds for energy-sector roadway repair—The West Virginia Department of Transportation recently issued a review of its O&G road policy. The new policy states that well operators with 5,000 or more barrels of liquids used must pay revenue bonds to cover anticipated damage of roads by the operator’s activities. The bonds must be overseen by the Division of Highways and have values ranging according to the road type: \$100,000 for paved mile, \$35,000 for tar and chipped mile, and \$25,000 for graveled mile (31).

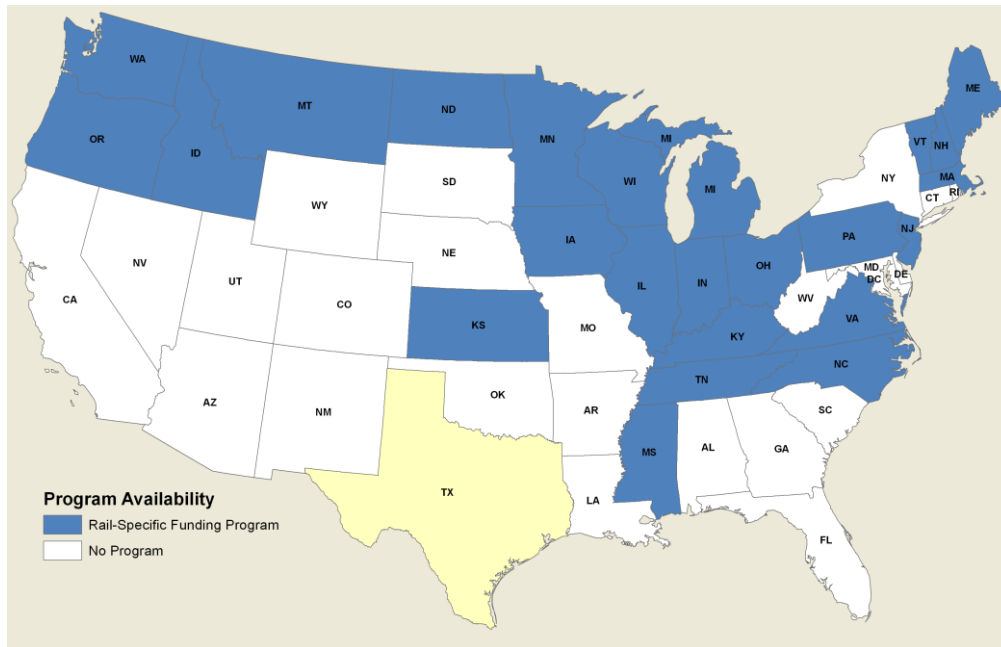
- Pennsylvania excess maintenance agreement—The Pennsylvania Department of Transportation has an agreement with haulers that exceed posted weight limits on state and local roadways, aimed at mitigating adverse roadway impacts caused by heavy-duty truck traffic. The fields that the agreement covers are mainly related to timber, coal, and natural gas exploration. According to the Pennsylvania Department of Transportation, after the type of roadway that will be impacted is decided, haulers must pay \$50,000 per mile of paved roads that can be reverted to unpaved roads, \$12,500 per mile of paved roads, and \$6,000 per mile of unpaved roads (32).
- Texas–New Mexico Railroad improvement—Permian Basin Railways, Inc., which owns nine local railroads throughout the country, received \$64.4 million in loans from the Federal Railroad Administration’s Railroad Rehabilitation and Improvement Financing program in 2009. The funding improved the Texas–New Mexico Railroad’s track speed and service consistency (33). This stretch of 104 miles from the UP connection at Monahans, Texas, to Lovington, New Mexico, is an important corridor serving crude-by-rail movement (34).

Public Involvement in Rail Infrastructure Investment

The availability of adequate freight transportation infrastructure has long been recognized as critically important for the growth of business and industry in local communities. Economic development through relocation of businesses from other states or expansion of existing businesses typically benefits a local economy through employment growth and/or increased tax revenues. Consequently, public resources are often used to expand local infrastructure to support economic development initiatives. Investing in local rail freight infrastructure may create new economic development opportunities for local communities. Examples of the types of freight railroad infrastructure projects that can benefit local business or industry include:

- Construction of a new rail line or restoration of track, structures, subgrade, or switches on an existing rail spur or industrial lead to improve connectivity between local industry and a railroad mainline.
- Installation of modern grade crossing devices, train signaling, or other communication systems to improve safety and increase capacity on a local rail line.
- Purchase of specialized rolling stock for use by local industry for freight transport.
- Construction of support facilities required for local industries to use rail for freight transport, such as storage buildings, silos, or transloading facilities.

