

Figure 5.2: Panhandle Generation Under Study

Recognizing the challenges associated with connecting a large amount of wind generation in the Panhandle, ERCOT initiated the Panhandle study in early 2013. The purpose of the Panhandle study was to identify the potential system constraints and to identify possible future projects to increase the Panhandle export capability. ERCOT has continued to evaluate Panhandle export capability throughout 2014 and 2015 based on actual wind generation development patterns.

ERCOT recently confirmed the need for several transmission improvements to increase the Panhandle export capability. These include the installation of synchronous condensers at both Alibates and Tule Canyon, and the installation of a second 345-kV circuit on the Alibates-AJ Swope-Windmill-Ogallala-Tule Canyon transmission line which is under the Competitive Renewable Energy Zone (CREZ) Order, or PURA §39.904(g), per the PUCT Open meeting on September 24, 2015.

While the upgrades will increase Panhandle export capability, continued development of generation resources in the Panhandle will likely lead to further constraints. New transmission lines on new right of way (ROW) will be required to further increase export limits. These improvements will require significant wind generation development commitment in order to be justified per the ERCOT planning criteria requirements.

## 5.2 Solar Integration

The ERCOT system has seen a limited increase in operational utility-scale solar installation since 2010, as shown in Figure 5.3. By 2015, the total installed capacity had only increased from 15 MW to 193 MW. However, as of October 2015, approximately 9,300 MW of solar projects have been submitted through the ERCOT Generation Interconnection Request (GINR) process. Approximately 1,530 MW of solar projects in the GINR queue have SGIA and are projected to be in service by 2017. In addition, a “stringent environment” scenario, developed for the 2014 LTSA, identified the potential for 16.5 GW of solar generation in ERCOT by 2029.

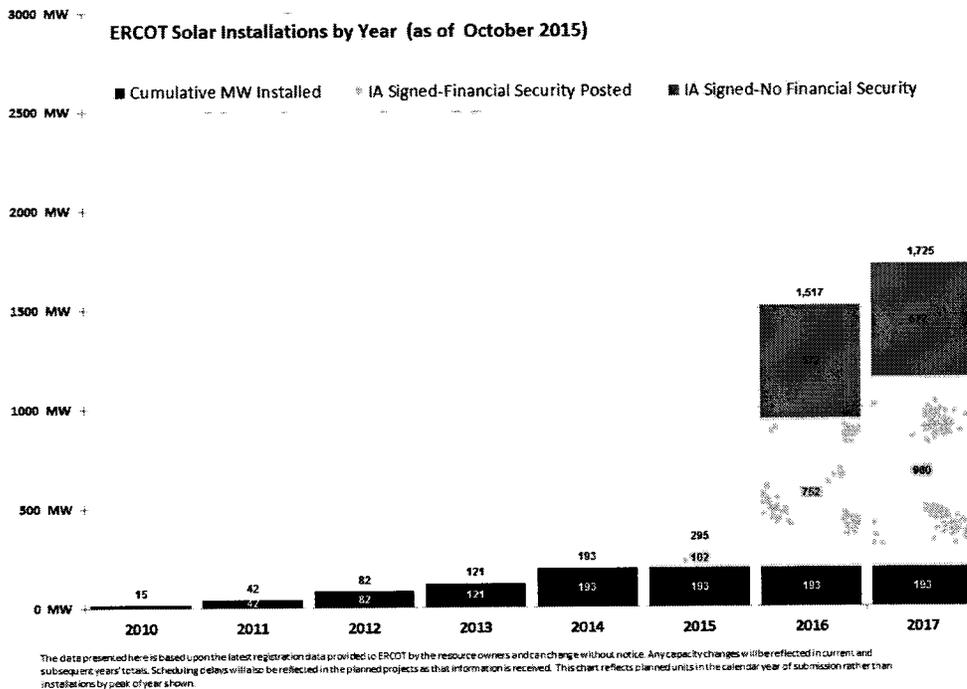


Figure 5.3: ERCOT Solar Installations by Year

Figure 5.4 shows the breakdown of the proposed solar GINR by weather zone. As shown, the majority of current GINR solar projects are located in the Far West weather zone, in Pecos and Upton Counties, where the existing transmission system is relatively weak. Under weak grid conditions, a small variation of reactive support results in large voltage deviations, and in extreme cases, can lead to a voltage collapse. All solar generation projects in the Far West weather zone are expected to be equipped with power electronic devices that will further weaken the local system strength due to limited short-circuit current contributions. Stability challenges and weak

system strength are expected to result in significant constraints in exporting solar from the Far West.

