

VERSION 1.0

# ERCOT PANHANDLE RENEWABLE ENERGY ZONE OUTLOOK – 2017 UPDATE

Feb 2017



LCG CONSULTING

4962 El Camino Real, Suite 112  
Los Altos, CA 94022  
Tel: 650-962-9670  
[www.EnergyOnline.com](http://www.EnergyOnline.com)

© LCG CONSULTING 2017. All Rights Reserved.

*This report contains confidential and proprietary information of LCG Consulting, protected by US copyright and other intellectual property laws. This report may not be reproduced or disclosed, wholly or in part, without written consent of LCG.*

TABLE OF CONTENTS

---

- 1. INTRODUCTION ..... 1
- 2. CURTAILMENT AND CONGESTION ..... 4
- 3. ECONOMIC IMPACT ..... 7

CONFIDENTIAL

## TABLE OF FIGURES

---

Figure 1 – Panhandle wind production.....	4
Figure 2 – Panhandle wind curtailment and congestion .....	5
Figure 3 – Flow duration across Panhandle interface.....	6
Figure 4 – Price duration for average Panhandle LMP .....	7
Figure 5 – LMP heat map for June and July 2018 .....	8

CONFIDENTIAL

# 1. INTRODUCTION

---

West Texas has seen unprecedented investment in wind generation and more is expected. From 2015 through early 2016, wind capacity in the Panhandle Renewable Energy Zone (PREZ) nearly doubled. Today the Panhandle region alone has 3,429 MW of operational wind winter capacity, more than most states<sup>1</sup>. Another 2,064 MW is on deck, with signed interconnection agreements with ERCOT and is projected to come online by January 2019, according to the December 2016 ERCOT Generator interconnection Status Report.

Panhandle area wind development, related transmission upgrades, interface limit and stability monitoring have been a frequent focus of discussion at ERCOT's monthly Regional Planning Group meetings and topics of interest of a variety of stakeholders in ERCOT.

LCG Consulting ("LCG") published the Panhandle Outlook report in 2016 analyzing the impact of congestion and curtailment on renewables units in the Panhandle region. This document reviewed several scenarios of future wind buildout, given the best available information at that time. At the end of 2016, Sharyland Utilities proposed several expansion options which could increase the transfer capability of the Panhandle interface out of which ERCOT's Regional Transmission Planning (RTP) group has evaluated and added Option 1 (addition of two 175MVA synchronous condensers) to their 2016 RTP Economic Cases.

In this Update, LCG examines some additional possibilities that include Sharyland's expansion Option 1, should it be implemented.

## 2016 Recap

The original 2016 LCG report examined the impact of ERCOT's plan's for Stage 1 and Stage 2 upgrades and Lubbock Power & Light (LP&L) integration in Panhandle<sup>2</sup>. For the LP&L integration cases, the analysis included transmission upgrade Option 8A, 8B and 40W which were studied by the ERCOT planning group. Both 5,106 MW and 6,522 MW of wind buildout in Panhandle were simulated in UPLAN for all the scenarios for the year 2021.

LCG found that the Stage 1 upgrade without LP&L integration for 2021, the Panhandle curtailment is about 6% and 20% for 5,016 MW and 6,552 MW of wind penetration, respectively. With both Stage 1 and Stage 2 upgrades implemented, wind curtailment is eliminated in the 5,016 MW case and drops below 4% with 6,552 MW wind penetration.

The integration of LP&L with ERCOT will add 594 MW of load and 185 MW of synchronized generation in Panhandle. LCG found these additions improve wind curtailment across

---

<sup>1</sup> ERCOT Capacity, Demand and reserve Report. December 2016.

<sup>2</sup> LCG Consulting, May 2016, ERCOT Panhandle Renewable Energy Zone and Lubbock Power and Light Integration.

[http://www.energyonline.com/Reports/Files/Panhandle\\_Excutive\\_Summary.pdf](http://www.energyonline.com/Reports/Files/Panhandle_Excutive_Summary.pdf)

Panhandle Interface. For the three LP&L integration options that we studied, the projected curtailment was less than 3% with Stage 1 upgrades and 5,016 MW of wind. However, with wind penetration of 6,552 MW, the curtailment was in the range of between 11% and 14%.

#### 2017 Update

Sharyland has proposed nine expansion options that could increase the Panhandle interface export limit. Out of the nine options proposed, Options 1, 3 and 9 meet ERCOT’s economic planning criteria (As outlined in ERCOT’s Nodal Protocol Section 3.11.2). ERCOT’s Regional Planning Group has evaluated Option 1 and has included it in their 2016 Transmission Expansion Plan (2016RTP Economic Cases). Table 1 summarizes all the options proposed by Sharyland Utilities.

