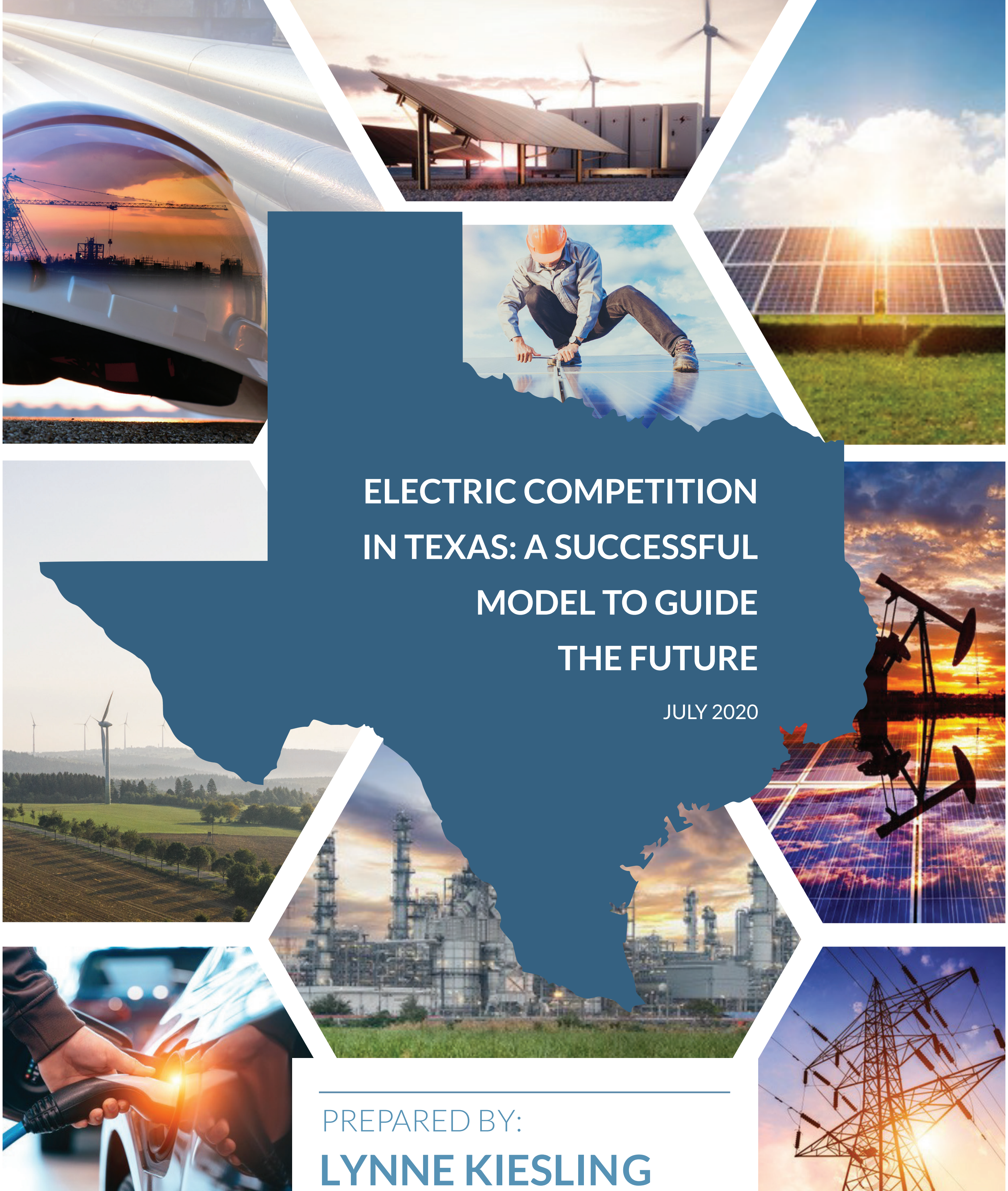

ELECTRIC COMPETITION IN TEXAS: A SUCCESSFUL MODEL TO GUIDE THE FUTURE

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TABLE OF CONTENTS

Executive Summary Page 3

Overview

Introduction Page 4

A Texas Power Market Primer Page 6

An overview of the electric power industry

- Electric power generation
- Retailing power
- The "wires" business
- Enabling customer choice in Texas

Powering economic growth in Texas:

Trends in power generation and consumption

ERCOT wholesale and retail prices, 2002-2019

Reliability in a restructured market

The roles of lawmakers and regulators in the market

Economic Principles for Power Systems Page 17

Issues in Competitive Electricity Markets for the 21st Century Page 19

Renewable energy and distributed energy resources

Negative prices in ERCOT

Active demand and response

Market design for energy storage systems

Challenges to the quarantine: Keeping markets competitive by restricting utility participation

Conclusion Page 28

About the Authors

A Note About COVID-19

EXECUTIVE SUMMARY

At least since the 1901 discovery of oil at Spindletop near Beaumont, the state of Texas has been unabashedly an energy state. Yes, the state is known for cattle and cotton. There is timber in East Texas and citrus grown in the South. But oil and gas has been an essential element of the Texas economy for over a century.

In the 21st century another energy story has been associated with the state —one driven by Texas's competitive electricity market. While a handful of other states also reformed their power markets to allow competition, Texas stands out as one of the best such reformed markets. Deregulation has produced lower barriers to entry and led to faster innovation and diversification in the state's grid. To illustrate, wind power in Texas has grown more than in any other state and more than many countries as a result of Texas' commitment to energy development.

Electric power is increasingly part of the Texas energy story.

How has it happened? The backstory is a little technical: Innovative small-scale generation technologies in the 1980s reduced the economies of scale in generation that had been a bulwark of the argument for regulated monopoly.

The 1990s saw the expansion and subsequent refinement of wholesale power markets in several regions of the United States, including at the Electric Reliability Council of Texas (ERCOT) in Texas.

Today, Texas is one among several states that have restructured their electricity industry to allow competition in both generation and retail service (with the transmission and distribution wires remaining a regulated monopoly).

The demand for electricity in Texas is growing along with population and economic growth. Competitive wholesale and retail power markets in Texas have seen investments in generating resources, vast additions to the electric power grid, and yet reduced costs to consumers.

Electric power has become a part of the state's heritage of energy development because it has been able to serve the state's continued growth. It is worth understanding how and why the Texas model of electric competition works well. This report offers a picture of the Texas market as well as challenges and opportunities the state is likely to face in the near future.

INTRODUCTION

When Daniel and Jordan married and moved into an Austin apartment, the electric power part of the move was simple: a city utility was the only choice. A few years later, having saved some money and with their first child on the way, they bought a house in the suburbs north of the city. (Full disclosure: Daniel and Jordan are a real couple related to one of the authors.)

This move required them to make a new decision: picking an electric supplier. You might think of it as a hassle—one more thing on a “to do” list which was long enough—or as an opportunity to choose the electric power deal you want.

Daniel talked to his colleagues at work about choosing a plan, then sorted through plans on the state’s *Power to Choose* website (www.powerto-choose.com) looking for a low rate and 100 percent renewable content. The Power to Choose site was useful, Daniel said, but frustrating, too.

The average price numbers prominently featured were sometimes misleading. A contract might offer low prices up to 1,000 kWh but absurdly high prices after. He found himself digging into the details of each contract he was interested in and doing his own math to avoid a bad deal. They liked the plan they found, but after a few years it was discontinued.

Again, Daniel found the *Power to Choose* site both useful and frustrating. Daniel and Jordan had discovered their home sometimes required quite a bit of electricity to keep cool in the summer, so plans were scrutinized for extra charges at high rates of consumption. Ultimately, they selected a new plan offering 100 percent renewable content at a price that rose from about 7.5 cents to 8.5 cents per KWh.

The state’s *Power to Choose* website makes it easy to search for offers with high renewable content, or especially low prices, or long-term contracts with stable prices.

Some retailers have special offers directed at consumers with home solar power systems, or prepaid contracts that don’t require credit checks or up-front deposits, or contracts with prices that vary month-to-month with the underlying power market.

If not quite something for everyone, the competitive Texas retail market offers many more options than available to consumers elsewhere.

For a long time in the electric power industry, in Texas and elsewhere, almost all electric power consumers had just one choice: the local monopoly electric utility designated by state regulators to serve an area and to keep power supply and demand in real-time balance.

One company built the power generators, transmission and distribution lines, and billed consumers under rates regulated by state or local governments.

In many parts of the country, the system still works that same way: one company, with a monopoly territory protected by state regulators, with rates overseen by state regulators.

In most of Texas and a handful of other states, retail consumers have a choice among competing retail power suppliers. Most Texans can choose from among dozens of suppliers and face as many as two hundred different plans.

The Texas approach is recognized among industry specialists as being different — some experts say it is one of the best.[1]

Our goal in this report is to describe the Texas approach and what makes it work. The market is not perfect, of course, and is under constant pressure to adapt and grow.

We also discuss some of the pressures facing the Texas electric power industry, and how market players and regulators can respond to those pressures while preserving the character that helps it succeed.

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[1] *Some of these expert observations: Zarnikau (2008): "the ERCOT market is generally considered to be the most successful of the restructured electricity markets in North America." Kim (2013), "the most robust restructured retail market in North America and one of the top three in the world." DEFG (2015): "Texas is the competitive residential electricity market leader for the eighth consecutive year." Littlechild (2018): "Texas is widely regarded as the most successful retail electricity market in the US."*

A TEXAS POWER MARKET PRIMER

2020

THE TEXAS ELECTRIC POWER INDUSTRY works differently enough to be worth explaining what makes it different, why Texas policymakers switched (most of) the state from monopoly to competitive supply, and what it all means for consumers. Here we introduce the Texas model, give some background, and then evaluate how the Texas system has been working.

AN OVERVIEW OF THE ELECTRIC POWER INDUSTRY

Monopoly has been common in electric power for so long that some people find it hard to imagine alternatives. In fact, the electric power market was once a hotbed of competition. At the very beginning of the 20th century a large city like Chicago might have had 20 or 30 small power companies competing for business. Electric power was slower to come to smaller towns, but by 1920 even a small West Texas town like Lubbock, with only a few thousand residents at the time, featured two competing electric suppliers. As the industry matured, commercial and political pressure ensured that state-protected monopolies quickly dominated the industry.

