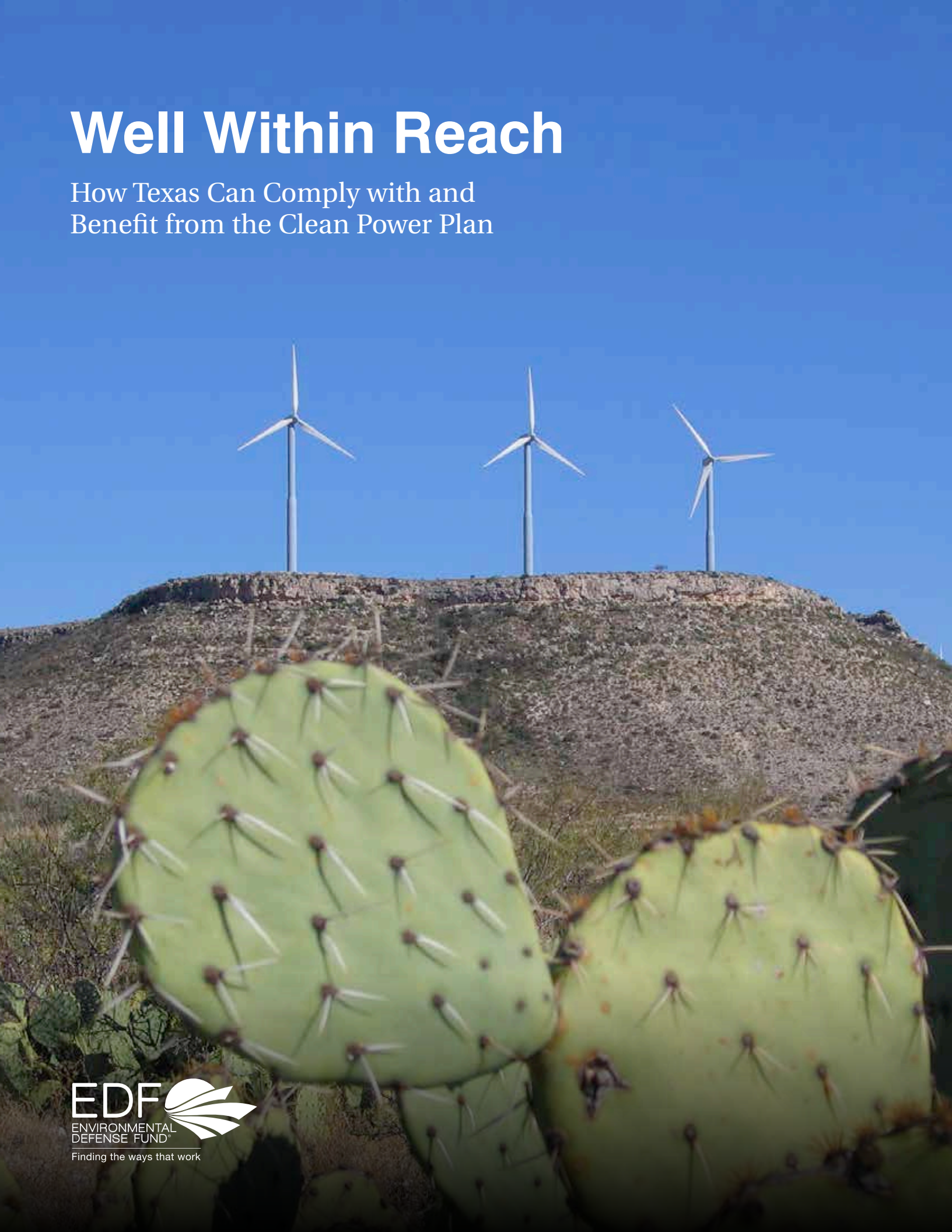
Well Within Reach

How Texas Can Comply with and Benefit from the Clean Power Plan



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Well Within Reach

How Texas Can Comply with and Benefit from the Clean Power Plan

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Acronyms used in this report

ACEEE: American Council for Energy-Efficient Economy
AE: Austin Energy
AWEA: American Wind Energy Association
BAU: Business-as-usual
BNEF: Bloomberg New Energy Finance
CAES: Compressed Air Energy Storage
CEIP: Clean Energy Incentive Program
CHP: Combined Heat and Power
CO_2: Carbon dioxide
CPP: Clean Power Plan
CREZ: Competitive Renewable Energy Zone
DER: Distributed Energy Resource
DR: Demand response
EE: Energy efficiency
EGU: Electric generating unit
EIA: Energy Information Administration
EPA: Environmental Protection Agency
ERC: Emission rate credit
ERCOT: Electric Reliability Council of Texas
FERC: Federal Energy Regulatory Commission
GW: Gigawatt
GWh: Gigawatt hour
HBCU: Historically Black College and University
HISD: Houston Independent School District
IOU: Investor-owned utility
KW: Kilowatt
KWh: Kilowatt hour
LCOE: Levelized cost of energy
MJB&A: MJ Bradley & Associates
MW: Megawatt
MWh: Megawatt hours
NAS: National Academy of Sciences
NREL: National Renewable Energy Laboratory
PACE: Property Assessed Clean Energy
PPA: Power purchase agreement
PUCT: Public Utility Commission of Texas
PV: Photovoltaic
REC: Renewable energy credit
SPEER: South-Central Partnership for Energy Efficiency as a Resource
TCEC: Texas Clean Energy Coalition
TCEQ: Texas Commission on Environmental Quality
TWDB: Texas Water Development Board
TWh: Terawatt hour
Volt/VAR: Voltage and Reactive Power
VVO: Volt/VAR Optimization

Environmental Defense Fund

Environmental Defense Fund is dedicated to protecting the environmental rights of all people, including the right to clean air, clean water, healthy food and flourishing ecosystems. Guided by science, we work to create practical solutions that win lasting political, economic and social support because they are nonpartisan, cost-effective and fair.

Acknowledgments

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The complete report is available online at edf.org/texas-clean-power/

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Executive summary

Texas has a remarkable opportunity on its hands: to use a national policy to capitalize on existing momentum to the benefit of our state's economy and citizens.

On August 3, 2015, Environmental Protection Agency (EPA) finalized the Clean Power Plan, the nation's first-ever limits on climate-altering carbon pollution from existing power plants.[1] Through the new standards, EPA is establishing a flexible framework for states to reduce carbon dioxide emissions from these generation facilities by 2030 through a variety of measures. Furthermore, consistent with comments filed by Texas officials and power companies, EPA made several changes in the final rule to make compliance even more feasible.

As a result of this flexibility, Texas officials have the opportunity to develop and implement a plan that fully harnesses its unique resources and that could bring huge economic gains to the Lone Star State. However, if Texas elects not to create its own compliance strategy, as it chose to do in 2010 with greenhouse gas emissions permitting, EPA will create a plan for Texas. Ceding this critical responsibility to EPA would be an enormous lost opportunity for Texas.

Texas is exceptionally well-positioned to meet its Clean Power Plan target. Market forces already are rapidly transitioning the state to a clean energy economy, and Texas has abundant clean energy resources.

Fortunately, Texas is exceptionally well-positioned to meet its Clean Power Plan target. Market forces already are rapidly transitioning the state to a clean energy economy, and Texas has abundant clean energy resources. For example, the state leads the nation in producing natural gas, wind power, and combined heat and power and has the potential to generate more solar power than any other state.[2,3] Moreover, Texas has substantial energy efficiency and demand response potential.[4] These advantages, if embraced, can enable the state to achieve deep reductions in carbon pollution while providing direct economic benefits to its citizens.

To better understand where Texas stands under the Clean Power Plan, Environmental Defense Fund (EDF) has evaluated differing forecast scenarios for the state's electricity sector, including a "Current Trends" scenario which examines compliance obligations in terms of:

- Business-as-usual trends in electricity generation based on projections from the state's primary grid operator, the Electric Reliability Council of Texas (ERCOT);
- The wind power capacity ERCOT projects will be on the grid in 2017, as well as independent sources' projections to 2029;
- The current energy efficiency results ERCOT's municipal utilities, Austin Energy, and San Antonio's CPS Energy are achieving; and
- The significant impacts that increased production and falling prices of natural gas have in reducing the demand for coal.

EDF also looks at a scenario in which Texas could go well beyond Clean Power Plan compliance in a manner that is achievable and maximizes economic, health, and water benefits.

Key findings and recommendations

These analyses show that under "Current Trends" Texas already is a long way down the road toward meeting its Clean Power Plan requirements. In fact, these trends alone will fulfill Texas' 2022–2029 interim goal and carry Texas 88 percent of the way toward achieving the 2030 goal. The state easily can fill the remaining gap with a handful of thoughtful policy changes, as long as policymakers do not undermine current market trends.

Moreover, the electric industry currently requires a significant amount of water to operate. By 2060, the Texas Water Development Board projects Texas' electricity sector will require an additional 1.1 million acre-feet of water—or enough water to fill Lake Travis—every year. By continuing to grow Texas' clean energy resources consistent with the goals of the Clean Power Plan, Texas could completely eliminate that additional need, which means more water for homes, agriculture, and businesses. In a state that has been plagued by record drought over the past five years, only to see devastating floods provide relief that lasted mere weeks, the value of saved water cannot be understated.

Current trends alone will fulfill Texas' 2022–2029 interim Clean Power Plan goal and carry Texas 88 percent of the way toward achieving the 2030 goal.

The recommendations EDF urges Texas policymakers to adopt are:

- Fully embrace Texas' clean energy resources and develop a state Clean Power Plan that will grow the economy, create jobs, and bring investment into the state.
- Place the emissions obligations of the Clean Power Plan on operating electric generating units (EGUs), or power plants, and authorize owners and operators of these facilities to use flexible mechanisms and market-based programs to achieve compliance.

Furthermore, Texas decision makers could use the opportunity to the state's economic benefit by leveraging its clean energy advantages to help other states comply. This could be achieved through both the sale of credits from surplus carbon emissions or emissions rate reductions, and the export of wind and solar energy to neighboring states.

Leaders should recognize that momentum has been building and market forces already are driving Texas toward a clean energy economy. By crafting a Texan plan that takes advantage of the state's plentiful clean energy resources, state policymakers can transform compliance with the Clean Power Plan into a robust economic development strategy.

Bird's-eye view of the Mueller neighborhood in Austin, TX, where rooftop solar ownership has caught fire.

Pecan Street, Inc.

PART 1

Introduction

The flexibility the Clean Power Plan allows will enable Texas to develop a compliance plan that is consistent with the Electric Reliability Council of Texas' competitive market structure.

Texas is the largest state in the continental U.S. and is experiencing phenomenal population and economic growth. Nearly 27 million people live in Texas,and the state accounts for approximately 10 percent of the nation's power sector emissions of CO_2, more than California, Florida, New York, and New Jersey combined.[5,6] Texas also has a robust and vibrant industrial sector, as well as corporate giants such as Facebook and Mars, that are increasingly turning to renewables for economic reasons.[7]

The Clean Power Plan (CPP) is designed to reduce carbon pollution from power plants in the nation by 32 percent below 2005 levels by 2030.[8] Under the CPP, EPA has established separate national emission standards for coal-fired and gas-fired power plants, which each state may either apply directly to its power plants or convert into a single state-wide emission target. Texas must reduce its power sector's carbon emissions rate from a 2012 baseline of 1,566 lbs/MWh to an average of 1,042 lbs/MWh by 2030, an emissions rate reduction of 33 percent.[9] The CPP sets interim goals to be met as this emission rate gradually is reduced.

A state can adopt emission standards that apply directly to generating facilities or a state measures plan that would apply more broadly.[10] If a state adopts emission standards, the state may adopt a rate-based or mass-based CO_2 goal and may authorize flexible means of compliance, such as trading of emission allowances or credits.[11]

The flexibility the CPP allows will enable Texas to develop a compliance plan that is consistent with ERCOT's competitive market structure. In addition, Texas can develop a state plan (SP) that harnesses its clean energy resources. The state's growth of clean energy resources presents the opportunity for Texas to be a net exporter of natural gas, wind, and solar power, as well as sell carbon allowances or emission rate credits (ERCs) to states who will have a more difficult time complying with the CPP than Texas.

Texas already is progressing towards a clean energy economy due to the fact that:

- Texas already has installed more wind generation than any other state with more than 13 gigawatts (GW) generation capacity online, and that number is expected to almost double to 23.4 GW by 2017.[12] Texas' wind energy potential is estimated to be 2,173 GW, more than twice that of the state with the second most wind potential.[13]
- Texas ranks first in the nation for solar energy potential, estimated to be more than 28,000 GW, almost three times that of the state with the second most solar potential.[14] The solar industry in the state has begun to experience rapid growth with over 1 GW expected to come online by 2016, and ERCOT currently forecasts more than 10 GW of solar projects for interconnection by 2029.[15,16]
- Texas has more natural gas reserves than any other state and currently produces 29 percent of the nation's natural gas.[17]
- Texas has significant potential to deploy more energy efficiency and other energy management programs.[18]
- Texas has more Combined Heat and Power (CHP) potential than any other state, in large part related to its refining and petrochemical sectors.[19]

Texas ranks first in the nation for solar energy potential, estimated to be more than 28,000 GW, almost three times that of the state with the second most solar potential.

