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Energy Policy Case Study – Texas: Wind, Markets, and Grid Modernization

September 2016

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U.S. DEPARTMENT OF ENERGY

Prepared for the U.S. Department of Energy
under Contract DE-AC05-76RL01830

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Executive Summary

This document presents a case study of energy policies in Texas related to power system transformation, renewable energy and distributed energy resources (DERs). Texas has experienced a dramatic increase in installed wind capacity, from 116 MW in 2000 to over 15,000 MW in 2015. This achievement was enabled by the designation of Competitive Renewable Energy Zones (CREZs) and new transmission lines that transmit wind to load centers.

The Electric Reliability Council of Texas (ERCOT) operates the competitive, partially deregulated electric market in Texas, which was originally designed to accommodate large, traditional power plants, interconnected to the transmission grid. As a result, ERCOT has been focused recently on large transmission and generation projects, and DERs have had a difficult time participating in the market. This case study focuses on Texas policies and progress in wind development and grid modernization, and highlights nascent efforts to include DERs in the ERCOT market. Distributed energy resources represent a broad range of technologies that can significantly impact how much, and when, electricity is demanded from the grid. In this report, DERs include distributed generation and storage technologies that are more modular than centralized power plants and that reside on a utility's primary distribution system or on the premises of an end-use consumer. DERs also include demand response and other enabling technologies that allow grid operators and consumers to better manage individual and system demand.

With its unique, partially deregulated market and a grid system not interconnected with the rest of the United States, Texas has been allowed to operate differently and autonomously from other states. Where other states are limited by transmission constraints, ERCOT recently completed its CREZ project, which includes 3,600 right-of-way miles of new 345 kV transmission lines that allow significant amounts of wind energy to be moved from west Texas to the load centers in central and east Texas.

With its focus on large-scale wind projects, Texas has very little other DERs, such as solar photovoltaic, but ERCOT and the Public Utility Commission of Texas are recognizing that the inclusion of DERs in the market is inevitable, and even desirable, and are starting to explore how to better accommodate DER in their market-based system. As costs decline and adoption rates increase, ERCOT expects distributed generation to have an increasing effect on grid operations, while bringing potentially valuable new resources to the wholesale markets.

Abbreviations and Acronyms

AMI	advanced metering infrastructure
BTU	British thermal unit
CREZ	Competitive Renewable Energy Zone(s)
DER	distributed energy resources
DREAM	Distributed Resource Energy and Ancillaries Market
EIA	U.S. Energy Information Administration
ERCOT	Electric Reliability Council of Texas
ETWG	Emerging Technologies Working Group
IOU	investor-owned utilities
IRP	integrated resource plan
ISO	independent system operator
kV	kilovolt(s)
kW	kilowatt(s)
kWh	kilowatt-hour(s)
LMP	locational marginal pricing
MW	megawatt(s)
NERC	North American Electric Reliability Corporation
PUCT	Public Utility Commission of Texas
PV	photovoltaic
REC	renewable energy certificate
REP	retail electric provider
RPS	Renewable Portfolio Standard
SPP	Southwest Power Pool
TSP	transmission service provider
WECC	Western Electricity Coordinating Council

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1.0 Texas Grid

The Texas grid system is unique in that it is both partially deregulated and not interconnected with the rest of the grid systems in the United States. This has allowed the state to operate differently and autonomously from other states.

1.1 Isolated Grid

Texas is the only state with its own power grid, as the Electric Reliability Council of Texas (ERCOT) grid does not interconnect with the neighboring Western Electricity Coordinating Council (WECC) and Southwest Power Pool (SPP) grids.

Some parts of Texas—El Paso, the upper Panhandle, and part of east Texas—are not included in ERCOT, as best shown by Figure 1. This is likely because the other utilities' service territories overlap with Texas or these locations are remote (e.g., the Panhandle is closer to Kansas than to Dallas) (Galbraith 2011).

