Report on Existing and Potential Electric System Constraints and Needs

December 2012
ERCOT Report on Existing and Potential Electric System Constraints and Needs

Executive Summary

The annual Electric System Constraints and Needs report is provided by the Electric Reliability Council of Texas, Inc. (ERCOT) to identify and analyze existing and potential constraints in the transmission system that pose reliability concerns or may increase costs to the electric power market and ultimately, to Texas consumers. This report satisfies the annual reporting requirements of Public Utility Regulatory Act (PURA) Section 39.155(b) and a portion of the requirements of Public Utility Commission Substantive Rules 25.361(i)(2)(I) and 25.505(c).

In 2012, by far the most significant constraints experienced on the ERCOT System, and also the greatest challenges in planning the system, were due to the rapid expansion of oil and gas exploration and production in Texas. In west Texas the revitalization of the Permian Basin oil play has increased electric demand at unprecedented rates in some areas causing a substantial amount of congestion on some transmission elements. In south Texas the development of the Eagle Ford Shale play has caused the need for transmission system improvements.

The primary difference between the Permian Basin area and the Eagle Ford Shale area from an electric transmission perspective is that a majority of the Permian Basin growth experienced so far has occurred at existing electric delivery points. Conversely, in the Eagle Ford Shale the demand has occurred in areas with little or no electric transmission infrastructure which has driven customers to self-supply their energy needs until new transmission circuits can be added.

Because of this difference the transmission system in west Texas has had to rely on many short-term upgrades to the transmission system and changes to the configuration of the transmission system to reduce the significant congestion which may continue until the long-term solutions, which were planned in 2010, can be fully put in place by the end of 2013. Even with the long-term transmission solutions, congestion in the area may still occur if the costs of additional projects to relieve the congestion exceed the economic benefit measured in terms of production cost savings.

In 2012, five sets of transmission projects in the Eagle Ford Shale area were reviewed and accepted by the Regional Planning Group (RPG) and ERCOT, and two more sets of projects
were under review for a total estimated cost of $296.9 million. These projects are expected to be in-service between 2013 and 2017.

Elsewhere on the ERCOT System, the Competitive Renewable Energy Zone (CREZ) project is expected to resolve the West to North stability limit constraint once all of the transmission lines associated with the project are in place by the end of 2013. This constraint had the third highest amount of congestion rent in ERCOT in 2012 and the highest in 2011.

In the Lower Rio Grande Valley (LRGV), a new 345 kV import line and the upgrade of the two existing 345 kV import lines are part of a project to increase the overall import capability into the area by 2016. Additionally, a new 345 kV line that runs from the west side of the LRGV to the east side is planned to meet reliability needs in and around the Brownsville area. Together these projects, with a total estimated capital cost of almost $800 million, are expected to serve the demand growth in the area for years to come.
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1. Introduction

The Electric Reliability Council of Texas (ERCOT), as the independent organization (IO) under the Public Utility Regulatory Act (PURA), is charged with nondiscriminatory coordination of market transactions, system-wide transmission planning and network reliability, and ensuring the reliability and adequacy of the regional electric network in accordance with ERCOT and North American Electric Reliability Corporation (NERC) Reliability Standards. The IO ensures access to the transmission and distribution systems for all buyers and sellers of electricity on nondiscriminatory terms. In addition, ERCOT, as the NERC registered Planning Coordinator, is responsible for assessing the longer-term reliability for the ERCOT Region.

ERCOT supervises and exercises comprehensive independent authority of the overall planning of transmission projects of the ERCOT Transmission System as outlined in PURA and Public Utility Commission of Texas (PUCT) Substantive Rules. ERCOT’s authority with respect to transmission projects that are local in nature is limited to supervising and coordinating the planning activities of Transmission Service Providers (TSPs). The PUCT Substantive Rules further indicate that the IO shall evaluate and make a recommendation to the PUCT as to the need for any transmission facility over which it has comprehensive transmission planning authority. In performing its evaluation of different transmission projects, ERCOT takes into consideration the need for and cost-effectiveness of proposed transmission projects in meeting the ERCOT planning criteria and NERC Reliability Standards.

Transmission planning (60 kV and above) is a complex undertaking that requires significant work by, and coordination between, ERCOT, the TSPs, stakeholders, and other Market Participants. ERCOT works directly with the TSPs, stakeholders, and Market Participants through the Regional Planning Group (RPG). Each of these entities has responsibilities to ensure the appropriate transmission planning and construction occurs.

The Protocols and Planning Guide describe the practices and procedures through which ERCOT meets its requirements related to system planning under Texas Statute, NERC Reliability Standards, and PUCT Substantive Rules.
2. ERCOT Transmission Planning

Every year ERCOT performs a planning assessment of the transmission system. This assessment is primarily based on three sets of studies:

1. The Five-Year Transmission Plan addresses region-wide reliability and economic transmission needs and includes the recommendation of specific planned improvements to meet those needs for the upcoming five years. The 2012 Five-Year Transmission Plan report is posted on the ERCOT Planning and Operations Information website.