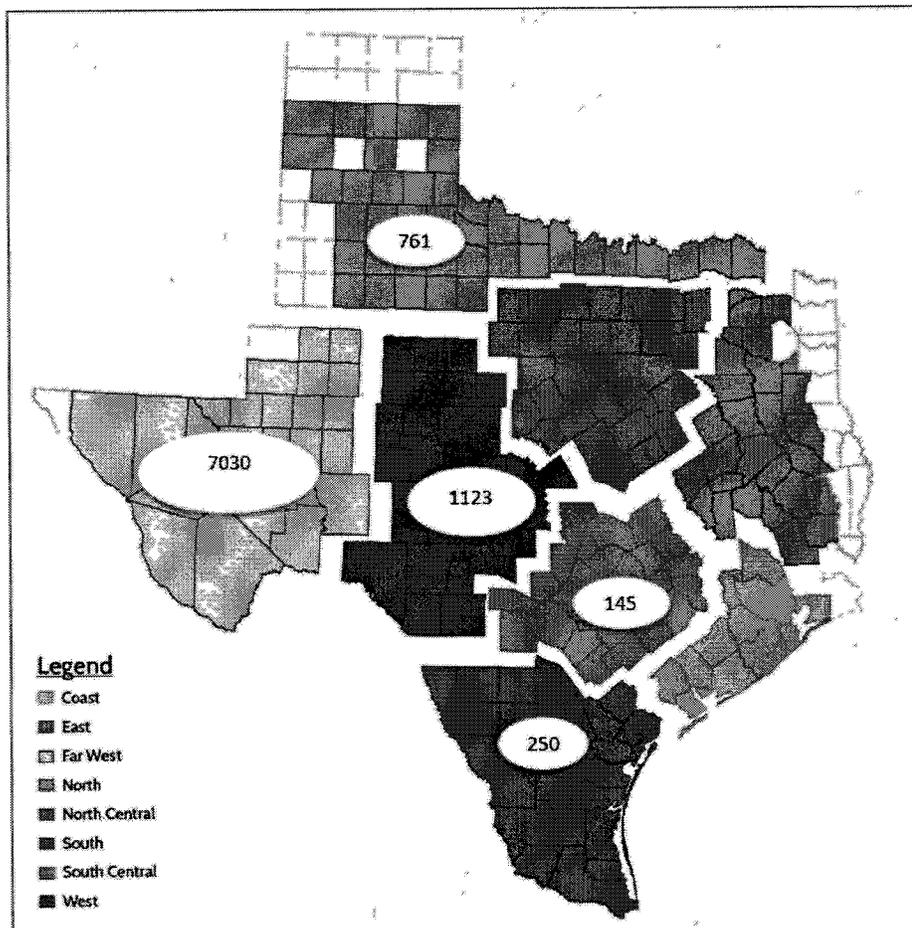


Figure 5.4: Solar Generation Interconnection Requests (MW) by Weather Zone

Recognizing the challenges associated with connecting a large amount of solar generation in the Far West weather zone, ERCOT initiated a solar integration study. The purpose of this study is to assess the impacts of the solar projects on ERCOT's current transmission system and get a high-level understanding of the needed transmission upgrades. The solar integration study is projected to be complete by the second quarter of 2016.