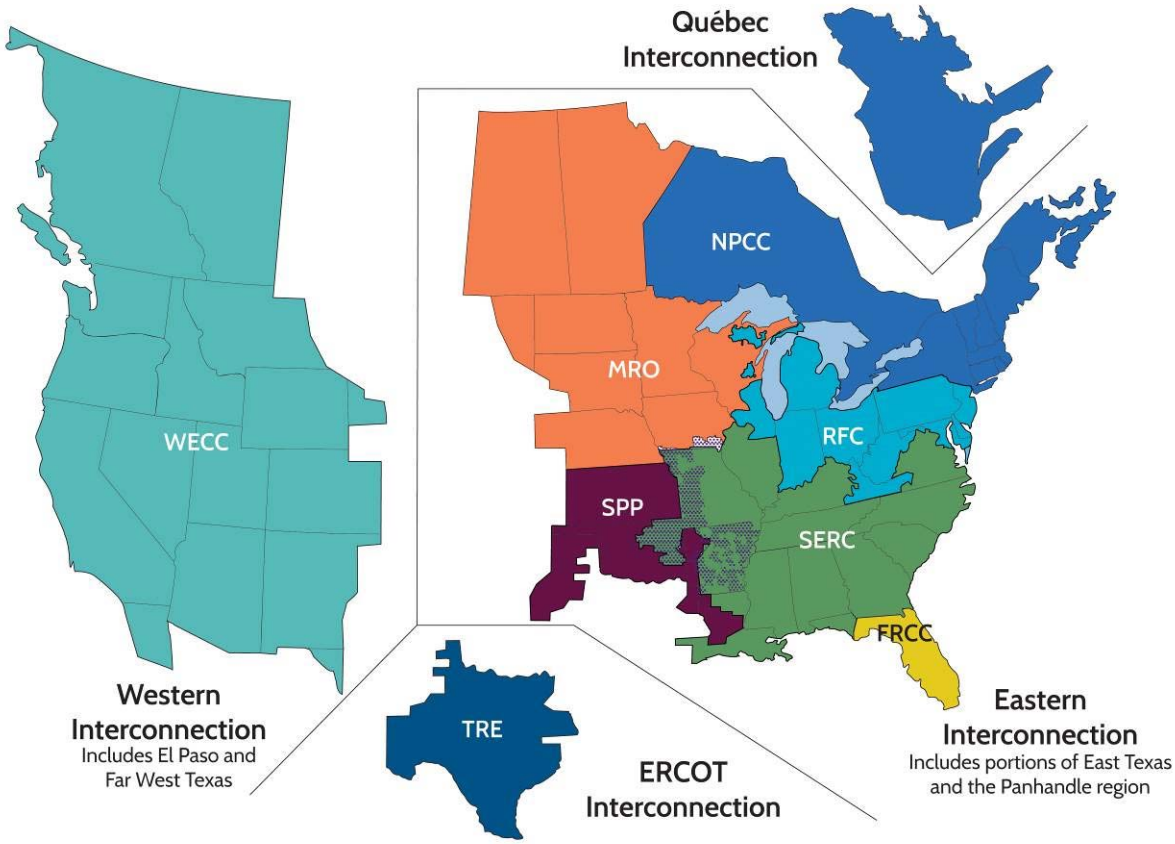

Figure 1. North American Electric Reliability Corporation (NERC) Interconnections Map (ERCOT 2015a)

1.2 Regulatory Oversight

ERCOT is primarily regulated by the Public Utility Commission of Texas (PUCT) and the Texas Legislature, not by federal authorities. However, for federal reliability standards, ERCOT is accountable to the Texas Reliability Entity Inc., the North American Electric Reliability Corporation (NERC), and the Federal Energy Regulatory Commission (FERC).

ERCOT is the corporation that administers and maintains the reliability of the state's electrical power grid. With respect to its internal oversight, each of the industry segments—investor-owned utilities (IOUs), municipally owned utilities, cooperatives, generators, power marketers, and retail electric providers—are represented on ERCOT's board.

1.2.1 Texas Legislature

In 1975, the Texas Legislature enacted the Public Utility Regulatory Act (PURA) and created the PUCT to provide statewide regulation of the rates and services of electric and telecommunications utilities (PUCT 2016a). The state Renewable Portfolio Standard (RPS) was implemented by the PUCT based on a bill enacted by the Texas State Legislature as part of an electricity market restructuring in Texas in 1999. Similarly, the Texas Energy Efficiency Resource Standard was a state senate bill implemented by the PUCT.

1.2.2 Public Utility Commission of Texas

The PUCT regulates the state's electric, telecommunication, and water and sewer utilities; implements respective legislation; and offers customer assistance in resolving consumer complaints. With the restructuring of the electric market in Texas in 1999, the PUCT's mission and focus shifted from regulation of rates and services to oversight of competitive markets and compliance enforcement of statutes and rules for the electric and telecommunication industries.

1.3 Deregulated Market

In 1999, the Texas Legislature restructured the Texas electricity market by creating retail customer choice in the areas that had previously only been served by IOUs. As a result, Texas is a partially deregulated state. Most of the areas in Texas without electric competition are served by municipal utilities, such as Austin Energy, or electric cooperatives. Other areas do not have a competitive retail market because the PUCT has determined there is not enough competition in the wholesale market to support a successful retail market (TEC 2011).

There is a strict separation between generators, utilities, and retail energy providers that do business with customers. For example, until 2003 aggregators were prohibited from having affiliations with retail electric providers (REPs). Now they must simply disclose any relationships with REPs (PUCT 2016b).

The deregulated structure has created a customer choice market with hundreds of different electricity plans from which to choose; the PUCT provides a website, Power to Choose (powertochoose.org), to help end-users sort through all the options. Customers can sort options by price, contract length, type of rate (i.e., fixed, variable, or indexed), how much renewable energy is included in the plan, and other factors. The REPs must disclose how much of the renewable content is provided from in-state generation, as the amounts vary, and the renewable energy may be in the form of renewable energy certificates (RECs), which are the environmental attributes of renewable energy that can be purchased separately from the

actual energy generation. The facilities from which RECs can be purchased can be within or outside of Texas. There is discussion and debate nationally about the extent to which REC purchases foster the development of new renewable energy resources. As such, selecting an energy plan with renewable energy content does not necessarily translate to construction of new renewable energy generation projects in the state— distributed or otherwise.

1.3.1 Market Players

Ninety percent of the Texas electricity load is provided by ERCOT, the corporation that administers and maintains the reliability of the state's electrical power grid. Within ERCOT, there are 24 million customers, more than 46,500 circuit miles of transmission lines, and more than 550 generating facilities (ERCOT 2016a). The 2015 installed generation capacity was 53% natural gas, 22% coal, 18% wind, 6% nuclear, and 1% hydro, solar, and biomass (ERCOT 2016a).