It is clear that the state can achieve deep reductions in carbon pollution while providing direct economic benefits to its citizens, and that it could have gone well beyond the targets laid out in the CPP as proposed. Nevertheless, consistent with comments filed by Texas officials and power companies, EPA made several changes in the final rule to make it even easier for the state to come into compliance. That includes:

- **Compliance timeframe.** EPA provided more time for states to develop their plans and for generation companies to prepare for compliance, even though multiple independent analyses of the proposed rule confirmed that the original timeframe was feasible. The final rule requires that the pollution limits start in 2022 rather than 2020, providing a full seven years to prepare for compliance;
- **Phase-in of reductions.** EPA also provided a more gradual "glide path" to compliance goals in 2030 which allows emission reductions to be phased in;
- **Reliability provisions.** Although the original proposal contained multiple, overlapping features that protected grid reliability, EPA went even further in the final rule by providing special provisions to deal with unforeseen reliability events; and
- **Obligation ease.** EPA has reduced Texas' overall emission reduction obligation.

As these changes indicate, EPA went above and beyond to address comments such as those raised by stakeholders in Texas—even though it is clear that the state can achieve even deeper reductions in carbon pollution.

PART 2

Powering Texas: Big, clean, market-driven changes are underway

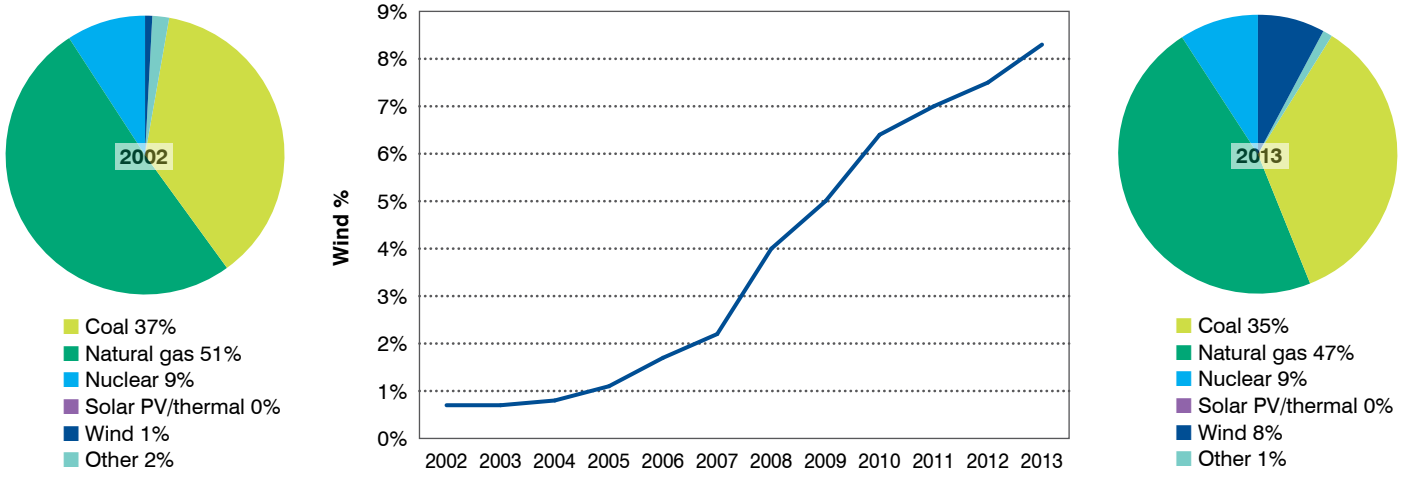
Texas' electricity sector has been trending cleaner over the past decade, and this momentum likely will continue for the foreseeable future. Drivers of this trend include:

- Market forces unleashed by deregulation of the wholesale electric market enacted in 1995 and the retail electricity market approved by the Texas Legislature in 1999;[20,21]
- Construction of the Competitive Renewable Energy Zone (CREZ) transmission lines for the purpose of transporting the electric output from wind and solar power plants as well as other resources in West Texas to the state's large population centers;
- Technological progress and innovations in clean energy as well as the dramatic drop in the price of wind and solar generation; and
- Increased production of natural gas leading to stable, low prices.

Together, these market, infrastructural, and technological forces have made economic conditions more favorable for cleaner sources of power in Texas.

FIGURE 1

Texas generation mix since deregulation: trending cleaner

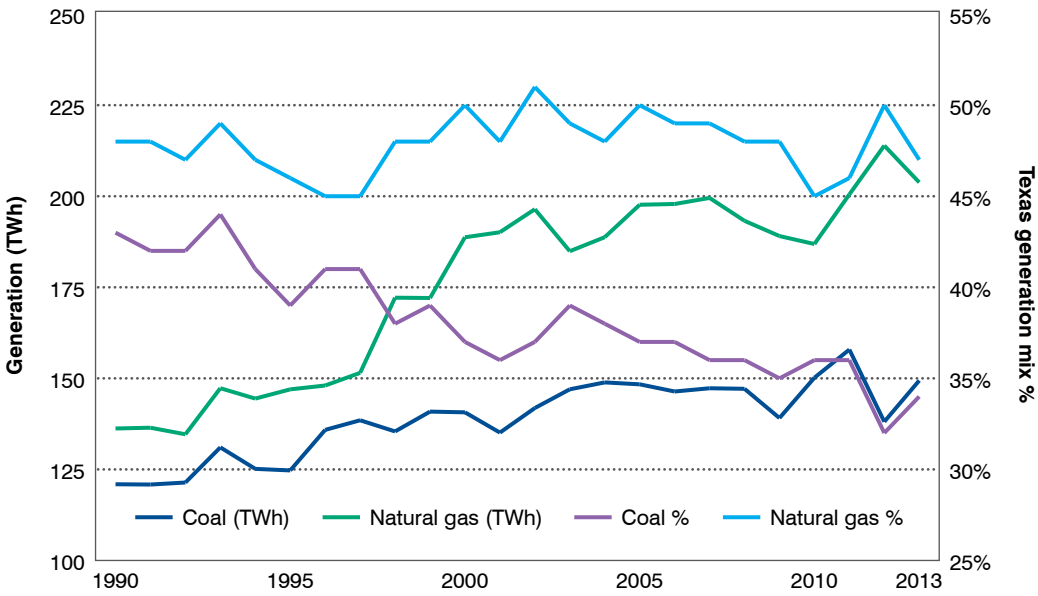


Source: EIA, 2015

FIGURE 2

Coal and gas generation in Texas

1990–2013



Source: EIA, 2015

From 2002, the year of Texas' competitive retail market implementation, to 2013, fossil fuels' slice of the generation mix shrunk 6 percent. Meanwhile, wind's share grew from 1 percent to 8 percent, and the growth of solar generation is increasing.

Texas' generation mix—past and present

Over the past two decades, coal-fueled generation has lost market share to natural gas and renewable energy resources. Further, from 2002, the year Texas' competitive retail market was implemented, to 2013, fossil fuels' (coal and gas) proportion of the state's electricity generation mix shrunk from 88 percent to 82 percent (see Figure 1, page 8). Meanwhile, wind's share grew from 1 percent to 8 percent, and the growth of solar generation is increasing.[22]

While the percentage of natural gas generation generally has remained steady in the range of 45 percent to 51 percent during the 1990-2013 period, the percentage of coal generation declined from almost 45 percent to 35 percent over the same period (see Figure 2).[23]

In sum, renewable energy and natural gas increasingly are powering Texas, while the use of coal is declining as a proportion of the state's generation mix.

Why is this trend toward cleaner power sources occurring?

Lower prices and technological progress for renewables and natural gas—under a deregulated, competitive market structure and in parallel with the construction of CREZ transmission lines—have improved the economic context for cleaner fuel sources.

With breakthroughs in the use of hydraulic fracturing, the price for natural gas as a fuel has declined dramatically over the past decade. Energy Information Administration (EIA) data show natural gas prices were nearly halved during 2008-2014.[24] Since natural gas generation remains the generation on the margin in ERCOT, this price reduction has led to reduced wholesale electric prices in ERCOT (see Figure 3, page 10) and enabled gas generation to compete more effectively against coal generation.[25]

Under this competitive environment, the use of natural gas and renewables—especially wind—also have increased significantly. Just as the earlier construction of the transmission

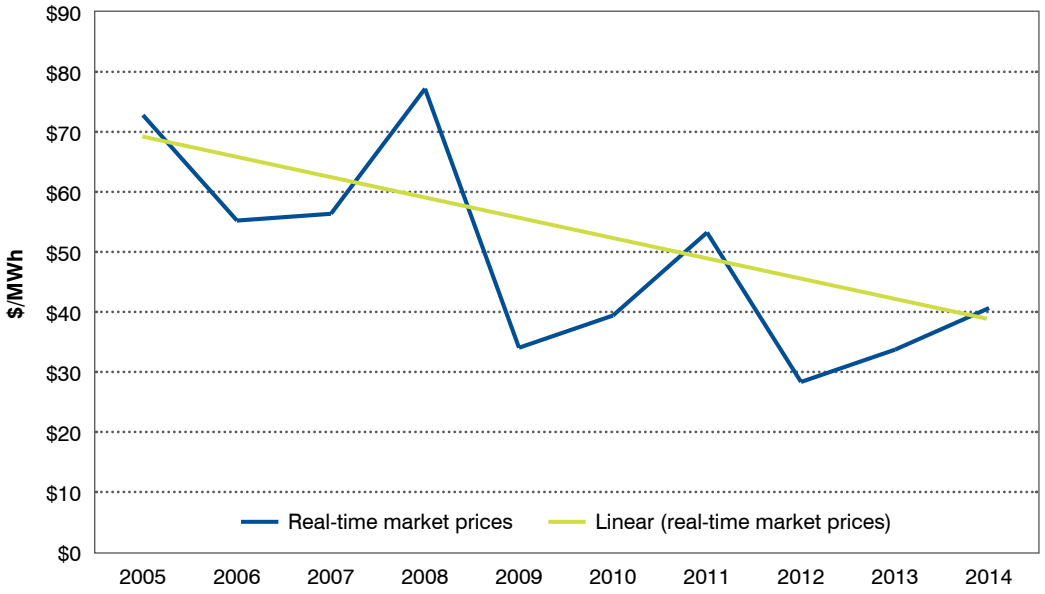
grid was necessary to enable development of coal and gas generation away from population centers in Texas, construction of the CREZ lines enabled the development of significant utility scale wind generation in the state.[26]

In addition, reductions in the costs of wind and solar power have improved clean power's ability to compete in Texas. The levelized cost of energy (LCOE)—the most commonly used metric for comparing cost competitiveness of fuel sources—for solar and wind power dropped