Monopolies had real advantages. Economies of scale and scope allowed bigger companies to capture technical efficiencies and have cost advantages. In addition, the electric power system is composed of several parts that must be carefully coordinated to maintain reliable service. The electric power industry traditionally has three basic parts: electric power generators, end users, and the transmission and distribution systems connecting them. Before the age of computers and advanced communication technologies it would have been difficult to maintain the coordination necessary to operate a competitive system.

Today the electricity landscape is more diverse. Homeowners and businesses may have solar power systems or other energy-generating capability, or electric vehicles that both consume power and store it. Widespread competition has emerged in the power generation segment of the industry. These and other innovations make it possible to reform the monopoly model and allow for wholesale competition among generators and retail electric choice.

> *"For much of the 20th century, the local electricity utility monopoly, conceived of as a vertically integrated business, from generation to the consumer meter, and even beyond, was spectacularly successful. The accrued benefits for the American people during this time frame virtually defy calculation. But things have changed so dramatically that in the 21st century conditions are nearly the opposite of those that prevailed in the 19th century when the monopoly system was born."*
>
> – Phillip O'Connor, former chairman of the Illinois Commerce Commission, in "Restructuring Recharged: The Superior Performance of Competitive Electricity Markets 2008-2016."

ELECTRIC POWER GENERATION

Early electric companies had just two or three generators, and at the time larger generators could be much more efficient than smaller ones. These economies of scale at the power plant meant that a single company with a few large power plants could operate more cheaply than several smaller companies with smaller power plants. The logic of efficiency drove the industry to larger and larger power plants. The five-megawatt steam turbine installed in Chicago in 1903 was the largest of its time and produced power at half the cost of smaller power plants.[2]

But by the 1970s, new power plants were being built that were 100 times larger, and sometimes even bigger than that. Small power plant technologies also improved over the century, and also by the 1970s sometimes a small power plant – when fit to the right situation and the right location – could be just as cost effective as a large power plant.[3] By the 1990s with the combined cycle gas turbine, smaller plants could compete effectively with large coal-fired plants in many situations.[4] The economies of scale justification for bigger power plants owned by one large monopoly, once a major force encouraging monopoly, faded in importance.

RETAILING POWER

At the retail end of the industry, where electric power is sold to the end user, simplicity rather than economies of scale drove monopolization. With a single company owning the power generators and the wires linking that supply to consumers, it was natural enough that a single company would sell to the final consumer. Those retail consumers spanned from large industrial consumers on one end to small individual households on the other, with a wide range of businesses in between the extremes. As regulated monopoly became the dominant system, regulated rates applied to three defined customer categories: industrial, commercial, and residential. Sometimes within a customer class there would be two or three options, but increased variety made regulation more difficult, so offerings were limited.

THE "WIRES" BUSINESS

The wires connecting generators and end consumers still show significant economies of scale ("wires" is a catch-all term for all kinds of equipment including poles, transformers, relays, some very high-tech electronic components, meters, and yes, a lot of actual wires). High voltage transmission systems connect distant power generators to big cities, while lower-voltage distribution systems cover cities and towns to deliver power to end-users. The electric meter, almost always owned by the distribution company, is the traditional "end of the line" so to speak.

While the generation business and the retailing business quickly became venues for potential competition in states that reformed, the wires business in the middle has remained a regulated monopoly. The wires business has been changing, with digital meters most obvious to end consumers, but high-tech components are growing in importance for efficient and reliable operation of transmission systems as well. Growth of consumer-owned generation like rooftop solar also creates new challenges for the distribution system. Still, economies of scope seem to dominate the wires business, since power delivery requires producing and coordinating many specific actions, so the logic of monopoly and regulatory oversight remains.

Economies of scale for generation, economies of scope for the wires part of the business, and the need to coordinate generation with consumption while managing the wires systems to prevent overloads, all pointed to monopoly as the way to do things for most of the twentieth century. But a century of technological growth had created alternatives. Economies of scale are not as important as they once were. Digital communications and computer technology can manage the necessary coordination between generators, consumers, and the wires business (with some oversight). In today's high-tech interconnected world, the old justifications for monopoly are no longer dominant.

[2] *Richard Munson, From Edison to Enron: The Business of Power and What It Means for the Future of Electricity. Westport, CT: Praeger, 2005.*

[3] *Robert H. Williams, "Industrial cogeneration," Annual Review of Energy 3.1 (1978): 313-356.*

[4] *Ulrika Claeson Colpier and Deborah Cornland, "The economics of the combined cycle gas turbine – An experience curve analysis," Energy Policy 30 (2002): 309-316.*

ENABLING CUSTOMER CHOICE IN TEXAS

The federal Public Utilities Regulatory Policy Act of 1978 (PURPA) set in motion a variety of changes in the electric power industry, opening the possibility of competition in wholesale and retail power. In Texas in the mid-1990s, most large electric power monopolies were physically connected to each other and a state-regulated Independent System Operator (ISO) called ERCOT took over scheduling and oversight of the transmission grid. ERCOT formed a wholesale market as part of the ISO to help the system work at least cost.

Elsewhere in the United States other ISOs were formed, eventually covering about two-thirds of the electric power grid. Similar developments were happening in other countries, too, in some cases even before they were developed in the United States. ISO management of the grid removed monopoly control over use of the high-voltage transmission part of the wires business, and set the foundation for wholesale competition.

Regulatory reform came to the retail level in Texas via Senate Bill 7 (SB7) passed in 1999, with a start date set for January 1, 2002.[5] SB7 required investor-owned electric power monopolies to separate the wires part of the business from the power generation and retailing segments. The wires business remained state-regulated monopolies, but use of the transmission grid was now overseen by ERCOT. Power generation and retail sales were opened up to competition for most Texans.

As a political compromise city-owned electric utilities and rural electric cooperatives were given the opportunity to choose whether to remain as traditional monopolies, and almost all of them have done so. In addition, some electric utilities distant from the major population centers were not connected to the ERCOT system and lacked access to a competitive wholesale market in 2002, and these utilities were also allowed to remain as regulated monopolies. Overall, however, about 90 percent of the electrical load in Texas is served by the ERCOT system, and about three-quarters of ERCOT power consumption occurs in the competitive retail power market in Texas.[6]

In addition to Texas, 12 states and the District of Columbia allow some form of retail customer choice for residential customers. A few more allow retail choice for large industrial and commercial customers. In many respects reforms in these states resemble what Texas has done, but two main differences set Texas apart. First, much more so than in most other reformed states, Texas insisted upon full corporate separation between the monopoly wires business and the other segments of the industry. Some states merely required separating segments of the industry into different divisions of a single company. In addition, most state policies allow consumers to remain on a state-regulated "default service," provided by an affiliate of the incumbent regulated wires company. Texas explicitly phased out this kind of standard offering. Instead, Texas required all retail billing and customer interaction to be performed by independent retail companies (Retail Electric Providers), and while those companies who were or had been affiliated with regulated incumbent utilities could continue to serve their customers, they were required to do so for several years at a higher price to encourage customer shopping for competitive offers. In fact, this last resort service has been only rarely used, considering the robust number of competitive offerings available.

One other reason that Texas is different is that the ERCOT power system is contained entirely within the state of Texas and the system is almost wholly regulated by the Public Utility Commission of Texas (PUCT). Reliability rules are under federal jurisdiction, but much of the rest of the industry is regulated by the PUCT. Elsewhere in the continental United States both federal and state regulators have separate but partly overlapping authority. The separate authority and diverse perspectives among federal and state policymakers sometimes adds to the challenges of overseeing the industry. Texas has benefited from the more unified regulatory system it has maintained.

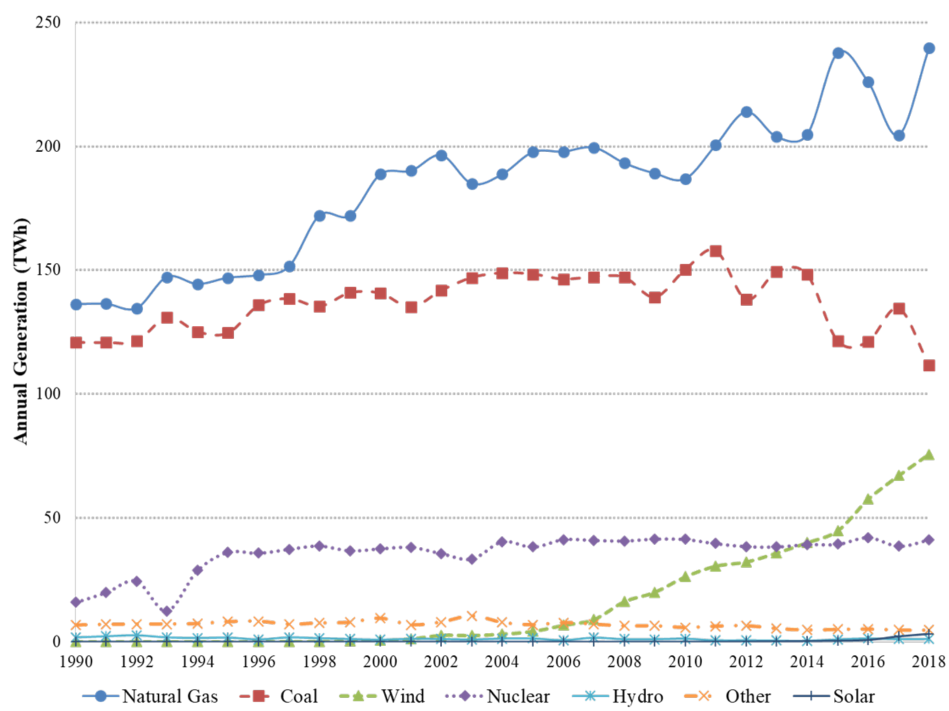
[5] *Pat Wood III and Gürcan Gülen, "Laying the Groundwork for Power Competition in Texas," in L. Lynne Kiesling and Andrew N. Kleit, eds., Electricity Restructuring: The Texas Story. Washington, DC: AEI Press, 2009.*

[6] *ERCOT, 2108 State of the Grid Report, April 16, 2019. http://www.ercot.com/content/wcm/landing_pages/88833/ERCOT_2018_State_of_the_Grid_Report.pdf*

POWERING ECONOMIC GROWTH IN TEXAS:
Trends in power generation and consumption

Analyzing historical data provides some insights into the outcomes of electricity competition in Texas. Figure 1 presents annual power generation by fuel source since 1990. Generation using natural gas technologies has shown a consistent upwards trajectory, growing from roughly 136 terawatt-hours (TWh) in 1990 to almost 240 TWh in 2018. In contrast, generation from nuclear and non-wind renewables has been relatively flat. Starting in the mid-2000s, generation from wind increased from 4 TWh in 2005 to over 75 TWh in 2018, or a nearly 1,700% increase over this timeframe. The growing dominance of natural gas and wind in the fuel portfolio is a striking feature in Texas.