### 5.3 Generation Retirement, Regional Haze, Clean Power Plan

In August 2015, the U.S. Environmental Protection Agency (EPA) released the Clean Power Plan (CPP) final rule, which sets limits on carbon dioxide (CO<sub>2</sub>) emissions from existing fossil fuel-fired

power plants. Under the CPP final rule, Texas will be required to meet a final CO<sub>2</sub> emissions rate limit of 1,042 lb. CO<sub>2</sub>/MWh (190 million tons of CO<sub>2</sub>), on average, by 2030. EPA calculated these limits based on assumptions about coal plant efficiency improvements, increased production from natural gas combined-cycle units, and growth in generation from renewable resources. The final rule phases in these reductions over three compliance periods between 2022 and 2029, referred to as the “glidepath.” Figure 5.5 shows the mass-based emissions limits for Texas published in the CPP final rule and the amount attributable to ERCOT based on the relative amount of load served in the ERCOT Region within Texas.

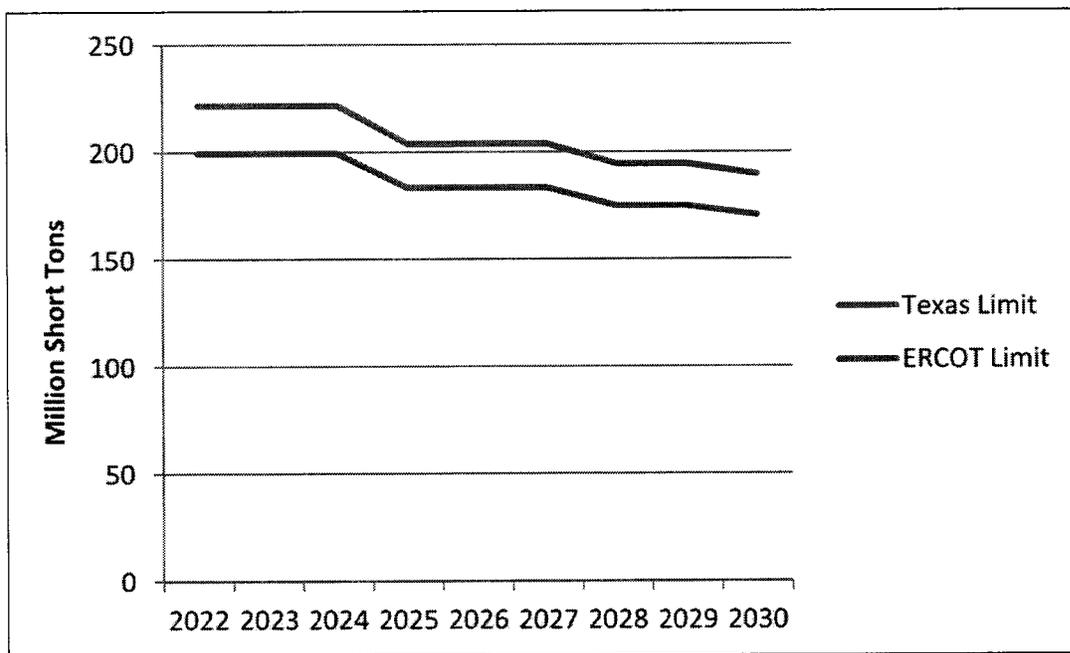


Figure 5.5: Carbon Dioxide Mass-Based Emissions Limits

In October 2015, ERCOT published an analysis of the potential impacts of compliance with the CPP final rule for the ERCOT Region’s resource mix and grid reliability.<sup>15</sup> The analysis used

<sup>15</sup> Electric Reliability Council of Texas, Inc. *ERCOT Analysis of the Impacts of the Clean Power Plan – Final Rule Update*, October 2015. Available at: [http://www.ercot.com/content/news/presentations/2015/ERCOT\\_Analysis\\_of\\_the\\_Impacts\\_of\\_the\\_Clean\\_Power\\_Plan-Final\\_.pdf](http://www.ercot.com/content/news/presentations/2015/ERCOT_Analysis_of_the_Impacts_of_the_Clean_Power_Plan-Final_.pdf).