According to the PUCT, there are 295 aggregators,[1] 312 power generation companies, 66 self-generators, 146 REPs, 14 IOUs, 67 transmission and distribution utilities,[2] 77 municipally owned utilities,74 electric cooperatives, and four river authorities currently doing business in Texas (PUCT 2016a).

1.3.2 Energy Purchasing (Time-Varying Pricing)

Energy within ERCOT is purchased both at day-ahead market prices and at real-time market prices based on locational marginal pricing (LMP). Locational marginal pricing is the cost (pricing) to serve the next increment of load (marginal) at an electrical bus (locational). This pricing can shift over the course of a day, and varies across the state depending on locational demand and transmission congestion; it can be tracked online at ERCOT's website.

1.4 Competitive Renewable Energy Zones and Transmission

The concept of Competitive Renewable Energy Zones (CREZs) in Texas was introduced in 2005 by the Texas State Legislature as a proactive means to alleviate grid congestion and to meet the state's renewable energy goals (Oncor 2012). CREZs are designated geographical areas where renewable energy resources and land availability coincide to provide significant potential for renewable energy project development. The Texas Legislature then passed Senate Bill 20, instructing the PUCT to build new transmission lines to transfer the electricity from generation projects in the five newly designated CREZs to the load centers in other parts of the state.

These five zones were created in the Panhandle and in central and west Texas where the wind resource is the strongest. However, the majority of energy demand comes from load centers in the central and eastern parts of the state. The transmission lines allow the large amounts of wind generation to be moved to the load centers, thereby alleviating curtailment of wind projects and unlocking transmission congestion (Del Franco 2013, Lasher 2014). Figure 2 shows the CREZs and the new transmission lines color coded by transmission service provider (TSP) with population densities color coded in shades of orange.

[1] An aggregator is a buyer's agent that joins customers together as a single purchasing unit and negotiates on their behalf for the purchase of electricity service in Texas.

[2] Transmission and distribution utilities, also called transmission service providers, are the local wires companies who are responsible for the actual delivery of electricity over poles and wires to customers.

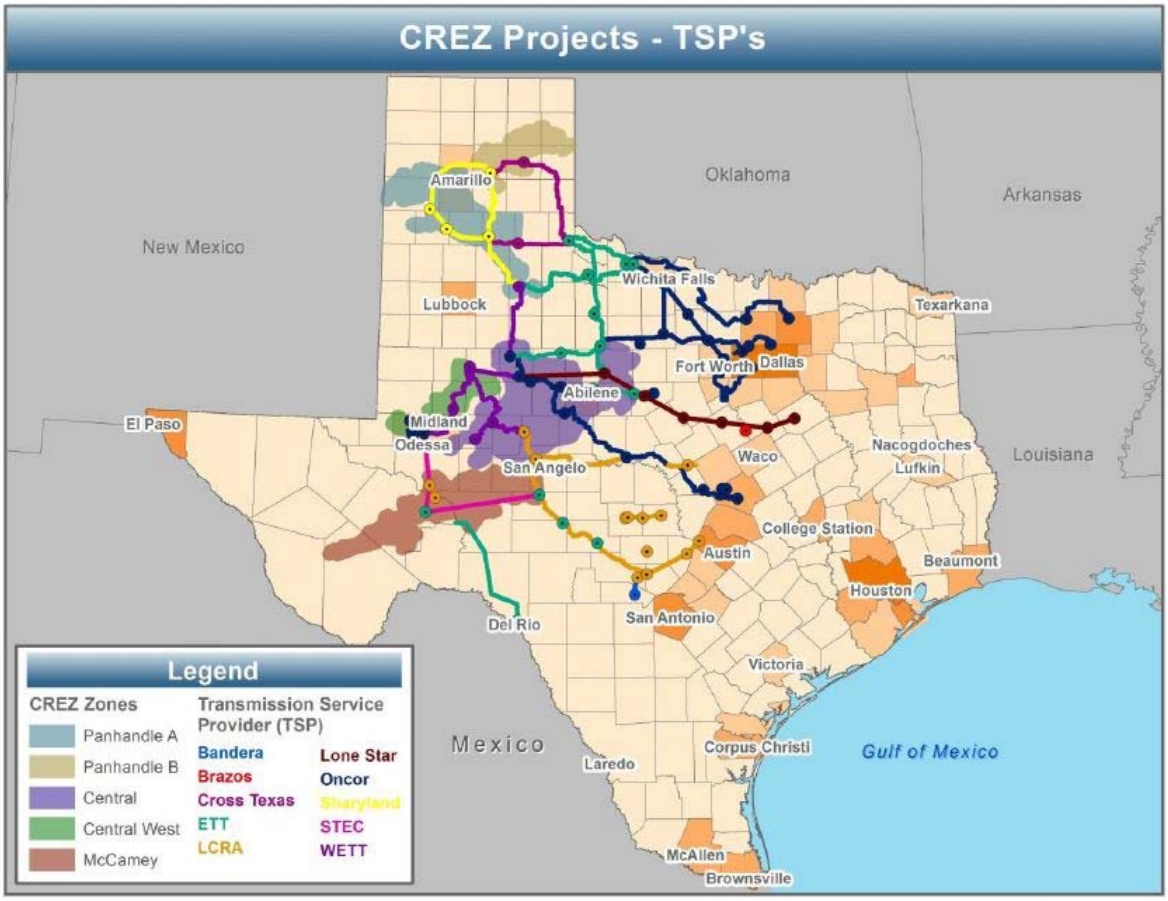

Figure 2. CREZ Map (Lasher 2014)

The 3,600 right-of-way miles of 345 kV transmission lines, costing $6.9 billion, are open to all interconnected generation projects, not just wind. The CREZ project has enabled installed wind capacity in the state to increase from 1,854 MW in 2005 to 15,764 MW in 2015 (ERCOT 2016b).