FIGURE 3

Average annual real-time market electricity price

ERCOT 2005–2014

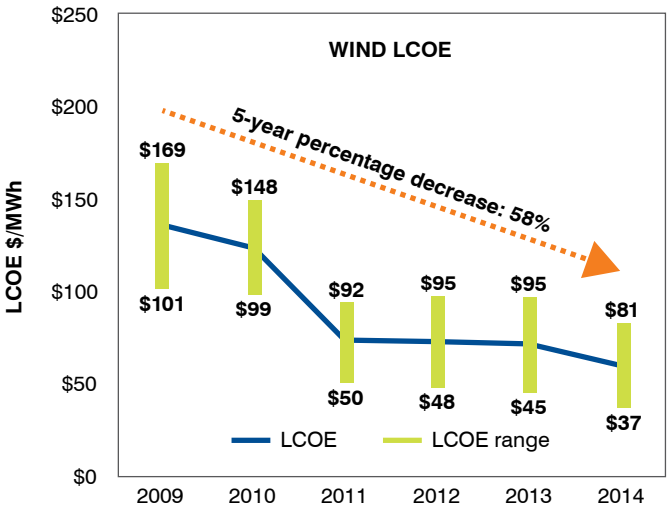


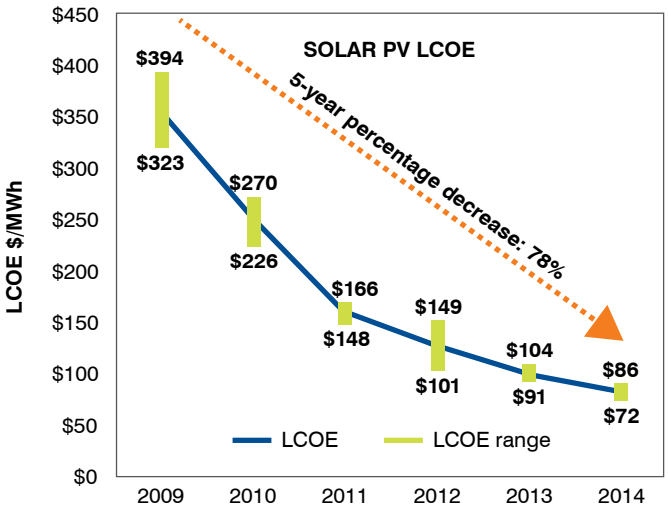
Source: Potomac Economics

FIGURE 4

Wind and solar price curves

2009–2014



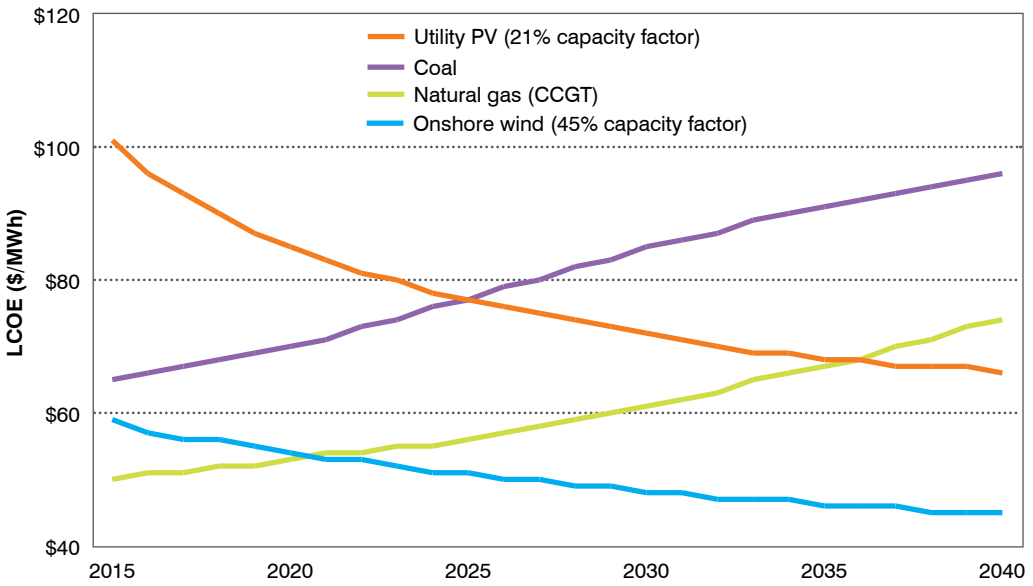


Source: https://www.seia.org/sites/default/files/resources/Levelized%20Cost%20of%20Energy%20-%20Version%208.0.pdf#overlay-context=research-resources/lazards-levelized-cost-energy-analysis-v80

FIGURE 5

U.S. LCOE forecast*

2015–2040



Source: Bloomberg New Energy Finance. "2015 New Energy Outlook—Americas." June 2015.

*LCOE is an acronym for "levelized cost of energy." Here, it is expressed in 2015 nominal dollars (not adjusted for inflation).

Austin Energy is reported to have recently received offers for a solar power purchase agreement at 4 cents/KWh, less than half the 10 cents/KWh Bloomberg New Energy Finance estimates as the average in the United States.

78 percent and 58 percent, respectively, during 2009–2014 (see Figure 4).[27] Bloomberg New Energy Finance (BNEF) forecasts energy from wind and solar will become even more competitive with coal and natural gas in future years. As shown in Figure 5, the costs of coal and natural gas generation are expected to rise steadily over the next 25 years, while those of wind and solar are expected to fall.[28]

Moreover, recent history leads one to believe that the decline in the cost for solar energy in Texas may be faster than reflected in these forecasts. Austin Energy is reported to have recently received offers for a solar power purchase agreement (PPA) at 4 cents/KWh, less than half the 10 cents/KWh BNEF estimates as the average in the United States. This low price is not an aberration and has been seen in other markets in the United States. Nevada Energy, for example, has signed a solar PPA at 3.87 cents/KWh.[29]

As prices for renewables decline, Texas stands to benefit more than any other state. Not only will electricity prices decline, but Texas can also develop renewable energy for export (unless policymakers choose not to prioritize state benefits over partisan politics). According to National Renewable Energy Laboratory, Texas is *by far* the most resource-rich state in the country for wind and solar energy.[30]

New technologies likely will facilitate CPP compliance

In the next ten years, the electric grid likely will change more than it has in the past 100 years. We have witnessed technological breakthroughs in a cluster of innovations—wind, solar, storage, lighting, sensing and control systems, advanced algorithms, communications, and the Internet of Things. As noted above, these innovations already have begun to coalesce to transform how we make, use, manage, and move electricity, and the pace of market adoption is accelerating quickly. The biggest potential opportunities may be in the Distributed Energy Resources (DER) area.

Pecan Street, Inc.: A case study on clean technology leadership in Texas

Pecan Street, Inc. is a research and development organization focused on accelerating innovation in the water and energy sectors. The organization was conceived in 2005 by the City of Austin, Austin Energy, and the University of Texas, among others, to tackle some of today's major urban challenges: create jobs, meet growing electricity needs, and limit climate pollution. First launched in 2008, it became incorporated in 2009, and it was rebranded in 2011 to become the Pecan Street we know today. Environmental Defense Fund is a Pecan Street board member.

Pecan Street's network of 1,200 households in Texas, Colorado, and California, who voluntarily allow Pecan Street to monitor their energy and water usage data, provide utilities, technology companies, and university researchers access to the world's best data on consumer energy and water consumption behavior. Such robust empirical data enable testing and verification of technology solutions and commercialization services thereby accelerating the maturation of clean technology innovations. Pecan Street's data are open source.

The area with the densest congregation of Pecan Street households is the Mueller neighborhood in Austin, TX, where Pecan Street, Inc. is headquartered. When Austin closed the Mueller airport in 1999, community leaders committed to redeveloping the site into a ground-breaking mixed-use, sustainable urban neighborhood. A decade later, Mueller is a bustling green community—home to the world's first LEED-platinum hospital, as well as dozens of green-built office buildings, stores, and homes. Over 250 homes at Mueller are instrumented with metering technologies to report electrical data in one minute and one-second intervals and gas data in 15-second intervals. More than 50 homes report 15-second interval water use data. These monitors record circuit-level (disaggregated) and whole-home electricity use data. There are more electric cars per capital in the Mueller community than in any residential neighborhood in America, and over 200 homes have rooftop solar panels. As a result, *Time* magazine has crowned Mueller as "America's Smartest City."

The market for storage is estimated to grow 10,000 percent from about $30 million to approximately $3 billion over the coming decade.

Distributed energy resources (DERs)

DERs operate at the distribution level and are showing enormous potential to provide sophisticated supply-and-demand balancing on the grid through advanced computerized controls that enable real-time optimization of energy resources. By integrating technologies such as solar, storage, smart thermostats, water heaters, and home energy management systems, we have the opportunity to build more reliability and resiliency into the grid as well as reduce waste from transmission line losses and lower electricity bills. Consumers enabled with DERs have the potential to become reliable DR market participants. DERs quickly are gaining traction in utility markets as a tool for integrating more renewable capacity on the grid. Storage is the most promising opportunity. The market for storage is estimated to grow 10,000 percent from about $30 million to approximately $3 billion over the coming decade.[31] Greentech media also anticipates exponential growth, pointing out that the industry grew 40 percent last year and is expected to grow 300 percent the next year.[32]

The most prominent battery technology currently in the market is Lithium-Ion. Bloomberg New Energy Finance has documented the cost "experience curves" of Li-Ion technologies to demonstrate the rapid decline in cost of this battery technology.[33] Other battery and storage technologies are experiencing similar rapid declines in cost.

In addition to batteries, Texas has the potential to see the benefit of utility-scale storage, particularly Compressed Air Energy Storage (CAES).[34] For example, Apex CAES is in the process of developing a 317 MW generation facility (expandable to 476 MW) in Anderson County that

will compress air in an underground cavern to store energy. This facility has the potential to shift large amounts of clean energy from off-peak to on-peak, and also to enable the integration of increased quantities of low-cost renewable resources into the electric grid.[35]

The solutions to our challenges will require a mixture of these existing and future technologies as well as an understanding of how to apply data to optimize the use of these technologies and provide flexibility and resiliency to the grid.

Advanced energy management practices

For most of its existence, the electricity business has been data poor. But that is changing rapidly with innovations in communication and sensing technologies.

The incumbent electricity players need to be considerably more flexible in order to both accommodate the technological advances transforming the grid as well as survive in an increasingly competitive marketplace.

As Steven Johnson points out in *How We Got to Now*, breakthroughs sometimes happen because of a dramatic increase in our ability to measure something. He states, "New ways of measuring almost always imply new ways of making . . . An increase in our ability to measure things turned out to be as important as our ability to make them."[36] Texas is just beginning to unlock the value of the data from our investment in smart meters that occurred this decade. Companies like Bidgely and Opower are helping Texas retail electric providers extract information to provide insight on how consumers use energy.[37,38] This accelerated flow of information and greater use of data analytics will better enable parties to respond in real time to price signals.

More consumers also are purchasing smart devices that automate and optimize energy consumption. New services are emerging, such as performance monitoring programs that understand the health of appliances and equipment based on interpreting high resolution electrical signatures, which ultimately will lead to more efficient operation of our homes and businesses. With innovative business models, utilities and other market participants will be able to leverage these customer-facing technologies to benefit their operations and increase system efficiency by leveraging investments customers are already choosing to make.

The current market trends are showing there is a broader paradigm shift in the electric utility industry. Not unlike the disruptive change in the telecom industry, the incumbent electricity players need to be considerably more flexible in order to both accommodate the technological advances transforming the grid as well as survive in an increasingly competitive marketplace.

This means that whatever path that Texas takes with its CPP compliance plan, ERCOT, the Public Utility Commission of Texas (PUCT), and the Texas Commission on Environmental Quality (TCEQ) should remain flexible and proactive so that the state can accommodate new and emerging technologies as they likely will improve grid reliability and reduce the cost of CPP compliance.

PART 3

Texas energy efficiency opportunities

In addition to the opportunity to rely on cleaner forms of electric generation, there also is significant potential in Texas to reduce energy consumption overall, as well as to move the use of electricity to low cost and low pollution hours. Three critical means of doing so are:

- Implementation of EE measures, which typically include lighting, air conditioning and heating, roofing, and other building improvements;[39]
- Demand response (DR), in which people and businesses are incented to reduce energy consumption when the electric grid is stressed;[40] and
- Volt/VAR Optimization (VVO) by distribution utilities,which ensures that customers' voltage is "right sized," thereby reducing wasted energy by reducing the total amount of energy put on the electric distribution grid.[41]

The National Academy of Sciences asserts that energy efficiency in residential and commercial buildings could lead to savings of 25-30 percent for the building sector by 2030-2035, and 14–22 percent in the industrial sector by 2020.

Texas EE potential

Over the past few years, several assessments have been completed to determine the EE and DR potential that exist in Texas. In 2008, the PUCT engaged Itron to complete a statewide EE study that concluded that 6.8 percent in energy savings were feasible over ten years, compared to the 2013 rate of 0.21 percent achieved by utilities within ERCOT.[42,43] In addition, the American Council for Energy-Efficient Economy (ACEEE) concluded in 2007 that 11 percent in energy savings were achievable over a 15-year period.[44]

These Texas-specific studies may be understating actual EE savings opportunities. According to McKinsey & Company, the United States' total end-use energy consumption could be reduced by 23 percent by 2020 relative to a business as usual scenario and relying only on measures that pay for themselves over a relatively short time.[45] In addition, the National Academy of Sciences (NAS) asserts that EE in residential and commercial buildings could lead to savings of 25–30 percent for the building sector by 2030-2035, and 14–22 percent in the industrial sector by 2020.[46] The NAS also has concluded that the average cost of conserved electricity in residential and commercial buildings is 2.7 cents/KWh, a fraction of Texas' average 2013 residential and commercial electricity prices of 11.35 cents/KWh and 8.02 cents/KWh, respectively.[47]

Within Texas, Austin Energy (AE) and CPS Energy of San Antonio, the state's two largest municipally-owned utilities located within ERCOT, have demonstrated how EE programs may be implemented cost-effectively in Texas and serve as a model for other parts of the state. The Brattle Group reviewed AE's energy efficiency programs in a 2014 report published on behalf of the Texas Clean Energy Coalition (TCEC), and concluded:

- EE programs saved $2 to $5 for each $1 invested;
- These programs have enabled AE's residential customers to use 900 kilowatt hours (kWh) of electricity per month, compared to an average consumption statewide of 1,200 kWh per month; and
- The cooling efficiency, commercial indoor lighting, and industrial pumping efficiency programs of AE could be extended across ERCOT and would alone reduce peak growth of electricity within ERCOT during 2014–2032 from 17 GW to 10 GW, a 41 percent reduction.[48]

In 2013, ERCOT's privately-owned utilities saved approximately 484,000 MWh through their EE programs.[49,50] AE and CPS Energy combined achieved EE savings of 230 MWh in 2013. Furthermore, AE is mid-way to achieving its 2020 target for peak demand savings due to EE of 800 MW, or 17 percent of what forecasted 2020 peak demand would be without EE, 4,800 MW.[51] Similarly, CPS Energy is midway to achieving its goal of saving 771 MW of electricity between 2009 and 2020.[52] Implementation of similar levels of EE by the investor-owned utilities in ERCOT would provide significant emission reductions towards the requirements of the CPP.