stakeholder-vetted planning processes and methodologies consistent with ERCOT's regional LTSA studies. ERCOT modeled scenarios in which the CPP limits were achieved through a system CO<sub>2</sub> emissions constraint and a price per ton of CO<sub>2</sub>, in comparison to a baseline. In addition to the CPP, the current requirements of the Cross-State Air Pollution Rule were included in all of the modeled scenarios, and EPA's proposed Regional Haze Federal Implementation Plan (FIP) for Texas was included in one of the modeled scenarios.<sup>16</sup>

Figure 5.6 summarizes the cumulative capacity additions and retirements by 2030 in the modeled scenarios. The results indicate that the CPP, by itself, will result in the retirement of at least 4,000 MW of coal generation capacity. When the impacts of the CPP are considered in combination with the requirements of EPA's proposed Regional Haze Federal Implementation Plan (FIP), there are additional unit retirements, many of which occur even before the start of CPP compliance in 2022. If ERCOT does not receive adequate notification of these retirements, and if multiple unit retirements occur within a short timeframe, there could be periods of reduced system resource adequacy and localized transmission reliability issues.

<sup>16</sup> In November 2014, EPA proposed a FIP disapproving portions of the Texas state implementation plan for Regional Haze, and setting SO<sub>2</sub> emissions limits for certain coal-fired units in Texas. EPA's proposed FIP would require seven coal-fired units in Texas to upgrade their existing scrubbers, and seven units (five of which are located in ERCOT) to install new scrubber retrofits.

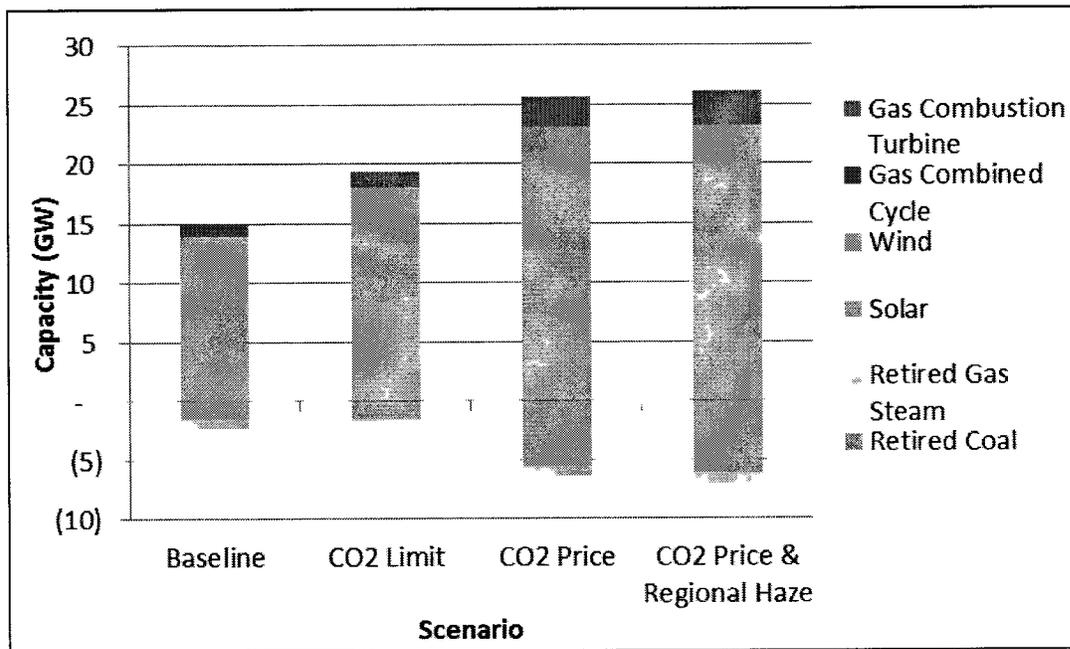


Figure 5.6: Capacity Additions and Retirements by 2030

ERCOT recently conducted a reliability analysis that evaluated potential retirement scenarios resulting from compliance with the proposed Regional Haze FIP.<sup>17</sup> The transmission impact study concluded that the retirement of coal-fired generation affected by the proposed Regional Haze FIP could have a significant local and regional impact on the reliability of the ERCOT transmission system. In one scenario that assumed the retirement of 4,200 MW of coal-fired capacity due to the proposed rule, comparable to the amount expected to retire due to the CPP alone, model results indicated that the following thermal capacities would be exceeded.