2. The Long-Term System Assessment (LTSA) uses scenario analysis techniques to assess the potential needs of the ERCOT System up to 20 years into the future. The role of the LTSA is not to recommend the construction of specific system upgrades due to the high degree of uncertainty associated with the amount and location of loads and resources in this timeframe. Instead, the role of the LTSA is to evaluate the system upgrades that are indicated under each of a wide variety of scenarios in order to identify upgrades that are robust across a range of scenarios or might be more economic than the upgrades that would be determined considering only near-term needs in the Five-Year Transmission Plan development. The 2012 Long-Term System Assessment report is posted on the ERCOT website in the following location: http://www.ercot.com/news/presentations/.

3. Stability studies are performed to assess the transient, voltage, and frequency response of the ERCOT system. Due to the critical nature of the information contained in these study reports, they are not normally published on the ERCOT website.

These studies are conducted using models that represent expected future transmission topology, demand, and generation. The models are tested against reliability and economic planning criteria per NERC Standards and the ERCOT Protocols and Planning Guides. When system simulations indicate a deficiency in meeting the criteria, a corrective action plan will be put in place which typically includes a planned transmission improvement project. TSPs also perform studies to assess the reliability of their portion of the ERCOT system.

Transmission improvement projects that are estimated to cost more than $15 million or that require a Certificate of Convenience and Necessity (CCN) are reviewed by the RPG prior to implementation. The RPG is a non-voting, consensus based group made up of ERCOT, TSPs,

\[\text{\footnote{Per ERCOT Protocol Section 3.11.4 certain projects are exempt from RPG review, such as projects to serve new generation or load customers.}}\]
Market Participants, other stakeholders, and PUCT Staff. Through November 30, the RPG has reviewed and accepted $596.8 million of transmission improvement projects in 2012.

Transmission system improvements are built by TSPs and are paid for by consumers. During the twelve month period between September 2011 and August 2012, TSPs completed $1.22 billion in transmission projects. This includes the addition or upgrade of 1,203 miles of transmission circuits, the addition of 5,642 MVA of autotransformer capacity, and the addition of 369 MVAr of reactive capability. A comprehensive list of recently completed and future transmission projects can be found in the Transmission Project Information Tracking (TPIT) report which is updated quarterly and can be located on the ERCOT Planning and Operations Information website.
3. Recent Constraints

While transmission improvements are sometimes implemented to reduce congestion, oftentimes the cost to implement a transmission project outweighs the cost of the congestion it is designed to solve. If the project does not meet the economic planning criteria\(^2\), the project will not be constructed, and the congestion will remain on the system. Other times, however, congestion will occur on the system due to actual system conditions being different than assumed conditions in the planning model. For example, load in an area may grow faster than anticipated. The table and maps below show the top 15 constraints on the ERCOT system from January through October 2012 based on real-time data.

<table>
<thead>
<tr>
<th>Map Index</th>
<th>Constraint</th>
<th>Congestion Rent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Odessa North 138/69kV autotransformer</td>
<td>$134,066,150</td>
</tr>
<tr>
<td>2</td>
<td>China Grove Switch - Bluff Creek Switch 138kV line</td>
<td>$61,898,847</td>
</tr>
<tr>
<td>3</td>
<td>West to North Stability Limit</td>
<td>$27,824,327</td>
</tr>
<tr>
<td>4</td>
<td>Moore Switch - Downie Switch 138 kV line</td>
<td>$20,422,574</td>
</tr>
<tr>
<td>5</td>
<td>Odessa - Odessa North 138 kV line</td>
<td>$18,830,852</td>
</tr>
<tr>
<td>6</td>
<td>Turnersville - Buda 138kV line</td>
<td>$17,352,442</td>
</tr>
<tr>
<td>7</td>
<td>Lewisville Switch - Jones Street 138 kV line</td>
<td>$17,099,428</td>
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<tr>
<td>8</td>
<td>Morgan Creek 345/138 kV autotransformer 4</td>
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<tr>
<td>9</td>
<td>Belton - Belton Southwest 138 kV line</td>
<td>$14,490,150</td>
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<tr>
<td>10</td>
<td>San Angelo Red Creek 345/138 kV autotransformer 2</td>
<td>$18,360,051</td>
</tr>
<tr>
<td>11</td>
<td>PH Robinson 345/138 kV autotransformer 1</td>
<td>$12,216,587</td>
</tr>
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<td>12</td>
<td>Amoco North Cowden Tap - Moss Switch 138 kV line</td>
<td>$9,686,322</td>
</tr>
<tr>
<td>13</td>
<td>Buttercup - Whitestone 138 kV line</td>
<td>$7,020,443</td>
</tr>
<tr>
<td>14</td>
<td>Odessa North - Odessa Basin Switch 69kV line</td>
<td>$6,762,448</td>
</tr>
<tr>
<td>15</td>
<td>Fort Stockton Switch - Barilla 69kV line</td>
<td>$6,135,940</td>
</tr>
</tbody>
</table>

Binding constraints with the highest congestion rent from January through October 2012

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\(^2\) ERCOT Protocol 3.11.2, Planning Criteria
Recent Constraints in West Texas
Recent Constraints in North and Central Texas
Recent Constraints in South Texas

The following sections provide more details on recent constraints on the ERCOT System.