Austin Energy is mid-way to achieving its 2020 target for peak demand savings due to energy efficiency of 800 MW, or 17 percent of what forecasted 2020 peak demand would be without energy efficiency, 4,800 MW.

Non-utility, local-level energy efficiency success stories from EDF's Climate Corps

Non-utility EE measures can help propel Texas to CPP compliance. Below, we highlight EE success stories that EDF's Climate Corps Program has driven in educational and medical facilities within Texas.

- The **Houston Independent School District (HISD)** is the largest public school district in Texas, and the seventh largest in the country, enrolling over 204,000 students. A few summers back, an EDF Climate Corps fellow worked with HISD on projects in behavioral change, lighting, air conditioning, water use, and more. The fellow identified savings from upgrading lighting and air conditioning that could save the school district over $2 million and 27 million kilowatt hours (kWh) annually, the equivalent to powering over 2,500 homes for one year. That's real savings—money that could be spent on essentials like books, teachers' supplies, and technology.
- **Huston-Tillotson University in Austin**, a Historically Black College and University (HBCU), has developed an ambitious target of a 50 percent reduction in campus carbon emissions by 2030, aiming to be one of the most sustainable HBCUs in the country. EDF Climate Corps is helping them reach that goal. Last summer's fellow found savings of 250 metric tons of carbon dioxide emissions annually by uncovering energy and resource efficiency opportunities within individual buildings as well as campus-wide systems. The University was so happy with the results they signed on another fellow for this summer who is currently looking into additional potential energy and water savings across campus.
- The **University of Texas Medical Center in Dallas** hosted a fellow in 2014 who focused on identifying water savings along with energy. She quantified water usage and identified water efficiency savings in research labs, thermal energy plants, and through water reuse projects. In addition to the estimated 36 million gallons of water that could be saved annually, 3 million kWh and more than $300,000 would also be saved due to the high energy needs of water.

These examples underscore the benefits that have arisen in Texas to those who have proactively pursued EE. With an appropriate state implementation plan, savings like these also could contribute to the state's carbon emission reduction goals.

The energy savings that utilities realize through their EE programs are just part of the EE opportunities that exist in Texas. State and local governments also are reducing their energy use to reduce costs. Businesses are doing the same to improve their bottom lines. In addition, prompt adoption of updated building codes by the State of Texas and local governments will produce substantial energy savings. Implementation of Texas' Property Assessed Clean Energy (PACE) program promises to bring about substantial EE outcomes for the state's commercial and industrial sectors. This program enables building owners and operators to acquire low interest loans against the accumulated equity in their buildings to pay for the upfront cost of EE improvements and to repay the loaned amount over time without affecting their bottom lines. Texas has the opportunity to expand this program to residential properties as well. In addition to the resulting energy savings, for every 100,000 homes that are retrofitted, more than 10,000 jobs would be created.[53]

Texas demand response potential

As with EE, Texas' untapped potential for DR is significant. DR is an effective energy management tool which saves customers money if they reduce their electric consumption at times when the electric grid is stressed. ERCOT currently utilizes approximately 2.5 GW of DR capacity, which is roughly equivalent to four percent of the grid's peak demand. [54] In addition, ERCOT estimates there is about an additional 1,400 MW of demand response that is active in the market but not subject to its deployment.[55]

Demand response is relevant to Clean Power Plan compliance because it can reduce the deployment of additional generation facilities, especially inefficient peaking units, and thereby reduce emissions.

In its 2014 report, the Brattle Group evaluated CPS Energy's demand response programs and concluded it was technically and economically feasible to implement these programs across ERCOT and grow DR levels approximately 2.5 times to 6,350 MW, or 9 percent of peak demand.[56]

In 2009, the Federal Energy Regulatory Commission (FERC) estimated DR could shave peak load in ERCOT between 15 and 21 percent.[57] And in a 2007 study, ACEEE estimated that a 13.5 percent peak load reduction in Texas was achievable.[58]

DR is a tool that can help the electric grid manage the variability of electric demand due to changes in weather and consumption. In 2011, DR prevented potential blackouts within ERCOT due to hot weather, and again during the 2014 polar vortex due to power plant malfunctions.[59,60]

DR is relevant to CPP compliance because it can reduce the deployment of additional generation facilities, especially inefficient peaking units, and thereby reduce emissions. According to Navigant Consulting, "DR can directly reduce CO_2 emissions by more than 1 percent through peak load reductions and provision of ancillary services, and that it can indirectly reduce CO_2 emissions by more than 1 percent through accelerating changes in the fuel mix and increasing renewable penetration."[61]

DR is also a key strategy to integrating intermittent renewables.

Volt/VAR optimization

Voltage can be thought of as the "push" or "pressure" behind the flow of electrons. Electric utilities have the challenge of providing electricity to customers at a voltage within a specified range (typically 120 Volts plus or minus 6 Volts) in order to ensure proper operation of customer appliances.

Voltage decreases the further away one gets from a source of electric power, such as a substation. In order to ensure there is adequate voltage at the end of distribution lines, utilities traditionally have provided voltages at the higher end of the specified range closer to sub-stations in order to ensure the voltage is still within the desired range father away from the substation. Until recently, this over-voltage was necessary because of the lack of information

American Electric Power, which operates in Texas and other states, has a Voltage and Reactive Power demonstration project in Ohio. The results of that study showed energy savings of 2–3 percent with associated reductions in carbon emissions, with net savings in cost.

that operators had about voltage levels in the distribution grid. The amount of voltage now can be reduced due to new technologies and their declining costs.

Investments in Voltage and Reactive Power (Volt/VAR) Optimization technologies can provide greater visibility and tighter control of voltages closer to the customer, and ensure that customer voltage is "right-sized," and extra energy is not wasted by maintaining a higher than required voltage on the line. American Electric Power, which operates in Texas and other states, has a Volt/VAR demonstration project in Ohio. The results of that study showed energy savings of 2–3 percent with associated reductions in carbon emissions, with net savings in cost. While ERCOT has used voltage reduction as a tool to respond to system emergencies, in a recent Task Force report, it was recognized that the deployment of smart meters and other technology allows the opportunity for additional voltage control.[62]

PART 4

Progress to Clean Power Plan compliance

Texas is on track under business-as-usual conditions to achieve 88 percent of the required carbon reductions to comply with the 2030 goal.

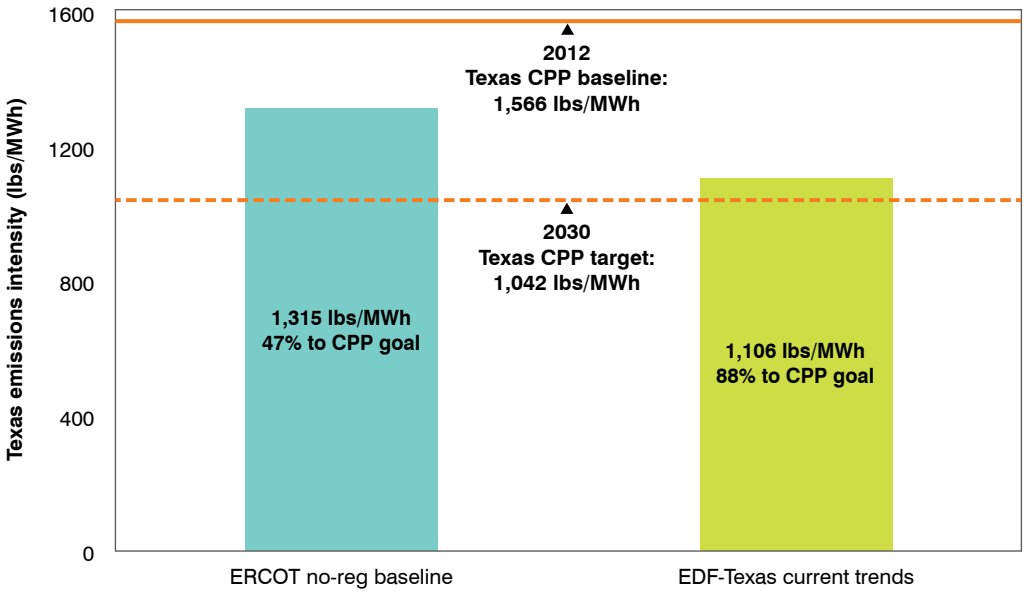
Market forces underway in Texas are propelling the state to meet the carbon emissions reduction goals established in the CPP. Based on ERCOT forecasts, the trend increasingly is toward cleaner power.

Using the MJ Bradley and Associates (MJB&A) "CPP Compliance Tool—Version 2.0," we have analyzed where Texas stands relative to CPP compliance under business as usual (BAU) conditions. [63] The starting point for this analysis is "ERCOT's Non-Regulatory" scenario, which assumes no Cross State Air Pollution Rules or Regional Haze provisions for the state.[64] Under this scenario, using ERCOT's numbers, Texas is already on track to achieve 51 percent of the state's interim goals for 2022–2029 and 47 percent of its goal for 2030.

A closer examination of ERCOT's projections show that there are conditions driving Texas to a clean economy which are not reflected in ERCOT's numbers. EDF believes these factors should be added to ERCOT's numbers to develop a comprehensive current trends scenario. These factors include:

FIGURE 6

2030 blended rate-based target achievability



Based on current trends, Texas' power sector emissions intensity is projected to improve from 1,566 lbs/MWh to 1,106 lbs/MWh, **88%** of the way to the EPA 2030 CPP target of 1,042 lbs/MWh.

TABLE 1

ERCOT's 2012 generation mix vs. BAU generation mix forecasts for 2020 and 2029

	ERCOT 2012[65]	ERCOT no-reg baseline 2020[66]	EDF-Texas current trends 2020[67]	ERCOT no-reg baseline 2029[68]	EDF-Texas current trends 2029[69]
Natural gas (%)	45	44	51[70]	45	51[71]
Coal (%)	34	32	21[72]	29	19[73]
Renewables (%)	9	12	17[74]	17	21[75]
Nuclear (%)	12	10	10	9	9
Energy efficiency savings (% of load)	NA	1	1	1	1.4[76]

TABLE 2

Progress to CPP compliance under current trends

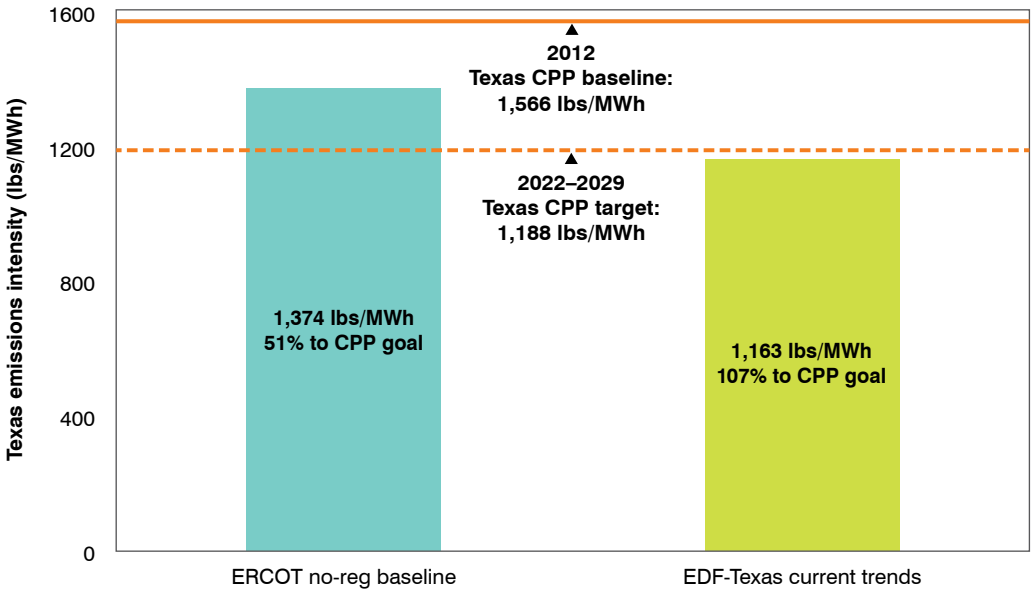
	ERCOT no-reg baseline 2029	EDF-Texas current trends 2029
2022 emissions intensity, assuming linear progress from 2020 to 2029[77]	1,419	1,207[78]
2030 emissions intensity	1,315	1,106
% to achieving EPA's 2030 emissions target, 1,042 lbs/MWh	47	88
2022–2029 emissions intensity, assuming linear progress from 2020 to 2029[79]	1,374	1,163
% to achieving CPP 2022–2029 interim target, 1,188 lbs/MWh, assuming linear progress from 2020 to 2029	51	107

Coal generation costs already are higher than those for natural gas and wind power, and even solar in some instances.