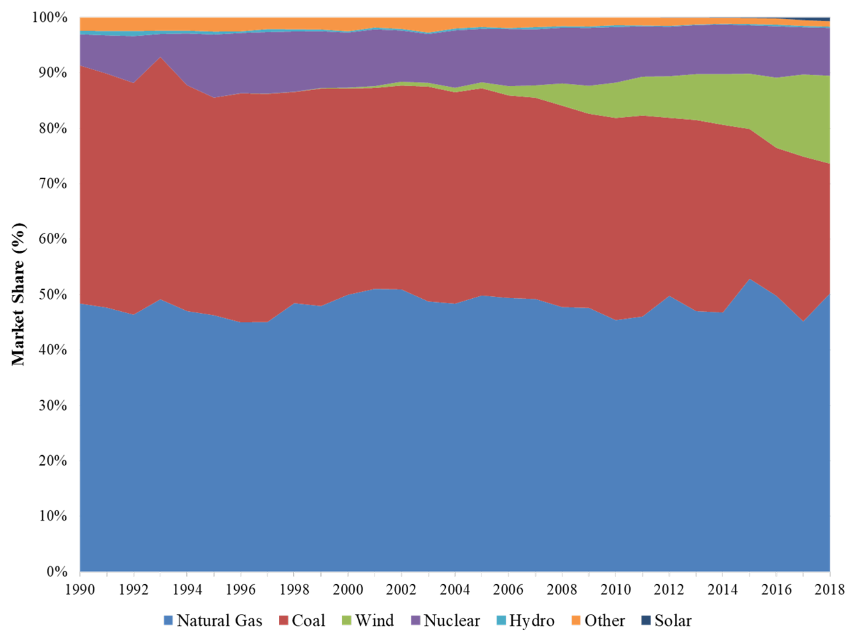
Figure 1 – Annual Generation by Fuel Type (Texas, 1990 – 2018)



Source: EIA State Historical Tables for 2018.

Figure 2 shows increased market shares for wind have coincided with falling market shares for coal. Coal's market share of electric power generation has gone from roughly 37% in 2005 to 23%, a difference of 14% that nearly matches the increase in wind's market share from 1% to almost 16%. Section 4 contains a discussion of the policy and market environments that led to this massive growth in wind power generation.

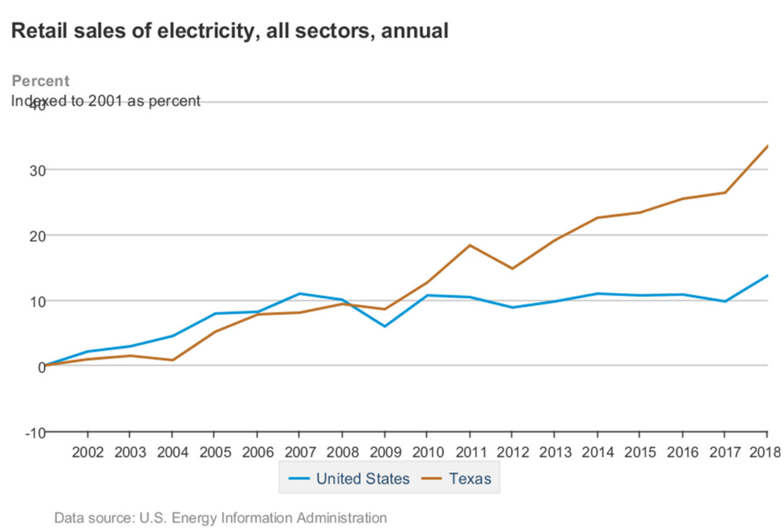
Figure 2 – Market Share by Fuel Type (Texas, 1990 – 2018)



Source: EIA State Historical Tables for 2018.

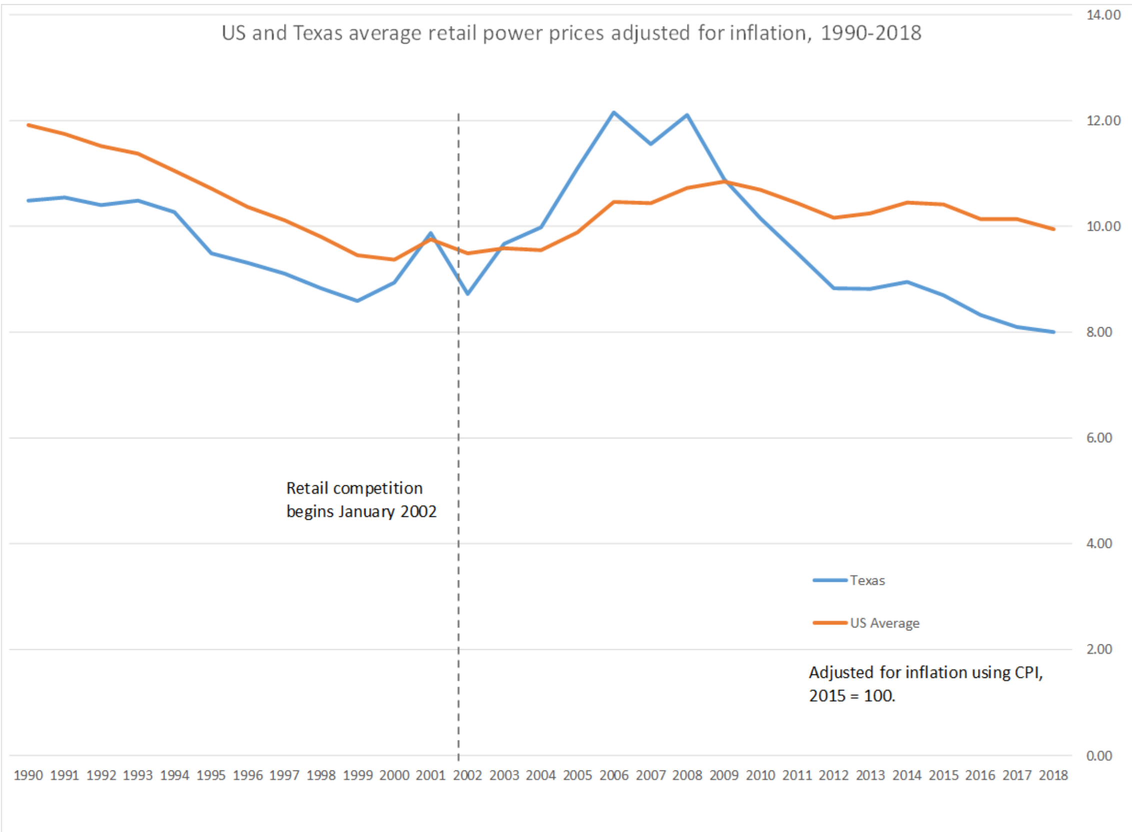
While nationwide sales of electricity have been relatively stable since 2006, Texas has seen continued growth as the state has experienced in-migration from other states and increased economic activity, seen in Figure 3.

Figure 3: Retail sales of electricity, all sectors, United States and Texas, percentage growth since 2001



At the same time, average prices in Texas have risen more slowly than for the nation as a whole. When adjusted for inflation, real power prices in Texas are lower now than in the 1990s. After the Texas retail market opened up to competition in 2002, prices rose faster than the U.S. average for a few years, reflecting higher natural gas prices over this period. Competition makes the passthrough of higher fuel costs to end consumers quicker and more transparent than with traditionally regulated utilities. When natural gas prices fell beginning in 2008, average prices started dropping quickly in Texas, while US average prices only fell slowly in response to sharply lower natural gas prices. After matching the US national average in 2009, average prices in Texas have remained below the nation as a whole, and the Texas advantage is slowly growing. Figure 4 displays retail electricity price data adjusted for inflation indicating this comparison.

Figure 4: Average retail price of electricity, all sectors, United States and Texas, 1990-2018. (Adjusted for inflation using CPI, 2015=100.)



Source: U.S. Energy Information Administration

ERCOT WHOLESALE AND TEXAS RETAIL PRICES *from 2002 to 2019*

The simple average prices shown in Figure 4 provide a general picture, but we should not jump to the conclusion that the Texas retail market reforms are the sole cause of this trend of falling prices. For example, the Texas power generation industry relies on natural gas more heavily than most other states. Natural gas prices did rise from 2001 to 2008, and they have been much lower since then because of the fracking-based boom in gas production. In addition, Texas has seen a substantial investment in wind power, and wind power tends to push wholesale prices down, but only slightly.[7] We have to look more closely to see whether the price trends shown above have resulted from retail competition or should be traced to some other cause.

The best analysis of Texas retail power prices has come from researchers affiliated with the Baker Institute and Department of Economics of Rice University in Houston. In a paper published in January 2019 in the journal Energy Economics, Peter Hartley, Kenneth Medlock, and Olivera Jankovska reported the results of an in-depth analysis of retail and wholesale power prices in Texas since the 2002 opening of retail competition.[8] Hartley, Medlock, and Jankovska apply some advanced statistical techniques to identify the consequences of allowing competitive supply and customer choice.

They rely heavily on the fact that parts of Texas remained under traditionally vertically-integrated forms of electric supply. As noted above, a few regulated electric utilities were outside of ERCOT were allowed to remain as state-regulated monopoly utilities as were rural electric coops and municipal utilities. These monopoly areas in Texas allow for a natural comparison group to the areas opened up to competition in 2002. In competitive market areas the authors found "strong evidence that residential price movements ... more accurately reflected corresponding movements in wholesale power markets" – suggesting again that fuel and other wholesale cost changes were more rapidly passed through to end consumers with competition. In addition, "the difference between residential and wholesale prices declined on average over the period in the competitive market areas" – meaning that competitive suppliers appear to have lower operating costs than monopoly suppliers. Patterns they find also suggest that rates in monopoly areas are driven somewhat more by political influence and a bit less by simple supply and demand factors.

