LCRA COMMENTS REGARDING NPRR 815

March 23, 2017

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Summary of NPRR815 Concerns

- ERCOT needs thermal generation to provide ramping capability, inertia and voltage support for the system
  - Load Resources can not provide.
  - Non-Spinning Reserve can not respond quickly enough and is a replacement reserve
- Twice in the last 11 years a weather situation occurred that would likely result in shedding firm load given the current level of West Texas wind generation
  - Extreme wind events result from a rare setup in the lower and middle atmosphere and are very difficult to predict
- Wind forecast variances during periods of low load and reduced thermal generation frequently results in price spikes due to lack of ramping capability

NPRR815 Reliability Impacts

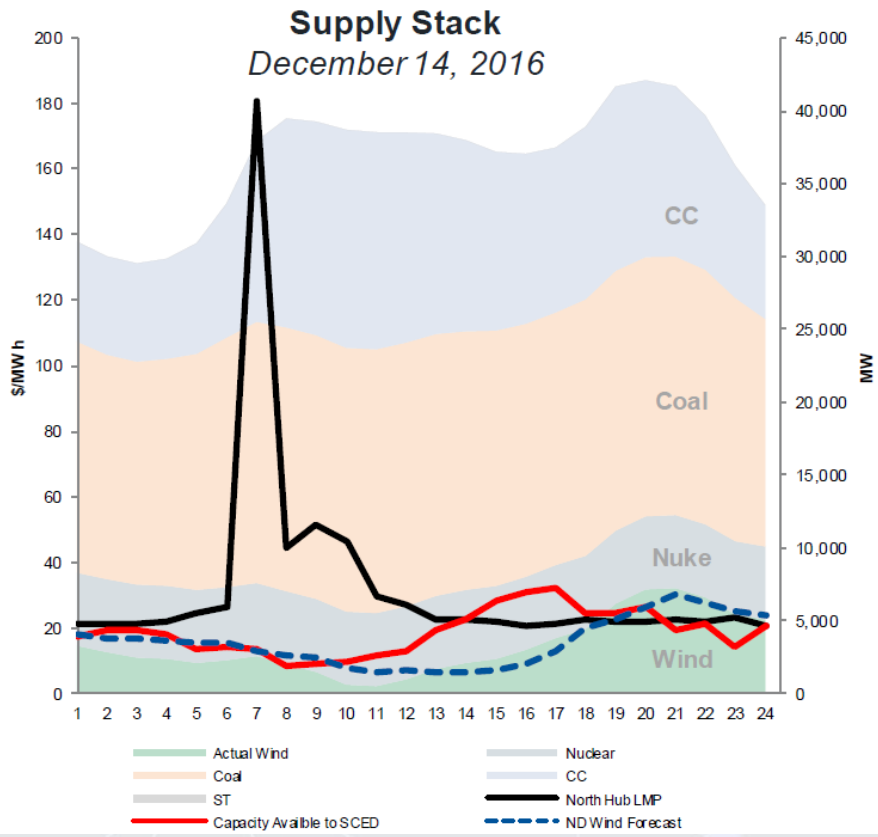
- Language change will lead to less online thermal generation that:
  - Protects the system against frequency events
    - Ability to respond to generator trips and correct the frequency before it drops to 59.7Hz (relay set point)
  - Protects the system against voltage related events
    - Ability to respond dynamically to voltage changes due to outages which Load Resources can not
  - Provides ramping capability that manages wind and load forecast misses
    - Ability to ramp quickly and thus mitigate price spikes which Load Resources can not
- ERCOT should consider additional reliability impacts
  - Currently only consider the simultaneous loss of two nuclear units

