Testimony before the Energy and Power Subcommittee
of the House Energy and Commerce Committee
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Executive Summary

Texas is the only state that has a physical presence within all three electric interconnections. In Texas, 85% of the electricity is consumed within the Electric Reliability Council of Texas power region (ERCOT), a non-FERC jurisdictional restructured, competitive, energy-only wholesale and largely competition retail market (the Texas ERCOT market). ERCOT's electric grid, which covers approximately 75% of the state, is an island with only limited direct current ties to the eastern and western interconnections. The remaining 15% of electric consumption takes place in areas outside of ERCOT served by cooperatives and vertically integrated, investor-owned utilities whose rates and terms of retail service are regulated by the Public Utility Commission of Texas (PUCT). All of the Texas utilities (public or private) located in the eastern interconnection are members of the Southwest Power Pool or the Midcontinent Independent System Operator.

Texas is disproportionately affected by the United States Environmental Protection Agency's (EPA) proposed Section 111(d) Clean Power Plan rule. The rule as proposed raises substantial questions around fairness (EPA proposes that Texas should account for 18% to 25% of national CO_2 reduction), cost, implementation alternatives, system reliability and whether compliance is even physically possible, at least within the timelines proposed by the EPA. The EPA compliance building blocks actually work at cross purpose, at least in Texas, largely because they do not give any credit for substantial improvements made since 2001, much less 2005, or recognize how security constrained economic dispatch works in organized wholesale power markets. For example, EPA's "building block" 1 (6% across the board improvement in

coal-fired heat rate) assumes that efficiency improvements are still available. The Texas ERCOT competitive market has already forced coal-fired generators to adopt state of the art technologies available to improve thermal efficiencies in order to compete effectively. Another example: "building blocks" 2 (70% capacity factor of natural gas combined-cycle generation) and 3 (increase in non-hydroelectric renewable energy megawatt hours (MWh) to 20% of the state's total energy produced) act counter to each other in Texas, making "building block" 1 impossible to achieve, and simultaneously worsening emissions of not only CO_2, but other harmful pollutants. "Building block" 3 assumes that the Texas renewable energy production can increase to a level above the minimum load in the Texas ERCOT market. Putting aside the timing, cost, and reliability issues, relying on this compliance alternative will likely shut down all other generation during certain times of the day, including nuclear. This creates a paradox. Texas cannot achieve both a 70% capacity factor for gas combined cycle plants and 20% renewable energy production without increasing CO_2 emissions. This occurs, in part, because the 2012 energy baseline year selected by the EPA does not give Texas any credit for the already dramatic increase in Texas wind generation that delivered 35.917 million MWh (16.24% of this nation's non-hydro renewable generation) in 2013.[1]

[1] United States Energy Information Administration, *Electric Power Monthly*, Data for June 2014, released August 25, 2014, Table 1.1.A Net Generation from Renewable Sources: Total (All Sectors), 2004 – June 2014. American Wind Energy Association, *Wind Energy Generation by State, 2013*, http://www.awea.org/generationrecords. For 2013, conventional hydroelectric is shown to be 269.136 million MWh. However the industrial sector used 3.4 million MWh of hydroelectric power generated in 2013, see US EIA note 4, at 94. Therefore, US renewable energy generated in 2013 less hydroelectric power in the Electric Power Sector was 487 – 269.136 + 3.4 = 221.264 million MWh. 35.937/221.264 = 16.24% of US electric power sector renewable generation not including hydroelectric.

EPA's Clean Power Plant Rule Applied to Texas

In early June of 2014 the EPA proposed a rule for reducing carbon dioxide (CO_2) emissions from existing power plants under Section 111(d) the Clean Air Act. As proposed, the rule requires each state to reduce its overall CO_2 rate of emission from existing power plants to a state-specific level, with an interim target to be reached by 2020 and the final rate to be achieved by 2030. The standard is set in pounds per MWh. The state standards vary dramatically, with Texas' standard set at a 2020 level of 853 lbs/MWh which must decline to 791 lbs/MWh by 2030. It is worth noting that both the interim and final standards applied to Texas is substantially lower than the CO_2 per MWh emission level required by the EPA to be achieved by new coal or gas power plants under Section111(b) of the Clean Air Act. EPA's proposal would require Texas to account for somewhere between 18 to 25% of the country's total CO_2 reductions.