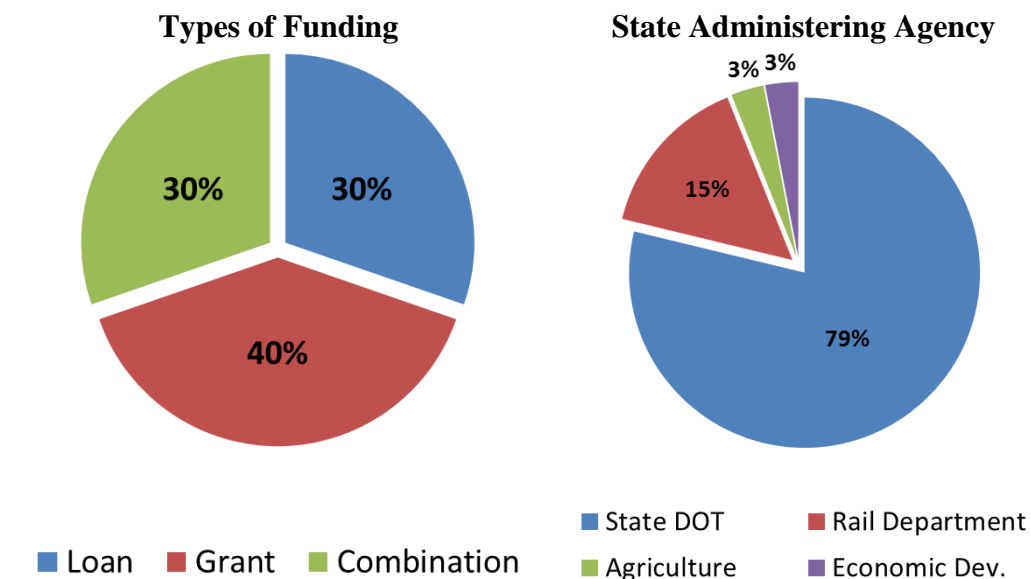
Improvements to local freight rail infrastructure can benefit local communities through economic development while also supporting broader transportation system goals, such as shifting freight from highways to rail or increasing connectivity between rail lines. As a result, many states have



Source: TTI analysis, 2013.

Figure 11. States with Rail-Specific Programs.

In the states with state-level rail-specific programs, the types of funding and the state agency that administers the rail infrastructure program differ (see Figure 12). Loans, grants, revolving funds, and the use of state funding to match available federal programs for rail improvements were all identified as strategies being used to attract rail-served businesses.



Source: TTI analysis, 2013.

Figure 12. Types of Funding and State Administering Agencies.

Rural Rail Transportation Districts

RRTDs are subdivisions of Texas state government, created at the county level, that have the authority to purchase, operate, and/or build new railroad and intermodal facilities; the right of eminent domain; and the ability to issue bonds based on projected revenues that may be generated by the rail improvements. RRTDs do not have taxing authority, however, and the lack of a dedicated funding source has prevented many RRTDs from being successful in either preventing rail abandonment or implementing proposed rail projects. RRTDs are seen by some local economic development entities as a vehicle they can use to enhance their local development efforts.

The 67th Texas Legislature first authorized RRTDs in 1981. RRTDs are formed by simple resolution of one or more county commissioners' courts under rules outlined in Texas Statutes and the Texas Transportation Code. The creation of an RRTD does not require approval by TxDOT or any other state-level planning authority.

RRTDs are not required to notify TxDOT or any other state agency upon formation, which makes tracking new RRTDs and monitoring their activity difficult. TxDOT has contracted with TTI to perform several studies to characterize RRTD formation and activities, with the latest update published in 2013 (35). As of June 2013, 42 RRTDs have been identified as being officially formed in Texas, with 95 of the state's 254 counties participating in at least one RRTD.

Several motivations were cited by counties for the formation of RRTDs (35). Such motivations generally fall into the following three categories:

- Rail preservation/prevention of abandonment—The RRTD was formed in response to proposed abandonment of a railroad line within the RRTD's jurisdiction, generally for the purpose of opposing the abandonment and preserving the line for future use.
- Economic development—The RRTD was formed to promote economic development within the RRTD jurisdiction, including construction of railroad spur lines to single industries or larger multi-parcel industrial parks, or construction of new railroad lines to promote alternative (i.e., dual) rail service.
- Improved passenger rail service—The RRTD was formed largely to promote establishment of improved passenger rail service along an existing Amtrak route.

Among the 42 RRTDs identified in the state, 15 (36 percent) were formed primarily in response to the threat of rail line abandonment, 19 (45 percent) were formed to promote economic development, four (10 percent) were formed for multiple reasons, and at least one was created primarily for promoting improved passenger rail service. The primary motivation for RRTD formation was not conclusively identified for three RRTDs (35).

Many of the RRTDs are located in counties with O&G activities. Figure 13 displays a map showing the RRTDs overlaid on the active and abandoned rail lines in the state and O&G wells between 1997 and 2010.