**Table 1 – Sharyland Utilities Panhandle transmission expansion options**

Option	Additional Synchronous Condensers (@175 MVA each)	Transmission Upgrades	Panhandle Export Limit for WSCR = 1.5
Base Case			4,004
1	2 SCs @ Windmill	None	4,781
2	2 SCs @ Windmill	345 kV Ogallala - Abernathy - Cottonwood line	4,961
3	1 SC @ Windmill	345 kV Ogallala - Abernathy - Grassland line	4,833
4	1 SC @ Windmill	345 kV Ogallala - Abernathy - Longdraw line	4,831
5	2 SCs @ Windmill	345 kV White River - Clear Crossing line	4,948
6	2 SCs @ Windmill	345 kV White River - Riley line	4,932
7	2 SCs @ Windmill + 1 SC each @ Tule Canyon and Alibates	None	5,321
8	1 SC @ Windmill	345 kV Ogallala - Abernathy line	4,520
9	1 SC @ Windmill	345 kV Ogallala - Abernathy & White River - Cottonwood (on separate ROW)	4,627

Sharyland expansion Option 1 (“SU-O1”) would introduce two 174 MVA synchronous condensers at the Windmill substation. LCG developed models for the years 2017, 2018 and 2021 to study the impact of SU-O1. This report discusses LCG’s findings for those study years.

The transmission network for the years 2017, 2018 and 2021 are based on the Summer Peak Power Flow cases published by ERCOT’s SSWG group in October 2016. Panhandle wind capacity addition in future years is modeled based on the Generation Interconnection Agreement published December 2016 by ERCOT.

The Panhandle interface operations export limit of 4,273<sup>3</sup> MW for 2018 and 2021 is modeled to reflect the completion of Stage 1 Upgrade of Panhandle interface along with the inclusion of approved SU-01. Since the Stage 1 Upgrade is scheduled to be completed and effective starting July 2018, LCG models the interface limit at 3,050 MW for entire study period of 2017 and through June 2018.

CONFIDENTIAL

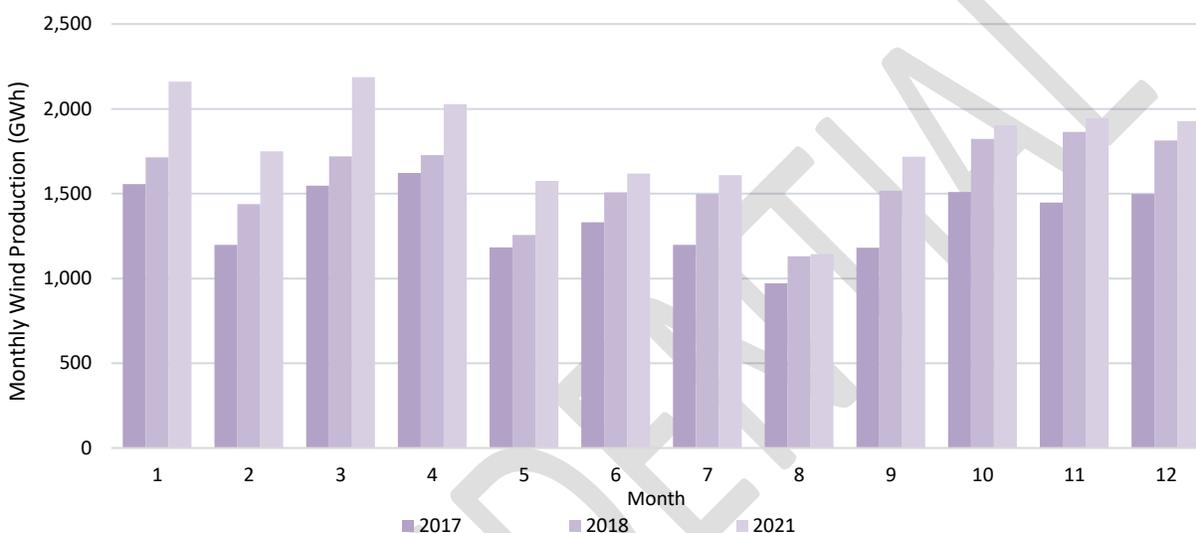
---

<sup>3</sup> ERCOT 2016 RTP Economic Case Final input assumptions published November 2016.

