



ERCOT Update
including DER Status Report

Organization of MISO States

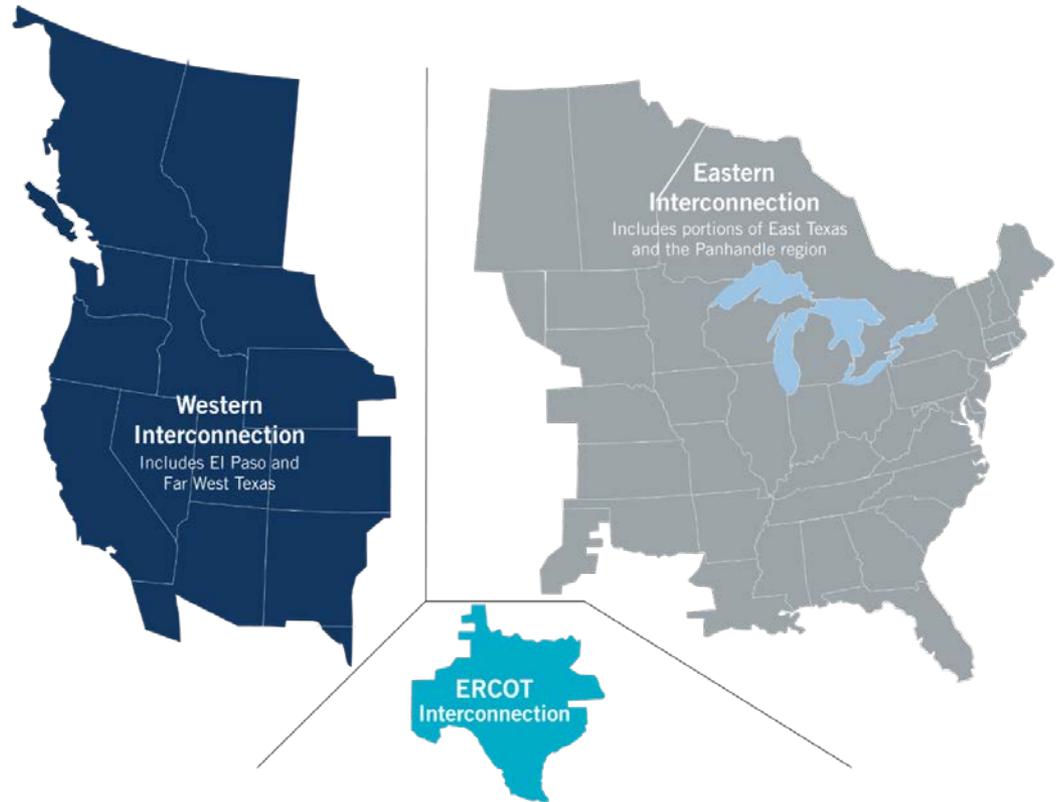
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Market Design & Operations

Oct. 25, 2018

What is ERCOT?

The Texas Legislature restructured the Texas electric market in 1999 and assigned ERCOT four primary responsibilities:

- **System reliability**
- **Competitive wholesale market**
- **Open access to transmission**
- **Competitive retail market**



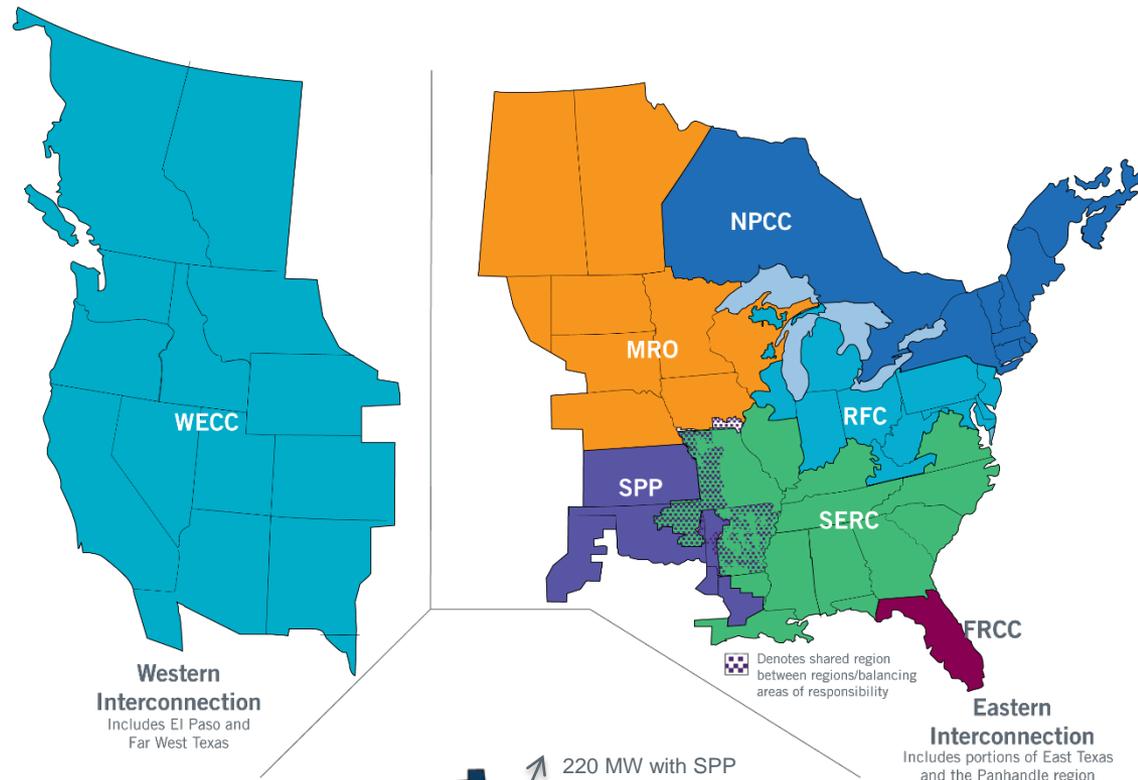
ERCOT is a nonprofit organization and regulated by the Public Utility Commission of Texas, with oversight by the Texas Legislature.