In the proposed Clean Power Plan rule the EPA set out four "building blocks" as the Best System of Emissions Reductions (BSER) to be used by the States in their State Implementation Plans (SIP) to reduce overall CO_2 emissions from existing power plants. As applied to Texas, the four building blocks are: (1) across the board coal plant heat rate improvements of approximately 6% (Block 1), (2) re-dispatch of existing coal plants so that gas combined cycle plants achieve roughly a 70% utilization rate or capacity factor[2] (Block 2), (3) an increase renewable energy produced (primarily from wind) of approximately 150% based upon Texas' 2012 energy output (Block 3), and (4) a substantial increase in energy efficiency programs (Block 4).

[2]By comparison, based solely on economic dispatch, gas plants, including both combined cycle and combustion turbines, produced 40.5% of all of the energy in ERCOT in 2013.

BSER Block 1: The Texas ERCOT Market has already achieved substantial improvements in efficiency

The improvements offered by Block 1 may be illusory. The EPA's proposed rule assumes that substantial thermal efficiencies can still be obtained from coal plants in Texas. However, at least within the ERCOT interconnection, there likely is little room for improvement in Block 1's heat rate improvement goal because much of the assumed efficiencies have already been implemented by coal-fired generation because of the competitive market.

ERCOT's energy market design has achieved this result by eliminating older, less efficient, and therefore less competitive generating facilities. Since 2002, over 13,000 megawatts (MW) of old thermal generation plants have been retired. Owners of generation are forced to make upgrades to their existing generating facilities to improve their thermal efficiencies so that they can remain competitive. If they are unable or unwilling to do so, they are driven from the market. Historically, new more efficient (and cleaner) units have stepped in to replace the older units. ERCOT's competitive market has in effect, already been implementing Block 1 for over a decade. By using 2012 as the base year, Texas gets no credit for having already achieved a significant amount of EPA's Block 1 goals.

The Paradoxes of Blocks 2 & 3

Within ERCOT, nuclear and coal-fired power plants provide base load generation and are most efficient (and with respect to coal plants, cleaner environmentally) when operating at or near 100% of capacity. ERCOT's nuclear generation fleet (in excess of 5,200 MW) was not designed for load following and therefore has very limited ramping capability. The Texas nuclear units operate most efficiently at 100% of capacity. Among other issues, operating a nuclear facility at lower efficiency means that the plant creates more spent nuclear fuel per megawatt hour of electricity production. Coal (as well as most gas-fired) generation also operates most efficiently at or near 100% capacity. While a base load coal facility has more ramping capability than a nuclear facility, emissions of CO_2, as well as other emissions that actually are harmful to life such as NOx and SO_2, increase substantially when ramping up or down or otherwise operating at less than 100% of capacity.

Figures 1 and 2 below illustrate seasonal load profiles experienced in Texas. Figure 1 is a typical August day in Texas. The ERCOT load almost doubles a summer day, increasing from about 36,000 MW to over 68,000 MW. This increase occurs over a 12 hour period. Figure 2 is a typical spring or fall day and shows how low the load in ERCOT typically can dip in the spring or fall. Texas must have a balanced diversified generation mix in order to be able to start up generation facilities as load climbs, and then be able to ramp them down as load declines.