3.1 West Texas Load Growth

The most significant congestion on the ERCOT system in 2012 was experienced in west Texas due to the unprecedented growth in electric demand from oil and natural gas exploration and production in the Permian Basin area. Of the top 15 constraints on the ERCOT System from January 2012 through October 2012, eight were related to constraints serving west Texas load. Those eight constraints comprise almost half of the entire amount of congestion rent in ERCOT in 2012.

Most of the increase in demand has been seen in the Far West weather zone in ERCOT. The chart below shows the annual peak demand increase in the Far West weather zone for years 2006 through 2012. The data indicates a sharp increase in 2011 and 2012. The peak demand for each of those years was 11.3% and 4.8% higher than the previous year’s respective peak.
However, certain areas within the weather zone experienced much larger growth than the zone as a whole due to the increase in oil and natural gas activity in these areas. For example, the demand at the substations most affecting loading on the Odessa North autotransformer, the most congested element in ERCOT in 2012, saw a peak increase of 37% between 2010 and 2012.
The majority of the load increase in the area can be attributed to the increase in oil and natural gas exploration and production. The chart below illustrates the increase in oil production in Texas between 2006 and 2012.
A significant portion of that increase is due to production gains in Texas District 8 which encompasses much of the Permian Basin and includes the Odessa North area. The chart below shows the increase in crude oil and casinghead gas production in Texas District 8. The crude oil production increase from January 2010 to summer 2012 was approximately 30%.

Several energy market analysis firms have identified the Permian Basin as one of the most profitable oil production formations in North America. The below graphics from BENTEK Energy illustrates internal rate of return (IRR) and the change in drilling rigs in production between January 2010 and May 2012 in the United States. They show that the Permian Basin has the highest IRR in the country and had the largest increase in drilling rigs.
Oil Plays Remain at the Top of the IRR Stack

Oil Rigs Keep Gaining Ground

Price Assumptions:
- Gas = 12 month forward average curve for each regional pricing point as of June, 2012 (price range $3.25-$3.49/MMBtu)
- Oil = 6 month average WTI + differential as of June, 2012 (price range $74.98-$96.06/barrel)
- NGLs = weighted average barrel based on current NGL, HGL, and NGL prices, and the typical composition in each region (price range $21.18-$31.82/barrel)

Note: Active rig count: May 2012 / Change in rig count from January 2010
The additional drilling rigs and increase in production correspond to the increase in electrical demand in the area. However, other factors are also driving the demand growth. New oil and natural gas recovery technology, such as horizontal drilling, enhanced oil recovery, and fracking has made previously unprofitable or unrecoverable reserves more viable. These new technologies, which require more energy intensive processes when compared to traditional techniques, have further driven electric demand.

Additionally, the industry resurgence has caused an economic boom in the area. Odessa has been projected to be the fastest growing city in the United States in 2012 according to an IHS Global Insight Report\(^3\). The report projected an annual population growth of 9.7% for Odessa and listed Midland and Odessa as the first and second ranked cities, respectively, for economic growth rate from 2001 to 2011. In October 2012 Midland and Odessa also held the lowest unemployment rates in Texas at 3.3% and 3.9%, respectively\(^4\).

Planning studies at ERCOT first identified this dramatic load growth and the corresponding need for transmission improvements in the area in late 2010 as part of the 2010 Five-Year Transmission Plan. The Odessa North area load, including both 69 kV and 138 kV substations, had increased to 480 MW in the 2010 analysis of the 2012 summer peak model, compared to the projection of 391 MW for the 2012 summer peak model in the 2009 analysis. The actual peak load for the area in 2012 was 465 MW. Although this is lower than the area peak forecast in 2010, the demand on the 69 kV substations was higher than predicted while the 138 kV substation demand was lower.