ERCOT is not a market participant and does not own generation or transmission/distribution wires.

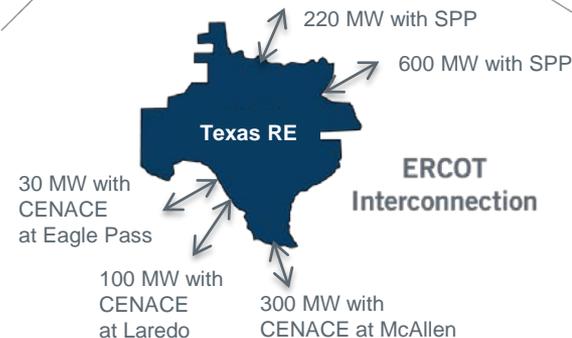
The ERCOT Region

The interconnected electrical system serving most of Texas, with limited external connections

- 90% of Texas electric load; 75% of Texas land
- 73,308 MW peak, July 19, 2018
- More than 46,500 miles of transmission lines
- 570+ generation units

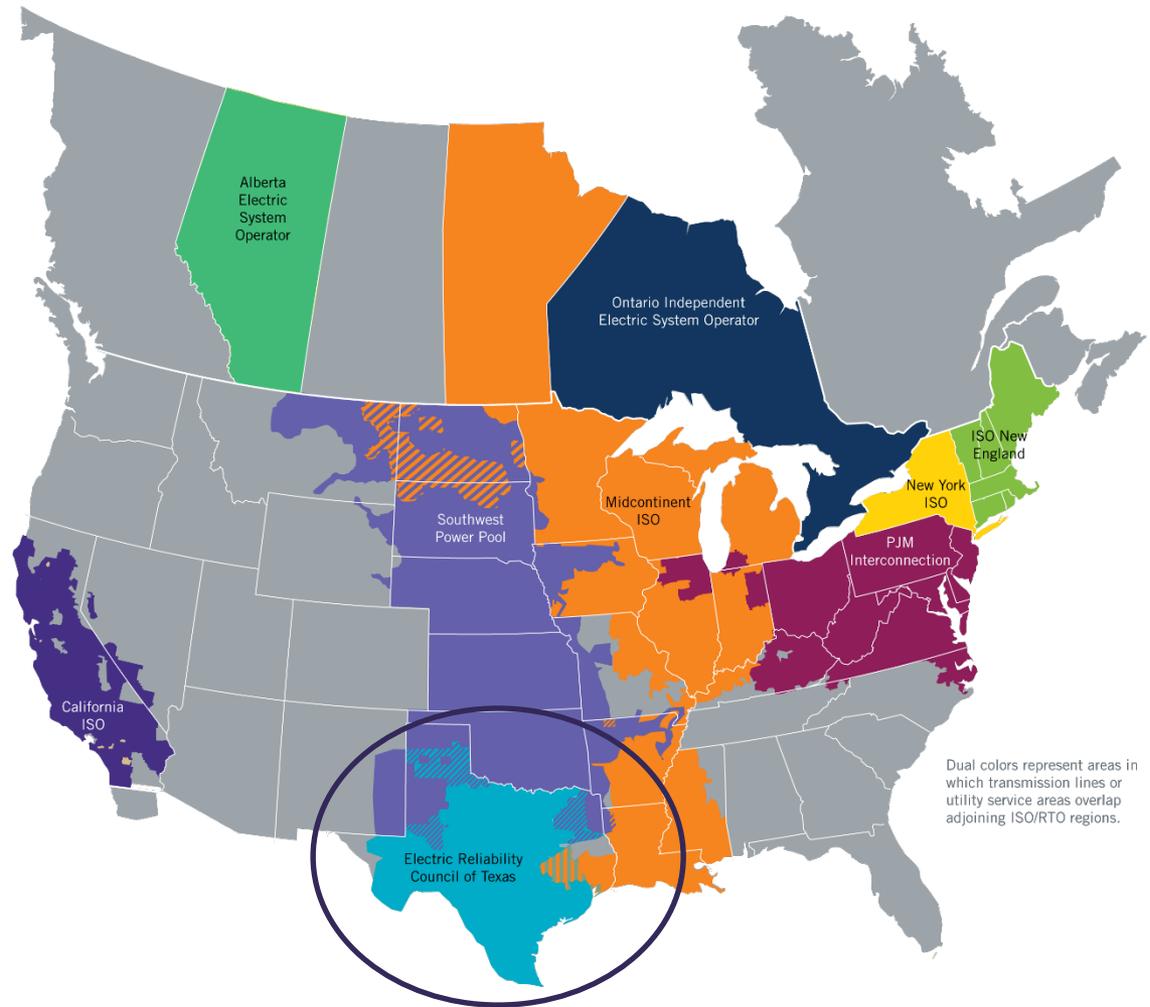


ERCOT connections to other grids are limited to ~1,250 MW of direct current (DC) ties, which allow control over flow of electricity