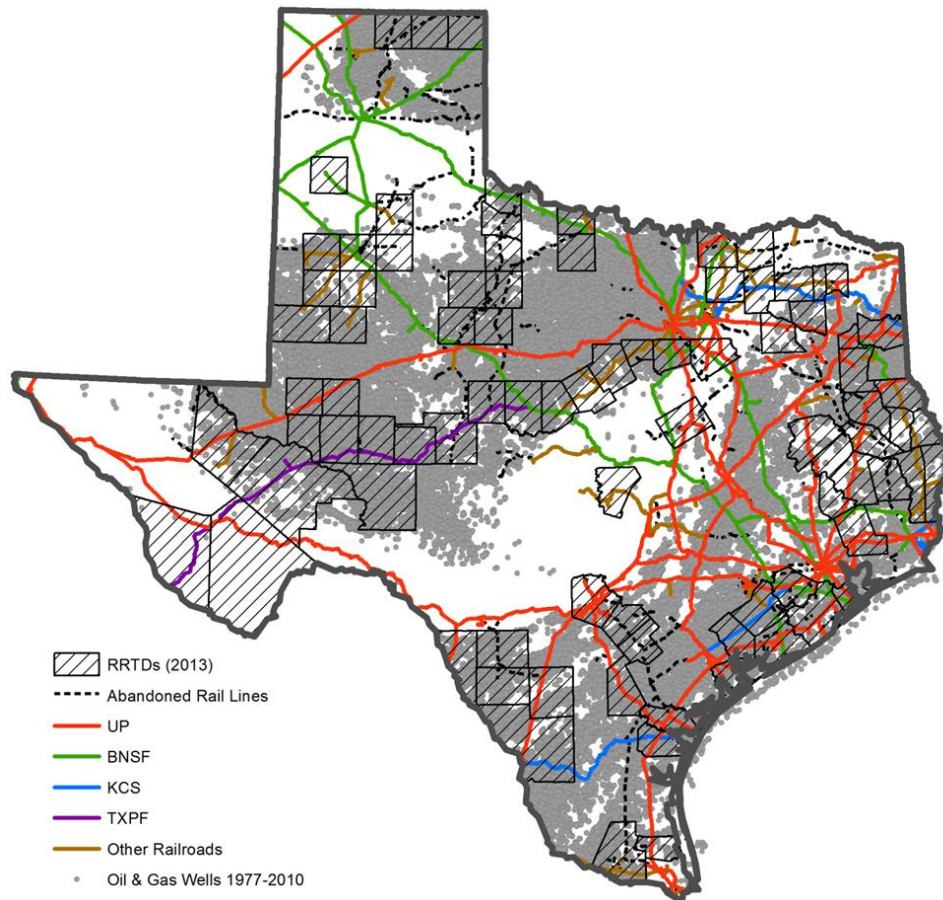


Figure 13. Location of Rural Rail Transportation Districts in Relation to Rail Lines and Oil and Gas Well Activity in Texas.

Few RRTDs are actively meeting and pursuing rail projects, but those that are active and located within O&G activity regions could be used as a tool to develop rail infrastructure projects. The following are some of the noteworthy projects identified in the 2013 update (35). These projects represent either activities by RRTDs located in O&G regions or project types that could assist with increased rail use for O&G activities.

- The Top of Texas RRTD was formed in 2006 to prevent the abandonment of a railroad line through Hansford, Ochiltree, and Lipscomb Counties in the Texas Panhandle. The RRTD was able to negotiate a deal to gain fee-simple ownership of the 90-mile right of way, while the former railroad owner was able to salvage the rail materials. The agreement allows the businesses along the line to retain their leases and the RRTD to collect lease payments as income. The right of way owned by the RRTD extends into Oklahoma, where the abandoned line connects to the nearest Class I railroad.

- The La Entrada Al Pacifico RRTD has proposed a north-south rail line between Seagraves, Texas, through the Midland-Odessa region and farther south to interchange with the South Orient Railroad/Texas Pacifico line at McCamey, Texas.
- The Ellis County RRTD has been active in enhancing the rail transport capabilities of the Railport Industrial Park adjacent to the BNSF Railway line in Midlothian, Texas, which opened in 2004. Recently, the RRTD undertook several track work projects to eliminate flooding issues and move storage tracks to accommodate a second entrance to the industrial park.
- In 2011, the Liberty County Rural Rail District #1 received \$15,000 from the Liberty Community Development Corporation for a feasibility study on the acquisition, construction, and rehabilitation of a 1.8-mile railroad spur line within the city of Liberty connecting several local industries to the mainline.
- The Reeves County RRTD formed in 2010 to assist with the development of transportation infrastructure associated with a proposed 500-acre industrial park near Pecos, Texas.

Chapter 4. Private-Sector Oil and Gas Rail and Pipeline System Improvements

Increased O&G production in Texas has encouraged private investments in rail facilities and pipelines to serve the wells being drilled and operated. This chapter offers illustrative examples of the private-sector activity in Texas.

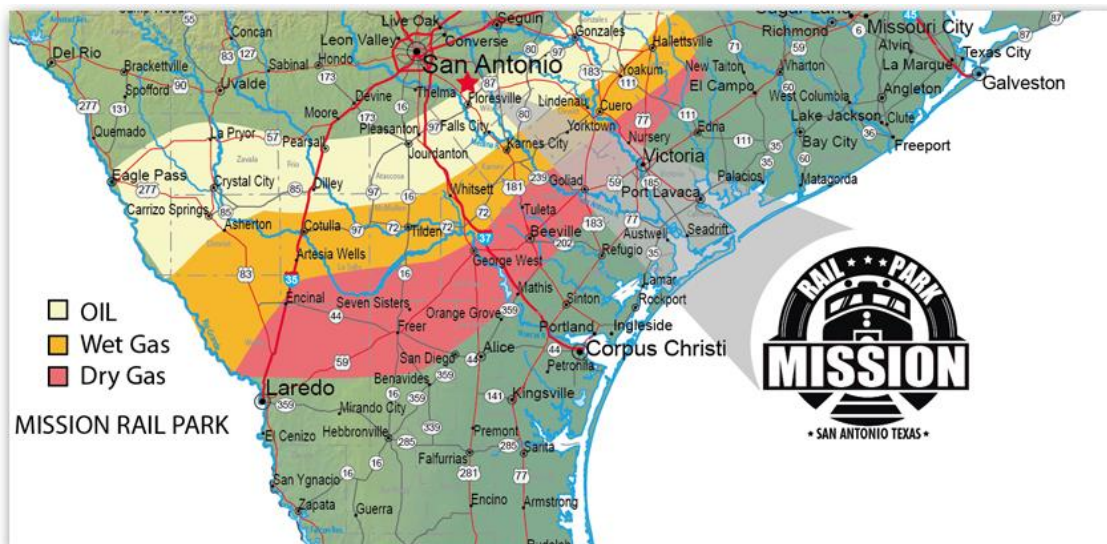
Recent Private-Sector Rail Infrastructure Development

The growth in O&G activities has resulted in the development of several major rail-served yard facilities and the upgrading and expansion of short-line railroads to serve the O&G industry.