Because this rise in demand was not forecasted before late 2010, there was not sufficient time to implement all of the transmission system improvements before 2012 since transmission design, procurement and construction typically takes two to five years to complete. ERCOT has been working with the TSP in the area since 2010 to employ solutions, both in the short-term and the long-term to address the constraints. Some of the improvements completed by the TSP include the following:

- Rebuild Holt South – Goldsmith 69 kV line as a double circuit 138 kV and 69 kV line and convert Goldsmith Substation to 138 kV service (June 2011)


• Install auxiliary cooling and temperature monitoring in order to uprate the Odessa North 138/69 kV autotransformer (September 2012)
• Reconfigure the system in the area in order to reduce congestion (September 2012)
• Upgrade terminal equipment on area 138 kV and 69 kV lines (September 2012)
• Convert Goldsmith Gulf Substation to 138 kV service (October 2012)
• Replace Odessa North 138/69 kV autotransformer with a larger capacity autotransformer (November 2012)
• Increase rating of the Moss – Odessa SW – Odessa EHV 138 kV line (December 2012)

Several transmission upgrade projects in the area are planned for 2013:

• Rebuild Holt – Holt South 69 kV line as a double circuit 138 kV and 69 kV line (May 2013)
• Rebuild Goldsmith – Goldsmith South 69 kV line as a double circuit 138 kV and 69 kV line and convert Goldsmith South Substation to 138 kV service (March 2013)
• Increase rating of Moss – Holt 138 kV line (May 2013)
• Rebuild Goldsmith South – Goldsmith Junction 69 kV line as a double circuit 138 kV and 69 kV line, and connect Goldsmith Junction to the Moss – Ector County North 138 kV line (June 2013)
• Upgrade Odessa – Odessa North 138 kV line (December 2013)
• Reconductor Moss – Holt 138 kV line (December 2013)

These improvements are expected to reduce the congestion in the area but not eliminate it. Currently, oil transportation limitations are restricting even more growth in the Permian Basin. BENTEK Energy estimates that when these existing limitations get resolved oil production in the Permian Basin will rise by nearly 1,000 Mb/d by the end of 2016.
The below chart from BENTEK Energy shows that oil production is expected to continue to rise in the United States through 2016. Because the Permian Basin has been so profitable it can be assumed that much of this increase will occur in west Texas. ERCOT is continuing to work with the TSPs in west Texas to analyze the forecasted increase in demand and plan transmission solutions to meet the resulting system needs. Congestion is expected to continue in the area for several years until all of the improvements can be implemented.
3.2 West-to-North Stability Limit

When the transmission system was constructed to serve west Texas, it was designed to support mostly rural load along with several cities, including Abilene, Odessa, and Midland, and oil and natural gas load. In the 2000’s technological improvements and policy incentives coupled with the vast wind resources in the region spurred the wind generation industry to develop a significant amount of wind generation plants in west Texas. Towards the end of the decade the region became a large exporter of power to the population centers in the rest of the ERCOT System at times when the wind was blowing. The chart below shows the growth in wind installations in ERCOT, most of which are located in west Texas.
The west Texas transmission system was too weak to accommodate the large exports of power so the West-to-North stability limit was established to keep power transfers from exceeding reliability thresholds. This constraint had the highest amount of congestion rent in ERCOT in 2011 and the third highest in 2012. Part of the reason that the congestion rent has dropped in 2012 is that ERCOT has implemented new tools to better manage the stability limiting constraint in real-time operations.

In 2008, the PUCT approved the Competitive Renewable Energy Zone (CREZ) transmission plan which includes the construction of nearly 2,400 miles of new transmission circuits designed to deliver up to 18,500 MW of wind generation on the ERCOT System. Some of the new CREZ transmission circuits have already been placed in-service, but the majority is expected to be energized in 2013 with all completed by the end of the year. Studies have shown that once the CREZ project is completed the existing West-to-North stability limit will no longer be a constraint.
By the end of 2013, when all of the CREZ transmission lines and substations have been placed in-service, it is expected that the ERCOT System will have over 12,000 MW of wind generation. Currently, there is over 1,000 MW of additional wind generation with a signed interconnection agreement that is expected to be in-service by the end of 2015.

However, at the end of November 2012 there were approximately 20,000 MW of new wind generation projects under study in ERCOT, including nearly 15,000 MW in the advanced study stage. Recent advances in wind turbine technology may make wind generation projects more financially viable due to increased capacity factors and the ability to generate during lower quality wind conditions. This will result in the new turbines being able to generate more during summer peak hours compared to older turbine technology. The table below illustrates the increase in capacity factors due to turbine technology improvements over the last 20 years.
### Wind Turbine Technology Period

<table>
<thead>
<tr>
<th>Wind Turbine Technology Period</th>
<th>Typical Rotor Length (meters)</th>
<th>Typical Output per Turbine (kW)</th>
<th>Relative Capacity Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early 1990s</td>
<td>33</td>
<td>500</td>
<td>20 to 30%</td>
</tr>
<tr>
<td>Early 2000s</td>
<td>60</td>
<td>1,000</td>
<td>25 to 35%</td>
</tr>
<tr>
<td>Mid 2000s</td>
<td>80</td>
<td>1,500</td>
<td>30 to 40%</td>
</tr>
<tr>
<td>Late 2000s</td>
<td>100</td>
<td>2,300</td>
<td>35 to 50%</td>
</tr>
</tbody>
</table>

Depending on wholesale market prices and whether or not the federal production tax credit (PTC) gets renewed, wind generation development in ERCOT could exceed the 18,500 MW level planned for in the CREZ project within a few years if the advanced turbine technology is utilized. Wind generation development projects located in the panhandle region, where capacity factors in excess of 50% may be achievable, may even advance without a renewal of the PTC.