- ERCOT's "Current Trends" scenario from its *2014 LTSA Scenario Results*, which was released within two months of the forecasts in Table 1, shows natural gas comprising 51 percent in contrast to 44 percent and 45 percent of the 2021 and 2029 generation mixes, respectively.[80,81] Many sources predict that natural gas will continue to constitute the same or a growing percent of the Texas generation mix.
- Coal plant retirements due to the Regional Haze requirements likely will exceed ERCOT's forecasted level of 3,900 MW,[82] particularly since the state's coal fleet is relatively old—80 percent will be more than 40 years old by 2029 and 37 percent will be more than 50 years old.[83] In general, these plants have a life expectancy of 40 years.
- Coal generation costs already are higher than those for natural gas and wind power, and even solar in some instances.[84,85] With the continued price reduction in wind and solar, Texas' competitive market tends to push those uneconomic coal plants to retire.
- Texas' installed wind capacity has grown to 16.4 GW in 2015 and will grow to 23.4 GW as soon as 2017, 58 percent and 125 percent increases, respectively, in comparison to the 2012 level of 10.4 GW.[86] This growth, coupled with ERCOT's projections of 10 GW of solar installed capacity by 2029, will increase renewables' generation to 21 percent of the state's generation mix by 2029, or to approximately 100 million MWh.[87,88] This forecast likely is conservative, as both wind industry representatives and reputable independent

FIGURE 7

2022–2029 blended rate-based interim target achievability



Based on current trends, Texas' power sector emissions intensity is projected to improve from 1,566 lbs/MWh to 1,163 lbs/MWh, **107%** of the way to the EPA 2022–2029 CPP target of 1,188 lbs/MWh.

sources, such as SNL Financial and Bloomberg New Energy Finance, contend that wind generation will grow significantly after 2017 rather than decline for unspecified reasons (see Part 5 of this report for more detail).[89,90]

- Current EE activity in ERCOT indicates the state should achieve better cumulative EE savings than 1 percent of load by 2029, the savings ERCOT assumed in its assessment of how to meet the CPP target. Currently, ERCOT is realizing about 750,000 MWh of EE savings annually—65 percent from ERCOT investor-owned utilities (IOUs), 17 percent from AE, 17 percent from CPS Energy, and one percent from the Pedernales Electric Cooperative. During the eight-year stretch of 2022–2029, annual savings of 750,000 MWh would be equal to 6 million MWh of cumulative savings, or 1.4 percent of projected demand.[91,92,93] At present, AE is on track to achieve its 2020 goal of saving 800 MW of peak demand savings through energy efficiency, the equivalent of reducing its peak demand by almost 17 percent, and CPS Energy is on track to achieve a similar goal of 771 MW of electricity savings by 2020.[94,95] With appropriate investment, ERCOT IOUs could be challenged to achieve similar goals by 2030.

Texas' installed wind capacity has grown to 16.4 GW in 2015 and will grow to 23.4 GW as soon as 2017, 58 percent and 125 percent increases, respectively, in comparison to the 2012 level of 10.4 GW.

If one adds these moderate assumptions to the ERCOT projections, one gets what we call the "EDF-Texas Current Trends" scenarios for 2020 and 2029 in Table 1. Under this comprehensive, current trends scenario, Texas is on track under BAU conditions to achieve 88 percent of the required carbon reductions to comply with the 2030 goal; and to achieve a 2022–2029 carbon emissions intensity average of 1,163 lbs/MWh, or 107 percent of the way towards achieving the state's interim CPP goal, during this eight-year period.

This analysis shows CPP compliance in Texas is within our grasp due to market forces, but additional effort still will be needed to achieve compliance.

PART 5

Clean Power Plan compliance and beyond

Texas leaders have voiced concern that compliance with the CPP will increase electricity costs to Texans, especially to the state's low-income households. Yet the evidence indicates that these concerns are misplaced, and that Texas can continue to achieve deep reductions in carbon pollution while maintaining affordable electricity for residents and businesses. First, Texas already is on a path under business-as-usual to comply with most of the CPP emission rate reduction requirements and there have not been the kind of cost increases that the state claimed would happen. To the contrary, power prices in ERCOT have declined significantly since 2005 even as the state's resource mix has become less carbon-intensive.

Second, with only a 12 percent emissions rate reduction gap between business-as-usual and CPP compliance, in the event technological changes do not fill the gap through the normal course of business, only modest cost increases would occur if the costs of the measures required to fill the gap to comply with the CPP exceed current electricity prices.

Third, and most importantly, Texas has the opportunity to fully comply with the CPP in 2030 by using EE to further reduce carbon emissions, growing it from 1.4 percent to 7 percent of peak demand reductions as shown in the "CPP Compliance" scenario in Table 3. EE is Texas' most cost-effective strategy to avoid emissions from electric generation facilities—and in many cases,

Power prices in the Electric Reliability Council of Texas have declined significantly since 2005 as the state's resource mix has become less carbon-intensive.

TABLE 3

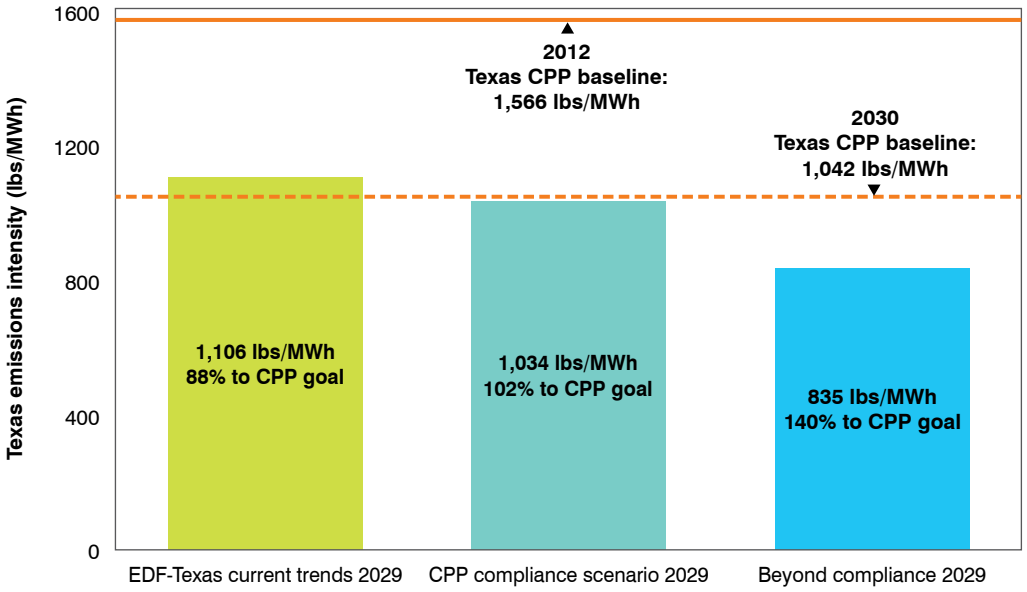
CPP compliance and beyond compliance

	EDF-Texas current trends 2029	CPP compliance scenario 2029	Beyond compliance 2029
Natural gas (%)	51	51	52
Coal (%)	19	19	13
Renewables (%)	21	21	26[96]
Nuclear (%)	9	9	8
Energy efficiency savings (% of load)	1.4	7[97]	10[98]
Implementation of Volt/VAR Optimization (VVO) measures	No	No	Yes[99]
Increase demand response (DR) capacity from current 2,500 MW level to 6,350 MW[100]	No	No	Yes
2029 Emissions Intensity	1,106	1,034	835
% to achieving EPA's 2030 emissions goal, 791 lbs/MWh	88	102	140

FIGURE 8

Current trends, compliance, and beyond compliance

2030 target



would yield direct financial savings for Texas families. For example, EE in residential and commercial buildings costs 2.7 cents/KWh,a fraction of Texas' average 2013 residential and commercial electricity prices of 11.35 cents/KWh and 8.02 cents/KWh, respectively.[101,102] On the whole, EE improvements generally pay for themselves in relatively short periods of time. For this reason, EPA has projected that the CPP will *reduce* average electricity bills by over $80 per year in 2030.

The substantial EE potential that exists in Texas was discussed in Part 3 of this report. In developing its SP, Texas can take steps to ensure that its EGUs can leverage savings from EE currently being realized by state and local governmental entities as well as industrial facilities, the state's PACE program, and through improved building codes. By doing so, Texas would be even farther along in meeting its CPP emission reduction obligations.

EDF strongly recommends that the state strengthen its investments in EE which will deliver a number of benefits to the citizens of Texas while making it easier for the state to comply with the CPP. Those benefits include reductions in a variety of air pollutants, including those that contribute to the ozone problem in the state, as well as reductions in customers' bills and reductions in water consumed by electric generation facilities.

Energy efficiency in residential and commercial buildings costs 2.7 cents/KWh, a fraction of Texas' average 2013 residential and commercial electricity prices of 11.35 cents/KWh and 8.02 cents/KWh, respectively.

Beyond compliance: Texas' opportunity to use the CPP to grow the state's economy

Texas is in a unique position regarding the CPP. The state has an abundance of clean energy resources.[103] In June 2015, SNL Financial forecasted Texas wind power plant supply capacity of 31 GW for 2020, and this estimate was "based on actual planned/under construction projects, and not based on any projects of unreported new developments or retirements."[104] Further, as prices for these resources drop, Bloomberg New Energy Finance forecasts that U.S. wind and solar capacity will grow 32 percent and 271 percent from 2020 to 2030, respectively.[105,106] As the state that consumes the most power and has the most potential for these resources, Texas should comprise a significant proportion of this growth. These growth and downward

price trends, coupled with the fact that the CPP establishes carbon reduction targets across the nation and authorizes states to use emission allowances or ERCs from other states to meet their compliance obligations, mean Texas can use its clean energy assets to help other states comply with the CPP while growing the state's economy in the process.

Texas should take action to increase rather than stifle the production and use of its clean energy resources, including wind, solar, EE, and DR. This bold move by Texas officials would put the state in the position not only to export natural gas and oil in the future, but also wind and solar power. Texas also could sell CPP compliance allowances that are freed up from over compliance or credits that are directly awarded to EE projects and no- or low-carbon generation to other states that have a more difficult path to CPP compliance.[107] However, Texas must take

Early energy efficiency investments not only would reduce electric bills for low-income citizens, but also jump-start job gains that are anticipated from energy efficiency projects under the Clean Power Plan.

Benefits of a Texas-designed plan to reduce carbon pollution

Following the time-tested "cooperative federalism" framework of the Clean Air Act, the CPP establishes minimum, nationwide carbon dioxide standards for existing power plants and provides broad flexibility to the states to design individualized plans that meet those standards. Texas has historically preferred to determine its own regulatory structure for its power sector, including implementing its own Clean Air Act programs under this cooperative federalism framework. Continuing this tradition would allow Texas maximum flexibility to determine how best to meet the emission standards in the CPP, informed by input from a wide spectrum of stakeholders including state regulators, power companies, environmental organizations, and community advocates.

A state-designed plan maximizes opportunities to benefit Texas residents and businesses. If a state does not submit a satisfactory plan to implement the CPP, the Clean Air Act requires EPA to issue a federal plan that implements the program. Such a federal plan would represent a lost opportunity for Texans for two key reasons. First, if Texas doesn't develop its own plan, it misses an opportunity to directly design a plan reflecting its own policy priorities. Second, there are certain cost-effective compliance options that Texas power companies could have the choice to leverage if the state were to design its own plan, but that EPA may not be able to include in a federal plan. A Texas-designed plan would maximize the array of options available to Texas power companies, and also ensure that power companies can leverage the full range of emission reduction opportunities that directly benefit Texas households and businesses—including demand side EE and distributed renewable energy generation.

Texas should take the initiative rather than wait for a federal plan to be issued. It would be far more sensible for Texas to take the initiative to design its own plan now, rather than wait for EPA to issue a federal plan before deciding to do so. If Texas moves to craft its own plan in a timely way, Texas power companies will have the regulatory certainty that comes from knowing the rules of the road, and as a result have maximum time to prepare the investment and resource planning decisions for compliance with the CPP by the beginning of the compliance period. Moreover, providers of EE, renewable energy, and other emission reduction measures will have the certainty they need to start investing and creating jobs. By contrast, waiting until a federal plan is issued—or delaying submission of a state plan—would create significant regulatory and investment uncertainty for Texas generation companies and other businesses. And if Texas were to replace the federal plan with its own plan, owners of regulated power plants would have to manage a potentially complex transition from one set of standards and administrative requirements to another. In short, the more straightforward path for Texas, that provides maximum certainty for the companies in the state with the compliance obligation, is to take the initiative to draft a "made in Texas" plan earlier rather than later.