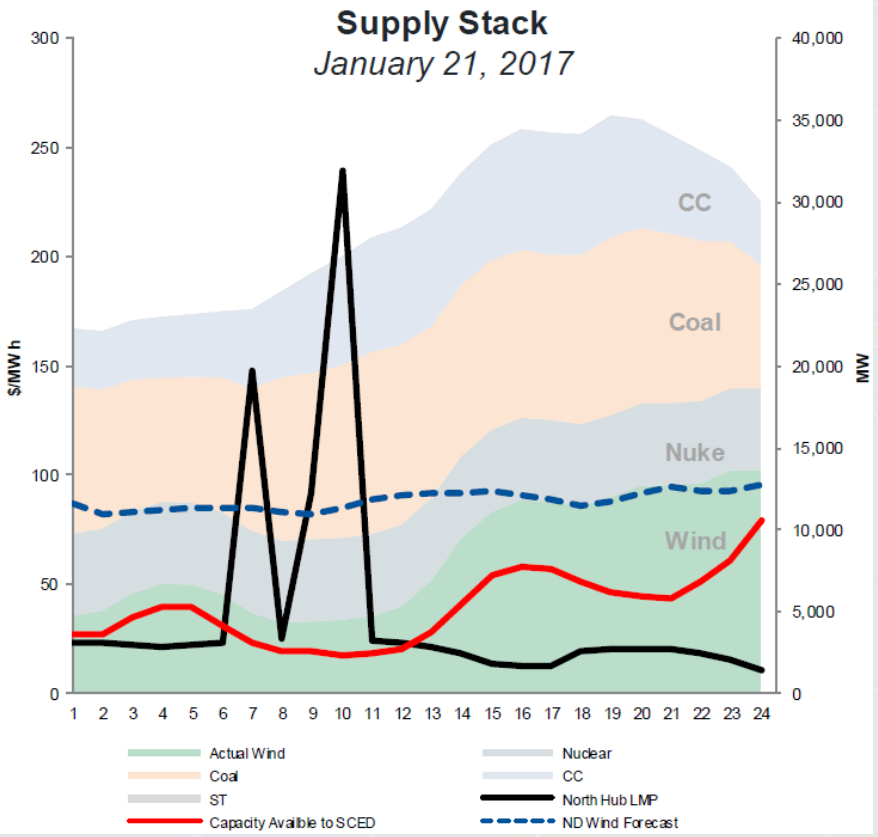
Wind Volatility Impact

- Wind forecast variances can have direct impact on price volatility
  - Per Genscape's ERCOT 2017 Spring Outlook; "What we tend to see pretty frequently is when there is a miss on the next day wind generation forecast of the day ahead market cleared wind generation, is when we tend to see pretty significant volatility in these markets."

Genscape Example – Low Load and High Price Volatility

Wind Volatility Slide





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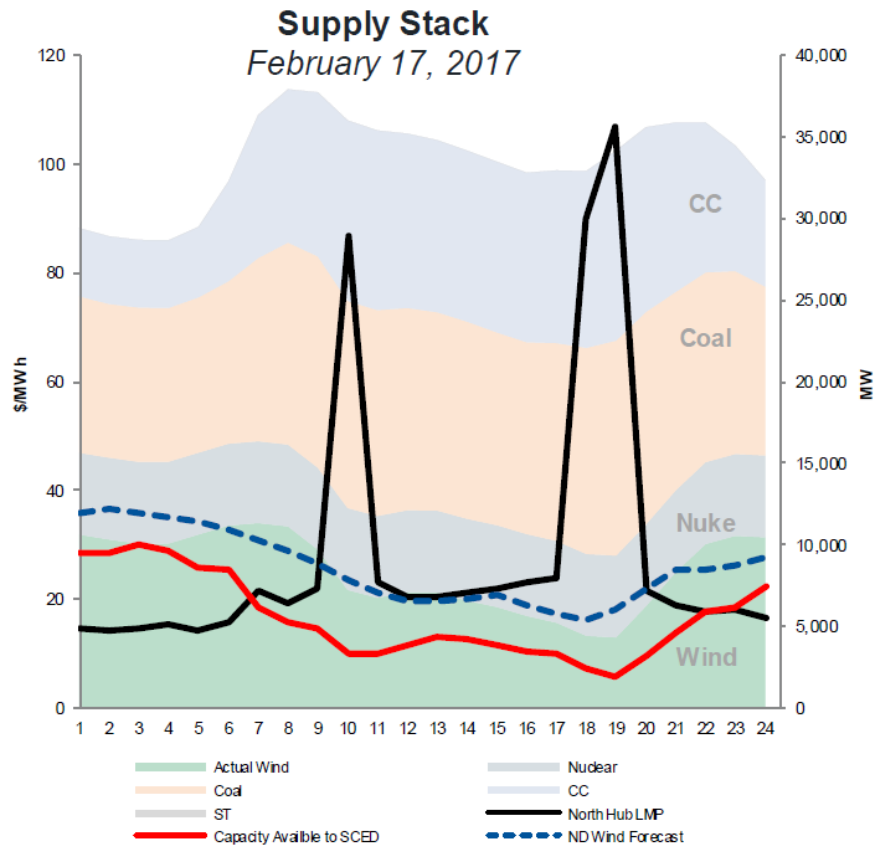
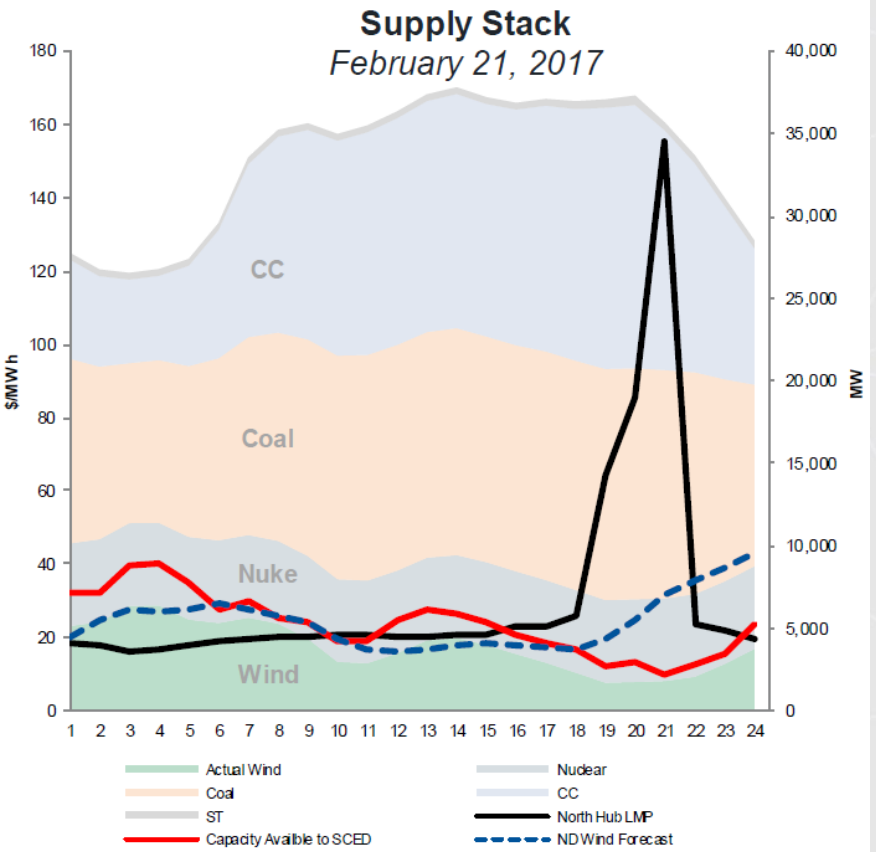
Per Genscape, “February 17th showed how much wind volatility can drive a price spike irrespective of what’s going on with load.”