If a significant amount of new generation develops in the panhandle region, the system in the area may be stability constrained in the future due to the long distances between resources in the region and the population centers in ERCOT. ERCOT will evaluate this on an annual basis to determine if additional stability limits or improvements are warranted.

### 3.3 Outage Related Constraints

Both planned and unplanned outages of equipment can cause significant amounts of congestion. Planned outages are typically scheduled in the spring and fall when demand is lower and the impact of the outage is likely to be low. Unplanned, or forced, outages can occur at any time of the year. Of the top 15 constraints in ERCOT in 2012, six were primarily congested due to the outage of other equipment.

The Turnersville-Buda 138 kV line in central Texas experienced congestion at several points during the year, but faced the most congestion during the planned outage of the Kendall 138 kV bus for CREZ-related construction. Two other 138 kV lines in central Texas, Belton-Belton Southwest and Buttercup-Whitestone, experienced congestion when other nearby 138 kV lines were out of service for maintenance.
The previously discussed high loading conditions in west Texas, coupled with the outage of parallel autotransformers caused congestion on both the Morgan Creek and San Angelo Red Creek 345/138 kV autotransformers. The Morgan Creek autotransformer #4 congestion occurred entirely in October when the Morgan Creek autotransformer #2 was out of service. The San Angelo Red Creek autotransformer #2 congestion occurred in early summer after the San Angelo Red Creek autotransformer #1 experienced a forced outage.

In the Houston area, the combination of a planned outage of PH Robinson autotransformer #2 and the unplanned forced outage of PH Robinson autotransformer #3 caused significant congestion on the PH Robinson autotransformer #1 in September.
4. Planned Improvements

Currently, there are $8.93 billion of future transmission improvement projects that are planned to be in-service by the end of 2017, including the Competitive Renewable Energy Zone (CREZ) projects. This involves the addition or upgrade of 6,900 miles of transmission circuits, the addition of 8,045 MVA of autotransformer capacity, and the addition of 2,763 MVAr of reactive capability. The table and map below shows significant improvements planned to be in-service within the next five years.

<table>
<thead>
<tr>
<th>Map Index</th>
<th>Project</th>
<th>In-Service Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>N/A</td>
<td>CREZ</td>
<td>2012-2013</td>
</tr>
<tr>
<td>2</td>
<td>Dunlap 345/138 kV autotransformer project</td>
<td>2013</td>
</tr>
<tr>
<td>3</td>
<td>Lon Hill to Rio Hondo 345 kV line reconductor</td>
<td>2013</td>
</tr>
<tr>
<td>4</td>
<td>Mont Belvieu area upgrades</td>
<td>2014</td>
</tr>
<tr>
<td>5</td>
<td>Freeport area upgrades and conversion to 138kV</td>
<td>2015</td>
</tr>
<tr>
<td>6</td>
<td>Lon Hill to North Edinburg 345 kV line reconductor</td>
<td>2015</td>
</tr>
<tr>
<td>7</td>
<td>Uvalde to Campwood line rebuild and conversion to 138/69 kV double circuit</td>
<td>2015</td>
</tr>
<tr>
<td>8</td>
<td>Denton 138kV system upgrades</td>
<td>2016</td>
</tr>
<tr>
<td>9</td>
<td>New 345kV line from Loma Alta to North Edinburgh</td>
<td>2016</td>
</tr>
<tr>
<td>10</td>
<td>New 345 kV line from Lobo to North Edinburgh</td>
<td>2016</td>
</tr>
<tr>
<td>11</td>
<td>Trinidad - Tri Corner - Watermill 345 kV line upgrade</td>
<td>2016</td>
</tr>
<tr>
<td>12</td>
<td>Lavon Switching Station and 345/ 138 kV autotransformer</td>
<td>2017</td>
</tr>
<tr>
<td>N/A</td>
<td>Eagle Ford Shale - related upgrades</td>
<td>2013-2017</td>
</tr>
</tbody>
</table>

Significant improvements planned for 2013 through 2017
Significant Improvements Planned for the ERCOT System
The following sections detail some of the significant improvements planned on the ERCOT System.

4.1 Eagle Ford Shale Oil and Natural Gas Related Projects

Eagle Ford Shale oil and natural gas production and exploration, located in multiple counties in south Texas, stretches from the Laredo area, bounded by Maverick and Webb Counties, northeast to Gonzalez and DeWitt counties, and beyond. Electric load related to oil and natural gas exploration is rapidly developing in and around this area. The map below depicts oil and natural gas activity in the Eagle Ford Shale.

The Eagle Ford Shale has been estimated by BENTEK Energy to be the second most profitable oil play in the United States, in terms of IRR, behind only the Permian Basin in west Texas. It is
said to be the sixth largest oil field discovered in the country and the largest discovery in the past 40 years. Texas Railroad Commissioner David Porter is quoted as saying that: “The Eagle Ford Shale has the potential to be the single most significant economic development in our state’s history.”