Figure 1: Typical Summer Load Profile

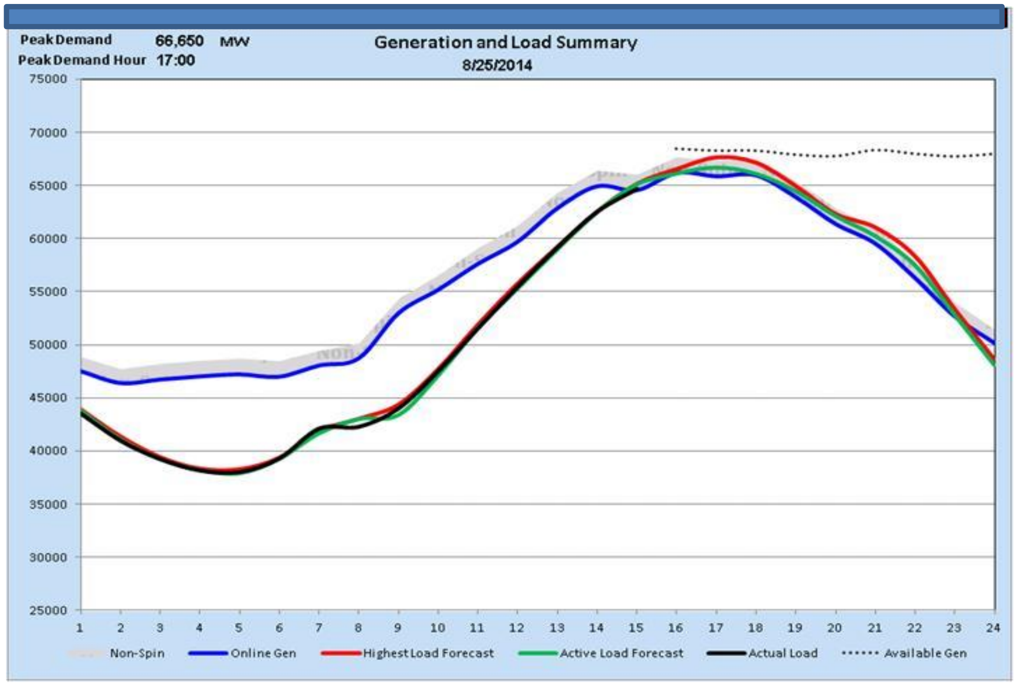
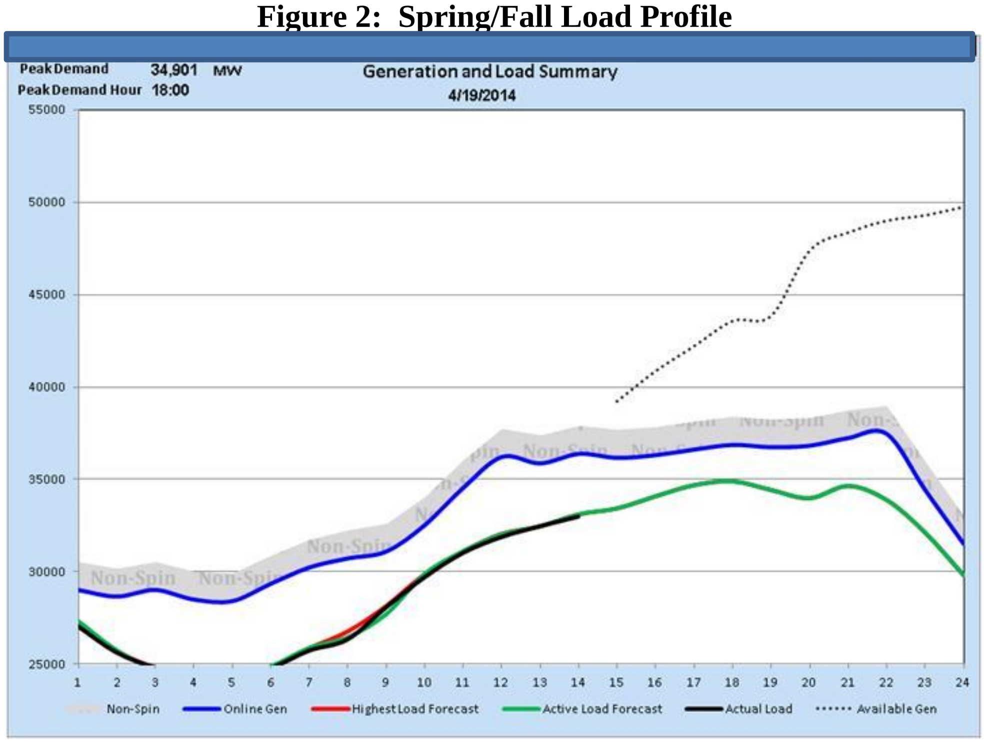