## 2. CURTAILMENT AND CONGESTION

LCG’s projection of monthly wind production within the Panhandle region is shown in Figure 1 for the update cases. Monthly wind production is much higher during off-peak hours than peak hours since the Panhandle wind availability is more during off-peak hours.

**Figure 1 – Panhandle wind production**



Based on the update cases studied in this report, Table 2 summarizes the Panhandle interface congestion along with its impact on curtailment of Panhandle wind generation.

**Table 2 – Curtailment and contingency summary**

Study Year	Panhandle Curtailment	Percentage of Time at Export Limit
2017	4.2%	20%
2018	6.3%	22%
2021	2.1%	14%

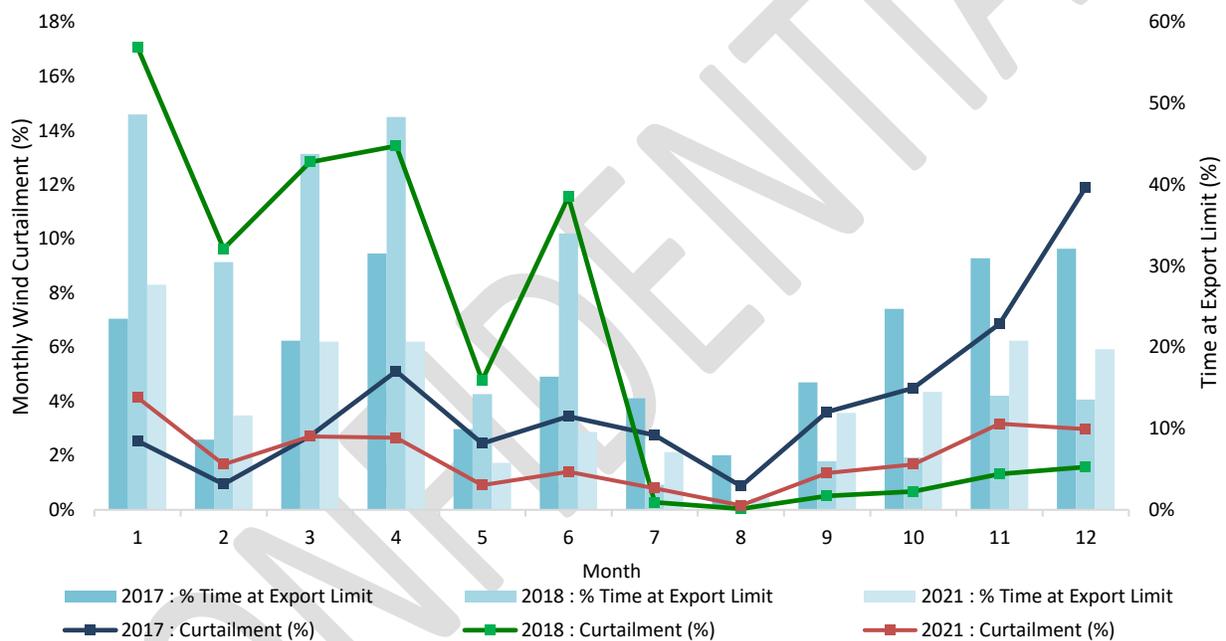
LCG projects the Panhandle interface to experience congestion at the export limit for about 20% of the time in 2017. Though this percentage increases to 22% in 2018, it is primarily due to the first half of the year when the export limit does not have the Stage 1 Upgrade and SU-01 in place, therefore the actual congestion that can be expected will be tied to the real date that Stage 1 is completed. This effect is exacerbated by addition of over 350 MW of wind unit in the Panhandle area. The study indicates significant reduction in percentage of hours congested at

export limit from 37% for the first half of the year to 7% for the second half in 2018. LCG's projection shows curtailment for 14% of time at export limit in 2021.

The impact of the Panhandle congestion results in an annual curtailment of 4.2% for Panhandle wind units in 2017 which elevates to 6.3% of annual curtailment in 2018. This increase is caused by the high Panhandle congestion before Stage 1 Upgrade and SU-O1 come online. Once introduced, these upgrades relieve Panhandle congestion and considerably alleviate curtailment in the Panhandle. The annual curtailment of Panhandle wind is 2.1% in 2021.