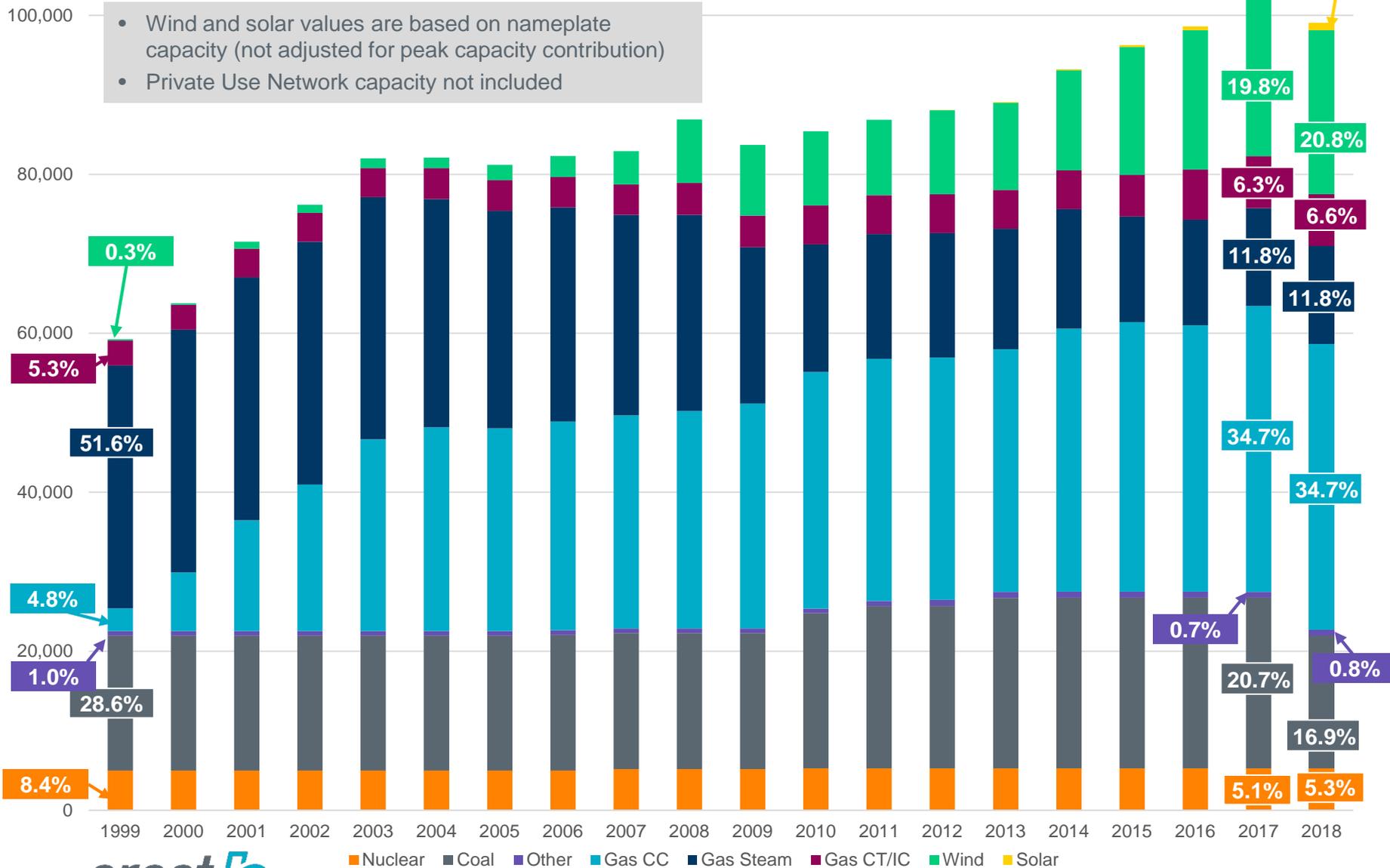


U.S.-Canadian ISOs and RTOs

Independent System Operators and Regional Transmission Organizations are the 'air traffic controllers' of the bulk electric power grids (60kV and up)