The Clean Power Plan's flexibility enables Texas to benefit from selling carbon allowance or emission rate credits to other states even if it does not form a joint target with another state.

affirmative action in order to create this economic opportunity and enable emissions trading to occur in a manner most efficient and beneficial to the state.

Given Texas' historical preference for self-determination, it is worth noting that the CPP's flexibility enables Texas to benefit from selling carbon allowance or ERCs to other states even if it does not form a joint target with another state. The CPP states: "This approach enables states to retain their individual state goals for affected EGUs and submit individual plans, but to coordinate plan implementation with other states through the interstate transfer of ERCs or emissions allowances. This approach facilitates emission trading without requiring states to submit joint plans. The EPA considers these to be individual state plans, not multi-state plans."[108]

The "Beyond Compliance" scenario in Table 3 underscores the extent to which Texas reasonably can surpass its final CPP target and reap further economic, health, and water benefits. This scenario includes higher levels of wind power and solar power, energy efficiency, and demand response.

Furthermore, EDF's "Beyond Compliance" scenario would help Texas officials capture additional incentives provided by EPA through the CPPs Clean Energy Incentive Program (CEIP). The CEIP "is a voluntary 'matching fund' program that states can use to incentivize . . . early demand-side energy efficiency projects that are implemented in low-income communities."[109] EPA will award "double" carbon allowances or ERCs to states that implement EE in low-income communities in 2020 and 2021. Early EE investments not only would reduce electric bills for low-income citizens, but also jumpstart job gains that are anticipated from EE projects under the CPP. Further, increased utilization of clean energy resources will provide significant health benefits to low-income communities due to reductions in priority pollutants and air toxics.[110]

PART 6

Benefits of the transition to clean energy under the Clean Power Plan

In addition to the direct benefits of the CPP towards reducing carbon emissions, it is important to note that compliance with the CPP will have other benefits as well, such as water savings, economic development, and health benefits. This section explores those additional benefits.

The Texas Water Deevlopment Board projects annual water demand for this sector increasing by 1.1 million acre-feet from 2010 to 2060, at the cost of $2.3 billion. Much of this projected increased water usage can be avoided, however, if Texas continues to increase its utilization of clean energy resources.

Substantial water savings for Texas

A byproduct of Texas' recent and forecasted economic and population growth is a projected increase in electricity generation and related water consumption.

Pervasive droughts in the Lone Star State

Drought is a regular feature of the Texas landscape. The state recently came out of a multi-year drought, after a series of devastating floods in May 2015, only to plunge back into drought a few weeks later.

Arby Reed/Flickr

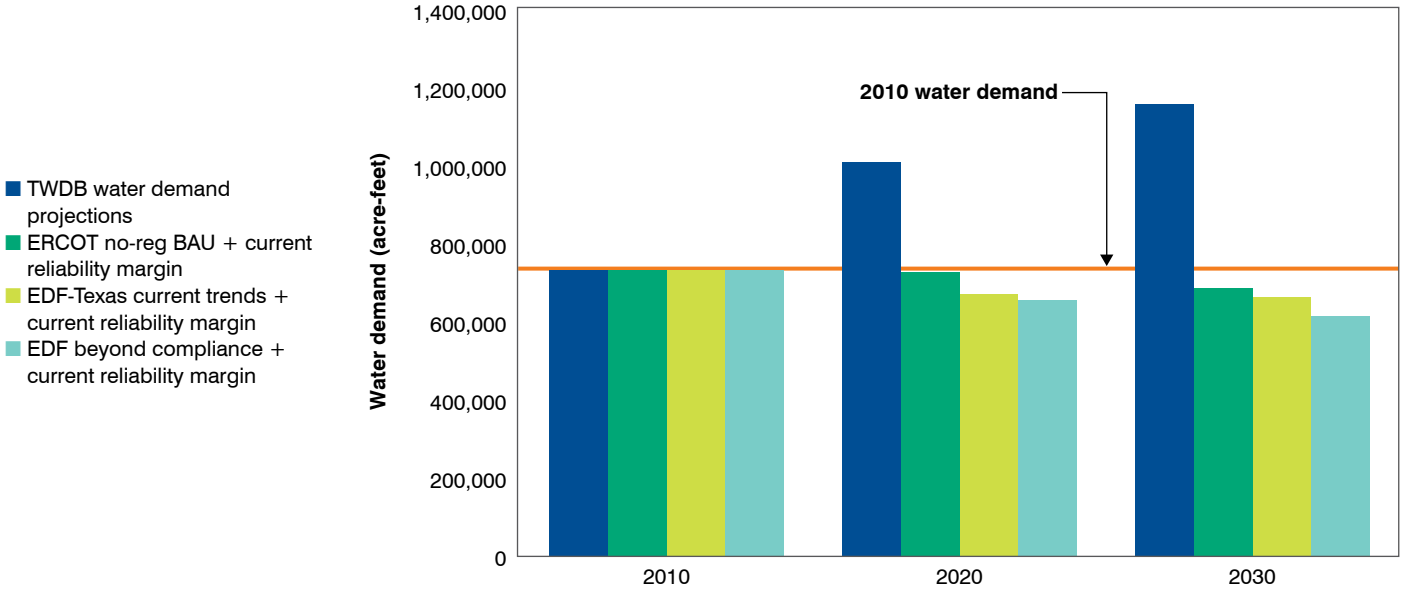
There is not yet enough data to say for sure whether this current drought-flood cycle was caused by climate change; however, droughts of the future must now be considered alongside the dire predictions of future climate models. The drought cycles, in particular, appear to be more intense under climate change. According to Texas' State Climatologist John Nielsen-Gammon, "We certainly know climate change is going to make temperatures warmer, make evaporation more intense and increase water demand for plants and agriculture, so it will make that aspect of drought worse. […] Since models are generally projecting a rainfall decrease, model-based analyses show some pretty nasty increases in drought intensity in [Texas]."

A study funded by the cities surrounding Lake Travis in Central Texas determined that low lake levels lead to impacts such as a loss of 241 jobs and $6.1 million in wages, and governments could lose up to $21.9 million in total fiscal revenues. Multiply these types of figures across the dozens of other recreational bodies of water across the state, as well as the agricultural sector, it is apparent why protecting our water sources is critical.

FIGURE 9

Projected water demand for electricity

TWDB vs. ERCOT BAU vs. EDF scenarios



In the 2012 State Water Plan, the TWDB reported that the water demand in the power generation sector was 733,179 acre-feet in 2010. The TWDB projects annual water demand for this sector increasing by 1.1 million acre-feet from 2010 to 2060, at the cost of $2.3 billion.[111] Much of this projected increased water usage can be avoided, however, if Texas continues to increase its utilization of clean energy resources. Negligible quantities of water are required to generate power from wind and solar PV, and virtually no water is required for EE purposes. By contrast coal, natural gas, and nuclear power consume 580 gallons, 310 gallons, and 460 gallons of water per MWh, respectively.[112]

EDF's analysis indicates that Texas' 2010 electricity-related water usage was about 500,000 acre-feet, leaving TWDB with about 230,000 acre-feet of water in reserve as a strategic reliability margin. Our analysis finds that, through 2030, water demand will remain below the 2010 level under both ERCOT's "No-Reg" BAU forecast, and EDF's "Texas Current Trends" and "Beyond Compliance" forecasts. These water savings are illustrated in Figure 9.

Coal, natural gas, and nuclear power consume 580 gallons, 310 gallons, and 460 gallons of water per MWh, respectively.

More specifically, the projected avoided water usage that can be achieved in 2030 in the "ERCOT No-Reg BAU," and the EDF "Texas Current Trends" and "Beyond Compliance" scenarios ranges from 456,000 acre-feet to 544,000 acre-feet. These results underscore the increased water savings that would result from Texas exceeding its CPP compliance goals. Additionally, the analysis completed by EDF clearly demonstrates there is a direct relationship between increased deployment of clean energy resources and reductions in the quantities of water required to generate electricity. This means Texas may be able to eliminate the need for any of the 1.1 million acre-feet—the amount of water in Lake Travis, or almost ten times the amount of water in Lake Houston—of additional water that the TWDB has projected for power sector use from 2010-2060 if required increases in electricity demand for the 2030–2060 period are met primarily by renewable energy and natural gas.

In short, Texas' transition to a clean energy economy is one of the state's most cost-effective strategies to ensure an adequate water supply In the future. It is much less costly than building new reservoirs.

Benefits of transitioning to clean energy for the Texas economy

Texas' transition to a clean energy economy and compliance with the CPP will help grow the Texas economy. This transition will lead to more energy jobs and increased revenues overall—part of which will flow to the state and local governments. The CPP is expected to increase the utilization of natural gas on a national basis, so states such as Texas with significant natural gas reserves stand to benefit.[113] Furthermore, multiple examples demonstrate the job potential in the renewable energy sector in Texas, with solar beginning to expand and wind well-established and growing:

- The Political Economy Research Institute and the Center for American Progress found the solar industry creates nearly twice as many jobs as coal and three times as many as natural gas.[114]
- In 2014, the Solar Foundation found there are more solar jobs in Texas than there are ranchers, and Texas was listed as one of the top ten states for solar jobs. According to the Solar Foundation, "[a]s of November 2014, the Texas solar industry employs 6,965 solar workers, representing 68.4% growth in employment over the previous year."[115]
- According to the American Wind Energy Association's (AWEA) annual U.S. Wind Industry Market Report for 2014, Texas leads the country with over 17,000 wind industry jobs, more than twice that of Iowa, the second place state.[116]

The solar industry creates nearly twice as many jobs as coal and three times as many as natural gas.

It should be noted that jobs associated with clean energy are not limited to renewable energy or construction and manufacturing. The Austin Technology Incubator and CleanTX Foundation's *Economic Impact Report for the Cleantech Sector in Central Texas* includes computer and semiconductor manufacturing companies for the role they play in building the components that make up clean energy technologies. Additionally, the report indicates the Austin Metropolitan Surrounding Areas have added $2.5 billion to the regional GDP with 20,000 jobs directly in the cleantech sector, which is expected to grow at 11 percent annually by 2020, almost twice the national growth rate.[117] Compliance with the CPP means more, not fewer, jobs in Texas.

Benefits to Texans' health

Transitioning to a less carbon-intensive power sector also is expected to provide significant public health benefits for Texans. Power sources that emit more carbon generally emit more of other pollutants as well. So reducing the power sector's carbon pollution has the added benefit of reducing other harmful pollutants at the same time. These other pollutants, including sulfur dioxide and nitrogen oxides, are the forerunners of soot and smog and can cause heart and lung disease, as well as contribute to asthma attacks and premature death.

In a recent study titled *Health Co-benefits of Carbon Standards for Existing Power Plants*, researchers analyzed three different scenarios for implementation of power plant carbon emission standards.[118] The scenario most similar to EPA's proposed CPP, described as "moderately stringent and highly flexible," was found to produce the greatest estimated health benefits. Implementing a carbon reduction strategy similar to the one that would result from the "moderately stringent and highly flexible" scenario would save approximately 2,300 lives and prevent 790 hospitalizations and 140 heart attacks in Texas alone between 2020 and 2030. The study notes Texas has persistent air quality problems due to power plant pollution, and therefore is one of 12 states with the most potential lives saved.

Additionally, EPA has concluded that implementation of the CPP will reduce ozone levels across the country by approximately 25 percent. There is a new ozone standard coming, and a smart CPP compliance plan in Texas will make compliance with that standard much less costly.

PART 7

Moving the clean energy economy forward: conclusions and recommendations

It has been noted throughout this document how deregulation of the wholesale and retail ERCOT electric markets and the construction of the CREZ transmission lines, coupled with improved economics for cleaner sources of power, are transitioning Texas to a clean energy economy. The shift underway has the potential to bring about several key outcomes:

- New energy jobs and investments related to areas like renewable energy and cleantech development;
- Significant water savings that could eliminate the need for new water reservoirs to meet projected future demands; and
- Substantial health benefits.

EDF's overarching recommendation to state leaders: Texas should develop and implement a bold strategy not only to comply with the Clean Power Plan, but to surpass the Clean Power Plan's requirements and grow the state's economy.

The CPP provides Texas the opportunity to hasten the clean energy transition already underway, thereby enabling the Lone Star State to lead the nation in producing natural gas, wind, solar, and combined heat and power, and in harnessing EE and DR. State officials should

seize these opportunities and develop a state implementation plan that maximizes the potential benefits to the state.