- 10 345 kV circuits (approximately 143 miles)
- 31 138 kV circuits (approximately 147 miles)
- 6 69 kV circuits (approximately 39 miles)
- 11 transformers

<sup>17</sup> Additional information on this study is available on ERCOT's Regional Planning Group (RPG) website at [http://www.ercot.com/content/wcm/key\\_documents\\_lists/76860/Transmission\\_Impact\\_of\\_the\\_Regional\\_Haze\\_Environmental\\_Regulation\\_Oct\\_RPG.pdf](http://www.ercot.com/content/wcm/key_documents_lists/76860/Transmission_Impact_of_the_Regional_Haze_Environmental_Regulation_Oct_RPG.pdf).

The CPP study also predicted a sizeable amount of renewable capacity additions, due to the improving economics of these technologies as well as the impacts of regulating CO<sub>2</sub> emissions. If there is not sufficient ramping capability and operational reserves during periods of high renewable penetration, the need to maintain operational reliability could require the curtailment of renewable generation resources. The ability to curtail intermittent generation resources in real-time operations is a key backstop for maintaining the reliability of the system. This type of curtailment of renewable generation may be restricted if low CO<sub>2</sub> generation is needed to achieve a system-wide emissions limit. Growth in renewable generation would also likely have a significant impact on transmission requirements.

#### **5.4 2016 Reliability Constraints**

When the annual Regional Transmission Plan is developed, there are usually a number of reliability needs identified where the projects designed to meet the needs will not yet be in-service when the reliability issue occurs. There are several reasons for this, the most common being faster-than-expected load growth and construction delays. Coordinating construction of multiple projects and equipment outages in the same area also affects the completion of projects.

When projects needed for reliability cannot be installed prior to need, the responsible TSPs 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, establishing a procedure to shed load if an overload is expected to occur or actually occurs. While these actions ensure that reliability standards are upheld, they can often lead to substantial amounts of congestion on the system if generation redispatch is needed or is not sufficient.

The recently completed 2015 RTP identified the projected 2016 single contingency<sup>18</sup> reliability constraints (Table 5.1 and Figure 5.7) that will not have a transmission project in place to solve the constraint before it is expected to occur. Many of these constraints are located in the West

<sup>18</sup> For a list of 2016 reliability constraints caused by multiple outages see the 2015 Regional Transmission Plan Report.

Texas and Eagle Ford areas where demand has increased faster than previously anticipated. The remaining constraints are located in regions of North Texas.

**Table 5.1: Projected 2016 Reliability Constraints**

Index #	Transmission Element
1	Walnut Springs - Glen Rose 69 kV line
2	Hamilton County TNP - Jonesboro TNP 69 kV line
3	Hamilton-Maverick-Eagle Hydro Tap-Escondido-Eagle Pass City 138 kV lines
4	Kenedy Switch-Kenedy 138 kV line
5	San Miguel Tap -North Callahan 69 kV line
6	George West area buses
7	Pleasanton-Jourdanton and Big Foot-Pearsall 69 kV lines
8	Dilley Switch-Cotulla 69 kV line
9	Koch Up River 138/69 kV transformer
10	Bessel 138 kV bus
11	Cassava or Barnhart Phillips Tap-Yucca 69 kV line
12	TNMP 69 kV loop along Pecos, IH20, Flat Top and Wickett area
13	Uvalde-Montell-Campwood 69 kV lines
14	Mason-Katemcy 69 kV line and Fort Mason 138/69 kV transformer
15	Big Lake-Big Lake Phillips Tap 69 kV line