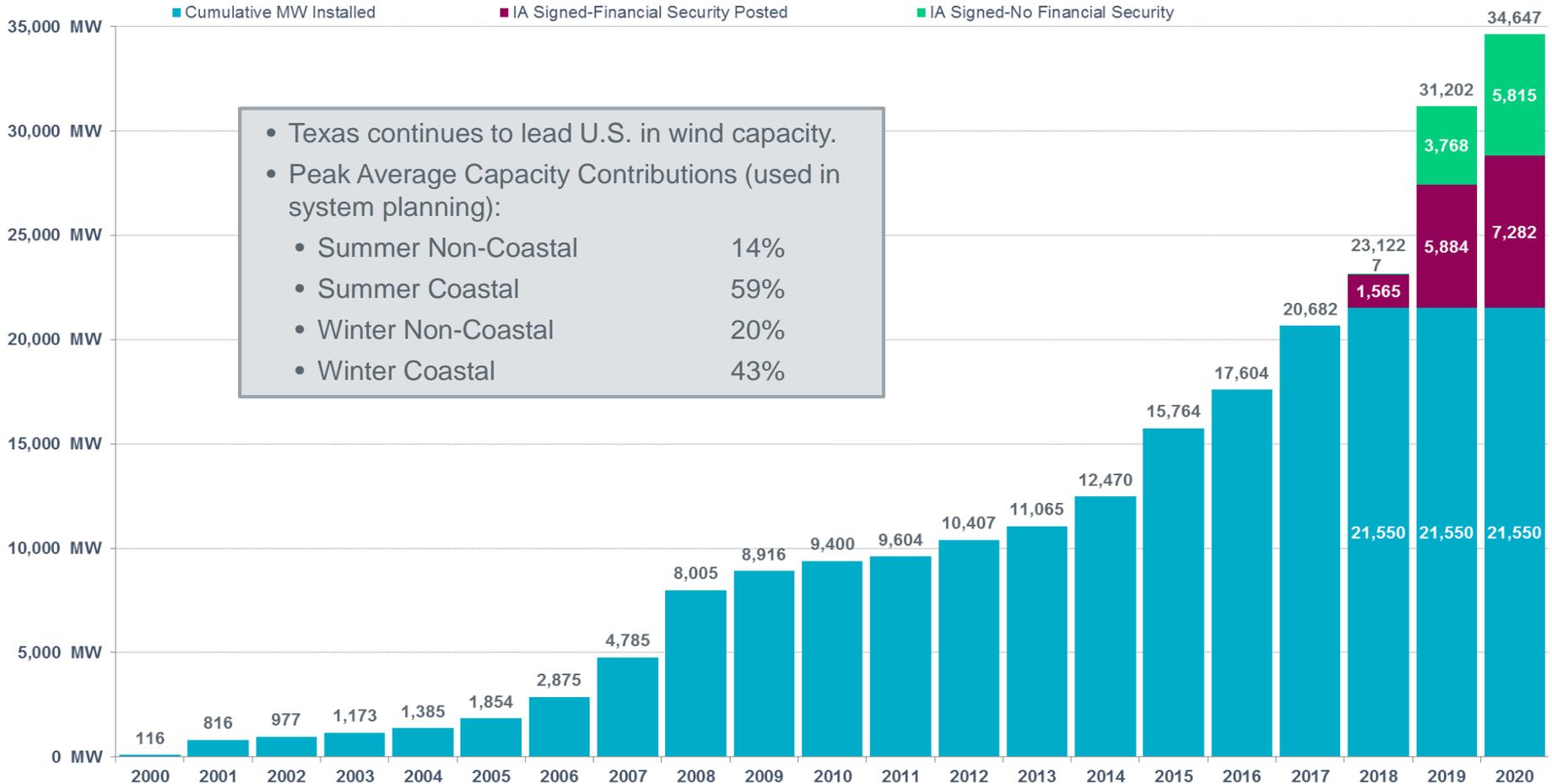


ERCOT Installed Capacity (1999-2018)



Wind Generation Capacity – Sept. 2018

ERCOT Wind Additions by Year (as of Sep 30, 2018)



- Texas continues to lead U.S. in wind capacity.
- Peak Average Capacity Contributions (used in system planning):
 - Summer Non-Coastal 14%
 - Summer Coastal 59%
 - Winter Non-Coastal 20%
 - Winter Coastal 43%

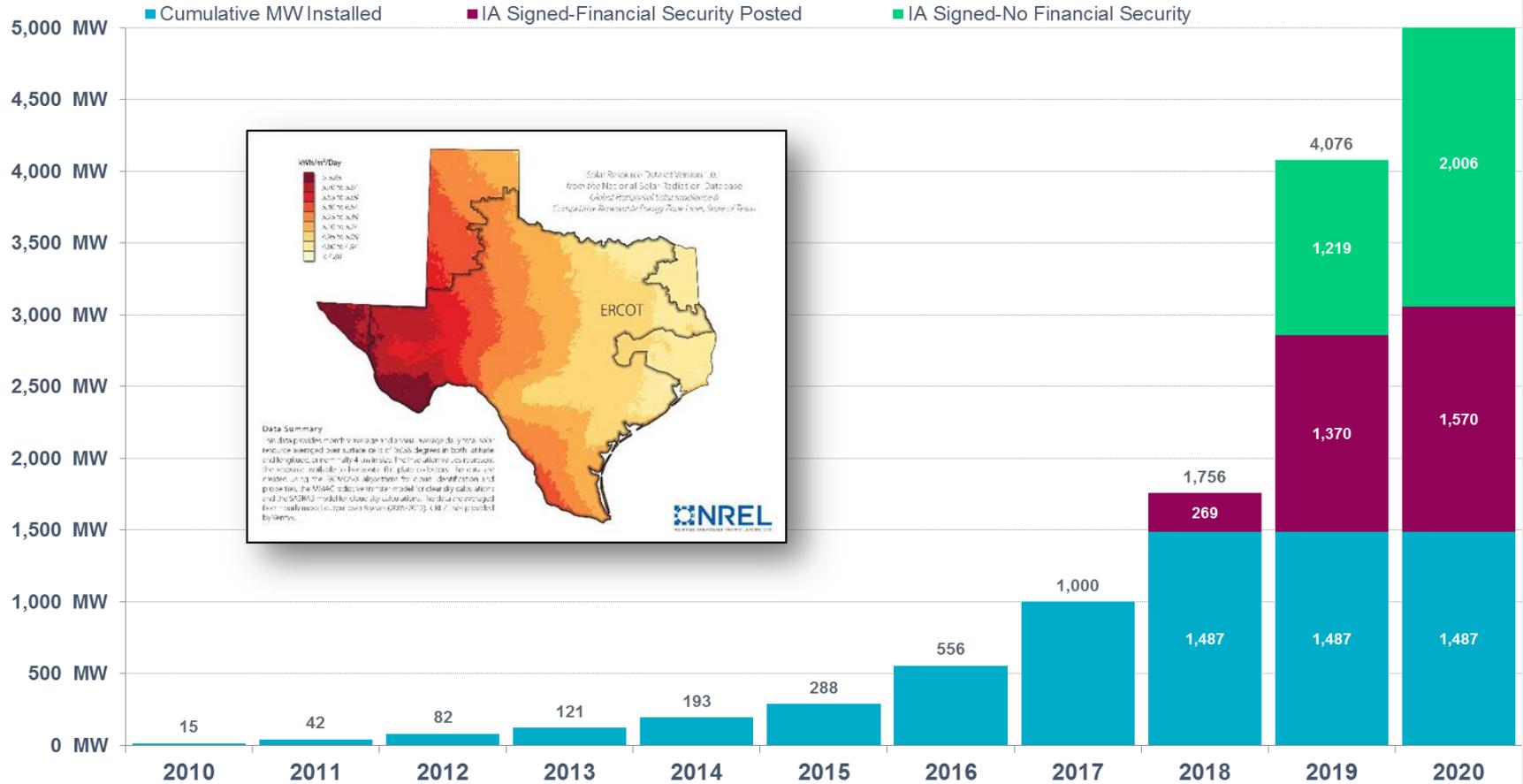
Notes:

- The data presented here is based upon the latest information provided to ERCOT by resource owners and developers and can change without notice.
- Installed capacities are the original nameplate rating of the generation facilities, and do not reflect retirements or rating changes over time due to facility expansions or repowering.
- Installed capacities include only wind facilities that have registered with ERCOT (Those larger than one megawatt and supply power to the ERCOT system.)



Utility Scale Solar Generation Capacity – Sept. 2018

ERCOT Solar Additions by Year (as of Sep 30, 2018)



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ERCOT Market Design

- Original (zonal) market launched Jan. 2002
- Retail competition
 - >55 Retail Electric Providers
 - Limited to Investor-Owned Utility territories
 - Municipally Owned Utilities and Electric Cooperatives may opt in to competition
- Energy-only market design embedded in PUC Rules
 - Scarcity Pricing Mechanism
 - \$9,000/MWh System Wide Offer Cap
- Nodal market design launched in Dec. 2012
 - 8 year, ~\$600M initiative

Advanced Metering

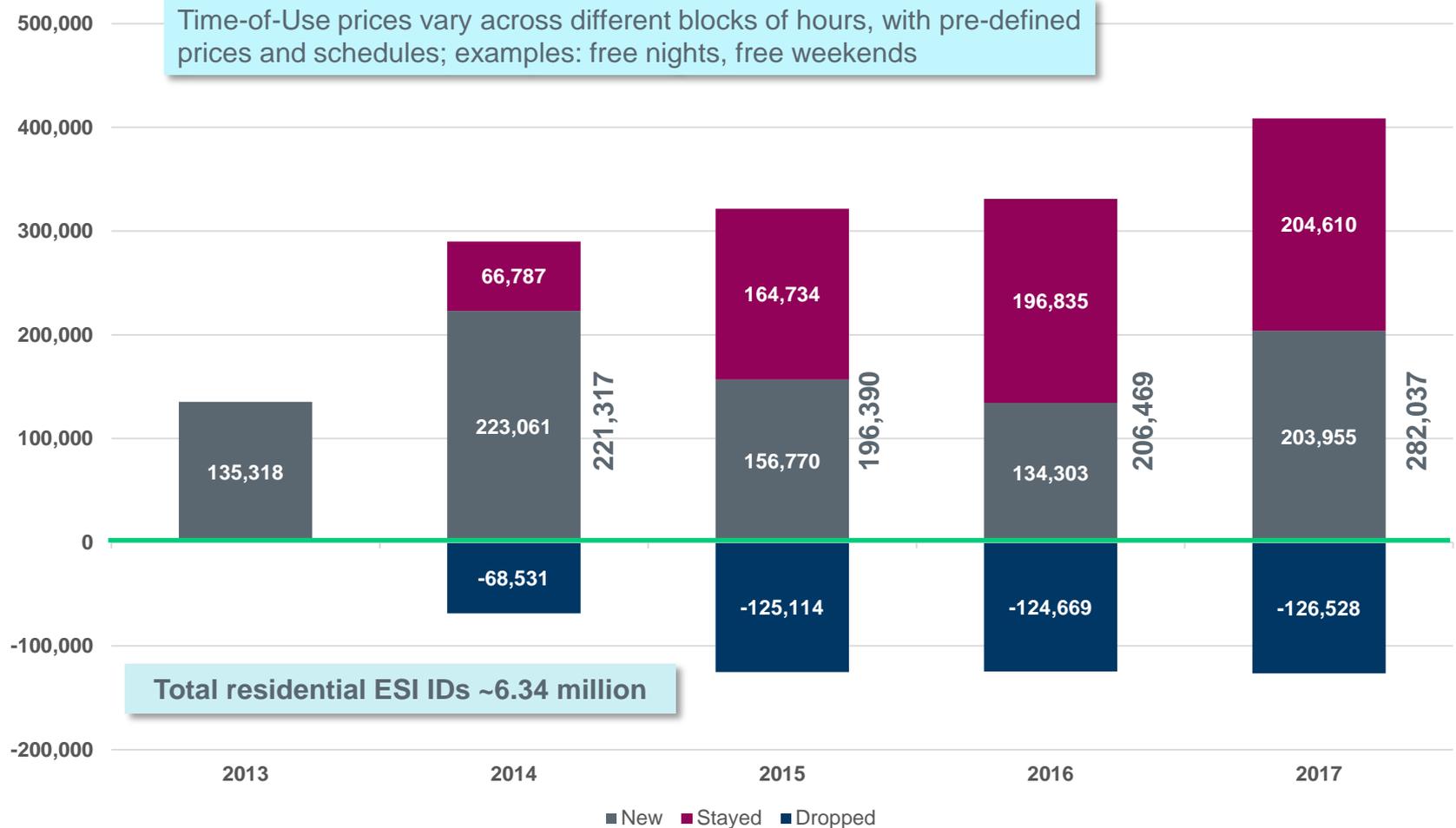