Rail Construction and Development in the Eagle Ford Shale Play

Mission Rail Park in San Antonio

Mission Rail Park is advertised as San Antonio's largest commercial rail park ever constructed. Located southeast of San Antonio, the park is over 1,000 acres and is designed to support O&G industry activities south of San Antonio and other commercial activities in the San Antonio region. Figure 14 shows the location of the facility in comparison to the bands of O&G activities. The facility is only 40 miles from the highest-producing Eagle Ford wells (36). Some of the capabilities include the capacity for multiple daily unit trains; hazmat loading and unloading, crude storage, and transloading sites; and fracking sand and other commodity storage and transloading. This facility is served by UP, which had to reconstitute previously out-of-service tracks for the development of the facility.



Source: (36).

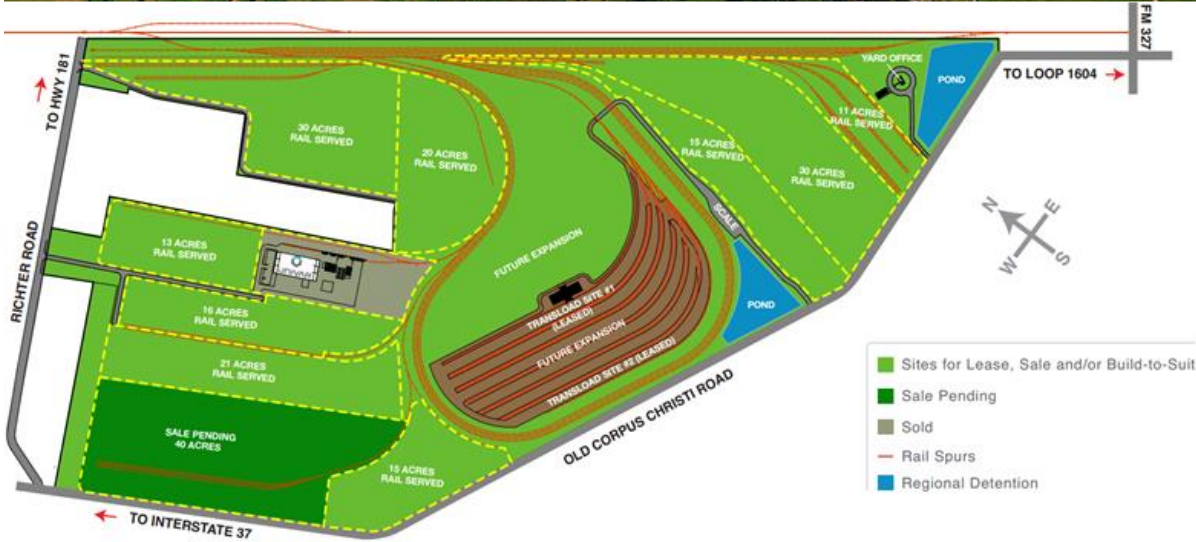
Figure 14. Mission Rail Park Location Map.

Alamo Junction Rail Park in San Antonio

Alamo Junction Rail Park is located a few miles northwest of Mission Rail Park. The 400-acre master planned industrial park promotes easy access to I-37, South Loop 1604, and U.S. Highway 181 and is in close proximity to many of the major oilfield service companies (37). Some of the stated rail services and capabilities include:

- Dual rail service (UP and BNSF Railway).
- Railcar handling, switching, and storage.
- Manifest and unit train service capability.

Figure 15 provides an aerial photograph and site plan of Alamo Junction Rail Park.



Source: (37).

Figure 15. Alamo Junction Rail Park Aerial Photo and Site Plan.

Gardendale Railroad in Gardendale

Gardendale Railroad, located in La Salle County between San Antonio and Laredo, is one of the most dramatic examples of rail growth in response to the recent O&G exploration activities. It began existence in 2010 with approximately 1,600 feet of connecting interchange tracks with UP. The railroad now operates over 29 miles, or over 153,100 feet, of track. Moreover, it grew from 395 annual carloads in 2010 to an expected 22,000 in 2013. Example shipments include inbound unit trains of fracking sand and outbound unit trains of pipe and crude. Its tremendous growth persuaded *Railway Age* magazine to crown Gardendale Railroad the Short Line of the Year in 2013 (38).

An April 2012 article in the *San Antonio Express-News* reported on the early growth of Gardendale Railroad (39). Gardendale Railroad is the only part of an abandoned railroad that stretched west, then north to Uvalde, then east, and then north again to connect to the UP line between San Antonio and Corpus Christi. Crystal City Railroad owned the track to the Del Monte plant, and Iron Horse Resources, owner of Gardendale Railroad, purchased the track in 1990. Most of the line was abandoned after Del Monte stopped using rail in 1995 (39). Figure 16 includes four photographs of the 2010 “before” conditions of the rail park, while Figure 17 provides an aerial photograph of the rail park after completion of Phase 2. The railroad is now on Phase 3, consisting of 220 acres located north of Phase 2 (40). The railroad has the ability to interchange multiple unit trains and handles commodities such as fracking sand, aggregate, line pipe, casing or drilling pipe, crude, petroleum, condensate, gas liquids, hydrochloric acid, barite, and bentonite (40).



Source: (39).

Figure 16. Gardendale Railroad 2010 “Before” Conditions.