Wind Volatility Slide





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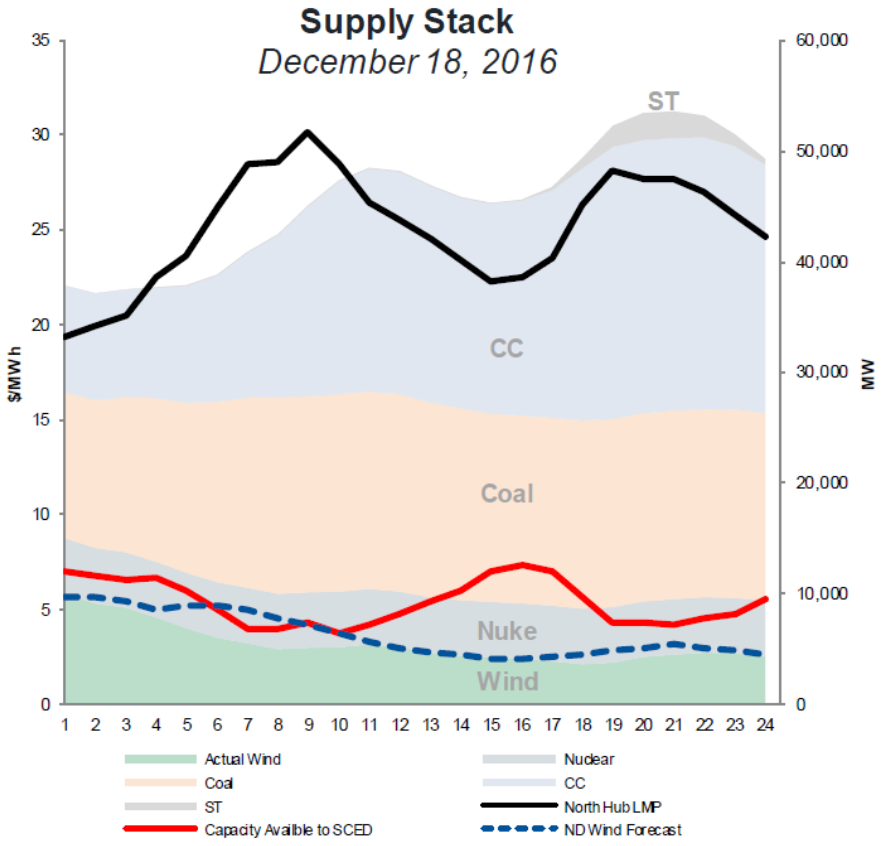
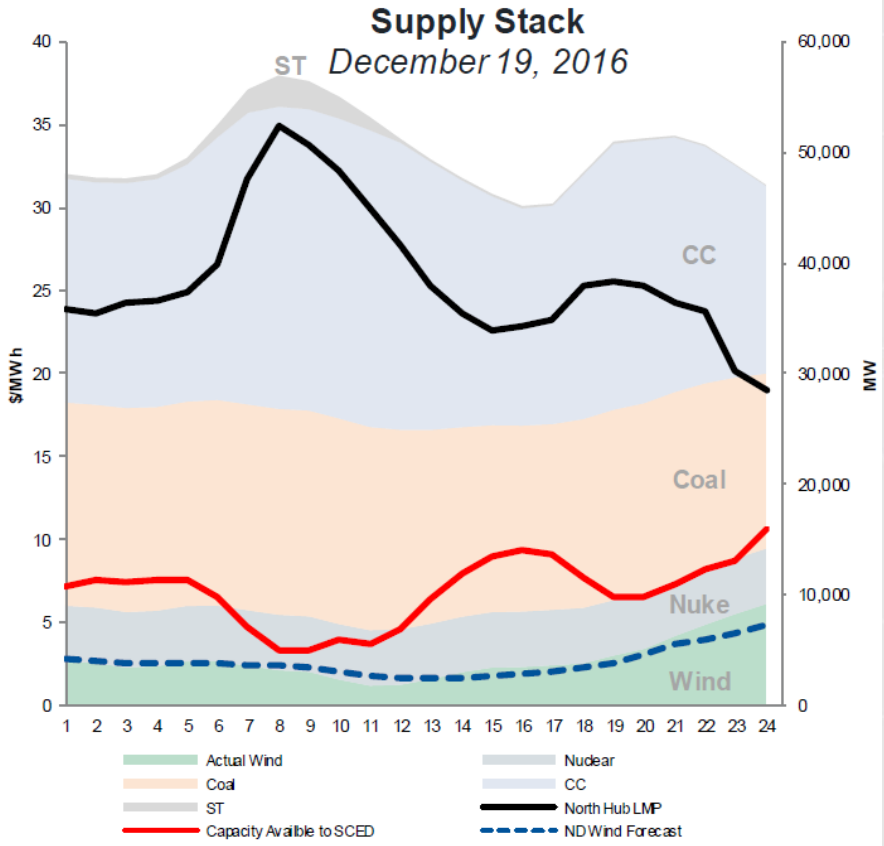
Wind Volatility Impact