- 2005 Texas legislation enabled TDSPs to receive accelerated cost recovery for Advanced Metering Infrastructure (AMI)
- PUC rule implemented the law in 2007, with goals of providing more customer choice and encouraging dynamic pricing and DR
- Key elements of the rule:
 1. Applies to investor-owned TDSPs only (~75% of ERCOT)
 2. AMI meters must measure consumption in 15-minute intervals

Energy data points per month:	
Pre-AMI:	1
AMI:	2,880

3. Interval data shall be used in wholesale market settlement at the ESI ID level
- Settling customers on their actual usage, rather than profiles, ensures that the benefits of load reductions during a period of high wholesale prices will accrue directly to the REP
 - This gives the REP an incentive proportional to real-time prices, to promote intelligent load management and demand response for its customers
 - ERCOT has worked with REPs since 2013 to collect data on various dynamic pricing products

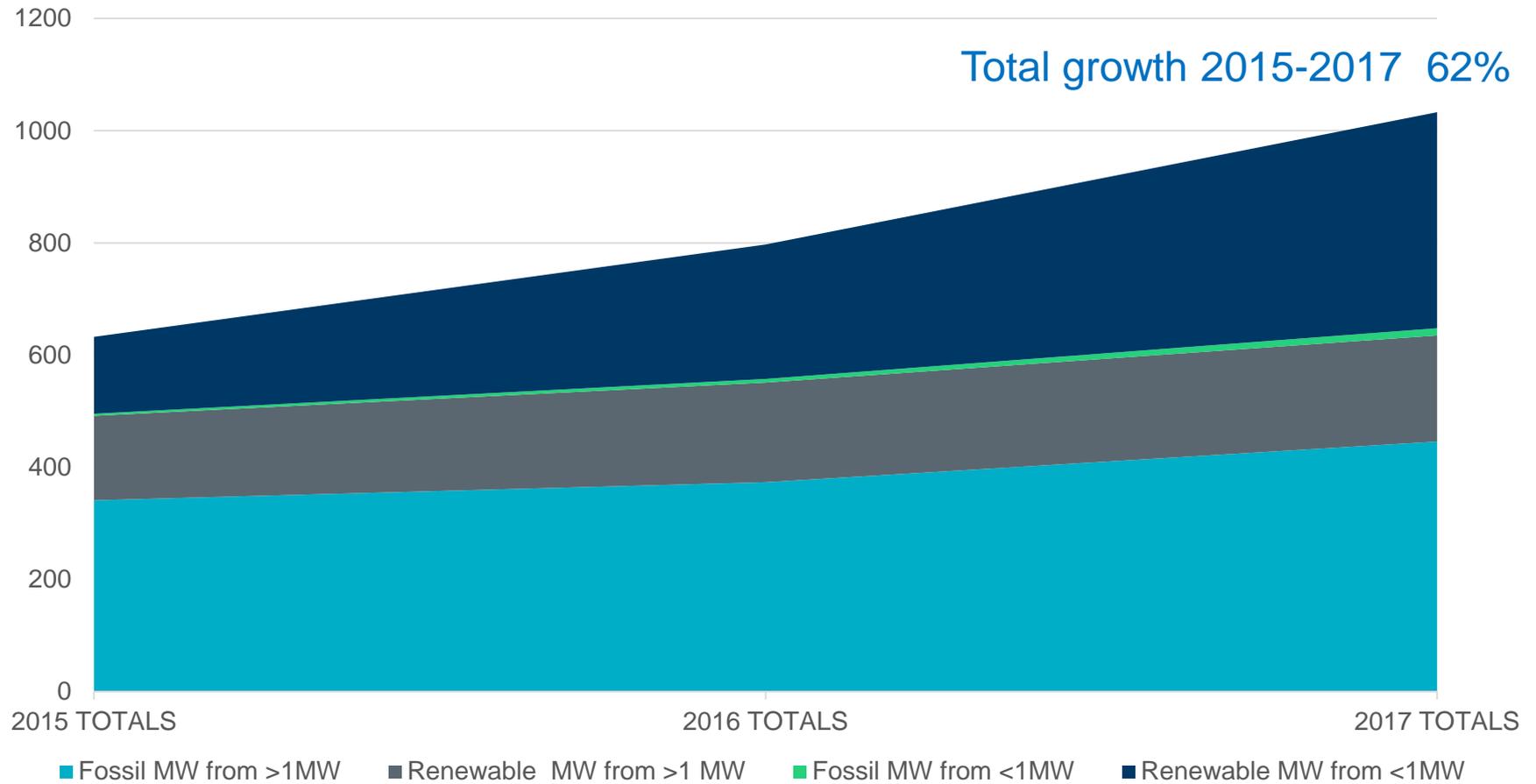
EXAMPLE: Residential Time-of-Use



ESI ID (Electric Service Identifier) is the basic identifier assigned to each Service Delivery Point used in the registration and settlement systems managed by ERCOT (in the vast majority of cases, equates to a meter).