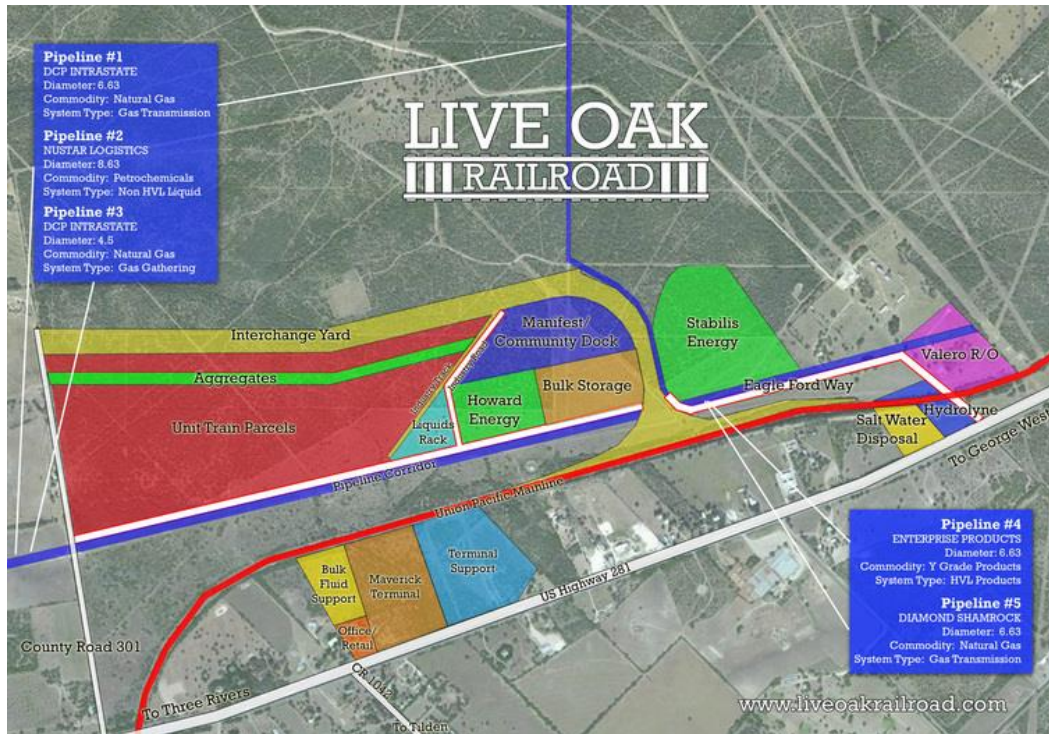


Source: (40).

Figure 17. Gardendale Railroad Phase 2.

Live Oak Railroad between Three Rivers and George West

Located in Live Oak County between San Antonio and Corpus Christi, this new rail park serves the Eagle Ford Shale Play and South Texas and connects to UP. With over 300 acres, Live Oak Railroad advertises capabilities for handling pipeline interconnects, bulk liquid terminals, transload services, and multiple unit trains (41). Figure 18 shows the Live Oak Railroad rail park site plan with interconnections to four pipelines at the complex (42).



Source: (42).

Figure 18. Live Oak Railroad Site Plan.

Other Eagle Ford Shale Rail Developments

In addition to the locations previously discussed, several other rail-based developments exist in the Eagle Ford Shale region, including:

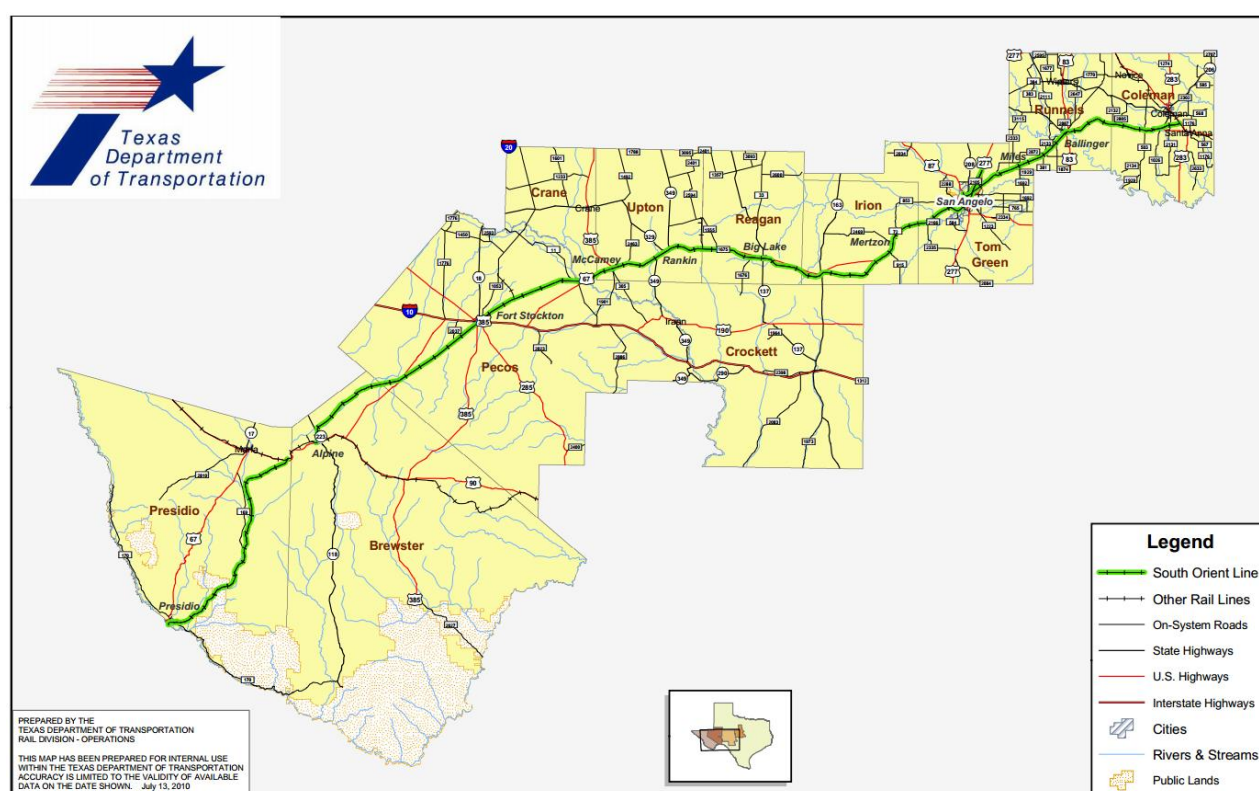
- Hondo Railway, LLC—co-located at the publicly owned Hondo airport and recently expanded from 13,000 feet to 80,000 feet of track.
- Port San Antonio’s East Kelly Railroad—expanded from 4 miles to almost 8 miles of track within the 350-acre site.
- Texas Gonzales and Northern Railway—expanded from 12 miles to 25 miles of track (43).