Some of the factors behind the success of this project are that there are few barriers to land development in west Texas because the population is sparse and the geographic scope of ERCOT (i.e., all within Texas) enables easier regional planning (Lasher 2014). Texas is not the only state that has pursued new transmission projects, but these other projects, particularly those that cross state lines, are typically slowed considerably by differing federal and state regulations, which do not apply to ERCOT.

While the transmission projects are complete, ERCOT is now considering upgrades and new ancillary services to maintain and improve system stability, particularly stabilizing the voltage along the long transmission lines. These stability challenges are especially prominent in the Panhandle area, which is considered a weak grid (Husch Blackwell 2014).

One way to address stability problems due to long transmission lines is to add generators or other electrical devices, such as capacitors and reactors, at strategic locations along the circuit to electrically bring the remote generator (or load) closer to the rest of the system (Del Franco 2013).

2.0 Energy Landscape

This section provides context and describes the overall energy and energy policy landscape in Texas. The energy landscape impacts policies, and vice versa, which in turn impact power system transformation in the state.

By area, Texas is the second largest state in the United States, behind Alaska. It is ranked second in terms of population, behind California, with more than 27 million residents (U.S. Census Bureau 2015). Population grew 7.2% from 2010 to 2014, and is expected to double from 27 million by 2050. On August 10, 2015, high summer temperatures plus population growth resulted in a new hourly peak record for ERCOT of more than 69,000 MW of demand for three consecutive hours (Kleckner 2015).

Texas's per capita energy usage is high. As of 2013, Texas ranked sixth in the nation with a per capita energy consumption rate of 488 million BTU (EIA 2016a). The average electricity consumption per Texas home is 26% higher than the national average (EIA 2009).

According to the U.S. Energy Information Administration (EIA), the average retail residential electric rate in Texas as of April, 2016, was 11.28¢/kWh with 7.74¢/kWh being the overall rate for all sectors (residential, commercial, industrial, and transportation) (EIA 2016b). For the same month, the national average retail residential price of electricity was 12.43¢/kWh and 9.81¢/kWh for all sectors.

ERCOT has been focused on building out its competitive energy market and transmission system. But with a growing state population, high energy use by residents, and moderate electricity costs, ERCOT is starting to consider the role distributed energy resources (DERs) play in the market.

2.1 Distributed Energy Resources

ERCOT operates a competitive electric market, originally designed to accommodate large, traditional power plants interconnected to the transmission grid. The market was constructed before current DER technologies were widely available. Therefore, DERs have had a difficult time participating in the market (SPEER 2016). With its emphasis on moving substantial amounts of electricity over great distances, ERCOT does not manage distribution grid systems. This is the responsibility of the transmission and distribution utilities. By definition, distributed generation projects are connected to the distribution system at lower voltages than the bulk power grid operated and managed by ERCOT (ERCOT 2016b). In addition, the ERCOT market is for energy only, meaning payments are only made for energy actually generated and consumed. Other markets have capacity markets, which pay generators to be available (SPEER 2016), which ERCOT does not, another current limitation for the integration of DERs in ERCOT.

While there is a limited amount of DERs in Texas now, ERCOT does see growth in the future with potential for more rooftop solar photovoltaic (PV), batteries, and natural gas backup generators (Greentech Media 2015). As costs decline and adoption rates increase, ERCOT expects distributed generation to have an increasing effect on grid operations, while bringing potentially valuable new resources to the wholesale markets. Some market players within ERCOT, such as transmission and distribution utilities, are taking actions with advanced metering and trying to address interconnection issues for distributed generation, as described below.

2.1.1 Penetration of Distributed Energy Resources

According to the EIA definitions, 287 MW of renewable energy generation and storage capacity in Texas was classified as distributed as of 2014 (EIA 2016c). This is an insignificant amount compared to ERCOT's 77,000 MW of expected available generation capacity for summer peak demand (ERCOT 2016b). Based on a population of roughly 27 million, this translates to a renewable distributed generation penetration rate of 0.01 kW per person.

2.1.2 Penetration of Advanced Metering Infrastructure

Advanced metering infrastructure (AMI) supports enhanced outage detection, remote electric meter reading, time of use rates and a more detailed understanding of customer usage patterns which allows for targeted energy efficiency and demand response programs (Wood 2006; EPRI 2007). AMI is a key part of an intelligent and responsive power system.

Table 1 shows the number of AMI meters installed in Texas as reported through the EIA.

Table 1. Penetration of AMI Meters in Texas in 2014 (Source: EIA Form 861)

	Residential	Commercial	Industrial	Total
AMI Meters	7,068,371	1,056,071	32,608	8,157,050
Total Meters	10,100,690	1,469,452	107,969	11,678,686
% AMI Meters	70%	72%	30%	70%

Although there is no statewide mandate in Texas requiring AMI metering infrastructure, Texas has a high penetration rate, suggesting AMI metering and time of use pricing programs are priorities for Texas utilities. One transmission and distribution utility, Oncor, has an advanced meter system that provides 15 minute interval data and allows the utility to make on-demand meter reads and remotely disconnect meters to support the deregulated electric market in Oncor's territory (Carpenter 2016). According to the Texas Office of Public Utility Counsel, "advanced meters have enabled residential customers to participate in demand-response programs, to use energy efficiency devices to control when and how they consume electricity, and to choose from a greater array of innovative product and pricing offerings including time of use products" (Baer 2016).