The Eagle Ford area has benefited from advances in oil and natural gas recovery technology, similar to the developments driving the growth in the Permian Basin. In fact, the high carbonate content in the Eagle Ford Shale causes it to be brittle and makes it easy to produce oil and natural gas using new fracking techniques. However, unlike the Permian Basin, the Eagle Ford Shale was largely untapped until recent years. The chart below shows the growth in oil and natural gas production in Texas Districts 1 and 2, which comprise most of the Eagle Ford Shale, between 2008 and summer 2012. The data indicates that between early 2010 and summer 2012 crude oil and condensate production climbed from under 2 million barrels per month to nearly 14 million barrels per month, a 600% increase. Meanwhile, natural gas production in the area increased significantly during a time of falling natural gas prices.

![Texas Districts 1 and 2 Oil and Gas Monthly Production](chart.png)

Source: Texas Railroad Commission
Whereas the Permian Basin growth was manifest in areas of previous oil and gas recovery, the Eagle Ford Shale growth is in areas with little supporting infrastructure. Consequently, the increase in electric demand growth is occurring in areas with little or no transmission to support it and new customers are self-providing for their energy needs until the electric grid can be built into the area. As an example, the total customer requests for new electric service in one area served by two electric cooperatives was nearly 250 MW, compared to a recent peak load of 28 MW for that area. It will take several years to construct the transmission needed to support the ten-fold increase in demand for the area.

From a macro level, it is simple to predict that overall electric demand in the area will see a significant increase over the next several years. However, transmission plans depend on precise locations and levels of new customer demand. For this type of detail ERCOT relies on the transmission and distribution companies in the area who have relationships with the individual customers. Planning for this type of load growth can be challenging for several reasons.

First, over the last couple of years customers have been continually requesting new service for oil and natural gas related loads. If plans are developed based on a certain set of assumptions for new demand, they may be obsolete just a few months later once several additional customers have committed to constructing new facilities. But, if the TSP overbuilds the transmission system in an area to account for the potential increase in demand they risk not being able to recover their investment through regulated rates should the potential demand not materialize. For this reason many TSPs prefer not to move forward with transmission plans until the customers have made a financial commitment. When analyzing project alternatives, though, preference is given to projects that have the greatest amount of inherent expansion capability.

Second, the customers are constructing facilities faster than it takes to construct new transmission circuits. Due to the competitive nature of the oil and natural gas industry many customers have a desire to wait as long as possible before making their plans public or risk a competitor undercutting their positions. As mentioned previously, many of the customers have to self-provide for their energy needs until the electric infrastructure can be put in place. In areas such as west Texas, where there is an existing weak system, the customers may connect to the system causing substantial amounts of congestion. The transmission and distribution
companies are allowing this to occur because they have an obligation to serve the customers. Thus far this has not been a big issue in the Eagle Ford area but could develop into a congestion problem as some infrastructure is added (allowing customers to connect) before the full set of transmission improvements is put in place.

Given these challenges, ERCOT and the TSPs in the area have been working on transmission plans to meet the rapid increase in load in the Eagle Ford Shale. In 2012 five sets of transmission projects, with a total estimated capital cost of $152.4 million, were reviewed and accepted by the RPG and ERCOT. Two additional projects, with a combined capital cost estimate of $144.5 million, are currently under review and are expected to be approved in early 2013. The map below shows the five projects accepted in 2012. These projects are expected to be in-service between 2013 and 2017.
### 4.2 Valley Import Project

The Valley Import Project, expected to be completed by 2016, is one of the most significant planned projects in ERCOT. The project includes the construction of a new, approximately 163-mile 345 kV line from the Lobo station, near Laredo, to the North Edinburgh station in the Lower Rio Grande Valley (LRGV). This new line will provide a third 345 kV import circuit into the LRGV from outside of the area. Additionally, the project includes reconductoring both of the existing 345 kV import lines. Two unique aspects of this project are the composite core conductor used and the fact that the installation of the new conductor will occur while each of the existing 345 kV lines are energized since they cannot be taken out of service for extended periods of time due to the region’s dependence on the import power they provide. This is accomplished by constructing a temporary transmission circuit phase in parallel to the actual line, bypassing the section the construction crews are working on.

Currently, demand in the LRGV is supported by the two existing 345 kV lines, three smaller 138 kV lines, and approximately 1,700 MW of natural gas generation at four plants. The area also has some hydro and wind generation and an asynchronous tie with the Mexico system. Because the area is dependent on such a small number of resources, maintenance outages must be carefully planned in order to be able to reliably serve the area. Likewise, the area is vulnerable to contingency events where multiple pieces of equipment are outaged due to maintenance or equipment failure.