EDF's overarching recommendation to state leaders: Texas should develop and implement a bold strategy not only to comply with the CPP, but to surpass the CPP's requirements and grow the state's economy. In addition, Texas' state plan should be developed to take advantage of the flexibility EPA has provided to ensure the state's compliance pathway is consistent with the competitive market structure within ERCOT. Texas' plan also should remain flexible to incorporate the benefit of new technologies that are on the horizon.

In doing so, state leaders should consider the use of flexible compliance and market-based programs, while placing the emissions obligations directly on operating EGUs, or power plants. Texas has successfully used such approaches before to address other power sector pollutants, such as sulfur dioxide and nitrogen oxides, and also with the development of the renewable energy credit (REC) program. Texas could use the experience it has gained through these programs to develop an appropriate approach to addressing carbon pollution.

In addition, EDF recommends that state officials take the following measures to help power companies maximize opportunities for compliance, and further reduce emissions of carbon pollution while positioning the state to take advantage of the growing low-carbon economy:

The State of Texas should include a framework in its state plan for electric generating units to use energy efficiency savings as compliance measures. Texas electric generating units, businesses, and residents will benefit from such a framework.

1. **Renewable energy:** Retain the existing policy framework, including the Renewable Portfolio Standard and completion of the CREZ lines that has stimulated growth of these low-cost clean energy resources.

2. **EE and DR:** The Texas Legislature and PUCT should remove barriers and expand opportunities to maximize EE and DR in the state, especially with regard to low-income communities in 2020 and 2021, and throughout ERCOT from 2022–2029. More specifically, the State of Texas should include a framework in its state plan for EGUs to use EE savings as compliance measures; Texas EGUs, businesses, and residents will benefit from such a framework. And, it is time for utilities to put in place new business models which will enable them to be properly incentivized and compensated for offering customers EE programs. Texas also should encourage water efficiency programs that can contribute to compliance with the CPP goals.[119]

3. **Use the EE blueprint:** South-Central Partnership for Energy Efficiency as a Resource (SPEER) has developed a comprehensive EE blueprint for Texas with the help of a broad group of stakeholders from the business community, state and local governments, the electric utility sector, and environmental advocates.[120] This blueprint, coupled with the completion of a study to identify and quantify Texas' EE potential, would enable state officials and stakeholders to chart an EE agenda that is cost-effective, achievable, and that maximizes the state's accumulation of carbon allowances or ERCs while helping to reduce customers' utility bills.

4. **PACE:** Texas' Property Assessed Clean Energy (PACE) program adopted by the Legislature in 2013 should be fully implemented in the commercial and industrial sectors. Texas policymakers also should take the necessary steps to implement the residential PACE program that was authorized by the Texas Legislature in 2009.

5. **Natural gas:** Texas should take proactive steps to reduce methane emissions from natural gas exploration, production, and transportation activities, so that expanded use of natural gas as a fuel provides a real climate benefit.

6. **Combined heat and power:** Encourage utilization of combined heat and power technologies in industrial developments.[121]

7. **Water:** The TWDB should adjust the Texas Water Plan as quickly as possible to reflect the dramatic water savings Texas will realize as it shifts to a clean energy economy and avoid unnecessary expensive alternatives.

8. **New technologies:** Texas power companies are required to fully comply with the provisions of the CPP by 2030. New technologies to address the intermittency of renewables and minimize the cost of complying with the new federal regulations are likely to be developed and brought to market over the next 15 years. Accordingly, state officials should ensure that power companies have the flexibility to fully leverage cost-effective new technologies for compliance with the state's plan.

9. **Equity in the form of environmental justice:** It is imperative for the state of Texas and other stakeholders to engage low-income communities in the CPP planning process to address three key issues:

   • Power plant emissions in and around low-income communities;
   • Prioritization of EE in these communities; and
   • Ensure low-income and minority communities share in the benefits of clean energy.

Only modest efforts are required for Texas to comply with the Clean Power Plan beyond business as usual. Such a well-positioned stance is a huge advantage that provides state officials and other stakeholders the opportunity to use the Clean Power Plan to grow the Texas economy.

In sum, Texas' CPP compliance plan can be developed within the context of ERCOT's competitive market, taking advantage of market trends towards the increased utilization of wind and solar generation, as well as maximizing the use of EE and DR. Such a plan will have the added benefit of serving as a water-supply strategy for the Lone Star State and lead to substantial public health benefits.

Yet, as demonstrated, only modest efforts are required for Texas to comply with the CPP beyond business as usual. Such a well-positioned stance is a huge advantage that provides

Combined heat and power: An industrial strategy to generate tradeable credits

Combined heat and power (CHP) facilities use fuel to generate electricity, and the heat is recovered from the electric generation process to provide additional useful thermal and/or mechanical energy. CHP facilities also may use fuel to provide thermal energy for an industrial process, and the waste heat then is used to generate electricity. While traditionally used in industrial settings, CHP also is used in building complexes, such as the Dell Children's Medical Center of Central Texas. EPA identified CHP as a strategy to reduce the CO_2 emission rate of electric generation units if a state implementation plan provides an appropriate accounting method. In developing our analysis, we have not included the CO_2 savings potential in calculating the extent to which Texas can meet its carbon emission reduction goals.

Texas has a significant opportunity to develop CHP in the state. To this end, the Texas Legislature has enacted law to ensure that CHP systems are considered and installed if cost-effective when:

(a) Constructing critical government facilities;
(b) Extensively renovating critical government facilities; or
(c) Replacing heating, ventilation, and air-conditioning equipment in these buildings.

Not only does the implementation of CHP increase the efficiency of the facilities in which it is incorporated, but CHP also provides a strategic means of reducing carbon emissions and creating tradeable credits that can be sold to other states—if state leaders take the steps necessary to allow that to happen.

state officials and other stakeholders the opportunity to use the CPP to grow the Texas economy. More precisely, Texas should maximize the production of its abundant clean energy resources to help other states meet their carbon reduction targets, either by:

(a) Exporting excess wind and solar power to other states; and/or

(b) Developing a state implementation plan that enables entities in Texas to sell emission allowances or ERCs to other states to meet their compliance obligations.

This bold but feasible approach will transform the CPP from a national environmental standard to a powerful economic engine for the state.

Notes

[1] Environmental Protection Agency, Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units, Docket No. EPA-HQ-OAR-2013-0602, Final Rule signed August 3, 2015 (hereinafter "Clean Power Plan" or "CPP"). All citations herein are to the initial publication of the final rule as signed on August 3, 2015 prior to publication in the Federal Register.

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[3] National Renewable Energy Laboratory (NREL). "Renewable Electricity Futures Study." 2012. Available online at: http://www.nrel.gov/analysis/re_futures/

[4] The Brattle Group. "Exploring Natural Gas and Renewables in ERCOT, Part III: The Role of Demand Response, Energy Efficiency, and Combined Heat & Power." Texas Clean Energy Coalition (TCEC). May, 2014. Available online at: http://www.texascleanenergy.org/Brattle%20III%20Final.pdf

[5] U.S. Census Bureau. "State & County Quick Facts: Texas." Available online at: http://quickfacts.census.gov/qfd/states/48000.html

[6] In 2012, Texas produced an estimated 254 million metric tons of carbon pollution. Energy Information Administration (EIA). "Electricity: Detailed State Data." June, 2015. Available online at: http://www.eia.gov/electricity/data/state/

[7] Fehrenbacher, Katie. "Facebook is building a big wind-powered data center in Texas." Fortune. July, 2015. Available online at: http://fortune.com/2015/07/07/facebook-data-center-texas/. See also Mars. "Mars Moves Towards Carbon Neutral Operations With Massive Wind Farm That Will Provide Electricity From Renewable Sources Equal To Its Entire U.S. Operations." April, 2014. Available online at: http://www.mars.com/global/press-center/press-list/news-releases.aspx?SiteId=94&Id=5629

[8] For context, the country already is about halfway to achieving this target.

[9] This paper analyzes the extent to which current trends are propelling Texas to achieve its rate-based targets under the Clean Power Plan. We analyze the state's rate-based goal rather than its mass-based goal or application of CO_2 emission performance rates because we base our modeling assumptions on publicly-available ERCOT data, and these data are better suited for analyzing the rate-based goal. As the EPA noted in its rule, the rate-based goals, mass-based goals, and the application of CO_2 emission performance rates are equivalent, so the results we reach are applicable regardless of the compliance strategy adopted. See CPP at 12.

[10] See CPP at 879–880.

[11] Id. at 881 and 885

[12] Electric Reliability Council of Texas (ERCOT). "Generator Interconnection Status Report—June 2015." July, 2015. Available online at: http://www.ercot.com/content/gridinfo/resource/2015/generation/GIS_REPORT_June_2015_REVISED.xls

[13] National Renewable Energy Laboratory (NREL). "Renewable Electricity Futures Study." 2012. Available online at: http://www.nrel.gov/analysis/re_futures/

[14] National Renewable Energy Laboratory (NREL). "Renewable Electricity Futures Study." 2012. Available online at: http://www.nrel.gov/analysis/re_futures/

[15] Electric Reliability Council of Texas (ERCOT). "Generator Interconnection Status Report: June 2015." July, 2015. Available online at: http://www.ercot.com/content/gridinfo/resource/2015/generation/GIS_REPORT_June_2015_REVISED.xls

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[17] U.S. Energy Information Administration (EIA). "Texas State Energy Profile." March, 2014. Available online at: http://www.eia.gov/state/print.cfm?sid=TX

[18] The Brattle Group. "Exploring Natural Gas and Renewables in ERCOT, Part III: The Role of Demand Response, Energy Efficiency, and Combined Heat & Power." Texas Clean Energy Coalition (TCEC). May, 2014. Available online at: http://www.texascleanenergy.org/Brattle%20III%20Final.pdf

[19] The Brattle Group. "Exploring Natural Gas and Renewables in ERCOT, Part III: The Role of Demand Response, Energy Efficiency, and Combined Heat & Power." Texas Clean Energy Coalition (TCEC). May, 2014. Available online at: http://www.texascleanenergy.org/Brattle%20III%20Final.pdf

[20] SB 373, 74th Texas Legislature, Regular Session.

[21] SB 7, 76th Texas Legislature, Regular Session.

[22] Energy Information Administration (EIA). "State Historical Data Tables for 2013." March, 2015. Available online at: http://www.eia.gov/electricity/data/state/annual_generation_state.xls

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[29] Trabish, Herman. "NV Energy buys utility-scale solar at record low price under 4 cents/kWh." Utility Dive. July, 2015. Available online at: http://www.utilitydive.com/news/nv-energy-buys-utility-scale-solar-at-record-low-price-under-4-centskwh/401989/

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[34] See www.apexcaes.com for more information on Compressed Air Energy Storage (CAES).

[35] See www.apexcase.com

[36] Johnson, Steven. "How We Got to Now." Riverhead Books. Penguin Group. New York. 2014.

[37] Tweed, Katherine. "Bidgely Lands a Major Deal with TXU Energy to Offer Energy Analytics in Texas." Greentech Media. November, 2014. Available online at: http://www.greentechmedia.com/articles/read/bidgely-goes-big-time-with-txu-energy-win

[38] Tinjum, Aaron. "Texas is struggling to cut its peak power demand. This technology can boost the state's demand response efforts." Opower. January, 2015. Available online at: http://blog.opower.com/tag/texas/

[39] See CPP at 1244–1246.

[40] Id.

[41] See CPP at 1242–1244.

[42] The Brattle Group. "Exploring Natural Gas and Renewables in ERCOT, Part III: The Role of Demand Response, Energy Efficiency, and Combined Heat & Power." Texas Clean Energy Coalition (TCEC). May, 2014. Available online at: http://www.texascleanenergy.org/Brattle%20III%20Final.pdf

[43] The amount of energy efficiency from utilities was about 720,000 MWh, 117,000 MWh from Austin Energy, 112,000 from CPS Energy, 10,000 from Pedernales, and the remaining 484,000 MWh from ERCOT IOUs. For this 484,000 MWh value, we subtract results from non-ERCOT IOUs—El Paso Electric, Entergy, SWEPCO, and Xcel SPS—from the total utility EE savings of 577,000 MWh for Texas in 2013. As total ERCOT net energy for load in 2013 was 331,624,102 MWh, EE savings amounted to 0.22 percent of load. See Tetra Tech. "Public Utility Commission of Texas: Third Party Evaluation, Monitoring & Verification (EM&V) Contractor for the Texas Utilities' Energy Efficiency and Load Management Portfolios." April, 2015. Available online at: https://eepartnership.org/wp-content/uploads/2014/07/Lark-Lee.pdf; Electric Reliability Council of Texas (ERCOT). "Energy for 2013." January, 2014. Available online at: http://bit.ly/1LBRr8C; CPS Energy. "Measurement and Verification of CPS Energy's FY2013 DSM Program Offerings." May, 2013. Available online at: http://www.sanantonio.gov/sustainability/Environment/STEPAnnual2013.aspx

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[48] The Brattle Group. "Exploring Natural Gas and Renewables in ERCOT, Part III: The Role of Demand Response, Energy Efficiency, and Combined Heat & Power." Texas Clean Energy Coalition (TCEC). May, 2014. Available online at: http://www.texascleanenergy.org/Brattle%20III%20Final.pdf

[49] For this 484 million KWh value, we subtract results from non-ERCOT IOUs—El Paso Electric, Entergy, SWEPCO, and Xcel SPS—from the total utility EE savings of 577 million KWh for Texas in 2013.