[7] Andrew D. Mills, Dev Millstein, Ryan H. Wiser, Joachim Seel, Juan Pablo Carvallo, Seongeun Jeong, and Will Gorman. „Impact of Wind, Solar, and Other Factors on Wholesale Power Prices: An Historical Analysis—2008 through 2017.“ (2019). Lawrence Berkeley National Laboratory. Available at: https://emp.lbl.gov/publications/impact-wind-solar-and-other-factors.

[8] Peter Hartley, Kenneth Medlock III, and Olivera Jankovska, "Electricity reform and retail pricing in Texas," Energy Economics 80 (2019): 1-11.

Figure 5: Average retail price of electricity, all sectors, United States and Texas, 1990-2018.

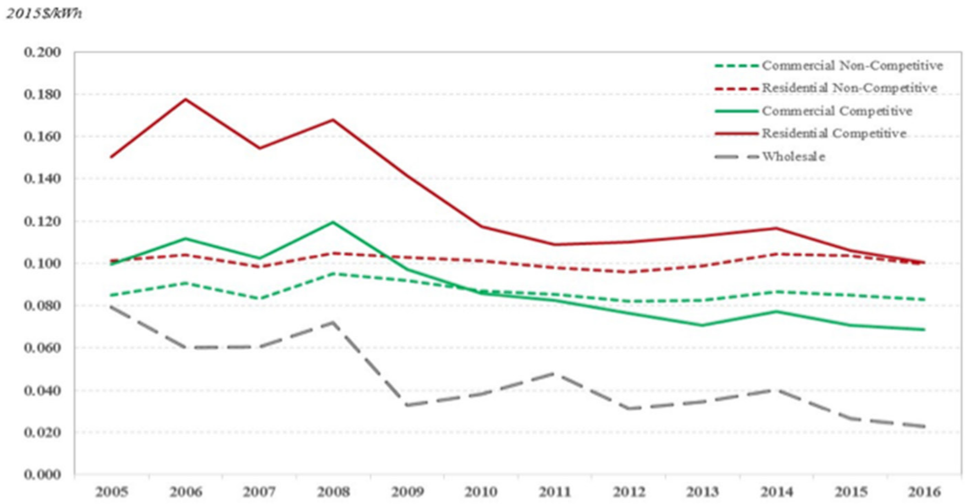


Figure 5 illustrates their comparison of retail prices in competitive and monopoly areas. The solid lines show competitive market price trends and how their overall decline has reflected underlying costs better than rates in monopoly areas (dotted lines).[9]

[9] *Data available at https://www.bakerinstitute.org/research/electricity-reform-and-retail-pricing-texas/.*

RELIABILITY IN A RESTRUCTURED MARKET

When citizens and policymakers in areas with a traditionally-regulated power industry consider introducing competition, one of the first concerns is reliability. Modern American society relies heavily on constant access to electric power supplies. Few would be interested in the promised benefits of competitive power markets if they meant unreliable power supplies.

Texas and other states allowing customer choice have dealt with reliability the same way. The companies that own the transmission and distribution wires part of the business remain regulated public utilities with a duty to serve end users and rates regulated by the state utility commission. While the power generation sector and the retail supply sector of the business have seen competition grow, the wires part of the business is still seen as a regulated natural monopoly business. In addition, U.S. law requires electric companies to comply with reliability standards issued by the North American Electric Reliability Corporation, the FERC-designated electric reliability organization for the United States. The grid in Texas operates under the same reliability rules as the rest of the United States.

Because end-use customers all draw power from the same electric power grid, in theory the reliability of service is the same for all. Retail competition does introduce a few complications. For one thing, a competitive retail supplier can go out of business. Customers of a failing retail supplier do not lose power. State rules provide for these customers to be transitioned to a provider of last resort until they pick someone new.

Allowing these badly-managed companies to fail provides valuable discipline in markets. One difficulty with the traditional monopoly system is that badly-managed regulated monopolies are hard to reform. Regulators try to encourage efficiency, but cost-of-service rate regulation is a cumbersome tool that can hamper the regulator's ability in this respect, so inefficiency can grow. In most of the economy, good companies thrive and badly run companies fail. The Texas market shows how this important mechanism for customer-oriented improvement can work in electric power retailing as well.

In fact, the restructured market in Texas has allowed some commercial consumers to get better reliability service than provided by the regulated distribution grid. Regional grocery store chain H-E-B paired up with energy services company Enchanted Rock to install small onsite natural gas generators.[10] When grid services are out, the generators kick in and keep a store's lights on and refrigerated food cold. When the grid is operating normally, Enchanted Rock uses the generators to provide reserves and other grid support services. Such systems are also in place in traditionally regulated states. In regulated states utilities sometimes block innovation that undercuts their position, while in restructured markets innovation is just about "business as usual."

The market design in Texas does not specify a particular amount of generation that has to be held in reserve for reliability purposes, and relies instead on price signals in the wholesale market to communicate that buyers should conserve and sellers should generate more power. Compared to other wholesale power markets, Texas has a high price cap of $9,000 per megawatt-hour, allowing high prices to signal scarcity.[11] On August 12, 2019, Texas had a heat wave and reached its highest ever peak load of 74,280 MW. Peak real-time prices were high and reserves were low, but there were no involuntary blackouts. As Alison Silverstein notes in her analysis of reliability in Texas, "even under the pressure of August heat and record peak load, the ERCOT market worked as designed."[12]

[10] Chris Tomlinson, "Houston company helps H-E-B keep the lights on," Houston Chronicle, July 20, 2017. https://www.houstonchronicle.com/business/columnists/tomlinson/article/Small-player-in-power-helps-H-E-B-with-low-cost-11304218.php

[11] For example, the price cap is $3,500 in MISO, $2,000 in CAISO and PJM, and $1,000 in NYISO and SPP. In Texas, market-clearing prices have only reached $9,000 three times. See, for example, "ERCOT Experiences Record Consumption, Real-Time Prices Reach $9,000 Cap," Texas Coalition for Affordable Power, August 14, 2019. Available at: https://tcaptx.com/industry-news/ercot-real-time-prices-hit-record-9000-mark.

[12] Alison Silverstein, Resource Adequacy Challenges in Texas: Unleashing Demand-Side Resources in the ERCOT Competitive Market. Environmental Defense Fund, May 2020, p. 2. Available at: https://www.edf.org/media/report-how-texas-can-unleash-next-wave-electricity-market-competition.

THE ROLES OF LAWMAKERS AND REGULATORS IN THE MARKET

States that have reformed their regulatory systems for electric power to allow customer choice are sometimes called "deregulated". That term is misleading, if for no other reason that the number of regulations involved likely increases. More on target is the industry term "restructured," but some observers prefer "reformed" or "competitive" as a simple term.

The scope of regulation does shrink in some areas, notably as regulators no longer have direct oversight over investment in new generating resources. Nor are regulators involved in approving every term and condition of retail products offered to consumers, although they continue to provide oversight of credit-worthiness, fraud, and consumer protection. Regulators no longer need immediate control over generation investment because these decisions no longer put end users on the hook to repay the investments. Investors shoulder those risks. Regulators no longer need control over all details of retail products because consumers have choices.

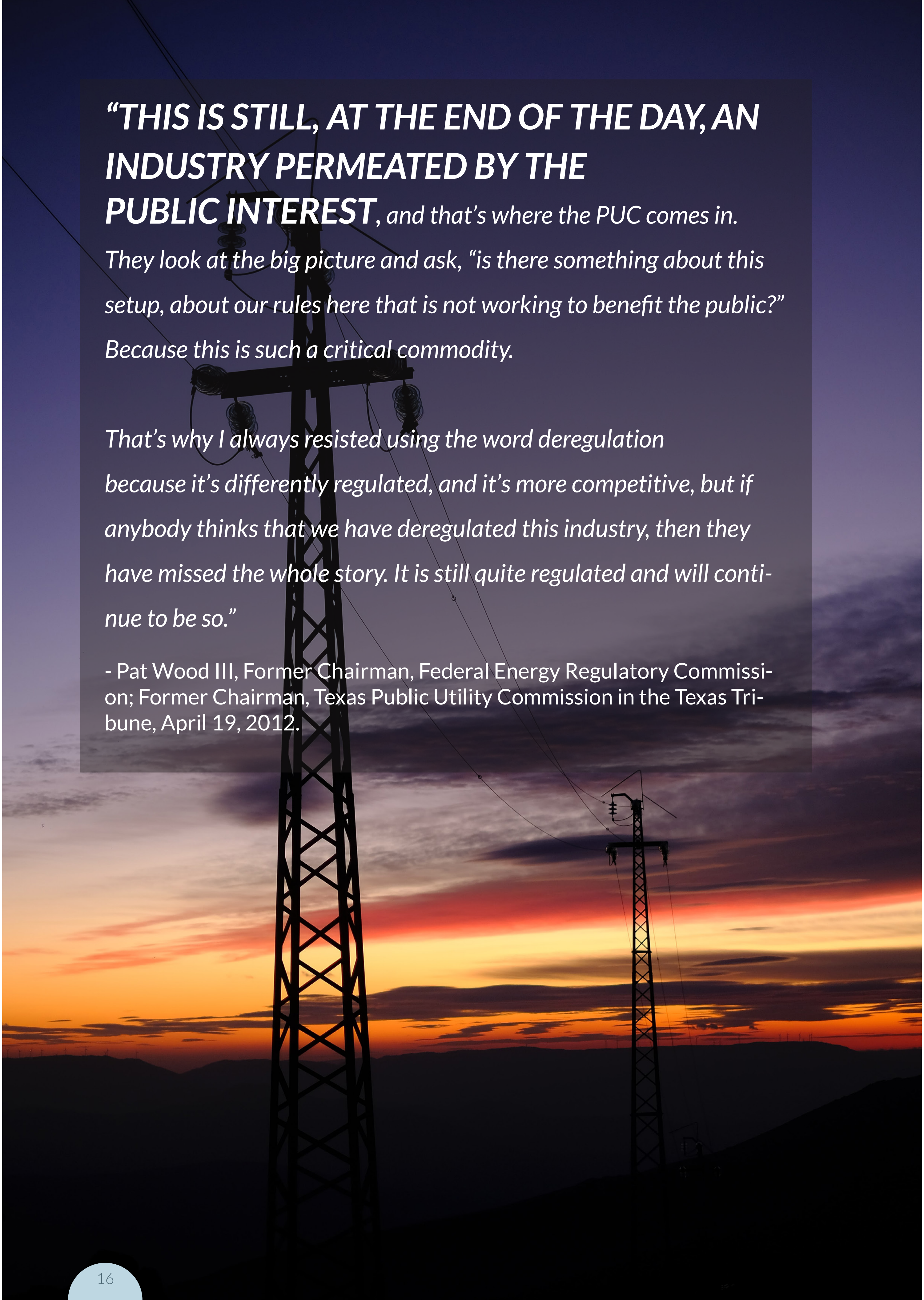
Importantly, regulators also no longer determine rates for either wholesale or retail transactions. Policymaker involvement in these activities is at once both more subtle and more critical: setting the rules governing investment in generation, product and service offerings in retail markets, and price formation in wholesale and retail markets.