- On December 18th, 2016, there was much higher load compared to February 17, 2017, but there was little price volatility due to substantially more combined cycle generation online. "Although the miss on wind generation was significant, we still saw capacity available to SCED remain at some very healthy levels."

Genscape Example – High Load and Low Price Volatility

High Load / Low Vol





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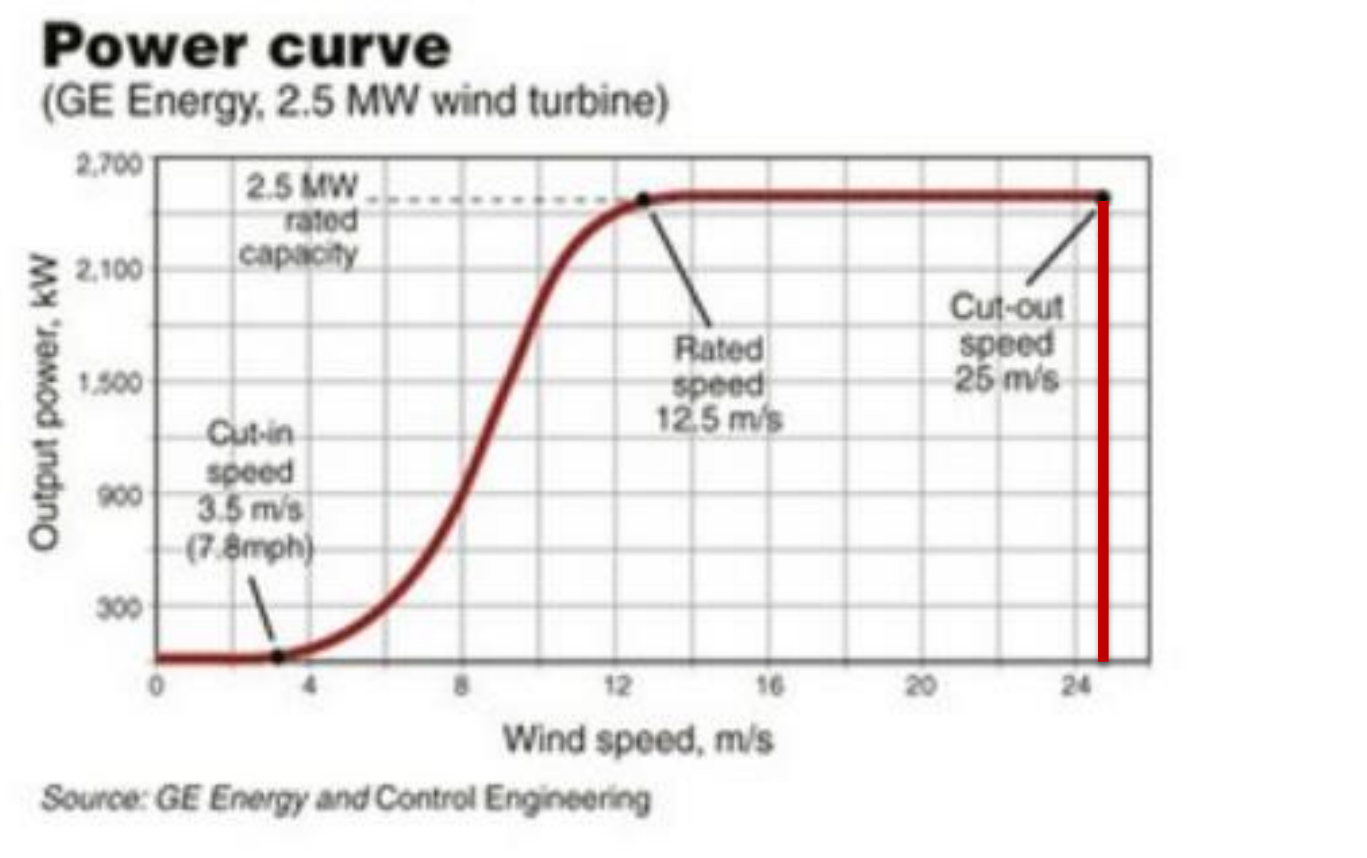
Example of a Wind Turbine Power Curve