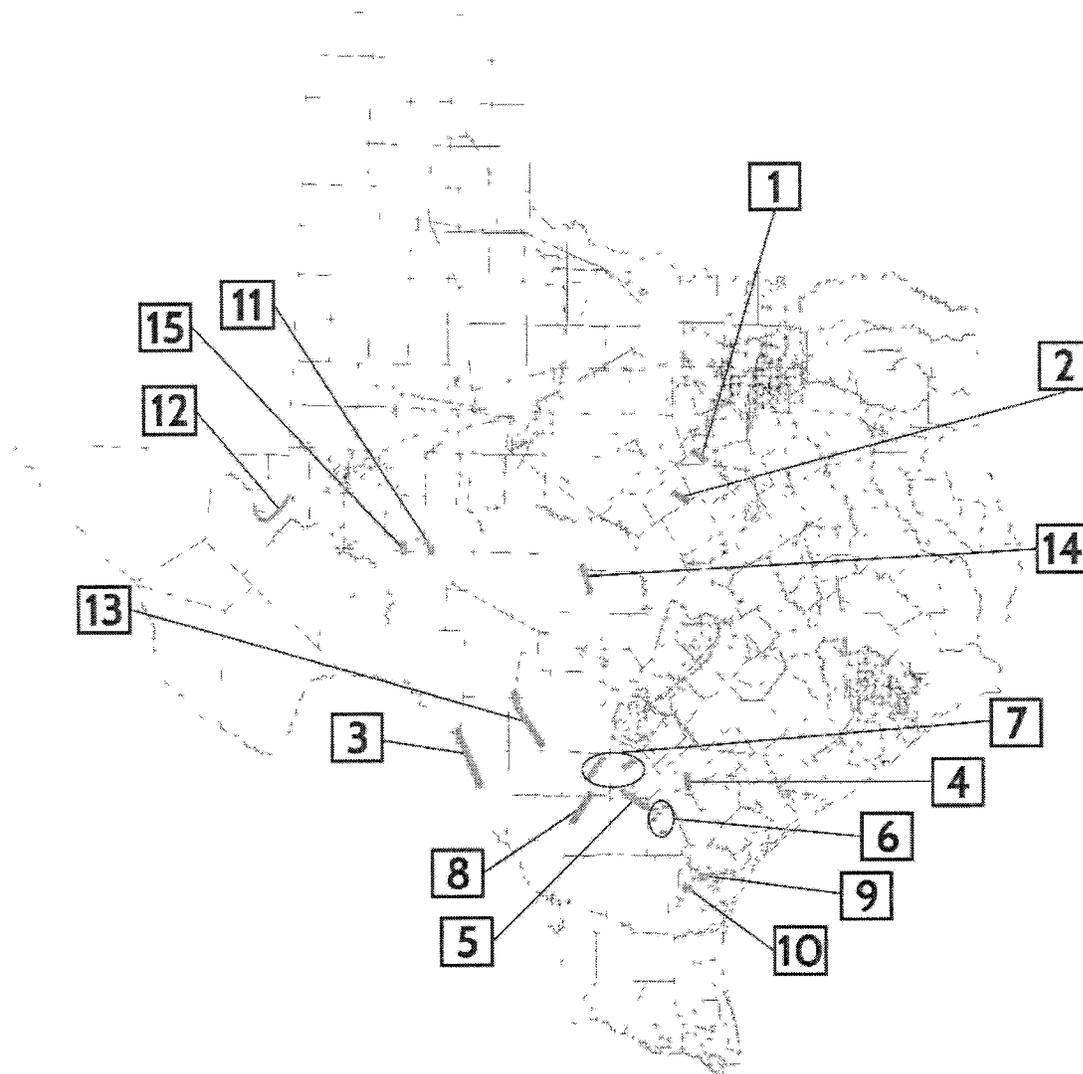


Figure 5.7: Projected 2016 Reliability Constraints

### 5.5 2018 and 2021 Projected Constraints

Future year constraints are also analyzed as part of the annual Regional 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 is included in the recommended project set. Often, however, the capital cost of the project is greater than the expected system-wide production cost savings. When this occurs, the project will not be constructed and the congestion will persist. Table 5.2 and Figure 5.8 show the constraints

projected to be the most congested for 2018 and 2021 based on model simulation in the 2015 RTP.