2.1.1 SPEER Activities

The mission of the South-central Partnership for Energy Efficiency as a Resource (SPEER) is to accelerate the adoption of advanced building systems and energy efficient products and services in the south-central United States (SPEER 2016). The organization has been involved in ERCOT's DREAM Task Force, described below, hosted distributed energy resource workshops and working groups, and published several whitepapers on DERs.

2.1.2 ERCOT Activities

ERCOT has an Emerging Technologies Working Group (ETWG) and a Distributed Resource Energy and Ancillaries Market (DREAM) Task Force. The ETWG provides ERCOT's Wholesale Market Subcommittee with input and recommendations on protocols that could limit the market participation of

emerging technologies and propose new or changed protocols that would instead allow greater market participation (ERCOT 2016c).

ERCOT's 2015 State of the Grid Report (ERCOT 2016b) states the following:

> As the ISO for its region, ERCOT currently has limited visibility into the distribution system, and the market structure needed to integrate these resources is largely undeveloped. Improved access to DER data, combined with increased opportunities for DERs to participate in the ERCOT wholesale markets, will be key to successful integration of these growing resources in the future. During 2015, a special ERCOT stakeholder engagement group—the Distributed Resource Energy and Ancillaries Market, or DREAM, task force—explored many policy and technical issues associated with introducing this next generation of resources to the ERCOT competitive wholesale market. In 2016, stakeholders and ERCOT staff will continue to explore the issues and possibilities those discussions identified. ERCOT will continue looking to the future to make sure the market is prepared to keep the grid reliable while also tapping the market potential for these emerging resources.

Per a subsequent draft report from the DREAM Task Force, some of the issues the task force is addressing are how to include DERs in congestion revenue rights markets, what provisions for aggregations would be needed, and how to account for outages of DERs (ERCOT 2016d). Standardizing interconnection is also an issue. The interconnection process for larger systems to the transmission system is handled by ERCOT directly and uniformly, but distributed generation is interconnected by each distribution utility with its own process (SPEER 2016).

In August 2015, ERCOT staff submitted a concept paper on DERs in the ERCOT region (ERCOT 2015b) to the DREAM Task Force. The concept paper makes the case for targeted data collection to support future DER penetration and a new market framework to accommodate DERs effectively and efficiently. These are the DER Minimal, DER Light, and DER Heavy scenarios, which are described below. These new market scenarios could create strong incentives for small-scale energy resources, but with increased real-time data measuring and reporting requirements (Greentech Media 2015).

2.1.3 DER Market Potential

ERCOT is considering the possibility of allowing DERs, particularly solar PV, to be aggregated and located in places where it is more costly to deliver power to end consumers (Greentech Media 2015), such as rural locations that may need higher-voltage, but also higher-cost, distribution lines because of the longer distances between customers. The aggregated DERs could be paid a wholesale price for the energy they export to the grid, or even play a role in ERCOT's energy and ancillary services markets (Greentech Media 2015). While not on equal footing with full net metering, aggregated DERs in higher-priced parts of the grid system could generate significant revenue.

In line with ERCOT's operating philosophy and deregulated energy environment, this is not a mandated DER plan, but an attempt to create a market for DERs. ERCOT is considering three potential, non-mutually exclusive, scenarios: DER Minimal, DER Light, and DER Heavy.

DER Minimal is essentially business as usual. There is no mechanism currently in place for linking DER payments to LMP (Greentech Media 2015). Under DER Minimal, a DER is simply paid based on the Load Zone Settlement Point price—the average price for the state load zone in which the DER is sited. Using load zone average pricing reduces the value of placing distributed generation in places where it could be beneficial to grid operations.

The DER Light scenario would allow aggregated DERs to be paid LMP for the energy exported to the grid (Greentech Media 2015). This price could be higher or lower than the load zone average price, but using LMP instead ties the value of the electricity from the DER to its value for the local grid. This scenario would require separate (dual) metering for generation and native load and telemetry and real-time or near-real-time information. In this scenario, DERs would not be eligible for the ancillary services market.

The DER Heavy scenario expands DER Light by allowing DERs to participate in the energy and ancillary services markets. These markets offer the potential for more lucrative payments for resources that can respond to changing grid conditions and would require the DER to be treated like a large power plant generator (Greentech Media 2015). An aggregated set of DERs could respond as a single unit when needed.

These changes could provide market opportunities for REPs, independent DER project developers, and, possibly, individual customers. The Light and Heavy scenarios would require additional costs for DERs with respect to metering technology and other requirements, but would allow DERs to participate in the more lucrative energy and ancillary markets.

2.2 Energy Generation Mix

This section of the report describes ERCOT's energy resource portfolio, recent changes to it, and future anticipated changes.

2.2.1 Past Changes to Energy Generation Mix

The most notable change to ERCOT's energy generation mix has been the dramatic increase in installed wind capacity, from 116 MW in 2000 to over 15,000 MW in 2015. This achievement was enabled by the designation of CREZs described previously and the new transmission lines that transmit wind to load centers. Solar capacity has not increased as significantly as wind, as described in more detail in Section 2.2.6. More recently, less energy is being supplied from coal resources, replaced by natural gas resources, likely as a result of declining natural gas prices in recent years (Friedman 2015).