When the wind speed is already close to the cut-out speed, an additional small increase in wind speed could result in the wind turbine shutting down.

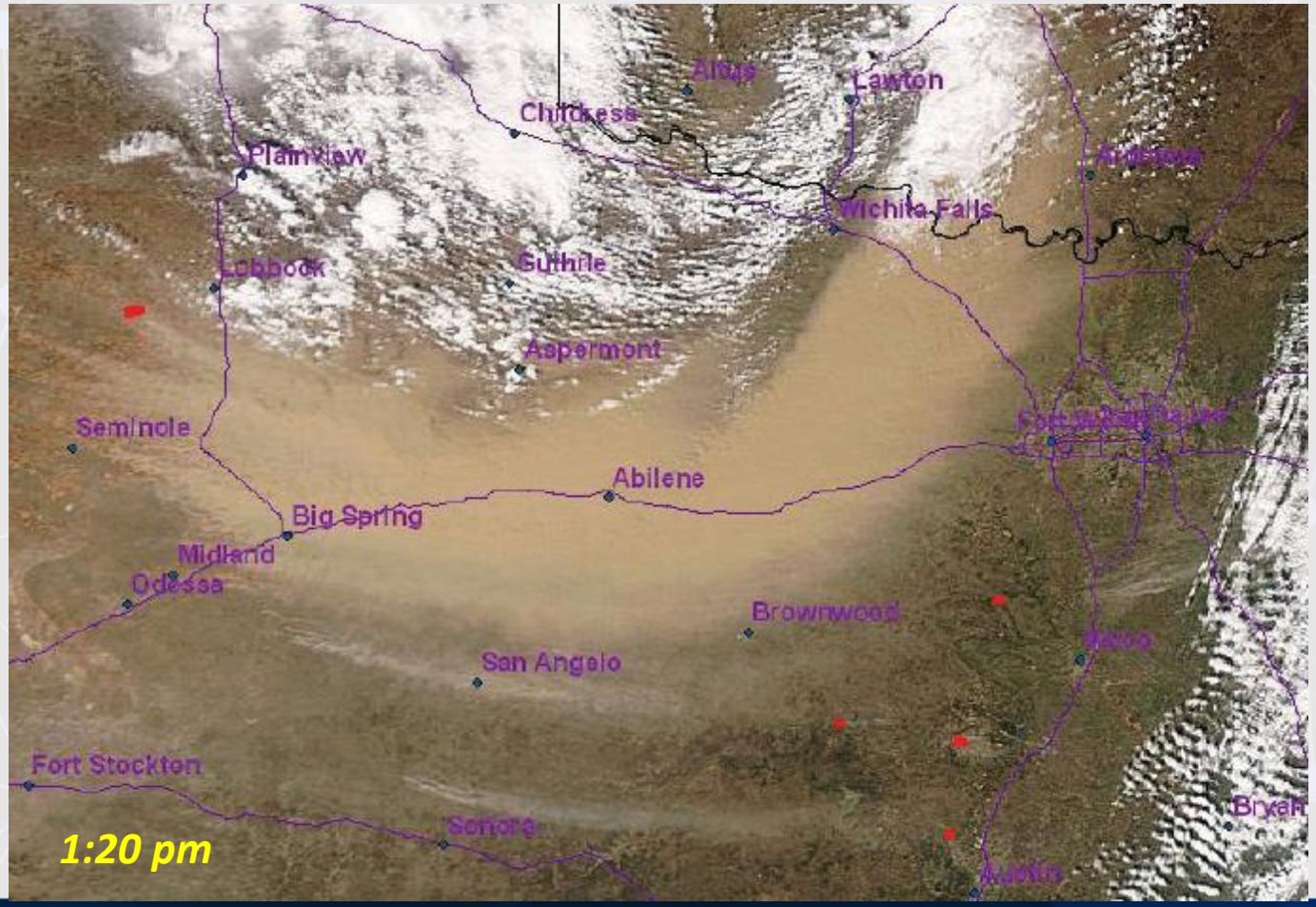
25 m/s = 55.9MPH



2007 EECP Event

- Wind gusts reached 64 mph in West Texas and led to significant loss of wind generation
- Wind generation lost 1,550 MW from its morning peak generation
- 1,550 MW loss in wind generation in 2007 translates to:
  - Loss of 8,500 MW based on 2017 west zone capacity
  - Loss of 14,100 MW based on 2021 west zone capacity
- Repeat of 2007 event would significantly increase the reliability risk to the ERCOT grid of having capacity shortages

Visible satellite view from February 24, 2007



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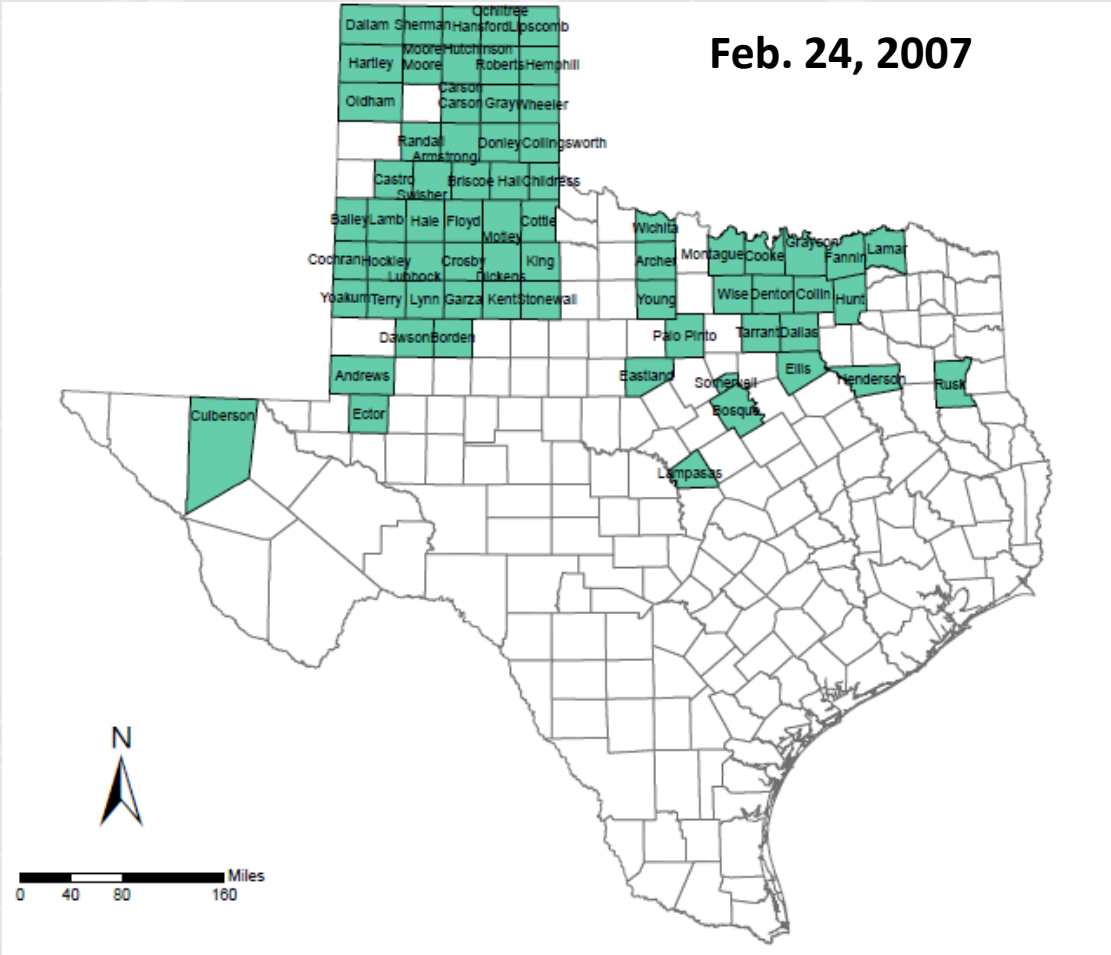
Counties reporting winds greater than 58 mph