**Table 5.2: List of Projected Most-Congested Constraints (2018-2021)**

Index	Projected Constraining Element	2018 Congestion	2021 Congestion	
1	Panhandle Interface	High	High	
2	Cico – Comfort 138 kV line	Medium	High	
3	Dupont Switch - Dupont PP1 (Ingleside) 138 kV line	Medium	High	
4	TNMP Tie – Solstice 138 kV line	High	High	
5	Cagnon – Kendall 345 kV line	Medium	High	
6	Long Road - North Denton Interchange 138 kV line	Low	High	
7	Goldthwaite - San Saba Switch 69 kV line	Medium	Medium	
8	Escondido - Eagle Hydro 138 kV line	Medium	Medium	
9	Rincon – Boniview 69 kV line	Medium	Medium	
10	Hamilton Road – Maverick 138 kV line	Medium	Medium	
11	Medina Lake - Pipe Creek 138 kV line	Low	Medium	
12	Wolfgang – Rotan 69 kV line	Medium	Medium	
13	Leon Switch – Putnam 138 kV line	Medium	Low	
14	Wirtz - Flat Rock 138 kV line	Medium	Low	
15	Hicks Transformer 345/138 kV transformer	Medium	Low	
<b>Legend</b>		<b>High</b>	<b>Medium</b>	<b>Low</b>