Such an event occurred in February 2011 when an extreme cold weather event forced generation in the LRGV out of service while other generation in the area was already on a planned maintenance outage. This occurred at a time when electric demand escalated to levels not previously seen or forecasted for the area due to the cold weather. ERCOT Operators were forced to order some load shed in the LRGV in order to maintain overall reliability for the area.
The aforementioned Valley Import Project was planned in order to meet reliability criteria for the LRGV area for 2016 and beyond. This project was estimated to cost $525 million. The map below illustrates the improvements associated with this project.

4.3 Cross Valley Project

A new 345 kV line from the North Edinburg station, located on the west side of the LRGV, to the Loma Alta station, located on the east side of the LRGV, is expected to be in-service before summer peak of 2016. This new ‘Cross Valley’ 345 kV line will support load growth in the cities along the eastern side of the LRGV, including the city of Brownsville. The city of Brownsville is currently supported by four 138 kV lines and a small natural gas powered plant. Given load growth projections, without the project, which also includes a new 138 kV line, the city and surrounding area would be vulnerable to a significant amount of load shed (local rolling blackouts) under conditions where more than one of the supporting transmission lines are
outaged. Additionally, the project provides opportunities to add a 345 kV to 138 kV transformer in the McAllen area to meet future transmission needs expected to be required before 2020.

The project was estimated to cost $274.7 million and is illustrated in the map below.

4.4 Additional Reliability Driven Planned Improvements

Continued growth of conventional load throughout the state is another key driver for transmission improvements in the ERCOT Region. The December 2012 Report on the Capacity, Demand, and Reserves in the ERCOT Region shows a 10.1% overall forecasted increase in demand throughout ERCOT between 2013 and 2017.
The recently completed 2012 Five-Year Transmission Plan identified 63 projects needed to satisfy reliability planning criteria in the 2013 to 2017 timeframe. These projects are in addition to those previously planned for the ERCOT System. More information on these projects can be found in the 2012 Five-Year Transmission Plan report which is posted on the ERCOT Planning and Operations Information website.
5. Projected Constraints

The following sections describe projected future constraints on the ERCOT System.

5.1 W. A. Parish 345 kV Bus Outage

Construction on a project to split the 345 kV bus at the W. A. Parish station, located southwest of Houston, into two separate buses is expected to be completed by the end of 2013. The project was identified by ERCOT as an alternative to a proposed project to add dynamic reactive devices in the Houston area to solve a voltage stability problem. The alternative project to split the 345 kV bus at the W. A. Parish station saves over $100 million in capital cost when compared to the originally proposed project but will require several significant 345 kV transmission lines that provide import power to the Houston area to be out of service in order for the construction to be completed.

It is expected that the import lines will be temporarily taken out of service in the spring and fall of 2013, when demand is typically lower, in order to allow for the construction to take place without causing a reliability problem for the Houston area. However, the Houston area has a small number of major import transmission lines, so even in the spring and fall the outage of any of the 345 kV import lines can cause a significant amount of congestion. This is due to the fact that older, less efficient generation located within the Houston area will be required to run to support the local demand rather than being able to import less expensive power from outside of the area. This congestion was considered when reviewing the project alternatives and was assumed to be a lower cost option when compared to the capital cost savings of the project. The map below shows the location of the project.
5.2 2013 Reliability Constraints

When ERCOT develops the Five-Year Transmission Plan each year there are usually a number of reliability needs that are identified where the projects designed to meet the needs will not be in place before the reliability needs are realized. There are several reasons that this occurs, the most common being faster than expected load growth and construction delays.
When projects needed for reliability cannot be installed prior to need, the TSP and ERCOT work to design temporary operational solutions to resolve the reliability issue until the transmission project can be completed. Such operational solutions may include temporarily reconfiguring the system, running less efficient generation, or in the worst case shedding load after a contingency occurs. While these actions ensure that reliability standards are upheld they can often lead to substantial amounts of congestion on the system.

The recently completed 2012 Five-Year Transmission Plan identified the below list of projected 2013 reliability constraints that will not have the transmission project planned to solve the constraint in place before the constraint occurs. A considerable number of these constraints are located in the aforementioned Permian Basin and Eagle Ford Shale oil and natural gas exploration and production areas where demand has increased faster than previously anticipated.

