VERSION 1.01

ERCOT PANHANDLE RENEWABLE ENERGY ZONE AND LUBBOCK POWER & LIGHT INTEGRATION

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EXECUTIVE SUMMARY

West Texas is experiencing a period of unprecedented investment in wind generation. From the beginning of 2015 through the end of February 2016, wind capacity in the Panhandle Renewable Energy Zone (PREZ) nearly doubled, from approximately 1,260 MW to over 2,450 MW. ERCOT ISO expects this growth to continue in the coming years. In addition, the likely integration of Lubbock Power and Light (LP&L) with the ERCOT grid may further impact the wind buildout in the PREZ area.

In light of significant changes in the Panhandle, this report outlines the infrastructure challenges, current developments, wind curtailment due to congestion, and an outlook for wind generation in the Panhandle region. LCG Consulting ("LCG") addresses these issues to give market participants an overview of the current conditions and what to expect in the coming years.

ERCOT has implemented the Panhandle Export Stability Interface in response to a series of studies iwhich suggest that increasing regional wind capacity may cause voltage instability. Although as of March 2016 this interface had not yet been enforced at a binding level during normal system conditions, ERCOT has enforced a reduced limit during certain outage conditions. ERCOT's Regional Planning Group is actively studying the configuration of transmission enhancement for integrating LP&L. ERCOT has released a preliminary scope document for a LP&L load integration study. AEPSC and Oncor have jointly submitted a proposal for transmission enhancement in the west.

The current operation export limit of 2,711 MW across the Panhandle Interface is proposed to be increased to 3,332 MW with a set of transmission upgrades - Stage 1 in 2018. There are also proposals to further upgrade the interface limit - Stage 2 - which will increase the Panhandle Interface limit to 4,680 MW when the Panhandle wind buildout reaches 6,552 MW. The LP&L integration with Stage 1 upgrades will improve the flow across the Panhandle Interface to 3,626 MW.

One ERCOT study shows that the savings with Stage 1 and Stage 2 upgrades will exceed the estimated cumulative cost of $115M and $560M in six years respectively, meeting the ERCOT economic criteria. LCG's independent analysis indicates that the savings will be very close to the ERCOT estimate in the year 2021. The expected integration of LP&L will affect savings from the upgrades.

In this report, LCG reviews several scenarios of future wind buildout, the impact of Stage 1 and Stage 2 upgrades and LP&L integration in Panhandle. For the LP&L integration cases, we have analyzed transmission upgrade Option 8A, 8B and 4OW which were recently studied by the ERCOT planning group. We have conducted UPLAN simulation for both 5 GW and 6.5 GW of wind buildout in Panhandle for all the scenarios for the year 2021. The table below summarizes the curtailment and the percentage of time that the flow is less than the Panhandle export limit under various scenarios.

Case Description / Electricity Index			Panhandle Interface Export Limit (MW)	Average Production Cost ($/MWh)	Total System Generation (GWh)	Curtailment	Percent of Time at the Export Limit
Panhandle Wind Build (2021)	5,016 MW	Stage 1 Upgrade without LP&L (Case 2)	3,332	$22.36	379,278	5.5%	24%
		Stage 1 & 2 Upgrades without LP&L (Case 2A)	4,680	$22.29	379,278	0.0%	0%
		Stage 1 Upgrade & LP&L Opt 8B (Case 4)	3,626	$22.37	381,800	2.9%	16%
		Stage 1 Upgrade & LP&L Opt 8A (Case 5)	3,831	$22.36	381,799	1.7%	13%
		Stage 1 Upgrade & LP&L Opt 4OW (Case 6)	3,822	$22.36	381,801	1.9%	11%
	6,552 MW	Stage 1 Upgrade without LP&L (Case 3)	3,332	$22.16	379,278	19.9%	47%
		Stage 1 & Stage 2 Upgrades (Case 3A)	4,680	$21.93	379,278	3.2%	17%
		Stage 1 Upgrade & LP&L Opt 8B (Case 4A)	3,626	$22.11	381,800	14.3%	40%
		Stage 1 Upgrade & LP&L Opt 8A (Option 5A)	3,831	$22.08	381,800	11.2%	35%
		Stage 1 Upgrade & LP&L Opt 4OW (Case 6A)	3,822	$22.07	381,801	11.4%	36%

The Panhandle LMPs become negative whenever wind generation reaches the interface export limit and the wind output is curtailed. For the 5 GW wind penetration cases, the percentage of negative prices varies from 0 – 24% and for 6.5 GW of wind, the frequency of negative prices varies from 17% - 47%. For the 6.5 GW high wind buildout cases, the curtailment level is between 11% - 20% without the stage 2 upgrade, which suggests additional upgrades for the Panhandle interface will be desirable.

The Panhandle wind buildout, the stability limit, transmission upgrades, and LP&L integration have been actively studied by ERCOT. This report is intended to provide an analysis of current happenings and their impact using UPLAN simulation.

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