

CCET Project Team Meeting Discussion Outline
Wind Integration Challenges that the Discovery Across Texas Project Addresses

1. **Voltage (Grid) Stability** – Wind generation, since it originates with a natural phenomenon, can change rapidly and does not usually match load requirements. The under or over supply of energy can create variations in voltage, which can change rather quickly. Voltage control can be a complex function that operators must manage with a wide range of tools.

DAT components that demonstrate capabilities to address voltage stability:

- a. Synchrophasor system through wide area visualization and real-time monitoring
 - b. The 1MW battery while performing fast response capability
 - c. The Frito Lay aggregated fleet FRRS
 - d. Pricing trial – shifting load involving PEVs which can be a variable load (not done)
2. **Power Flow** – The variability of wind generation, the loads being served and the other sources of generation make it challenging for operators to keep a complex system like ERCOT running efficiently.

DAT components that demonstrate capabilities to address Power Flow:

- a. Synchrophasor system through wide area visibility
 - b. BESS for flattening transients
3. **System Transients** – Wind generators are not synchronous machines and wind speed (therefore energy generated) is constantly changing. Transients can contribute to inefficient operation and instability on a power system. (Wind integration includes both parts)

DAT components that demonstrate capabilities to address System Transients:

- a. Synchrophasor system using wide area visibility
 - b. Synchrophasor system through generator parameter validation or analysis
 - c. Synchrophasor system leveraging frequency response
 - d. Ramping capability of the 1MW BESS
 - e. BESS modeling
 - f. Solar community analysis
 - g. Frito Lay FRRS
4. **Transmission System Planning** – System operators must plan and build a transmission system to reliably and safely deliver the energy needs of all consumers. Wind generation variability adds complexity to the planning process and transmission systems are necessarily built to handle all contingencies. Transmission planning is done years in advance, so the variability in wind generation is a challenge.

DAT components that demonstrate capabilities to address Transmission System Planning:

- a. Potentially all seven components may improve operations through better visibility, faster response capabilities, better understanding of sources of harmonics related to rooftop solar, shifts in load patterns and reliable DLC. These could facilitate improved system planning in the future for interconnections, ancillary services, transformer sizing, etc.
- 5. **Demand Response** – Modern power systems have programs for limited demand control, mainly with large industrial consumers. The variability of wind generation and the challenge to accurately predict wind generation means more DR would be beneficial in getting the most from our wind resources. The timing of DR control is also important so that rapid changes in wind generation can be effectively offset.

DAT components that demonstrate capabilities to address Demand Response:

- a. Pricing programs at PSI – especially PEV off-peak
- b. TXUE DLC dual path
- c. BESS
- 6. **System Condition Visualization** – Wind generation is generally not located near load centers. Changes in wind generation on one side of the state can significantly impact ability to serve load on the other side of the state in addition to making system stability control more challenging. It would be helpful to have a broad view of real time conditions, see changes as they occur throughout the state and have developed actions to mitigate adverse effects of changes in load or generation.

DAT components that demonstrate capabilities to address System Condition Visualization:

- a. Synchrophasor system with simultaneous visibility in TO and ISO control rooms
- b. Synchrophasor system with wide area visualization
- c. Synchrophasor system real-time monitoring and alarming
- d. Synchrophasor system as a back-up to EMS
- 7. **Energy Storage** – Wind generation patterns are inherently different than load patterns, making energy storage a natural fit for modern power systems. Energy storage can also make valuable contributions to wind generation stability, frequency control and buffer ramping due to changes in wind speed.

DAT components that demonstrate capabilities to address Energy Storage opportunities:

- a. 1MW BESS operating in sync with wind turbines
- b. BESS modeling and testing
- c. BESS economic analysis
- d. The Frito Lay aggregated fleet FRRS
- 8. **Wind Forecasting** – The inability to precisely predict wind speeds limits the benefits from wind generation. System operators generally must have reserve generation available since the wind

generation level is, to a degree, uncertain. If the wind could be forecast precisely with a high level of confidence, less reserve generation could be used.

DAT components that demonstrate capabilities to address Wind Forecasting:

- a. Note! ERCOT has recently upgraded their wind forecasting model
 - b. Not directly although the capabilities of weather forecasting improvements and optimal design/operation of wind farms by our TTU/RTC partners provide such
9. **Other Distributed Renewables** – As more solar, geothermal and other renewable sources are connected to modern power systems, the systems become more complex to plan, operate and control. All energy sources become more useful and valuable as they are able to be seamlessly integrated.

DAT components that demonstrate capabilities to address Other Distributed Renewables:

- a. The solar community monitoring at Houston and Austin communities provide improved insight to the challenges from concentrations of rooftop solar
 - b. Pricing programs address distributed renewables
 - c. BESS
 - d. FRRS
10. **Electric Vehicles** – Electric vehicle charging is a natural fit for wind generation supply. The ability to plan charging using wind generation has significant benefits.

DAT components that demonstrate capabilities to address Electric Vehicles:

- a. PEV charging evaluations within pricing trials
 - b. BESS modeling
 - c. BESS
 - d. FRRS (not done, but feasible)
11. **Cyber Security Protection**—Some parts of the electric grid systems could be new sources of potential security threats.

DAT components that demonstrate capabilities to address Cyber Security Protection

- a. SF as applied to the synchrophasor system
- b. Solar community circuit monitoring using IPSEC and distribution protocols
- c. Pricing trial data protection schemes