The revision of the role of policymakers reflects a re-conception of ideas concerning which things policymakers—state legislators and regulators—can do well and which things private businesses should take responsibility for. Setting the rules is prototypically a policymaker's job. The industry's complexity ensures that getting the rules done well will be difficult. That complexity is one reason that across the fourteen jurisdictions allowing customer choice at the residential level, each pursued slightly different approaches. The benefit of hindsight enables us to understand better which decisions have allowed competition to flourish and which seem to hamper the emergence of competition.

***"THIS IS STILL, AT THE END OF THE DAY, AN INDUSTRY PERMEATED BY THE PUBLIC INTEREST**, and that's where the PUC comes in. They look at the big picture and ask, "is there something about this setup, about our rules here that is not working to benefit the public?" Because this is such a critical commodity.*

That's why I always resisted using the word deregulation because it's differently regulated, and it's more competitive, but if anybody thinks that we have deregulated this industry, then they have missed the whole story. It is still quite regulated and will continue to be so."

- Pat Wood III, Former Chairman, Federal Energy Regulatory Commission; Former Chairman, Texas Public Utility Commission in the Texas Tribune, April 19, 2012.



ECONOMIC PRINCIPLES *for power systems*

Although electricity's physical features influence market design, the fundamental economic principles of the supply-demand market model remain an essential foundation. Markets serve a crucial social purpose by coordinating the actions and plans of individuals who are each pursuing their own objectives and "life projects," as philosophers put it.

Whether those projects are a profit-oriented firm selling energy, a budget-oriented family buying energy for cooking, cooling, and charging, or a small business owner who wants to save money and reduce greenhouse gases by buying wind energy, markets coordinate their actions and plans through the informative role of the price system.

Market participants have personal, private knowledge about their own preferences and opportunity costs. When they want to buy or sell something, they weigh their options and evaluate tradeoffs without knowing specific details of the similar calculations that others are making. All they see are products offered and market prices, and they respond to them. When they do, that choice communicates something about their perception of options and tradeoffs. Market prices that emerge out of this kind of process convey some of this private knowledge and indicate important characteristics like whether a product has become more or less scarce, or more or less expensive to produce, or more or less valuable to some consumers. These emergent market prices are an effective way to convey such information in a world that is complex and involves production and consumption by parties who are independent strangers.

This fundamental concept about the knowledge content of prices is embedded in the institutional framework of markets – the rules (formal and informal) that shape the market context and the incentives facing participants. Market institutions are not created equal; some perform better than others by providing better incentives for decentralized coordination, by aligning market rules with policy objectives, by reducing transaction costs among participants, and/or by providing accurate and transparent investment signals through informative, market-emergent prices.

By necessity power markets are more deliberately designed than the more common markets that have emerged over millennia of human exchange. The requirement for real-time physical balance and the emphasis on reliability shape wholesale and retail market designs. The wholesale market consists of rules for participation, for price formation, for how sellers submit offers and buyers submit bids, for payment and settlement, and for delivery and fulfillment. The retail market design similarly identifies participants, sets some terms of contracts, allows some terms to be flexible, and so on.

Ultimately the market rules aim to help market participants secure the benefits of cooperation while protecting them from things that can go wrong. The two ends of the business, wholesale and retail, present different opportunities for coordination and face different kinds of challenges to be guarded against. Different kinds of transactions need different market rules.

At the wholesale end, businesses are buying and selling power, making future promises to buy or sell power, and supplying the electric grid with support. At the same time owners and potential owners are building new plants and maintaining or retiring old plants. These transactions are almost exclusively about electricity and can involve millions or even billions of dollars. These transactions are big enough to warrant continuous oversight and sometimes teams of business analysts constantly running the numbers and making adjustments.

At the retail end of the business, most of the transactions are only incidentally about electric power. People want to cook a meal, or light a room, or cool a house or office. Each decision may add a few dollars to a monthly bill, or maybe just a few cents. Often the extra expense is so small that the consumer, when thinking about cooking or lighting a room, just does not pay too much attention to the power transaction side of things (cooling a house, on the other hand, can be a big enough part of a bill in Texas to capture at least some serious attention from the consumer from time to time).

The two very different environments for transactions add up to the need for different kinds of rules.

ISSUES IN COMPETITIVE ELECTRICITY MARKETS *for the 21st century*

Will the Texas competitive market continue to adapt to changing circumstances? Since the beginning of the competitive retail market a number of stresses have been placed on the system. Natural gas prices have seen dramatic swings up and down, shifting the pattern of low-cost generation this way and that. Wind power has grown from just over 1,000 MW of installed capacity to nearly 25,000 MW. The Texas economy was more resilient than most during the financial crisis in 2008 and has grown steadily in population, and electric power consumption, since. Change has not stopped. Let's look at some of the new challenges now surrounding the market.

RENEWABLE ENERGY AND DISTRIBUTED ENERGY RESOURCES

Texas policy has relied primarily on market forces to induce investment in wind and solar resources. While these resources have attractive economic and environmental features, they are intermittent and therefore must be integrated as part of a larger generation system that includes complementary energy sources and/or storage.

Texas' history of small-scale distributed generation for industrial activity goes back to the early 20th century, with an emphasis on energy-efficient cogeneration/combined heat and power (CHP).[13] Little of this distributed generation was renewable – through the 1990s Texas had modest amounts of wind and solar capacity, and what renewable capacity existed in the state was small hydroelectric generation. By the late 1990s, though, wind generation technologies had improved enough that investment in wind capacity increased, particularly in wind-intensive areas in West Texas.

The original deregulation legislation in Texas, SB 7, incorporated several provisions to encourage renewable energy.[14] SB 7 included a renewable portfolio standard (RPS) that was modest by comparison with other states, but served as a policy platform for signaling the combined economic and environmental value of investing in wind generation. SB 20 in 2005 augmented the original renewable target, as energy economist Jay Zarnikau noted in 2011:

> *SB 7 set an initial goal for renewable energy capacity of 2000MW by 2009. SB 20 in the 2005 legislative session increased Texas' goal for renewable energy to 5880MW in 2015 and set a "voluntary" target of 10,000MW of wind power for 2025. Texas has already met the 2015 goal and is on track to meet the 2025 goal well ahead of schedule.*[15]

Texas also learned from the beneficial economic and environmental effects of federal sulfur dioxide emission permit trading and implemented tradable renewable energy credits (RECs) as a tool for meeting renewable generation targets. Load-serving entities, which are the retail energy providers in Texas, are required to have a market share-weighted number of RECs as their contribution to the state's renewable energy goals, and they can meet that requirement by either purchasing renewable energy to sell to their customers or by purchasing RECs in the market.[16]

While West Texas is rich in wind energy potential, the ability to capitalize on wind investments there was constrained by the lack of a transmission network. Increases in wind capacity would create congestion on the existing network, which would lead to price differences across ERCOT in a balkanized wholesale power market. To facilitate these wind investments, SB 20 in 2005 also included provisions to facilitate statewide planning for grid expansions based on the locations of the most attractive renewable resources. These Competitive Renewable Energy Zones (CREZ) connected wind-rich areas of West and South

[13] *Nat Treadway. "Distributed Generation Drives Competitive Energy Services in Texas," in L. Lynne Kiesling and Andrew N. Kleit, eds., Electricity Restructuring: The Texas Story. Washington, DC: AEI Press, 2009.*

[14] *Dennis Elliott et al. "New Wind Energy Resource Potential Estimates for the United States". Available at: https://www.nrel.gov/docs/fy11osti/50439.pdf. Additionally, maps of potential wind capacity and generation from WINDExchange at U.S. Department of Energy available at: https://windexchange.energy.gov/maps-data/321.*

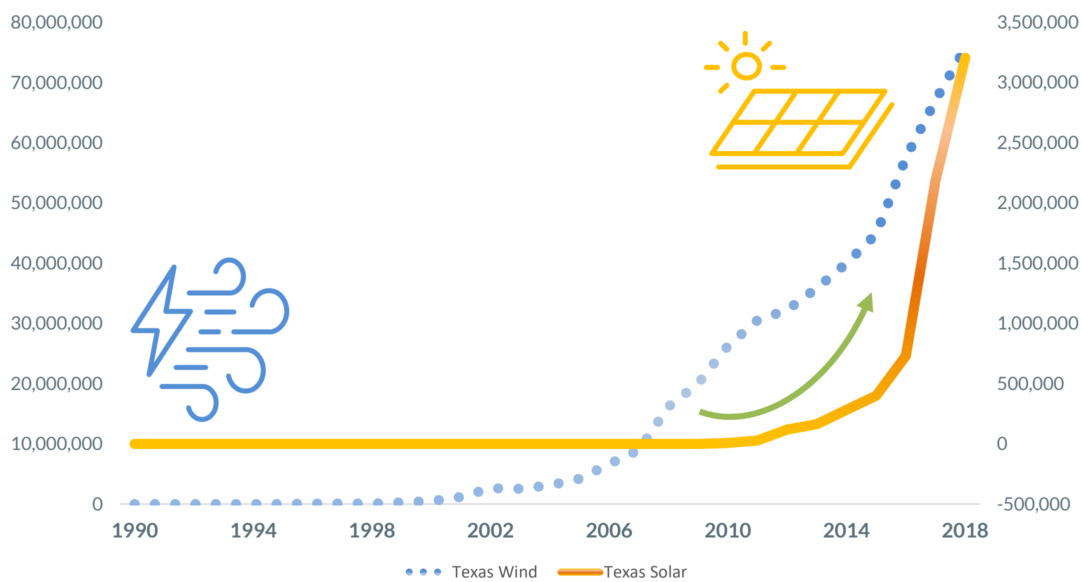
[15] *Jay Zarnikau. "Successful Renewable Energy Development in a Competitive Electricity Market: A Texas Case Study," Energy Policy 39 (2011), p. 3909.*