2.2.2 Current Energy Generation Mix

Figure 3 shows ERCOT's generation capacity portfolio as of the end of 2015.

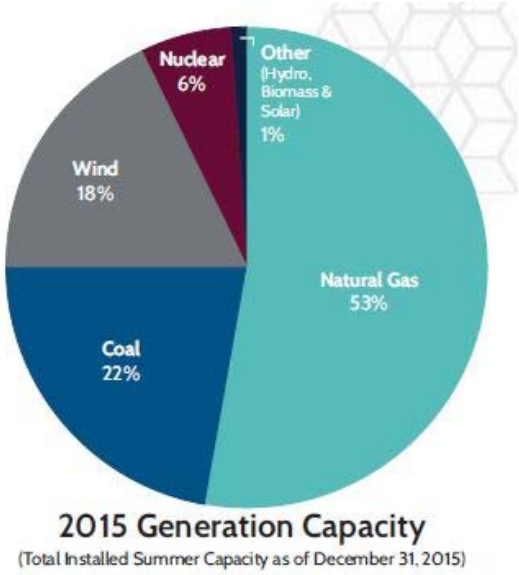

Figure 3. ERCOT's 2015 Generation Capacity Portfolio (ERCOT 2016a)

2.2.3 Coal

As of the end of 2015, coal represented 22% of ERCOT's installed generation capacity and provided more than 97 million MWh of energy in 2015 (ERCOT 2016a), 28% of ERCOT's 2015 energy use. This is in contrast to 2011 when coal represented 39% of ERCOT's energy use.

2.2.4 Natural Gas

Natural gas makes up the majority of ERCOT's generation capacity at 53%, and provided more than 167 million MWh of energy (48% of energy use) in 2015 (ERCOT 2016a). Natural gas's contribution to ERCOT's portfolio has grown from 40% of energy use in 2011; the increase in natural gas usage displaces coal usage.

2.2.5 Nuclear Energy

Nuclear energy represents 6% of ERCOT's generation capacity and provided more than 39 million MWh of energy (11% of energy use) in 2015 (ERCOT 2016a). Nuclear energy use has stayed fairly consistent since 2011 when it provided 12% of ERCOT's energy use.

2.2.6 Renewable Energy

Renewable energy installations in Texas are dominated by large-scale wind energy projects. As of the end of 2015, wind accounted for 18% of ERCOT's installed generation capacity, with 15,764 MW, and provided more than 40 million MWh of energy in 2015. In 2000, there were just 116 MW of installed wind capacity in Texas (ERCOT 2016b). In 2011, wind represented 8.5% of ERCOT's energy use, compared to 11.7% in 2015.

The amount of wind generation Texas can produce in one day is increasing. In September 2015, ERCOT achieved 11,467 MW of wind generation in one day. This record was broken on Feb. 18, 2016, with 14,023 MW (ERCOT 2016a).

Other renewable energy resources are far less developed in comparison. ERCOT records 288 MW of solar PV installed at the end of 2015, although more is expected in the future, and this is an increase over the 15 MW of capacity installed as of 2010. The Solar Energy Industries Association (SEIA) cites 534 MW of installed solar capacity in Texas as of March 2016 (SEIA 2016). The solar resource in Texas is strong, particularly in west Texas (where large projects would have access to CREZ transmission), and is not the barrier to solar PV development. Instead, a lack of incentives for solar PV, the lack of full net-metering policies (critical for growth of residential rooftop systems), and lower cost energy choices are credited with restricting solar PV growth in Texas.

2.2.7 Future Changes

With respect to resource mix changes in the future, ERCOT considers generation resources, demand response, and distribution level resources their primary strategic areas (Mele 2016). ERCOT anticipates having over 26,000 MW of wind capacity installed in 2018 and over 2,000 MW of solar PV installed in 2017, which will require additional forecasting capabilities to better manage and integrate these variable-generation resources and new ancillary services (Mele 2016). As mentioned above, with new cost-effective technologies becoming available, ERCOT anticipates more customer participation in load management and distributed generation resources. Moreover, with the growth of advanced metering, a significant percentage of the retail market now has some kind of incentive for demand response, price response, or a behavioral shift from on-peak to off-peak demand (Mele 2016).

The increase of DERs and renewable energy generation, particularly from wind, is not likely to fully displace baseload plants in Texas; while energy generation from coal is already declining, it is also being displaced by energy generation from natural gas. However, because of the abundance of wind power, Texas has already experienced negative power pricing. Negative pricing occurs when output from wind and solar farms is so high that supply exceeds demand, and prices have to fall below zero to force some generators offline (Malik and Weber 2016).

3.0 Policy Environment

One purpose of this report is to provide a common basis for comparing energy policies among states. Table 2 summarizes key policies, programs, and requirements being implemented in states throughout the country that support and/or respond to power system transformation. Table 2 indicates whether or not these policies and programs are in place in Texas. Details for the important, key items are described below the table.