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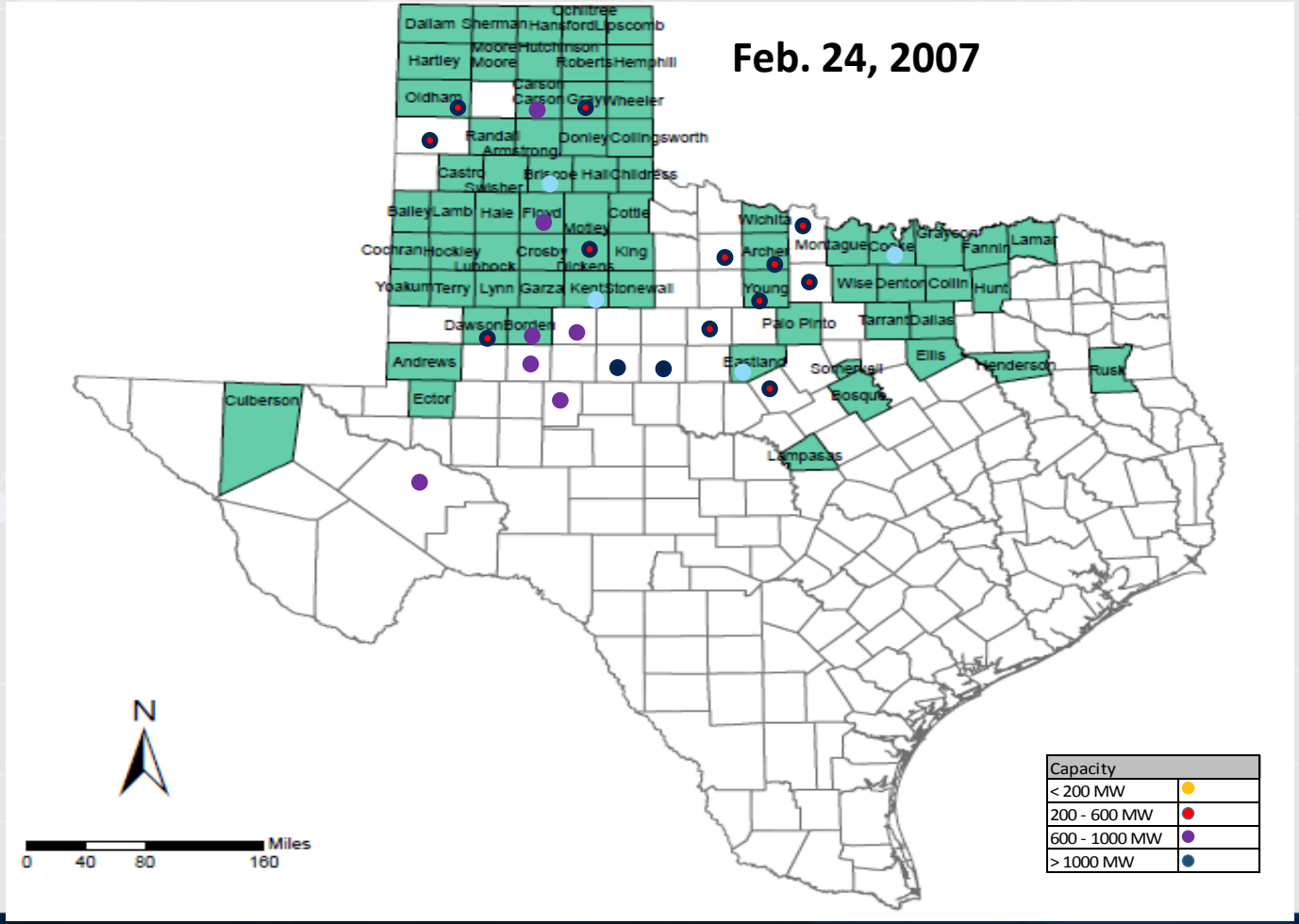
Most if not All Wind Generation in the West would have been impacted

The wide spread event would have impacted all counties within close proximity of the counties reporting.