[16] *ERCOT's description of the REC program is available at https://www.texasrenewables.com/recprogram.asp.*

Texas into the transmission grid, enabling increased sales of wind power to meet demand in urban areas elsewhere in the state. By the time $7 billion in transmission investment projects in the five CREZ zones were completed in 2013, investments in installed wind capacity had increased while transmission congestion fell, and wholesale market prices converged across ERCOT, creating an integrated market capable of capitalizing on Texas' wind resources.[17] Developers find that development costs are generally lower in Texas than other states due to faster permitting times and a regulatory environment conducive to investment and innovation.[18]

These state policies have harnessed competition and markets to facilitate energy innovation by reducing transaction costs in adoption and deployment. As a result, wind and solar investments have grown in Texas since 1990. Figure 6 below shows the amount of power generated annually from wind and solar photovoltaic (PV) in megawatt hours (MWh) from 1990 to 2018. Note the dramatic increase in wind generation as capacity increased and more wind resources were integrated into ERCOT's markets after the CREZ-enabled investments in 2006-2013. Solar's different growth trajectory arose from its less attractive cost profile and lower energy efficiency compared to wind through the mid-2010s. Both wind and solar PV projects have seen larger-than-expected cost reductions as energy efficiency improves, production grows, and a competitive solar installation market drives down installation costs.[19]

Figure 6: Wind (left axis) and Solar PV (right axis) Generation in Texas, 1990-2018



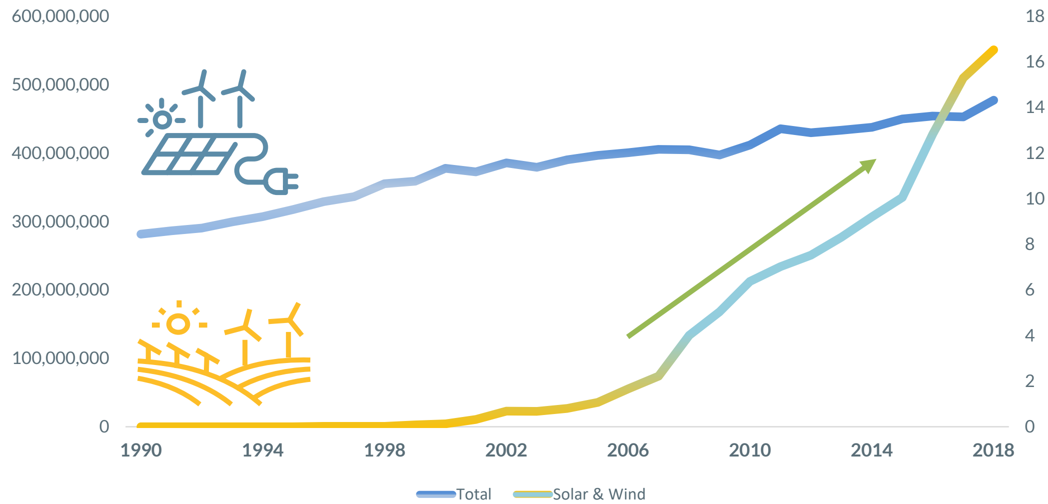
Source: EIA State Historical Tables, October 2019

[17] Xiaodong Du and Ofir Rubin. "Transition and Integration of the ERCOT Market with the Competitive Renewable Energy Zones Project," The Energy Journal 39(4): 235-259. See also Alison Silverstein, Resource Adequacy Challenges in Texas: Unleashing Demand-Side Resources in the ERCOT Competitive Market. Environmental Defense Fund, May 2020, p. 29. Available at: https://www.edf.org/media/report-how-texas-can-unleash-next-wave-electricity-market-competition.

[18] Jay Zarnikau. "Successful Renewable Energy Development in a Competitive Electricity Market: A Texas Case Study," Energy Policy 39 (2011), p. 3910.

[19] Adelina Jashari, Jana Lippelt, and Marie-Theres von Schickfus. "Unexpected Rapid Fall of Wind and Solar Energy Prices: Backgrounds, Effects and Perspectives." In CESifo Forum, vol. 19(2) (2018): 65-69. München: Ifo Institut–Leibniz-Institut für Wirtschaftsforschung an der Universität München. For an analysis of wind turbine cost reductions, see United States Department of Energy. 2018 Wind Technologies Market Report. doi:10.2172/1559881. Available at https://www.osti.gov/servlets/purl/1559881.

Figure 7: Total Electricity Generation (left axis), Solar and Wind Share (right axis), 1990-2018



Source: EIA State Historical Tables, October 2019

Figure 7 shows that while total electricity generation in Texas has increased slowly, particularly over the past decade (left y-axis), solar and wind's share of that generation has increased dramatically since 2007 due to market policies conducive to innovation and investment while the underlying technology costs are falling.

The falling cost and rising energy efficiency of both wind and solar technologies make them increasingly economical while also addressing environmental concerns about pollution and greenhouse gas emissions.

Federal tax policies have also stimulated investment in wind and solar, although as the technologies become more economical those subsidies are being phased out. The federal wind production tax credit (PTC) was implemented in 1992, and has been modified and extended several times. The PTC allows a wind developer to claim a tax credit of 2.4 cents (inflation-adjusted) per kilowatt hour (kWh) generated. The PTC remains available for projects that began construction before January 1, 2020, and will be discontinued for subsequent wind projects.[20]

Solar projects are eligible for a federal investment tax credit (ITC) of 30 percent of the project's invested basis that was implemented in 2006; the ITC is currently scheduled to reduce gradually to a tax credit of 10 percent for commercial and utility installations installed after 2023 and reduce to no tax credit for residential installations after 2023. While intended to increase adoption of renewable technologies, these tax policies also create market distortions, particularly the suppression of prices and amplification of periods of negative prices. Phasing out the wind PTC and solar ITC as those technologies have become commercially attractive will reduce the distortions that the subsidies have introduced into ERCOT markets.

[20] Congressional Research Service. The Renewable Electricity Production Tax Credit: In Brief. CRS Report R43453, November 27, 2018. Available at https://fas.org/sgp/crs/misc/R43453.pdf. Closed-loop biomass and geothermal are also eligible for the PTC. Other renewable technologies were also eligible for the PTC but have been reduced to half credit. See CRS Report R43453 Table 1.

NEGATIVE PRICES IN ERCOT

Although markets typically have positive prices, sometimes power markets have negative market-clearing prices. Negative prices mean a power supplier will pay someone to take their power. They arise in ERCOT for three main reasons: transmission constraints, the construction of new wind capacity in regions with less transmission capacity leading to a mismatch in time and place between supply and demand, and the production tax credit paid to wind resource owners. Negative prices are not unique to the wind industry, though, as Texas has seen negative prices bid by other electric generation resources, including coal and nuclear units, as well as in other energy markets, including natural gas and even oil.

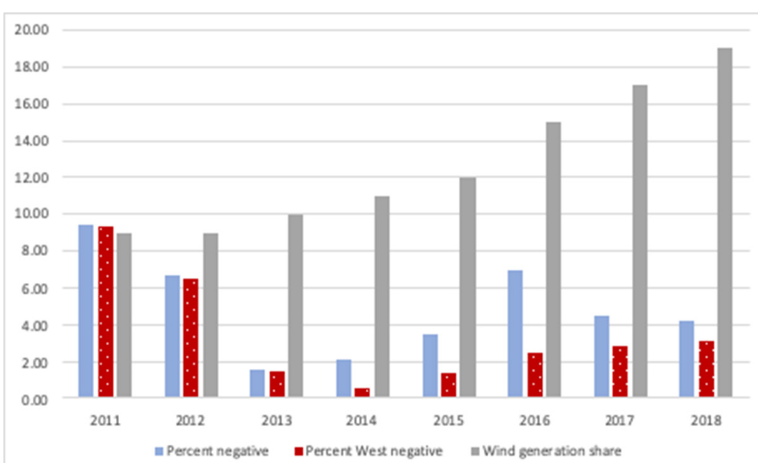
Negative prices in markets with large-scale central generation and demand that is stable (but that fluctuates over the day) tend to occur because of the cost of ramping down the generator's production – turning down a nuclear power plant is expensive, so paying someone to take the power can be cheaper than ramping down generation. Markets enable buyers to benefit from this situation, for example, by being paid for pre-cooling a commercial building and reducing their electricity demand for air conditioning later in the day.

The increasing share of renewables in the generation portfolio introduces a new context for negative prices. In the 2000s as more wind generation came online in West Texas (and costly and uneconomical storage), the West Texas zone of ERCOT saw more periods with negative prices. The combination of insufficient transmission capacity to move the wind power to areas with more demand and insufficient local demand for the power caused negative prices as wind generators sought to get their energy out of constrained areas to demand centers. Thus high wind periods can also be periods with negative market prices.

In a transmission network with no congestion, inexpensive wind in West Texas could power consumption on the Gulf Coast. But when network capacity to deliver that power does not exist, markets balkanize, prices diverge, and plentiful West Texas wind power sells locally at a negative price (or is curtailed or not used if no local demand exists even at a negative price).

Wind is a challenging energy resource because it tends to be most available in sparsely-populated locations and when demand is relatively low, such as overnight and in winter months. Figure 8 shows the percentage of time that ERCOT experienced negative prices overall and in the West Texas zone.

Figure 8: Negative Prices ERCOT-wide and West Zone



Source: ERCOT annual reports 2011-2018

The increasing incidence of negative prices contributed to the impetus for the CREZ transmission investments that went live in 2012 and 2013.[21] ERCOT and PUCT used negative price data as signals indicating congestion and market balkanization that could be reduced through transmission capacity investment.[22] The foundational commitment to competition led PUCT staff to use these price signals as information guiding their policy decisions about where transmission investment would be most valuable. As Figure 8 shows, negative price incidence fell sharply in 2013, indicating the effects of CREZ investments. More recently, ERCOT has experienced more negative prices in West Texas as wind's share of generation has grown from 15 to 19 percent.