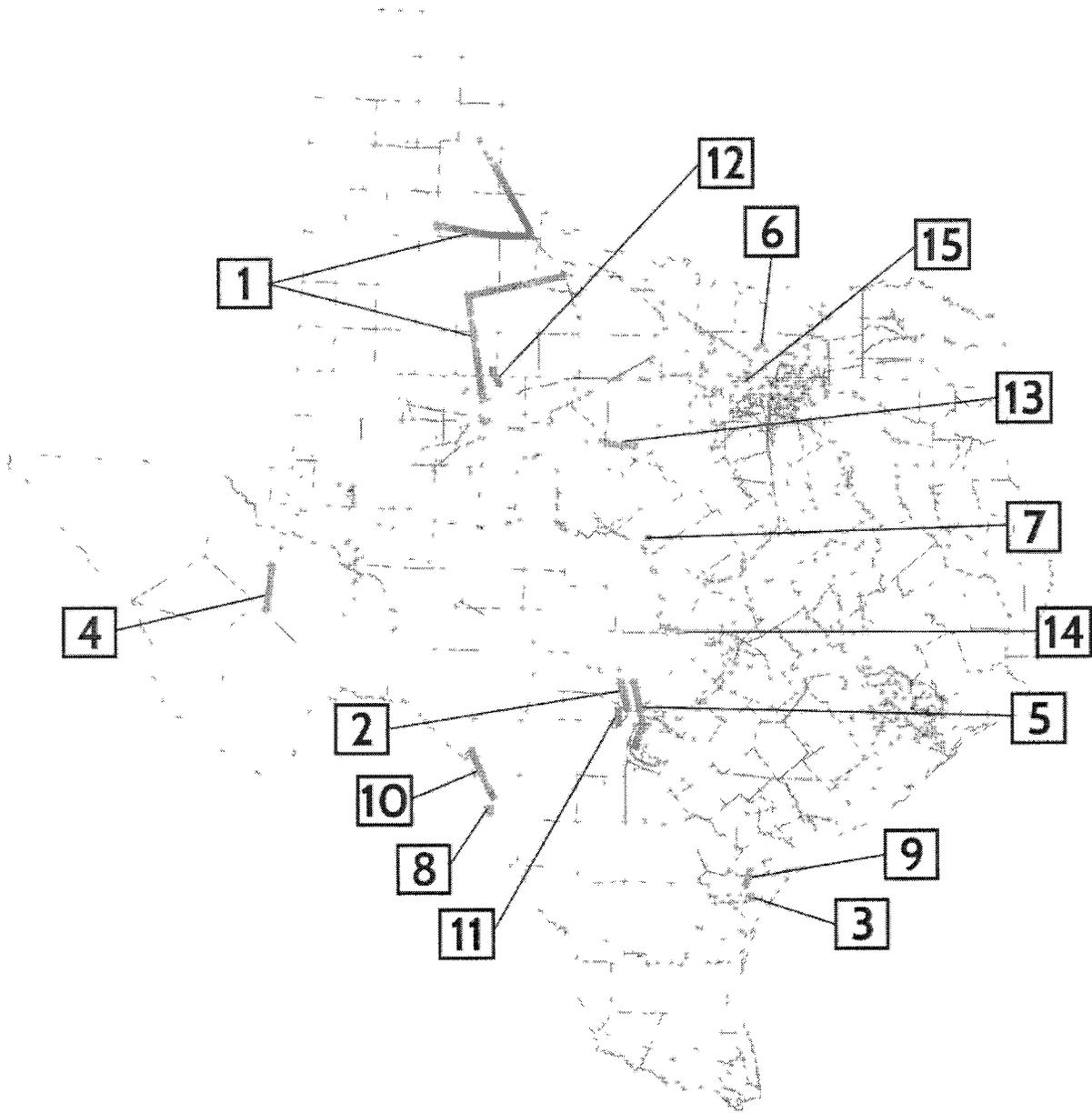


Figure 5.8: 2018-2021 Projected Most-Congested Constraints

## Chapter 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  
512-225-7213

Regulatory and Government Relations  
Shelly Botkin  
512-225-7177

### 6.2 Internet Links

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

Market Information System: <https://mis.ercot.com/pps/tibco/mis>

Users must obtain a digital certificate 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 the following:

- Generation Project Interconnection Information
- Regional Planning Group Information
- Steady-State Base Cases
- System Protection Data

## **Chapter 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.

ALL INFORMATION CONTAINED HEREIN IS PROVIDED "AS IS" WITHOUT ANY WARRANTIES OF ANY KIND. ERCOT, ITS ELECTED AND APPOINTED OFFICIALS, EMPLOYEES AND ASSIGNS MAKE NO REPRESENTATIONS WITH RESPECT TO SAID INFORMATION AND DISCLAIM ALL EXPRESS AND IMPLIED WARRANTIES AND CONDITIONS OF ANY KIND, INCLUDING WITHOUT LIMITATION, REPRESENTATIONS, WARRANTIES OR CONDITIONS REGARDING ACCURACY, TIMELINESS, COMPLETENESS, MERCHANTABILITY, OR FITNESS FOR ANY PARTICULAR PURPOSE.

The specific suitability for any use of the report and its accuracy should be confirmed by the person or entity choosing to make such use. Use of any of the information in this report is solely at the user's risk.

ERCOT ASSUMES NO RESPONSIBILITY TO YOU OR ANY THIRD PARTY FOR THE CONSEQUENCES OF ANY INTERRUPTION, INACCURACY, ERROR OR OMISSION, RESULTING FROM THE USE OF INFORMATION CONTAINED IN THIS DOCUMENT. ERCOT SHALL NOT BE LIABLE TO YOU OR ANY THIRD PARTY FOR, AND BY USING THE INFORMATION CONTAINED IN THE DOCUMENT YOU AGREE TO INDEMNIFY ERCOT, ITS DIRECTORS, OFFICERS, EMPLOYEES, AND REPRESENTATIVES FOR ANY CLAIM, DAMAGES, OR LOSSES RESULTING FROM, DAMAGE OF ANY KIND ARISING DIRECTLY OR INDIRECTLY OUT OF OR RELATING TO YOUR USE OF THE INFORMATION CONTAINED IN THIS DOCUMENT (INCLUDING ANY BREACH OF THIS AGREEMENT), INCLUDING, BUT NOT LIMITED TO, ANY LOST PROFITS, LOST OPPORTUNITIES, SPECIAL INCIDENTAL, DIRECT, INDIRECT OR CONSEQUENTIAL DAMAGES, EVEN IF ERCOT IS

ADVISED OF THE POSSIBILITY OF SUCH DAMAGE OR OF A CLAIM, OR POTENTIAL CLAIM, BY ANOTHER PARTY, INCLUDING CLAIM FOR PUNITIVE DAMAGES.