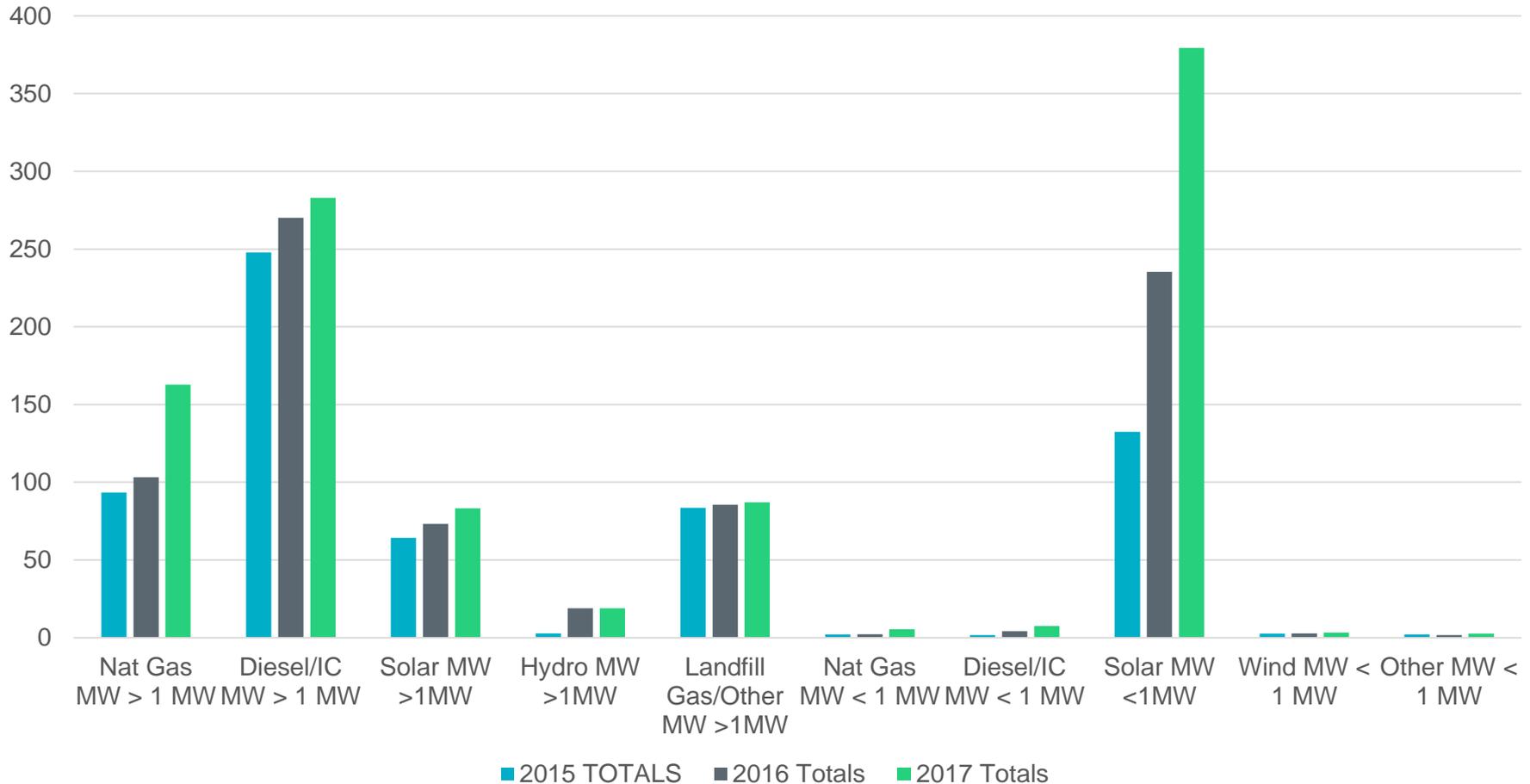


Distributed Energy Resources



Note: This estimate includes *informal* data reporting by many NOIE's as well as excludes generation data *informally* reported by investor owned utilities for generation that would typically be considered backup or emergency generation.