Table 2. Policy Checklist for Texas

Policy	Comment/Description
Integrated Resource Plan	No. The PUCT does not require IRPs. See Section 3.1.
Renewable Portfolio Standard	Yes. First established in 1999. See Section 3.2.
Energy Efficiency Resource Standard	Yes. First established in 1999. See Section 3.3.
Distribution Resource Plan	No. There is no formal DER planning in ERCOT.
Retail Deregulation	Yes. Started in 1999. See Section 1.3.
Wholesale Deregulation	Yes. Started in 1999. Se Section 1.3.
Requirements for filing Smart Grid Plans	No.
Net Metering	No. No statewide policy and very few and limited utility policies. See Section 3.4.
State Climate Goals or Mandates	No.
Distributed Generation Goals or Local Generation Goals	No.
State Loading Order	No.
Cap and Trade	No.
Public Purpose/Benefits Charge	No.
State and Utility DER Incentives	Some. See Section 3.5.
Time-Varying Pricing	Yes. See Section 1.3.2.
Incentive-Based Demand-Response Programs – Mass Market Demand-Response Programs	Some. Some utilities offer demand-response programs. See Section 3.6.
Feed-in Tariffs	No. No programs in state.
Community Solar Programs	Some. A few utilities have recently started these programs.
Carbon Limits on Generating Resources	No.
Microgrid Incentives	No.
Voluntary Renewable Energy Programs	Only a few utilities are known to offer green power pricing to its customers. See Section 3.7.
Green Tariffs Offered	No.
Energy Storage Mandates or Initiatives	No.

Table 3 provides a summary of proceedings related to distribution system operators, market animation, customer choice, and other important ongoing issues associated with regulation and the utility business model.

Table 3. Key Policy Initiatives and Proceedings Related to the Utility Business Model

Explicit Statewide Initiatives or Proceedings Addressing:	Comment/Description
Distribution system operator or distribution markets	No. ERCOT is beginning to consider markets for distribution services in some locations.
Expanding customer services and choice	Yes. Customer choice is high in deregulated market environment, but not for DERs.
Market animation	Yes and No. Wholesale and retail markets are mature, but DER markets are nascent, being explored through DREAM Task Force.
Fixed cost recovery/rate structure	No. Issues that affect regulated markets do not impact deregulated markets. Very limited DERs and net metering, so these issues are not as prevalent.
Reforming regulation / changes to utility business model	No.
Reliability and resilience	No. Not being addressed in specific initiatives.

3.1 Integrated Resource Plan

A utility's integrated resource plan considers all supply-and-demand options as potential resource contributors and then selects a least-cost integrated set of resources that meets expected needs. Thirty-nine of the 50 states have a rule or requirement for long-term resource planning or procurement, but the variations between the state rules are substantial (Synapse 2011).

Integrated resource planning began in the late 1980s as states began to respond to the oil embargoes of the 1970s and to nuclear cost overruns that occurred during the same time period and into the 1980s (Synapse 2011). However, as the electric industry began to restructure in the mid-1990s, integrated resource planning rules were often repealed or ignored.

In 1995, the Texas Legislature added integrated resource plans (IRPs) to the Public Utility Regulatory Act. This requirement was removed in 1999 with the restructuring to a deregulated, competitive market. At present, IRPs are not required in Texas (EPA 2015). ERCOT does publish an annual 10-year capacity, Demand and Reserves Report in May, with updates each December, using data provided by resource developers and transmission service providers (ERCOT 2016e).

In 1995, the PUCT dictated that public opinion must be accounted for in the IRP process. As a result, between 1996 and 1998, eight Texas utilities polled their customers to determine what energy options they preferred to meet future electricity needs (NREL 2003). Customers responded that they were willing to pay more for renewable and efficiency resources, they were concerned about the environment, and they had strong preferences for project options with higher construction costs but lower, steady operating costs.

The feedback surprised both the PUCT and the utilities. As a result, both entities changed their level of interest in and commitment to renewables and efficiency, which helped lead to the enactment of the RPS and Energy Efficiency Resource Standard in 1999.

3.2 Renewable Portfolio Standard

The Texas RPS, called the Renewable Generation Requirement, was adopted in 1999. The RPS applies to IOUs that have not unbundled, to REPs in deregulated areas, and to municipal utilities and electric cooperatives that offer customer choice (i.e., who have opted in to the competitive market).

The RPS mandate has progressed in steps, starting with a call for statewide generation of 2,280 MW of renewable energy capacity by 2007, to the target of 5,880 MW by 2015, and ultimately to a voluntary goal of 10,000 MW by 2025—with a voluntary target of 500 MW of renewable energy capacity from resources other than wind (DSIRE 2015a). Texas surpassed the 2025 goal in 2010 and now has 17,713 MW of installed wind capacity per the American Wind Energy Association (AWEA 2015) and 15,764 MW per ERCOT (ERCOT 2016a).3 Solar, hydro, and biomass facilities make up just 1% of the generation capacity in Texas, with solar contributing 288 MW (ERCOT 2016a), but there are no noncompliance penalties for not meeting the voluntary 500 MW carve-out.

The combination of a strong wind resource, continually improving renewable energy technologies, and the creation of the CREZ lines, along with the public support evidenced in the IRP feedback process, has allowed Texas to surpass its renewable energy goal.

3.3 Energy Efficiency Resource Standard

Texas is credited with being the first state to establish an Energy Efficiency Resource Standard in 1999. Per amendments made in 2011, IOUs must reduce energy usage and demand to the point that such savings represent 30% of the annual growth in peak demand on each utility's system or (if this standard was already met) up to 0.4% of each utility's peak demand thereafter (DSIRE 2015b).