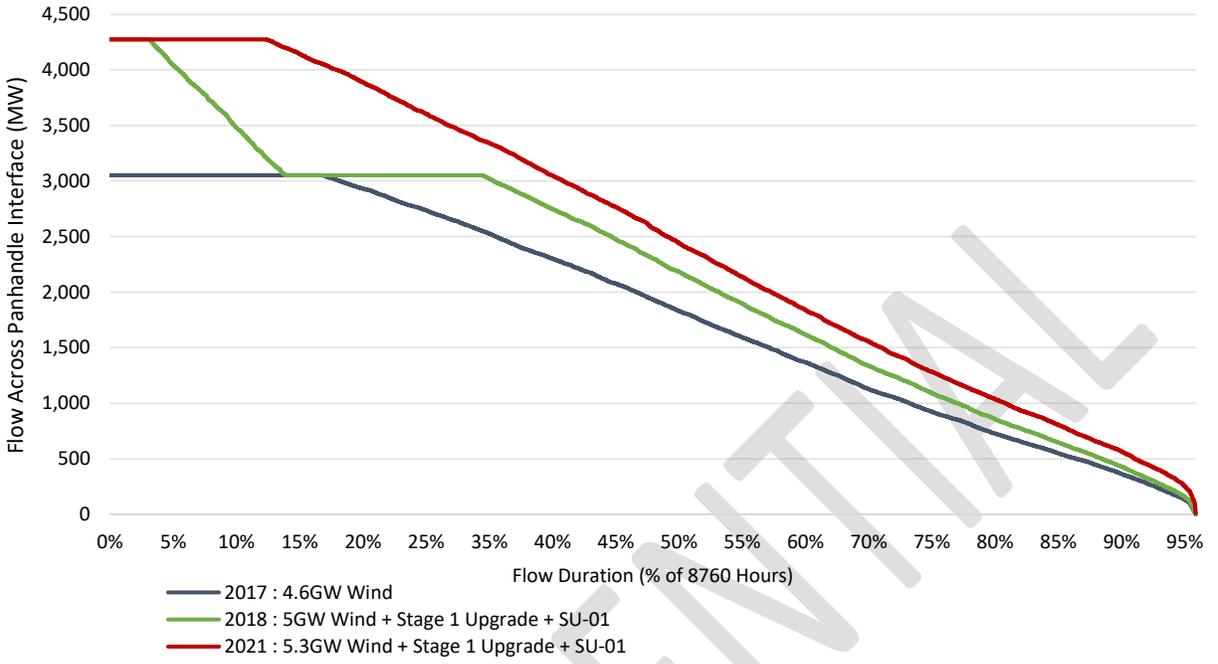
Figure 2 displays the monthly trend of Panhandle wind curtailment and congestion. As expected, curtailment follows a similar progression to congestion across Panhandle interface.

**Figure 2 – Panhandle wind curtailment and congestion**



The flow duration curves in Figure 3 capture the impact of export limit on congestion across the Panhandle interface between the studied cases.