Rail Construction and Development in the Permian Basin Region

The Permian Basin of West Texas has also seen construction and development of several new rail-based facilities for transporting equipment and loads related to the O&G industry. This section discusses several of these.

Texas Pacific Transportation in West Texas

TXPF operates and maintains via lease from TxDOT the South Orient Rail Line between San Angelo Junction (near Coleman, Texas) and Presidio, Texas, at the Mexican border (44). Approximately 371 mainline track miles exist over the route between San Angelo Junction and Presidio. TxDOT completed the purchase of the line and leased operations to TXPF in 2001. Figure 19 shows a map of the South Orient Rail Line.

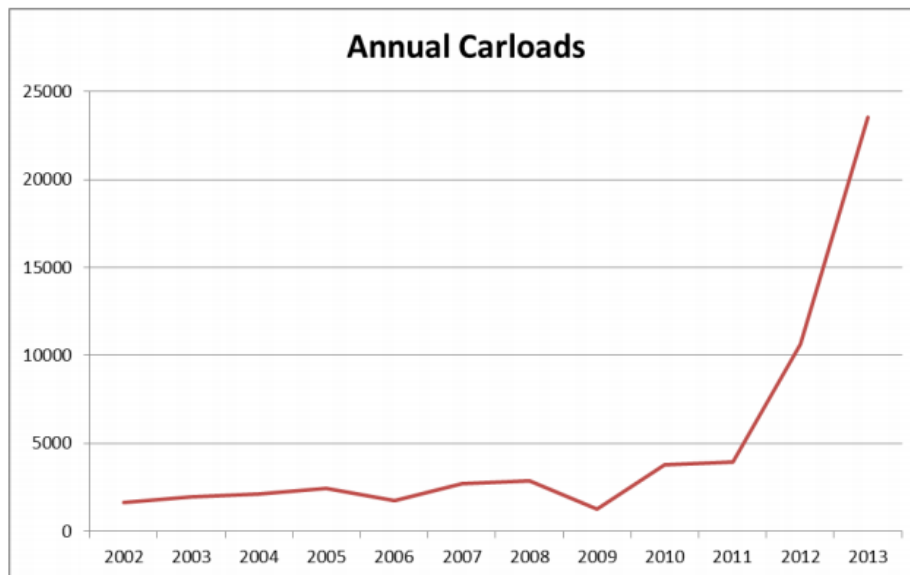


Source: (45).

Figure 19. TxDOT Map of the South Orient Rail Line (2010).

TXPF has experienced a tremendous jump in traffic with the recent O&G exploration growth. Figure 20 shows the annual carloads from 2002 to 2013. Before the O&G exploration began to rapidly expand, TXPF delivered 1,527 carloads of sand, grain, wheat, and other shipments. The end-of-year count for 2014 was expected to exceed 25,800 carloads, with projections for 2015 totaling almost 40,000 (46). In response to acquiring the line and the growth in O&G exploration-related shipments, TxDOT and TXPF have undertaken several infrastructure

projects, including a project partially funded using \$14.01 million in American Recovery and Reinvestment Act funds.



Source: (46).

Figure 20. TXPF Annual Carloads in 2002–2013.

BNSF Logistics Center in Sweetwater

In November 2014, BNSF Railway opened the BNSF Logistics Center in Sweetwater to help accommodate the traffic growth in the Permian Basin. According to *Progressive Railroading*, the facility will provide rail, truck, and transload services and serve several industries, including agricultural products, sand, pipe, and aggregates (47). The 75-acre facility has rail capabilities that include a 100-car unit train sand terminal, 100-car unit train agriculture terminal, 90-car unit train aggregate terminal, 30-car dimensional transload site, and expandable switch yard. The project added 40,000 feet, or over 7.5 miles, of new track at the site. The local economic development director said that “the rail hub helps alleviate tractor-trailer traffic in the area by using rail cars to transport products that would have been shipped by truck” (48).

Pipelines

Private-sector pipeline expansion in terms of mileage and capacity is expressed in Table 5 and Figure 21. Table 5 shows the growth of regulated and unregulated pipeline mileage throughout the state. Figure 21 illustrates the recent growth of natural gas pipelines in natural-gas-producing regions of the state. These pipelines not only connect Texas natural gas to other states but also provide natural gas feedstocks to chemical manufacturing plants in Texas.

Table 5. Texas Pipeline Mileage.