[50] Tetra Tech. "Public Utility Commission of Texas: Third Party Evaluation, Monitoring & Verification (EM&V) Contractor for the Texas Utilities' Energy Efficiency and Load Management Portfolios." April, 2015. Available online at: https://eepartnership.org/wp-content/uploads/2014/07/Lark-Lee.pdf

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[53] "PACE Finance Summary Sheet." Available online at: http://www.hecweb.org/wp-content/uploads/2010/04/PACE_Summary.pdf

[54] ERCOT, "Annual Report of Demand Response in the ERCOT Region." March, 2015.

[55] Id. at 6–7.

[56] The Brattle Group. "Exploring Natural Gas and Renewables in ERCOT, Part III: The Role of Demand Response, Energy Efficiency, and Combined Heat & Power." Texas Clean Energy Coalition (TCEC). May. 2014. Available online at: http://www.texascleanenergy.org/Brattle%20III%20Final.pdf

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[62] See VRTF Final Report to ROS, July 14, 2014. Available online at: http://www.ercot.com/content/meetings/ros/keydocs/2014/0904/17._VRTF_Final_Report__07142014.doc

[63] M.J. Bradley & Associates, LLC. "Clean Power Plan Evaluation Tools." August, 2015. Available online at: http://www.mjbradley.com/about-us/case-studies/clean-power-plan-evaluation-tools

[64] Electric Reliability Council of Texas (ERCOT). "Impacts of Environmental Regulations in the ERCOT Region." December, 2014. Page 21. Available online at: http://www.ercot.com/content/news/presentations/2014/Impacts%20of%20Environmental%20Regulations%20in%20the%20ERCOT%20Region.pdf

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[67] We estimate total 2020 generation of 450 million MWh, a linear midpoint between 2012 generation of 430 million MWh and forecasted 2029 generation of 473 million MWh (this 2029 forecast is explained further below).

[68] Electric Reliability Council of Texas (ERCOT). "Impacts of Environmental Regulations in the ERCOT Region." December, 2014. at page 21. Available online at: http://www.ercot.com/content/news/presentations/2014/Impacts%20of%20Environmental%20Regulations%20in%20the%20ERCOT%20Region.pdf

[69] For this calculation, we estimate total 2029 generation of 473 million MWh. This estimate is based on extrapolating from ERCOT's forecast that 2012 generation capacity of 102.5 GW will grow 11.4 percent to 114.2 GW in 2029 under current trends. Of this additional capacity, ERCOT projects that about 10 GW will be solar generation and 4.6 GW will be combined cycle gas generation that will in part replace 0.8 GW of retiring coal and 2 GW of retiring gas steam. Assuming a 75 percent capacity factor for the new natural gas combined cycle installations and a 20 percent capacity factor for the new solar installations, the combined capacity factor of the new capacity is 37 percent, or about 87 percent of the state's cumulative capacity factor in 2012. Thus, the increase of 11.4 percent capacity equates to about a 10 percent increase in generation. State-wide generation was about 430 million MWh in 2012, and a 10 percent increase would amount to 473 million MWh. For consistency, for all other 2029 and/or 2030 scenarios in this report, we use this total generation level for our modeling. See "ERCOT Analysis of the Impacts of the Clean Power Plan," December, 2014.

[70] In its October 2014 LTSA scenario results, ERCOT forecasts natural gas as 51 percent of the 2021 "Current Trends" generation mix.

[71] In its October 2014 LTSA scenario results, ERCOT forecasts natural gas as 51 percent of the 2029 "Current Trends" generation mix.

[72] In its October 2014 LTSA scenario results, ERCOT forecasts coal as 27 percent of the 2021 "Current Trends" generation mix. Current trends suggest that this percentage could be lower; so, here, we reduce coal's percentage relative to the 2020 ERCOT "No Reg" BAU scenario by the amount that counterbalances this scenario's higher natural gas and renewables levels.

[73] 37 percent of active coal capacity in Texas was constructed in the 1970s (80 percent in the 1970s and 1980s). By 2029, each of these coal units would be 50–60 years old, which generally is considered beyond the retirement age of coal units. In addition, ERCOT forecasts that up to 8,500 MW of coal, or 37 percent of the state's coal capacity, is at moderate to high risk of retirement by 2029 even without the Clean Power Plan. If these units retire, coal generation in the state would decrease about 37 percent from 138 million MWh in 2012 to about 87 million MWh in 2029 if one assumes for modeling purposes a linear relationship between capacity retirement and reduced energy output. Estimating total 2029 demand of 473 million MWh, 87 million MWh of coal generation would amount to less than 18 percent of the generation mix. Here, the percentage of coal capacity is adjusted to 19 percent to avoid over-estimating the impact of the increased presence of natural gas and renewables compared to the 2029 ERCOT "No Reg" BAU scenario.

[74] ERCOT projects installed wind capacity in 2017 will be 23.4 GW and installed solar capacity will be 1.4 GW. This combined 24.8 GW is 136 percent higher than the combined 10.5 GW of installed capacity in 2012. Without accounting for increased efficiency of new generation, if one estimates for modeling purposes that energy output increases linearly with capacity growth, output from wind and solar generation should grow from 33 million MWh in 2012 to 77.9 million MWh in 2020, or 17 percent of estimated 2020 generation of 450 million MWh.

[75] Using ERCOT's projected 2017 level of wind capacity of 23.4 GW, and solar comprising 6 percent of the 2029 generation mix as ERCOT forecasts, renewables should generate approximately 100 million MWh of energy in 2029—72 million MWh from wind and 28 million MWh from solar. Estimating 2029 demand of 473 million MWh, and wind and solar generation growing at a similar rate as wind and solar capacity, renewables generation would comprise 21 percent of generation in 2029.

[76] 1.4 percent cumulative load savings from EE for 2022-2029 assumes current annual EE levels of 750,000 MWh continue over the eight-year stretch of 2022–2029 so that 6 million MWh of savings are amassed by 2029.

[77] 2022 and 2029 are the outer bounds of the eight-year Interim period, and—in line with trends—emissions intensity should improve during that period. For purposes of this analysis, we estimate that emissions

intensity improves in a linear fashion from the 2020 level to the 2029 level. Here, the 2022 value is along the linear trend from 2020 to 2030.

78 For this calculation, we estimate total 2022 generation of 455 million MWh, an appropriate amount estimating a linear increase in generation between the 2012 generation of 430 million MWh and the projected 2029 generation of about 473 million MWh.

79 2022 and 2029 are the outer bounds of the eight-year Interim period, and—in line with trends—emissions intensity should improve during that period. For purposes of this analysis, we estimate that emissions intensity improves in a linear fashion from the 2020 level to the 2029 level, and for the interim target's emissions intensity, we use the average for 2022–2029.

80 Electric Reliability Council of Texas (ERCOT). "2014 LTSA Scenario Results Update." October, 2014, at Appendix F.

81 ERCOT's analysis of the impact of environmental regulations and its 2014 LTSA use consistent stakeholder-vetted planning processes and methodologies. ERCOT "Impacts of Environmental Regulations in the ERCOT Region," December, 2014 at page 2. Available online at: http://www.ercot.com/content/news/presentations/2014/Impacts%20of%20Environmental%20Regulations%20in%20the%20ERCOT%20Region.pdf. The model ERCOT used for its December 2014 forecasts, however, differs from the model used for the October LTSA. The fact that the same scenario can produce different forecasts for the same "Current Trends" scenario underscores the uncertainty inherent in 15-year forecasts. For this report, we treat 51 percent gas as ERCOT's upper bound for 2029 BAU and 45 percent gas as ERCOT's lower bound. For the EDF Current Trends scenario, we use this upper bound.

82 This level of retirements is towards the low end of the 3,000-8,500 MW range of coal capacity in Texas that ERCOT "projects faces moderate to high risk of retirement due to the Regional Haze requirements." This 8,500 MW represents more than 35 percent of the of the state's coal active coal capacity in 2012. Electric Reliability Council of Texas (ERCOT). "Impacts of Environmental Regulations in the ERCOT Region." December, 2014 at page 28. Available online at: http://www.ercot.com/content/news/presentations/2014/Impacts%20of%20Environmental%20Regulations%20in%20the%20ERCOT%20Region.pdf

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84 Bloomberg New Energy Finance. "2015 New Energy Outlook—Americas." June, 2015.

85 Trabish, Herman. "NV Energy buys utility-scale solar at record low price under 4 cents/kWh." Utility Dive. July, 2015. Available online at: http://www.utilitydive.com/news/nv-energy-buys-utility-scale-solar-at-record-low-price-under-4-centskwh/401989/

86 Electric Reliability Council of Texas (ERCOT). "Generator Interconnection Status Report—June, 2015." July, 2015. Available online at: http://www.ercot.com/content/gridinfo/resource/2015/generation/GIS_REPORT__June_2015_REVISED.xls

87 Electric Reliability Council of Texas (ERCOT). "2014 LTSA Scenario Results Update." October, 2014, at Appendix F.

88 Assuming wind generation increases linearly with wind capacity, a 125 percent capacity increase from 10.4 GW in 2012 to 23.4 GW in 2017 would lead to a 125 percent generation increase from 32 million MWh in 2012 to 72 million MWh in 2017. Further, as solar power is forecast as 6 percent of the 2029 generation mix, which we estimate to be 473 million MWh, 2029 solar generation should be 28 million MWh. Summing 2017 wind generation and 2029 solar generation equals 100 million MWh.

89 SNL Financial. "Historic & Future Power Plant Capacity." June, 2015. Available online (with subscription) at: https://www.snl.com/interactivex/ea_pp_capacity_content.aspx?ListComps=&UseParent=0&Y1=2010&Y2=2024&G=1&M=1&F=1&RTO=0&St=TX&N=57&Action=

90 Bloomberg New Energy Finance (BNEF). "2015 New Energy Outlook—Wind." June, 2015.

91 For this 484,000 MWh value, we subtract results from non-ERCOT IOUs—El Paso Electric, Entergy, SWEPCO, and Xcel SPS—from the total utility EE savings of 577,000 MWh for Texas in 2013. Tetra Tech. "Public Utility Commission of Texas: Third Party Evaluation, Monitoring & Verification (EM&V) Contractor for the Texas Utilities' Energy Efficiency and Load Management Portfolios." April, 2015. Available online at: https://eepartnership.org/wp-content/uploads/2014/07/Lark-Lee.pdf

92 CPS Energy. "Evaluation, Measurement, & Verification of CPS Energy's FY2015 DSM Programs." June, 2015. Available at: http://www.sanantonio.gov/sustainability/Environment/STEPAnnual2015.aspx

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95 City of San Antonio. "Save for Tomorrow Energy Plan (STEP)." 2015. Available at: http://www.sanantonio.gov/sustainability/Environment/SaveForTomorow.aspx

96 Using SNL Financial's June 2015 forecast for 31 GW of wind capacity by 2020, Texas should generate 95 million MWh from wind, assuming a linear correlation between generation and capacity, from 10.4 GW to 31 GW, or 198 percent from 2012 levels to 2020. Summing this wind generation with ERCOT's projection for solar comprising 6 percent of the 2029 generation mix, Texas is on track to generate 123 million MWh from renewables in 2029, or 26 percent of the estimated total generation of 473 million MWh.

97 This EE assumption is the only one that differs from the "EDF—Texas Current Trends" scenario.

98 As discussed previously, several reports indicate Texas has the opportunity for increased energy efficiency. This estimate of 10 percent includes not only utility-based energy efficiency, but also energy efficiency opportunities outside of utilities including PACE, more efficient building codes, and other opportunities outlined in recommendations from the South-central Partnership for Energy Efficiency as a Resource (SPEER). SPEER Commission. "Recommendations of the SPEER Commission on Texas Energy Efficiency Policy." 2015. Available online at: https://eepartnership.org/wp-content/uploads/2015/02/speer_report_021615_d10lr.pdf

[99] Based on the AEP pilot project discussed earlier, we estimate 2 percent emissions intensity improvement due to pervasive VVO measures.

[100] The Brattle Group has estimated that it is feasible and cost effective for DR levels in ERCOT to increase to 6,350 MW over the next five years. As referenced earlier, Navigant Consulting found DR could reduce carbon emissions upwards of 2 percent. For this analysis, we estimate 1 percent emissions intensity improvement due to this increased DR.

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