A third factor contributing to negative prices in ERCOT has been the production tax credit (PTC). Wind companies receive the PTC based on actual generation, so they are willing to pay up to the amount of the PTC in pre-tax income (which had been $34/MWh and is now $23/MWh) to continue generating and not curtail production. The PTC subsidy has introduced a distortion to ERCOT markets by amplifying the phenomenon of negative prices. The scheduled elimination of the wind PTC at the end of 2020 should reduce this distortion.

ERCOT has experienced negative prices due to increased wind energy in the market, and has used negative price patterns to inform transmission investment and long-term infrastructure planning. These market-based policies have succeeded in attracting wind (and now increasingly other energy resources like solar and storage) investment to Texas. By comparison, California is a state that also has a large economy and population, is also physically well-suited to renewables, and yet provides a contrast to Texas by creating a very different policy environment. While California does have a wholesale power market (the California Independent System Operator, or CAISO), its political landscape relies more heavily on mandates and on state subsidy programs to supplement the federal tax credits for wind and solar.[23] California also has net energy metering regulations that enable residential solar owners to receive payment of the full retail rate for any excess energy they "sell back" to the utility, which amplifies the encouragement for homeowners to install solar.

CAISO's incidence of negative prices arises for different reasons and in different times of the day and year than in Texas. California relies on more hydroelectric and solar power, both of which are abundant in the spring. In rainy years like 2011 and 2017, "run of river" hydroelectric plants generate more electricity, pushing down CAISO prices and increasing the incidence of negative prices.[24] The second reason is the policy-amplified increase in solar capacity, including residential rooftop solar. For example, in 2017 "Negative prices occurred more frequently in the 15-minute and 5-minute markets during 2017 compared to the previous year as a result of a growth in installed renewable capacity and increased hydro-electric generation. Negative prices during 2017 were most frequent in midday hours between February and April when loads were modest and hydro and solar generation were greatest."[25]

In contrast to the market-based use of negative prices as a signal to inform investment, California passed legislation requiring utilities to invest in energy storage capacity by 2020.[26] The high incidence of negative prices in 2017 suggests that this legislation's effects have so far been limited.

When transmission capacity is insufficient to transport wind energy as it is generated, then the generator may be curtailed, which means that the dispatch controllers in ERCOT tell those resources that they are not allowed to send out

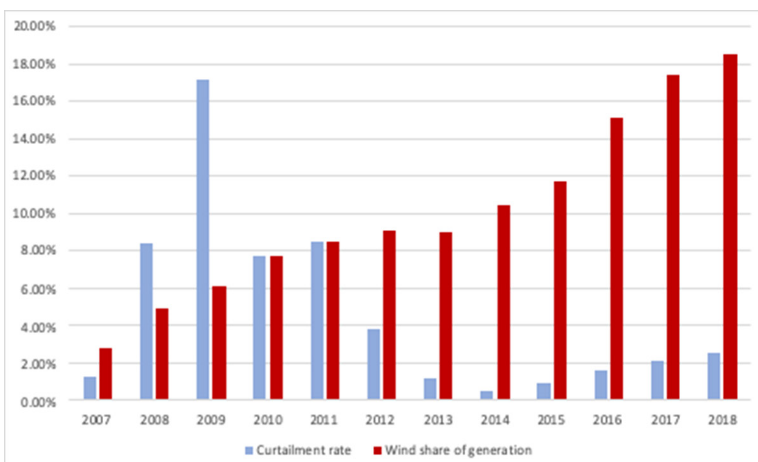
[21] Jess Totten. "Texas Transmission Policy," p. 103, in L. Lynne Kiesling and Andrew N. Kleit, eds., Electricity Restructuring: The Texas Story. Washington, DC: AEI Press, 2009.

[22] Eric Schubert, and Parviz Adib, "Evolution of Wholesale Market Design in ERCOT," in L. Lynne Kiesling and Andrew N. Kleit, eds., Electricity Restructuring: The Texas Story. Washington, DC: AEI Press, 2009.

[23] Felix Mormann, Dan Reicher, and Victor Hanna, "A Tale of Three Markets: Comparing the Renewable Energy Experiences of California, Texas, and Germany," Stanford Environmental Law Journal 35 (2016), pp. 65-67.

their energy. Figure 9 shows the curtailment rate in ERCOT in comparison to the share of generated energy coming from wind resources. Curtailment was particularly high 2008-2011 (and especially in 2009), and was alleviated starting in 2012 as the CREZ program's transmission investments increased network capacity. Low curtailment rates along with increasing wind shares since 2013 show the effects of the CREZ program, although curtailment has increased again recently. Reducing transmission constraints and congestion reduced the incidence of negative prices and curtailment, and integrated the regional zones in ERCOT into a well-connected market.

Figure 9: Wind Curtailment and Share of Generation, Texas, 2007-2018



Source: United States Department of Energy, Wind Technologies Market Report, 2018, Figure 42

ERCOT and PUCT view the informative role of the price system as an important aspect of how the competitive market adapts to innovation. Everything has tradeoffs and wind is no exception. It provides clean and increasingly affordable power, but requires investments in transmission and the use of other resources to address intermittency. Negative prices send both an investment signal and a purchase signal. The CREZ program explicitly used such price signals to coordinate transmission investment where it was likely to be most valuable. The ability of resources to participate in markets, often using automation, means that resources that can respond with flexibility can profit from that capability.

[24] Lucas Davis, "Is solar really the reason for negative electricity prices?" Energy at Haas, August 28, 2017. Available at https://blogs.berkeley.edu/2017/08/28/is-solar-really-the-reason-for-negative-electricity-prices/.

[25] California Independent System Operator 2017 Annual Report. Available at http://www.caiso.com/Documents/2017AnnualReportonMarketIssuesandPerformance.pdf.

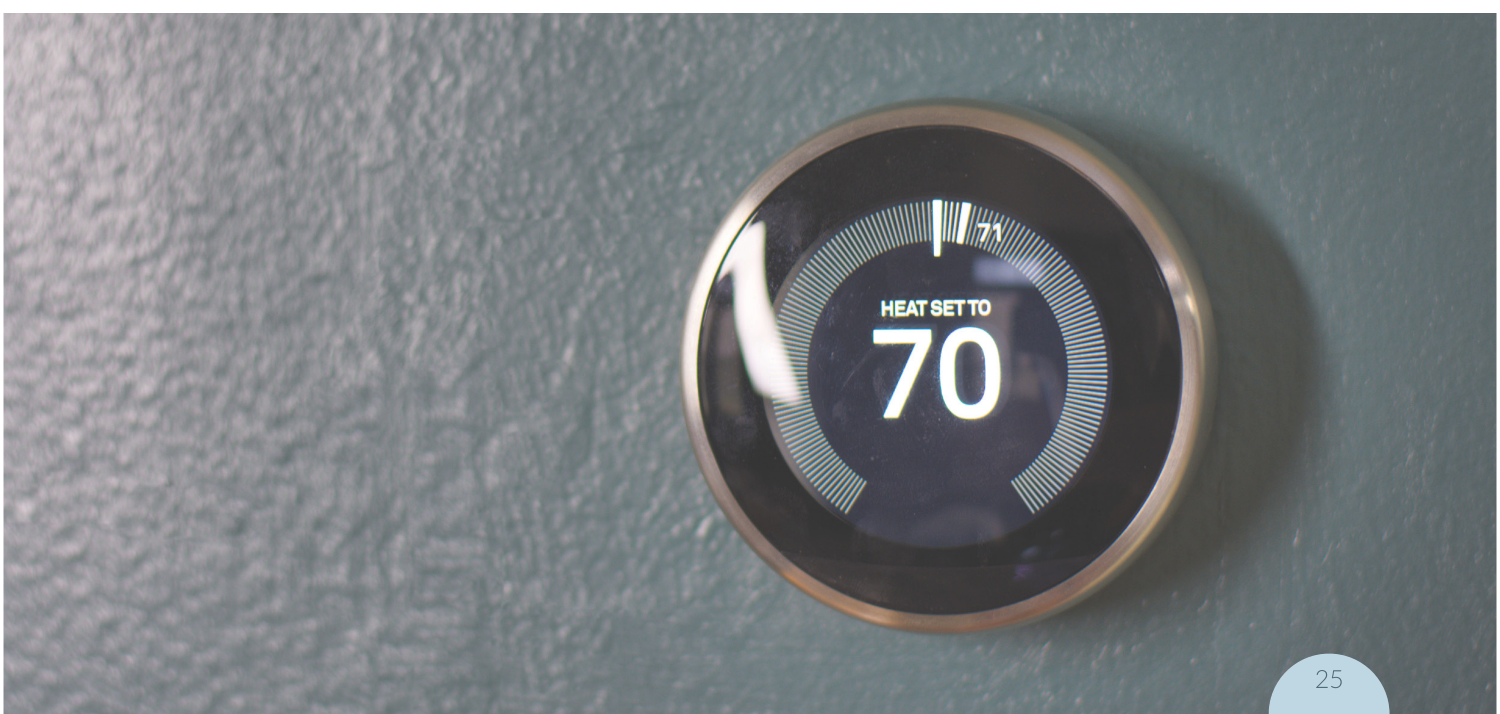
[26] Felix Mormann, Dan Reicher, and Victor Hanna, "A Tale of Three Markets: Comparing the Renewable Energy Experiences of California, Texas, and Germany," Stanford Environmental Law Journal 35 (2016), pp. 88-89.

ACTIVE DEMAND AND DEMAND RESPONSE

In a traditional vertically-integrated regulatory framework, demand is assumed to be inelastic or unresponsive to price changes. Rates are cost-based and fixed by regulation, reflecting the average cost of providing standard service and generally are not varying over the course of the day even though the marginal cost of generating energy does vary. Changes in technology and the competitive regulatory framework in Texas are challenging that assumption.

Active demand, including demand response either to changing prices or to an administrative RTO program, yields several benefits. By reducing quantity demanded when prices are high, demand response reduces the frequency and magnitude of prices spikes, reducing energy costs both to those engaged in active demand response as well as those who do not respond but pay lower prices due to the impact of reduced demand on the grid. High prices tend to occur in peak hours, so by shifting demand to other hours, demand response reduces peak demand, which consequently reduces the chance of outages and overall transmission and distribution system costs. These system benefits are the main motivation for administrative demand response programs that pay customers for reducing consumption when the RTO requests it. RTOs in the US, including ERCOT, have such administrative demand response programs that have been designed for large commercial and industrial customers, but also enable the participation of aggregations of residential and small commercial customers.