	Type of Pipeline	2012 Mileage	2013 Mileage	2014 Mileage	2015 Mileage
1	natural gas distribution	100,645	100,404	101,995	101,856
1a	service lines	40,573	40,800	44,563	44,305
2	natural gas master meter*	438	419	408	408
3	LP-gas distribution	163	164	164	167
4	natural gas transmission & storage	33,797	32,739	32,888	32,228
5	natural gas gathering	3,993	4,029	4,004	4,346
6	hazardous liquids transmission and storage	28,252	29,768	30,428	31,895
7	hazardous liquids gathering	699	1,041	1,849	1,860
8	total regulated intrastate miles (sum of 1 through 7)	208,560	209,364	216,299	217,065
9	intrastate production and gathering lines leaving lease	154,225	159,604	163,543	168,268
10	total intrastate pipeline miles in Texas (regulated and non-regulated) (sum of 8 and 9)	362,785	368,968	379,842	385,333
11	interstate natural gas transmission pipeline	21,580	21,724	21,618	21,554
12	interstate hazardous liquids transmission pipeline	22,482	24,426	24,479	25,090
13	total regulated interstate miles (sum of 11 and 12)	44,062	46,150	46,097	46,664
14	total regulated miles (intrastate and interstate) (sum of 8 and 13)	252,622	255,514	262,396	263,729
15	total pipeline miles in Texas (interstate and intrastate, regulated and non-regulated) (sum of 10 and 13)	406,847	415,118	425,939	431,997

*A master metered system is a pipeline system, other than one designated as a local distribution system, for distributing natural gas within but not limited to a definable area, such as a mobile home park, housing project, or apartment complex, where the operator purchases metered gas from an outside source for resale through a gas distribution pipeline system.

Note: LP = liquefied petroleum.

Source: (I).



Source: Based on data from (49).

Figure 21. Texas Natural Gas Pipeline Capacity Measurement.

Table 6 lists new O&G pipelines under construction in Texas, showing the continued private investment in pipeline infrastructure to collect and distribute new energy resources being extracted in the state.

Table 6. Texas Pipeline Construction Projects in Progress.

Contractor/Owner	Project Name/Location	Miles	Completion Date
Natural Gas			
Bechtel/Cheniere Energy, Inc.	Corpus Christi Liquefaction Project	22	2018
Blueknight Energy Partners, LP	Leon, Walker, and Houston Counties	160	2016
Burk Royalty Co., Ltd./Midcoast Energy	Ghost Chili Lateral/Houston County	NA	2016
DCP Midstream	Carlsbad, NM–Andrews, TX	164	2016
Energy Transfer Partners, LP	Panola Pipeline/Carthage–Mont Belvieu	181	2016
Femaca/CFE	El Encino–La Laguna Pipeline/Waha, TX	263	2017
Larrett Energy/NRG Energy	CO ₂ Project/Corpus Christi	80	2016
Pumpco, Inc./Energy Transfer	Pecos–Presidio/El Paso–Pecos	342	2017
Pumpco, Inc.; Strike Construction/Lone Star NGL, LLC	Lone Star NGL Pipeline/Bosque County–Mont Belvieu	533	2018
Strike, LLC; Pumpco, Inc./Energy Transfer	Volunteer Pipeline/Brazos County	70	2016
Oil			
Boots Smith/Kinder Morgan	Sweeney	24	2016
JP Energy Partners, LP	Silver Dollar Pipeline Extension/Reagan County	55	2015
Knight Warrior, LLC	Madison County–Houston County	160	2016
Medallion Pipeline Co., LLC	Santa Rita Lateral/Reagan County	55	2016
Navigator Energy Services	Big Spring Gateway System/Martin, Glasscock, Howard, Midland Counties	450	2016
Plains All American Pipeline, LP	Caddo Pipeline/Longview–Shreveport, LA	80	2015
Plains All American Pipeline, LP	Three Rivers/Corpus Christi	125	2017
Progressive Pipeline/Phillips 66; Energy Transfer Partners, LP; Sunoco Logistics Partners, LP	Bayou Bridge Pipeline/Nederland, TX–Lake Charles, LA	60	2016
Pumpco, Inc.; Strike, LLC/Sunoco Logistics	Permian Express Phase II/Colorado City–Wortham	308	2017
Two Rivers Pipeline/Frontier Energy Services	Alpha Crude Connection/Lea County, NM–Winkler County, TX	400	2017
MDS Boring and Drilling, Inc./Strike	Houston, Grimes, Madison, and Walker Counties	50	2016
Price Gregory International, Inc./TransCanada Keystone Pipeline, LP	Chambers, Harris, and Liberty Counties	48	2015

Source: Based on data from (50).

Chapter 5. State Policy Implications

The two most recent PRC energy development publications (relating to crashes and pavement condition) describe the public costs associated with increased O&G production (6, 7).

Costs of crashes, particularly rural crashes involving commercial motor vehicles (CMVs), have the following impacts (7):

The cost of injuries resulting from rural CMV crashes in energy development regions increased significantly and was largely responsible for the net increase in the cost of injuries resulting from rural CMV crashes in the state from 2006–2009 to 2010–2013. In the Eagle Ford Shale region, the increase was \$139 million in economic costs or \$801 million–\$2 billion in comprehensive costs. In the Permian Basin region, the increase was \$176 million in economic costs or \$1.03–\$2.0 billion in comprehensive costs.

This information adds to the 2012 report’s findings that increased energy development activity will increase state highway needs by approximately \$1 billion per year and have a similar impact on county and local roads (4).

The pavement condition report shows a correlation between new wells and pavement deterioration (6):

In general, as the number of new wells increases, pavement conditions deteriorate. The correlation level varies significantly from region to region. Pavement structures in the Eagle Ford Shale region have suffered the most, followed by pavement structures in the Permian Basin region. Pavement structures in the Barnett Shale region have begun to recover, although this is due in part to a reduction in the number of new wells in recent years. The number of new wells could be used as a predictor of changes in pavement conditions, which could facilitate the allocation of limited maintenance dollars depending on the anticipated need.