<table>
<thead>
<tr>
<th>Map Index</th>
<th>Constraint</th>
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<tbody>
<tr>
<td>1</td>
<td>Odessa North – Odessa 138 kV line</td>
</tr>
<tr>
<td>2</td>
<td>Permian Basin – Wink 138 kV line</td>
</tr>
<tr>
<td>3</td>
<td>Permian Basin – Barrilla Junction 138 kV line</td>
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<tr>
<td>4</td>
<td>Yellow Jacket – Eden 69 kV line</td>
</tr>
<tr>
<td>5</td>
<td>San Angelo Concho 138/69 kV autotransformer</td>
</tr>
<tr>
<td>6</td>
<td>Uvalde 138/69 kV autotransformer</td>
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<tr>
<td>7</td>
<td>Elkton – Tyler Southwest 138 kV line</td>
</tr>
<tr>
<td>8</td>
<td>Munday – Munday 2 69 kV line</td>
</tr>
<tr>
<td>9</td>
<td>Knox City – Gillespie – Munday 69 kV line</td>
</tr>
<tr>
<td>10</td>
<td>Ben Davis – Murphy Road 138 kV line</td>
</tr>
<tr>
<td>11</td>
<td>Euless – Grapevine Highway 360 138 kV line</td>
</tr>
<tr>
<td>12</td>
<td>Northaven – Welch double circuit 138 kV line</td>
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<tr>
<td>13</td>
<td>Lon Hill - Robstown - City of Robstown 69 kV line</td>
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<tr>
<td>14</td>
<td>Lon Hill - Calallen 69 kV line</td>
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<tr>
<td>15</td>
<td>Lon Hill 138/69 kV autotransformers #1 and #2</td>
</tr>
<tr>
<td>16</td>
<td>Kenedy Switch – Seguin 138 kV line</td>
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<tr>
<td>17</td>
<td>Dilley Switch – Cotulla 69 kV line</td>
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</tbody>
</table>

The map below shows the location of these constraints.
5.3 2015 and 2017 Projected Constraints

Future year constraints are analyzed as part of the annual Five-Year Transmission Plan. Projects are identified to resolve the constraints expected to cause the most congestion on the system. If a project meets the economic planning criteria by reducing overall system costs it will be included in the recommended project set. Many times, however, the capital cost of the project does not outweigh the expected production cost savings. When this occurs, the project will not be constructed, and the congestion will persist. The table and map below show the constraints projected to be the most congested for 2015 and 2017 based on model simulation.

The simulation indicates that three of the highest congested elements are related to importing power into the Houston area from the north. After the CREZ project has been completed in 2013 the models predict that the congestion will cause Houston area locational marginal prices
(LMPs) to be higher than the rest of the ERCOT System. ERCOT will continue to evaluate the feasibility of import projects into the Houston area in future assessments.

<table>
<thead>
<tr>
<th>Map Index</th>
<th>Projected Constraining Element</th>
<th>2015 Congestion</th>
<th>2017 Congestion</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Boggy - Bell County 138 kV line</td>
<td></td>
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<tr>
<td>2</td>
<td>Cico - Comfort 138 kV line</td>
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<tr>
<td>3</td>
<td>Collin Switch - Anna Switch 345 kV line</td>
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<tr>
<td>4</td>
<td>Edroy - Smith 69 kV line</td>
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<tr>
<td>5</td>
<td>Fayetteville 345/138 kV autotransformer</td>
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<tr>
<td>6</td>
<td>Hamilton Road - Maverick 138 kV line</td>
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<td>7</td>
<td>Jack Creek - Twin Oak SES 345 kV line</td>
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<td>8</td>
<td>North to Houston voltage stability limit</td>
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<tr>
<td>9</td>
<td>Nueces Bay - Morris Street 138 kV line</td>
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<tr>
<td>10</td>
<td>Oklaunion - Riley 345 kV line</td>
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<tr>
<td>11</td>
<td>Plano Jupiter - Ben Davis 138 kV line</td>
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<tr>
<td>12</td>
<td>Royse 345/138 kV autotransformer</td>
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<tr>
<td>13</td>
<td>Singleton - Zenith 345 kV line</td>
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<tr>
<td>14</td>
<td>Skidmore - Sinton 69 kV line</td>
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<tr>
<td>15</td>
<td>Treaschwig - Westfield 138 kV line</td>
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</tbody>
</table>
6. Contacts and Links

6.1 Contacts and Information

For general communications and queries, the public can submit a request for information at: http://www.ercot.com/about/contact/inforequest.cfm

Media:
Robbie Searcy
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Regulatory:
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512-248-4577

Government Relations:
Theresa Gage
512-225-7074

6.2 Internet Links

ERCOT Home Page: http://www.ercot.com

Operations and System Planning Data Area: http://planning.ercot.com

Users must register for access to this area. Folders in this area include data, procedures, reports and maps for both operations and planning purposes. Helpful information that can be found on this site includes:
- Demand and Energy Reports (D&E) Monthly Actuals
- Generation Project Interconnection Information
- Regional Planning Group information
- Steady-State Base Cases
- System Protection Data
- Transmission Project and Information Tracking (TPIT)
7. Disclaimer

This report was prepared by the Electric Reliability Council of Texas (ERCOT) staff. It is intended to be a report of the status of the transmission system in the ERCOT Region and ERCOT’s recommendations to address transmission constraints. Transmission system planning is a continuous process. Conclusions reached in this report can change with the addition (or elimination) of plans for new generation, transmission facilities, equipment, or loads. Information on congestion costs presented herein is based on the most recent settlement calculations at the time of the development of this report. Future settlements as well as ERCOT Board of Directors and Public Utility Commission of Texas directives may change the figures presented herein.

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