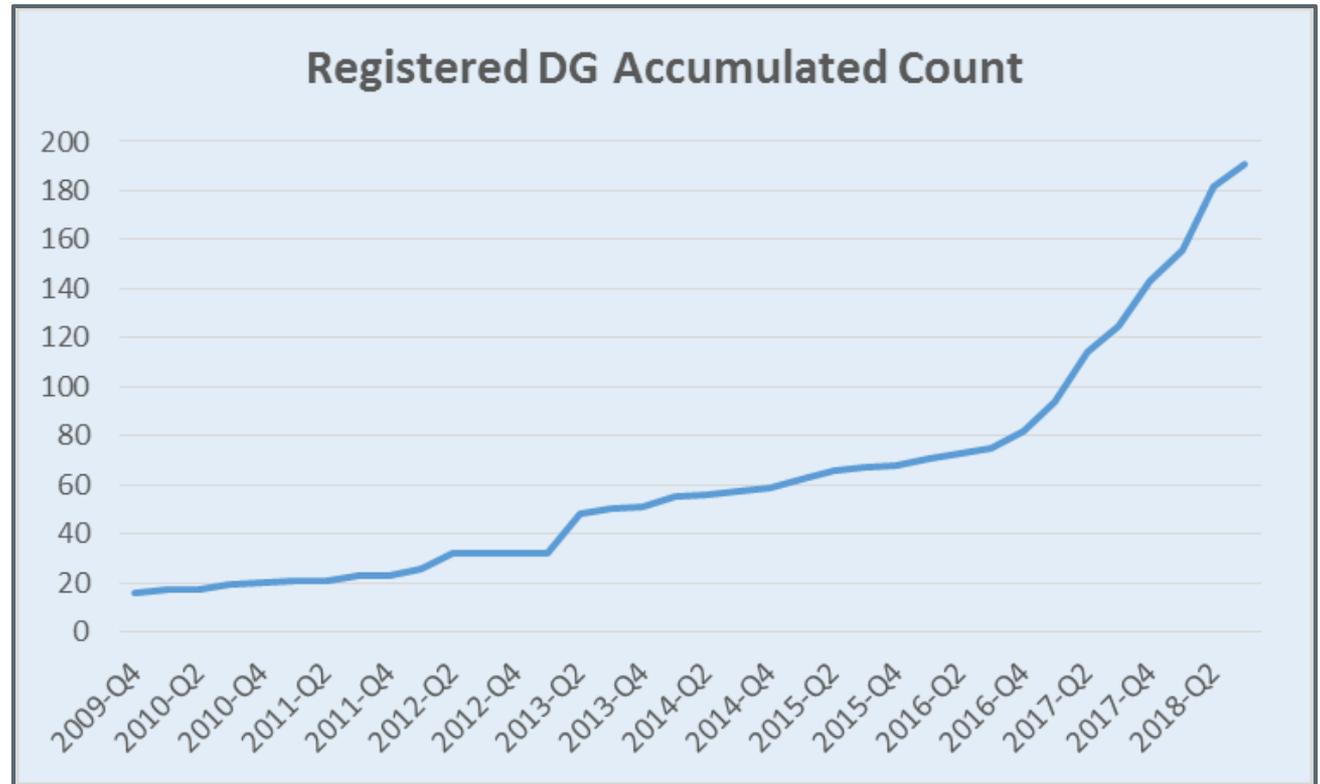
ERCOT Estimated DG Growth by category 2015-2017 (MW)



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Rapid growth in DERs 1-10 MW

- At the time of Nodal Go-live, there were very few registered DGs
 - Registration required if >1 MW and injects to grid
- Over the last few years, the number of registered DGs has increased dramatically
- Majority of MWs are thermal and capable of price response



The Basics: PUC Subst. Rule §25.501

- (f) **Nodal energy prices for resources.** ERCOT shall use nodal energy prices for resources. Nodal energy prices for resources shall be the locational marginal prices, consistent with subsection (e) of this section, resulting from security-constrained, economic dispatch.
- (h) **Zonal energy prices for loads.** ERCOT shall use zonal energy prices for loads that consist of an aggregation of either the individual load node energy prices within each zone or the individual resource node energy prices within each zone. Individual load node or resource node energy prices shall be the locational marginal prices, consistent with subsection (e) of this section, resulting from security-constrained, economic dispatch. ERCOT shall maintain stable zones and shall notify market participants in advance of zonal boundary changes in order that the market participants will have an appropriate amount of time to adjust to the changes.

Why nodal pricing?

- Output levels from generators settled using zonal pricing can create bad market outcomes:
 - Lack of accurate incentive to generate in a Load pocket
 - Lack of accurate incentive to decrease output in a generation pocket
 - Other resources are moved to compensate
 - Load pays for the net excess cost through Load Ratio Share
 - Lack of accurate incentives and disincentives for siting of future generation on the distribution system
- Proliferation of these generators under current rules would effectively revert a significant part of the ERCOT System back to zonal, negating a primary benefit of the nodal system -- congestion management
- **In short, zonal pricing incentives are counter to the nodal market design concept and can adversely affect grid reliability**

Moving these units to nodal pricing

- ERCOT is proposing to change the way Registered DG units are settled
- Method now being implemented to map Registered DGs to transmission grid
 - NPPR 866 to be implemented by 1Q19
 - Improves situational awareness for grid operators
 - Also enables the ISO to assign the correct nodal price to the DG unit
- We are proposing ONLY to change the price signal
- We are not proposing to increase overhead by requiring affected DG units to:
 - Submit COPs
 - Be subject to RUC
 - Submit Outage Schedules

Snapshot of affected units (as of 9/14/18)

Registered DG

Fuel Type	No. of units	MW capacity
Natural Gas	96	150
Diesel	47	321
Solar PV	25	159
Landfill Gas	12	75
Hydro	6	22
Other	6	27
TOTAL	192	753



Exported MWh to grid	
2017	731,907
2018 (thru 8/31)	500,770

Jan. thru June 2018 based on Final Settlement
July-Aug. 2018 based on Initial Settlement

- Emphasis on thermal generation can be attributed to weather: natural gas and diesel units provide backup power to critical infrastructure and key retailers during extreme weather events

Potential DER Reliability Impacts

- ERCOT published a white paper in March 2017 detailing reliability concerns in future scenarios with high DER penetration
- Primary areas of concern:
 - Power Flow and State Estimation (SE)
 - Incorrect handling of energy injection data from distribution circuits may lead to invalid SE results, inaccurate Load Adaptation and hence incorrect Load Distribution Factors (LDFs) in Operational Studies
 - Load Forecast
 - Inaccuracies Short-Term and Mid-Term Load Forecast may lead to excessive dependence on reserves
 - Inaccuracies in forecasting DERs used Long-Term Load Forecast may lead to less than optimal transmission planning decisions
 - Limited reactive power, voltage control, and lacking dynamic response to faults may affect grid reliability during abnormal system disturbances
 - Lack of coordination during system restoration of DER energization following a system blackout may cause power quality issues