Figure 3 – Flow duration across Panhandle interface

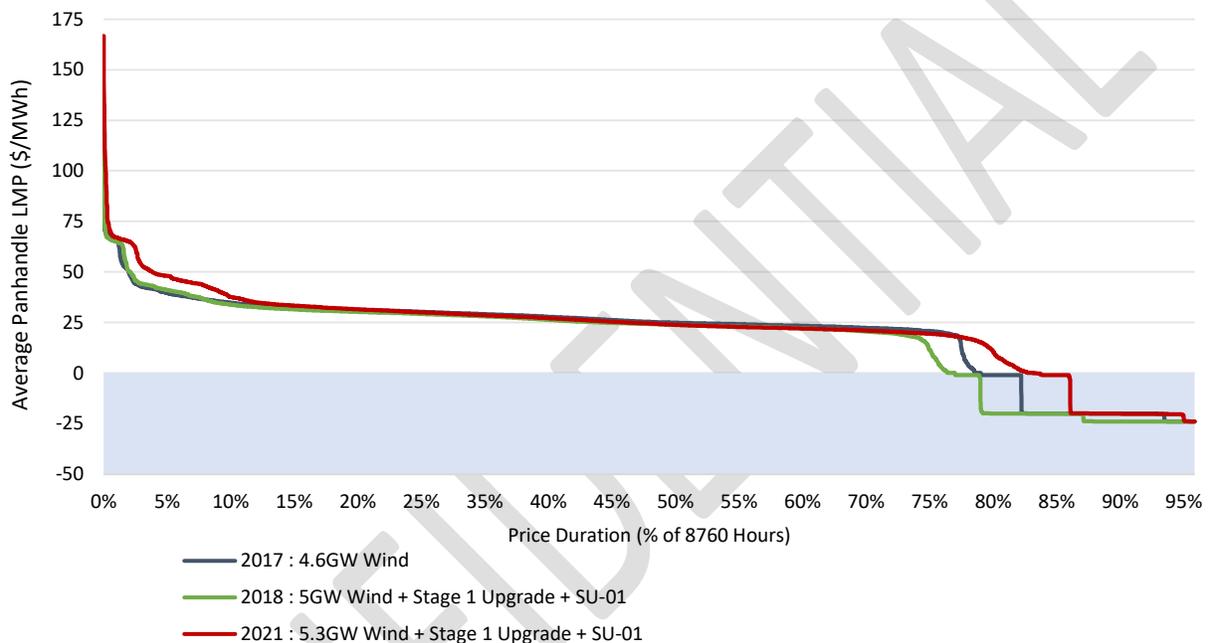


CONFIDENTIAL

### 3. ECONOMIC IMPACT

The price duration curves for the scenarios are shown in Figure 4. The excess duration below \$0 per MWh is 20%, 22% and 15% for the years 2017, 2018 and 2021 respectively. Excess duration is a representation of the percentage of time that the average LMP is below a given limit.

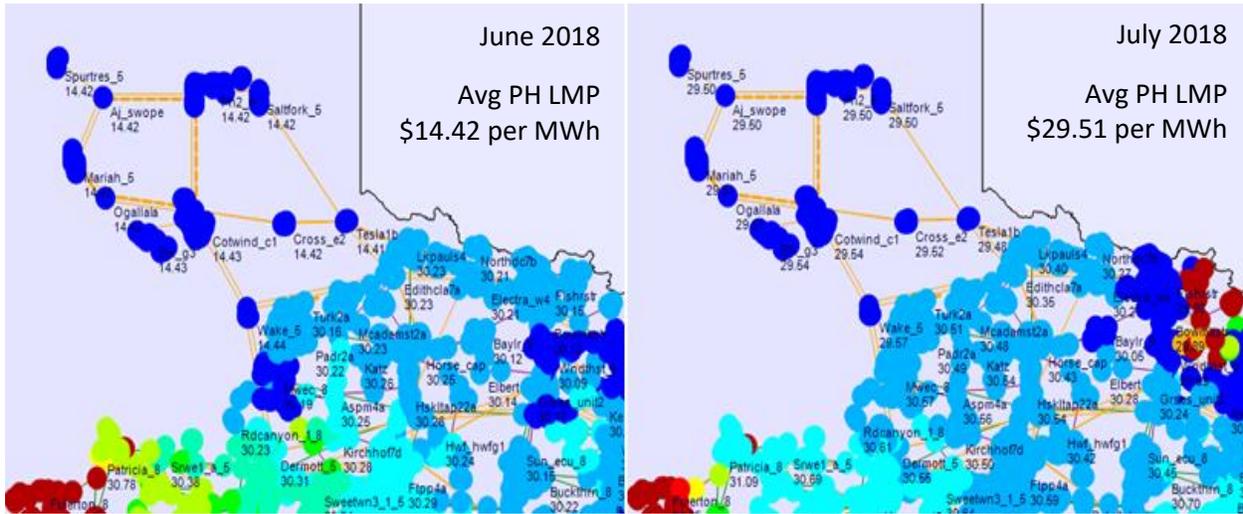
**Figure 4 – Price duration for average Panhandle LMP**



When the Panhandle interface gets congested at the export limit, LMPs at the Panhandle nodes drop below zero, and the generators are curtailed to maintain grid stability. To bypass curtailment, the wind generators within Panhandle region opt for negative bidding. This is an affordable option because of tax incentives, thereby significantly affecting the generation revenue in the area.

The impact of increased Panhandle export limit on the nodal price in the region can be seen in Figure 5, which displays the monthly average LMP at nodes in the Panhandle region in June and July 2018. The average monthly prices for 2018 almost double from June to July within the region due to relieved congestion across Panhandle interface.

**Figure 5 – LMP heat map for June and July 2018**



The overall benefit observed in LCG’s study is shown in Table 3 in terms of system-wide average production cost. Implementation of Stage 1 Upgrade and Sharyland expansion Option 1 indicate notable benefit in terms of enhanced cost effectiveness for the ERCOT system.

**Table 3 – Annual average production cost**

Description	Average Production Cost (\$/MWh)
2017 : 4.6GW Wind	24.74
2018 : 5GW Wind + Stage 1 Upgrade + SU-O1	23.42
2021 : 5.3GW Wind + Stage 1 Upgrade + SU-O1	24.17

In the study, LCG assumes Panhandle export limit to be dependent on wind development, transmission upgrades and the introduction of Sharyland expansion Option 1. Other mitigating factors like outages and contingencies based on which the interface export limit, that can be modified by ERCOT, are outside of the scope of this study.