Active demand and demand response from residential customers are now easier and cheaper than before because Texas utilities in the ERCOT territory have implemented digital metering. With guidance from the Public Utility Commission of Texas, distribution utilities began installing digital meters in 2008 and completed the digital meter rollout in 2012, replacing all of the analog meters in their service territories. Digital meters enable residential customers to send and receive data in 15-minute intervals. The data from the meter can be sent to devices in the home, which can be automated to change their settings in response to real-time data from the meter, which is called transactive energy. For example, if there's a price spike during a heat wave, sending that price to a household's thermostat can trigger an automatic temperature setting change in the thermostat, reducing energy consumption and protecting the customer from paying that high price. Such distributed small-scale demand response can add up to a big enough response to dampen price spikes during heat waves, saving money for customers while also conserving energy at the exact times when generating it is the most expensive.



MARKET DESIGN FOR ENERGY STORAGE SYSTEMS

Cost-effective energy storage has long been the holy grail of the energy system. Energy storage would reduce some of the costly real-time coordination between generation and consumption, between supply and demand. In an electricity system with a growing share of intermittent renewables, economical energy storage becomes all the more valuable because it mitigates some of the costs of intermittency while enabling access to the environmental and resilience benefits of those resources.

Wind and solar resources are intermittent, and thus need to be part of a broader generation mix with complementary fuel sources. The chief complement to renewables thus far has been natural gas. But increasingly it will be storage as costs fall and investments increase. Energy storage technologies range from pumping water uphill (which has been used for millennia) to newer and more portable lithium-ion batteries. Improvements in battery energy efficiency and production costs in the past five years have increased investments in battery storage, particularly at larger scales.

Independent storage companies are beginning to invest in Texas, drawn to the state by the high amount and share of wind and solar in the resource portfolio as well as ERCOT's market design and low entry costs (although ERCOT is generally viewed as a rivalrous, competitive environment for suppliers). For example, in 2018 Vistra Energy built a 10 MW capacity battery storage system alongside a solar facility in West Texas.[27] More recently, GlidePath Energy has built a 10 MW storage system south of Houston,[28] and is adding storage to wind farms in North Texas (in the Southwest Power Pool wholesale market, not ERCOT) that it purchased from Exelon Generation.[29]

Storage arbitrages price differentials across time and across regions in Texas, and provides flexibility that will become increasingly valuable as the share of renewables increases. It also increases capacity utilization across all resources in the system, thus improving efficiency. In Texas, where generation reserve margins have been below ERCOT's target of 13.75% in recent years and summer price spikes in heat waves have hit the $9,000 price cap, investors see battery storage as a potentially profitable way to increase capacity in the system and make energy available in high-price hours. Storage is thus a reliability resource as well as a means of improving economic efficiency in the system.

CHALLENGES TO THE MONOPOLY QUARANTINE: KEEPING MARKETS COMPETITIVE BY RESTRICTING UTILITY PARTICIPATION

For most of the 20th century, investor-owned electric utilities in the United States have been regulated monopolies that are vertically integrated, with a single firm performing generation, transmission, distribution, and retail functions. In the 21st century, falling transaction costs due to digital technologies are changing the footprint of the regulated utility. Texas is a leader in taking advantage of innovation to enable competition to serve the interests of electricity consumers.

Digital devices bring embedded sensors and automation to the core and the edge of the distribution grid, which means that more people can take more control of their own energy use and energy budgets, and can use digital technologies to automate that control. Digital technologies reduce transaction costs and make it easier and cheaper for more people to participate in markets, especially in a state like Texas that already has a well-established retail market with retail energy suppliers. Digital technologies also enable easier DER interconnection, reducing the cost of installing residential rooftop solar and working with a retailer to be able to sell energy into organized markets with little effort.

[27] Julian Spector. "How Vistra and FlexGen Made the Largest Battery in Texas Pencil Out." Greentech Media, June 22, 2018, https://www.greentechmedia.com/articles/read/how-vistra-and-flexgen-made-the-largest-battery-project-in-texas-pencil-out#gs.tl96UK0.

[28] Julian Spector. "GlidePath Builds Merchant Battery Plant in ERCOT, Bucking Industry Wisdom." Greentech Media, June 17, 2019, https://www.greentechmedia.com/articles/read/glidepath-bucked-the-industry-trend-and-built-a-merchant-plant-in-ercot#gs.xb2qzh.

[29] Julian Spector. "GlidePath Took on Storage in Texas. Now It Wants to Add Batteries to Wind." Greentech Media, August 21, 2019, https://www.greentechmedia.com/articles/read/glidepath-took-on-storage-in-texas-now-it-wants-to-add-it-to-wind.

Texas has done a better job than the other restructured states of *quarantining the monopoly*.[30] The phrase "quarantine the monopoly" arises from the work of William Baxter, who in his position as Assistant Attorney General in the U.S. Department of Justice in the 1980s was the primary architect of the settlement of the U.S. vs. AT&T case that led to AT&T's divestiture in 1982. One of Baxter's principal concerns regarding the welfare effects of the AT&T monopoly was what came to be known as Baxter's Law, or the Bell Doctrine — if there is sufficient rivalry or potential rivalry in that related market, then allowing monopolist participation in that market could reduce or stifle competition, enabling the monopolist to extend its monopoly into the related market. Baxter's argument was that the best feasible approach to such a situation, in which a regulated monopolist sits in the middle of a vertical supply chain with competitive or potentially competitive markets on either or both sides, is to quarantine the monopoly by restricting its market participation to its regulated functions.

The best way to do this is to separate the ownership and control of the regulated functions from the other competitive or potentially competitive functions.

Other states struggle with costly cross subsidies arising from regulatory programs such as net energy metering, and restructured states continue to offer incumbent default retail service that makes it hard for competing retailers to enter their markets. Texas, however, quarantined the wires monopoly very clearly in its implementation of restructuring. Incumbents were permitted to provide retail service in their native regulated territories only through their affiliated retail providers. They also are only permitted to provide wires-related services, which includes metering, and must offer wires service on open-access terms to their affiliated retailers and to competing retailers. Texas has done a better job than the other states of applying the Bell Doctrine in electricity, and the wholesale and retail markets have thrived and created value for consumers as a result.

New technologies and economic growth of the kind occurring in Texas create new market opportunities, such as residential solar and electric vehicle charging. These industries are likely to see lots of entry and be competitive, yielding benefits for consumers. Regulated utilities, though, have incentives to build and own assets to provide services like these that could otherwise be competitive. Such utility participation in potentially competitive new markets would be a violation of the monopoly quarantine that has made the Texas model the most robust and competitive in the country.

[30] *L. Lynne Kiesling, "Incumbent Vertical Market Power, Experimentation, and Institutional Design in the Deregulating Electricity Industry," Independent Review 19:2 (2014): 239-264.*

CONCLUSION

The Texas model has been frequently recognized as one of the best wholesale and retail electric market designs. Texans are well-known to exaggerate the virtues of their state, so it is worth noting that experts far from Texas are among those singing its praises. Stephen Littlechild, former chief electric power regulator in the United Kingdom, has recognized the state for having "the most advanced and effective electric power market in the US."[31] Littlechild pointed to two contributing factors: first, Texans maintain a general "laisser faire political philosophy towards markets," and second, policymakers have kept regulatory jurisdiction over ERCOT and competitive retail markets at the Texas Public Utility Commission (while in every other state jurisdiction is divided between state regulators and the Federal Energy Regulatory Commission).

Littlechild's summary is solid, but it is worth clarifying what laisser faire ("hands off") means in the context of the Texas electric power model. The Texas model is not deregulation, but rather regulatory reform that means "hands off" certain decisions – generator investments and retail contract prices, for example – but "hands on" in other areas – setting capital requirements to help protect consumers from defaults by their suppliers, discouraging the exercise of market power, and otherwise establishing a foundation for the emergence of a competitive market.

The Texas competitive electric market has been through evolutions and revolutions, and through them all has managed to deliver power at reasonable rates. The regulated electricity of the past was filled with "one size fits all" solutions that at best might have served the majority of consumers well. In Texas consumers sometimes now complain they face so many options it is hard to sort them all out. The latter is the better problem. Texas is a big state and its population is incredibly diverse. "Too many options" usually just means that there are a lot of offers better-suited to someone else's circumstances. Among the many options, though, is likely a few that are better than the old "one size" selection. As the price data show, on average Texans are paying less while getting a wider range of options.

The revolutions and evolutions have not come to an end. As new technology comes along, new opportunities arise and old ones fade in significance. Electricity storage is coming onto the market. Texas is seeing increasing investment in solar, both large scale and small. Customized energy management systems, once the province only of the largest industrial and commercial customers is increasingly becoming possible for small residential customers. As technical advance reshapes the possibilities, old rules sometimes need adapting and new rules need developing. Policymakers and market participants should keep in mind the commitment to competition, which has been maintained even as the market rules have been revised and updated over the years. To the extent possible as changes are made, those parts that have remained as regulated monopoly should remain isolated from competitive sectors. Policymakers and market participants should avoid expanding monopoly services to the extent possible a regulated monopoly, and allow competition to serve customers to flourish as much as possible.

To electric power industry specialists, reliance on competition to regulate industry performance sometimes seems odd. It really isn't. It is the same market approach to regulating prices and product quality that drives innovation in automobiles, housing, agriculture, and other important industries. Of course, none of these industries are unregulated, but the regulations in place are targeted to protect consumers from fraud or abuse and to address specific issues like pollution. Outside of these regulations, producers are free to compete to earn the business of consumers. The goal of policymakers and market participants when reforming the restructured Texas electric power market should be the same. Choose solutions consistent with the foundational commitment to competition.

[31] *Littlechild S. The regulation of retail competition in US residential electricity markets. Technical Report. University of Cambridge; 2018 Feb 28.*

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A Note About COVID-19

Since March 2020 Texas has been experiencing both COVID-19 pandemic-related changes in electricity use and a global collapse in oil and gas prices that will affect the Texas economy. These related events have reduced electricity consumption and shifted consumption from commercial to residential use, and also across the day. The job losses associated with both the pandemic and the oil and gas industry are likely to reduce electricity consumption into the future. The movement toward increasing distributed energy resources and renewable energy will continue despite these events. Maintaining the commitment to competitive power markets in Texas will enhance the forces of innovation, reliability, resilience, and affordability that Texans have embraced.