Furthermore, the report details the decreases in pavement condition associated with new horizontal wells, which generate more intense truck activity. The report also mentions the impacts of truck traffic to transport liquid waste to injection well sites in areas without sufficient pipeline infrastructure for that purpose. The pavement condition report describes how maintenance expenditures in energy development areas have gone up at a higher rate than statewide, and at higher per-lane-mile amounts to keep up with drilling activity (6).

These findings demonstrate that while increased O&G drilling and production activity create significant benefits for the state’s economy, particularly in spreading job and income growth into rural areas outside the Texas Triangle, the O&G activity increases truck activity, which affects infrastructure conditions and CMV safety. These effects in turn have real monetary costs for the state.

The private sector is already responding to the new energy development business opportunities by expanding pipeline capacity and offering more rail transloading facilities, as described in Chapter 4. Both the expansion of pipelines (particularly pipelines that collect O&G from wells, pipelines that transport liquids and gas to injection wells, and pipelines that distribute water to wells) and the addition of new rail lines and facilities to serve O&G production areas may reduce CMV mileage and the associated public costs. Some of these new rail facilities are being developed with the participation of local economic development corporations and other public investments.

Some of the state's increased tax revenues from O&G activity are being allocated to transportation needs. A portion of the O&G severance tax revenues that were deposited in the state's Economic Stabilization Fund and then transferred into the State Highway Fund under Proposition 1 (2013) are now appropriated to upgrade and repair state highways affected by energy development activities (estimated to be \$121,627,400 for fiscal year 2016 and \$119,739,300 for fiscal year 2017). As those transferred funds go into the State Highway Fund, they are dedicated to highway-related purposes as required by the Texas State Constitution. None of the severance taxes collected through O&G activities are currently allocated to any non-highway transportation purposes.

In 1997, the state created a State Infrastructure Bank (SIB), as authorized by federal law, capitalizing a revolving loan program for transportation purposes. TxDOT reports that the Texas Transportation Commission has approved 109 loans totaling more than \$596 million from the SIB program. TxDOT estimates that the loans have helped leverage more than \$4.8 billion in transportation projects in Texas (51). In Texas, SIB financial assistance can be granted to any public or private entity authorized to construct, maintain, or finance a transportation project eligible for funding under the existing federal highway rules (Title 23) to comply with SIB requirements. This usually requires a project to be on a state's highway system and included in the statewide transportation improvement plan.

The state might consider the creation of a multimodal SIB, capitalized by funds other than the State Highway Fund, so that SIB loans could be used for multimodal projects including freight rail and pipelines. In developing such a program, the Texas Legislature could consider whether projects that are estimated to reduce energy-development-related commercial truck traffic (projects with expected reductions in truck crashes and reductions in pavement damage) could be eligible for SIB loans that could leverage pipeline and rail projects, with loans to be repaid by project developers (public or private). If such a program were to be authorized and a loan fund capitalized, TxDOT would need to carefully consider the economic viability of the proposed projects in light of unstable commodity prices. Estimates of project impacts on O&G well truck activity would require updated traffic analyses that count trucks servicing existing wells with new horizontal well drilling or continued fracking operations.

Why get involved with the private sector in railroads or pipelines? Fundamentally, the only reason for the State of Texas to contemplate doing so is to advance clear public interests (as

mentioned in a PRC report on public freight rail projects) (52). As was the case in the public freight rail projects, the public sector may want to be involved in a project with a for-profit railroad or pipeline company for a number of reasons:

- **Public interest may not match business objectives.** O&G producers may be agnostic about how many trucks serve their facilities, or reducing truck trips may not have as much private cost savings for the producer as it does for the public. Property owners with mineral leases may receive royalties from O&G production, but they also pay county property taxes that are used to repair county roads damaged by frequent heavy-truck traffic. Their interests in reducing truck traffic are rarely reflected in the terms of their O&G leases, so they have little influence on actual production activities.
- **There may be multiple producers with nearby wells.** A number of different O&G producers may be operating wells in close proximity with different leasing agreements and multiple landowners—these competing interests may not be able or willing to coordinate or cooperate in pipeline or rail projects that benefit the public by reducing truck trips in and out of these concentrated well locations.
- **Railroads may not have access to capital to address public needs.** This is particularly true for short lines and RRTDs that may be able to use underused or soon-to-be-abandoned rail lines to reach O&G production areas.

As Chapter 4 describes, the private sector is expanding non-highway transportation capacity serving O&G production regions. A multimodal revolving loan program may allow the public sector to further incentivize private activity that moves more O&G-related products, by-products, equipment, and supplies with fewer trucks—a public policy goal that has the potential to bring public benefits in better roads, lower maintenance costs, and fewer crashes involving larger trucks.

One final note on state policy: private-sector railroads and pipeline companies are granted statutory powers of eminent domain in the acquisition of property. Railroad companies are granted this power in Chapter 112, Title 5 of the Texas Transportation Code, and Sections 112.052 and 112.053 enumerate those powers. O&G pipeline operators can be considered common carriers under Chapter 111, Title 3 of the Texas Natural Resources Code, and Sections 111.019 and 111.0191 list the common carriers' powers under state law. Chapter 21 of the Texas Property Code outlines standard procedures for the exercise of statutory authority for eminent domain. As pipeline construction has increased in the past 10 years, so have the concerns of Texas landowners about this particular application of eminent domain powers. The issue has been extensively litigated and discussed in numerous legislative sessions, and the subject is too complicated to fully discuss in this particular report. However, expanded private-sector pipeline construction activity affects property owners in areas of the state outside the O&G production areas. Since both the Texas Railroad Commission and TxDOT are under Sunset Commission review during the 2016–2017 review cycle, the Texas Legislature may have an

opportunity to revisit the roles of both agencies in monitoring the use of eminent domain authority by pipeline and railroad companies.

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