3.4 Net Energy Metering

According to EIA records, only about 70 MW of solar PV and wind are net metered in Texas (EIA 2016c). Texas has a grade of "F" for net metering from the Freeing the Grid project because of its lack of a statewide net-metering policy (Freeing the Grid 2015). A handful of utilities—City of Brenham, El Paso Electric, San Antonio City Public Service, and Austin Energy—have net-metering policies, but each of them only reimburses net excess generation at the avoided-cost rate, not the retail rate. The avoided-cost rate of electricity is lower than the retail rate, and thus being reimbursed at that rate decreases the cost-effectiveness of, and interest in, on-site distributed generation for the customer.

SolarCity, a solar leasing company, is working with the utility MP2 Energy to implement full net metering in the Dallas-Fort Worth region (Ayre 2015). Full net metering allows excess generation in one month to be carried over and credited on the customer's next monthly bill at the full retail rate. This program will increase the cost-effectiveness of solar PV, and any distributed generation, for this utility's customers and thereby increase adoption rates. Without statewide policies and incentives, independent companies, such as SolarCity, are likely to continue to break into the market piecemeal by working with willing utilities and REPs.

[3] This difference is likely because AWEA is reporting the Texas statewide value and there are some areas in Texas with wind projects that are not part of ERCOT.

3.5 State and Utility DER Incentives

There are no state-level DER incentives in Texas, but multiple utilities offer rebates or other incentives for small wind, solar PV, and similar customer-sited distributed generation. Texas utilities currently offer 31 different rebate programs for renewable energy and energy efficiency projects (DSIRE 2016). These are typically small-scale programs with limited impact. For example, the City of San Marcos offers a rebate of $2.50 per watt up to $5,000 total for solar PV projects and $1 per watt up to $5,000 total for wind projects (DSIRE 2015c). In 2015, this program provided funding to seven projects totaling 115 kW (Orrell and Foster 2016).

3.6 Incentive-Based Demand-Response Programs—Mass Market Demand-Response Programs

A number of utilities and cooperatives in Texas report demand-response program data to the EIA (EIA 2016c). In addition, many utilities and cooperatives have energy efficiency programs. Austin Energy's energy-efficiency and demand-response program offset the need to build a 700 MW power plant in the 1982 to 2006 time frame (Austin Energy 2016).

3.7 Voluntary Renewable Energy Program

Only a few municipally owned utilities within ERCOT have green pricing programs: CPS Energy (San Antonio), City of College Station, and Austin Energy (EERE 2015). Residents in the service areas of these utilities do not have customer choice, but these utilities have offered customers the option of paying a premium on their electric bills to cover the cost of adding renewable energy, specifically Texas wind in all three cases, to each utility's portfolio mix. In general with green pricing programs, the renewable energy could be purchased from projects located anywhere.

Green pricing is in contrast to a green tariff, which is also a voluntary premium offered by a few utilities (not in Texas) in which a customer could pay more for utility-owned renewable energy, thus supporting renewable energy development directly by and for the utility.

4.0 Challenges

While ERCOT has been focused on transmission and large-scale energy generation, there is recognition at ERCOT and the PUCT that the inclusion of DERs in the market is inevitable and even desirable (SPEER 2016). Some of the challenges around this inclusion are (1) ERCOT's limited visibility into DERs and thus its need to coordinate with distribution utilities, each of which has its own interconnection process; (2) maintaining grid reliability, through additional ancillary services and forecasting, while increasing DERs, specifically increased levels of variable wind generation; and, primarily, (3) the need to develop market structures to increase opportunities for DER participation in ERCOT.

While the CREZ transmission project is complete, ERCOT recognizes the need for upgrades and ancillary services to maintain and improve system stability, particularly stabilizing the voltage along the long transmission lines. These stability challenges are especially prominent in the Panhandle area, which is considered a weak grid (Husch Blackwell 2014). ERCOT is considering how to address the stability problem by adding generators or other electrical devices, such as capacitors and reactors, at strategic locations along the circuit to electrically bring the remote generators (or loads) closer to the rest of the system (Del Franco 2013).

In general, introducing increased levels of DER into the ERCOT market will necessitate technical review of issues such as interconnection requirements, forecasting capabilities, and operations management. As discussed with the DER Light and DER Heavy scenarios being explored by ERCOT, some additional technology requirements, such as the ability to track and forecast net load and generation separately, would be required to fully include DERs in the ERCOT market. ERCOT's ETWG and DREAM Task Force are expected to continue to examine policy and technical issues associated with introducing more DERs into the ERCOT competitive wholesale market.

5.0 Conclusions

Without specific mandates, policies, or planning requirements in place, Texas has had limited DER development. The small amount of installed distributed solar PV capacity, which is due to a lack of incentives for solar PV, the lack of full net-metering policies, and lower cost energy alternatives, is one example of limited DER growth. However, Texas has relatively high penetration of AMI, at 70%, and the quantity of wind capacity in Texas is truly impressive, increasing from 116 MW in 2000 to nearly 16,000 MW in 2015. Most customers in Texas have choice when it comes to their energy providers, and electricity prices in Texas are roughly $0.01 below the national average.

With its unique isolated grid and deregulated market, and the success of the CREZ transmission project, ERCOT clearly has the ability to achieve goals that its members support. If the inclusion of DERs is deemed a priority, ERCOT would likely be able to address all of the challenges described above and successfully expand its market to include DERs.

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