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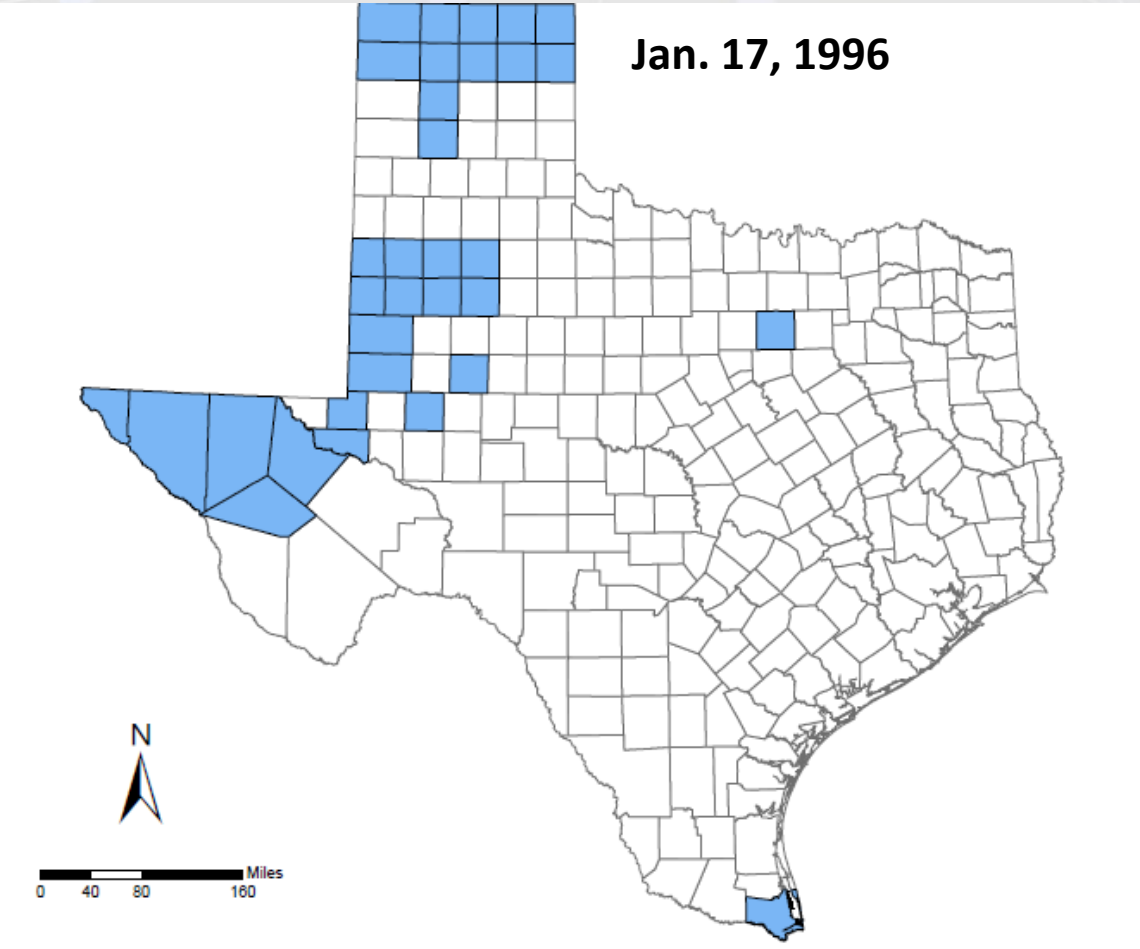
Counties reporting winds greater than 58 mph

Reporting in 1996 was limited due to lack of stations and recording equipment



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Feb. 2007 and Jan 1996 extreme wind events

- Neither wind event was associated with thunderstorms
- Localized high wind events are fairly common across West Texas
- Extreme wind events happen when strong winds from the middle atmosphere are allowed to sink to the surface

Feb. 2007 and Jan 1996 extreme wind events

- Weather models that provide input into wind forecasting models like AWS True wind do fairly well forecasting strong wind events
- Extreme wind events result from a rare setup in the lower and middle atmosphere
- Weather models will generally under-forecast the scale and magnitude of extreme wind events

Conclusion

- ERCOT needs thermal generation to provide ramping capability, inertia and voltage support for the system
  - Load Resources can not provide.
  - Non-Spinning Reserve can not respond quickly enough and is a replacement reserve
- Twice in the last 11 years a weather situation occurred that would likely result in shedding firm load given the current level of West Texas wind generation
  - Extreme wind events result from a rare setup in the lower and middle atmosphere and are very difficult to predict
- Wind forecast variances during periods of low load and reduced thermal generation frequently results in price volatility

The Impact a 2007 Event could have with Today's Level of West Texas Wind

Time	PRC	Total Wind	Online Reserves	Offline Reserves	West/North Wind	South/Houston Wind
12/16/2016 9:00	3,255	12,195	6,118	4,130	11,290	905
12/16/2016 10:00	3,212	11,990	6,413	4,058	11,016	974
12/16/2016 11:00	3,189	11,930	6,412	4,066	10,851	1,079
12/16/2016 12:00	3,460	12,058	7,129	4,106	10,794	1,264

Reserves= [6,118 MWs online + 4,130 MWs offline (30 min) - 11,290 MW West Texas wind]

= **-1,042 MW Reserve deficit.**