Figure 2: Spring/Fall Load Profile



While Figure 1 shows the 30,000 MW swings that the diversified ERCOT generation fleet must be able to handle in the summer, Figure 2 demonstrates a different problem that can occur with too much renewable generation. Between 3:00 a.m. and 6:00 a.m. electricity consumption can drop below 25,000 MW. ERCOT already has experienced days in which wind has provided as much as 38.4%[3] of the generation on the system. If Texas were to use Block 2 in any SIP in an attempt to comply with EPA's proposed Clean Power Plan, both practical as well as perverse difficulties would result. Wind turbines in Texas typically have a much higher capacity factor during spring and fall months. During the spring and fall a 20% renewable energy goal as proposed by the EPA under Block 3 could put more renewable generation on the grid than there is existing load. Consequently, during the early morning hours ERCOT would have to both curtail a substantial amount of the wind and back or shutdown much of the nuclear fleet and all other thermal generation, simultaneously reducing the effectiveness of both Block 2 and Block 3. As previously noted, nuclear generators operate most efficiently at or near 100% capacity. The practical problem is that large nuclear generating units are not designed to ramp up and down quickly or easily. The result of too much wind on the system would be that either the nuclear plants would bid negative prices in order to remain on the system, which would impair the financial viability of all on-line generation including the wind farms (particularly if the production tax credit is not renewed, because it enables wind farms to bid negative prices and still earn money) or the nuclear plant would have to shut down, which takes time and presents another Clean Power Plan rule compliance problem. ERCOT's nuclear plants are pressurized water reactors that are not designed for load following. After shutting down to the condition of hot standby, it takes about 12 hours for large nuclear generating units to start and return to full service. During that period, as wind declines, as it inevitably would (see Figure 3 below), the

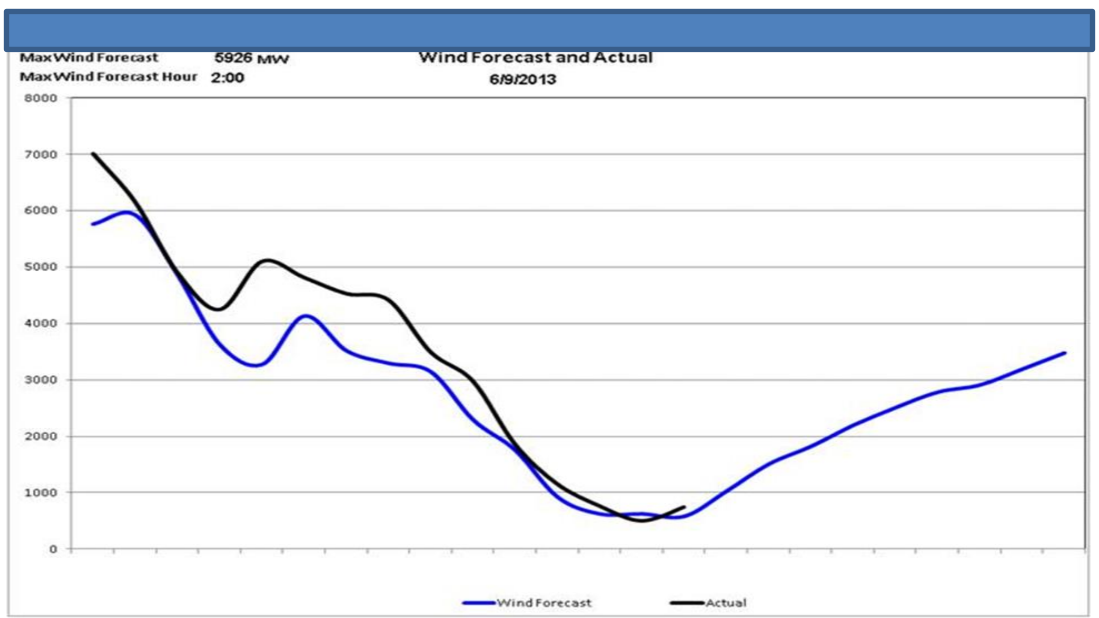
[3] ERCOT News release, *Wind generation output in ERCOT tops 10,000 MW, breaks record*, reporting two records broken. On March 26, 2014 instantaneous output reached 10,296 MW at 8:48 p.m. (nearly 29% of total system load), and on March 27, 2014 at 3:19 a.m. when 9,868 MW served a record 38.43% of the 25,677 MW system-wide demand.

gap would have to be filled by CO_2 emitting resources such as gas-fired combined cycle or combustion turbine units; presumably an outcome that EPA would prefer not occur.

Like nuclear units, base load coal-fired generation units operate most efficiently when they are at or near 100% capacity. Too much renewable energy could cause them to operate at less than peak efficiency and result in more CO_2 and other actually harmful pollutants being emitted.

But Blocks 2 and 3 yield a paradox as well. In a diversified, efficient market, Blocks 2 and 3 work at cross purposes. Figures 3 and 4 show the high variability of wind.

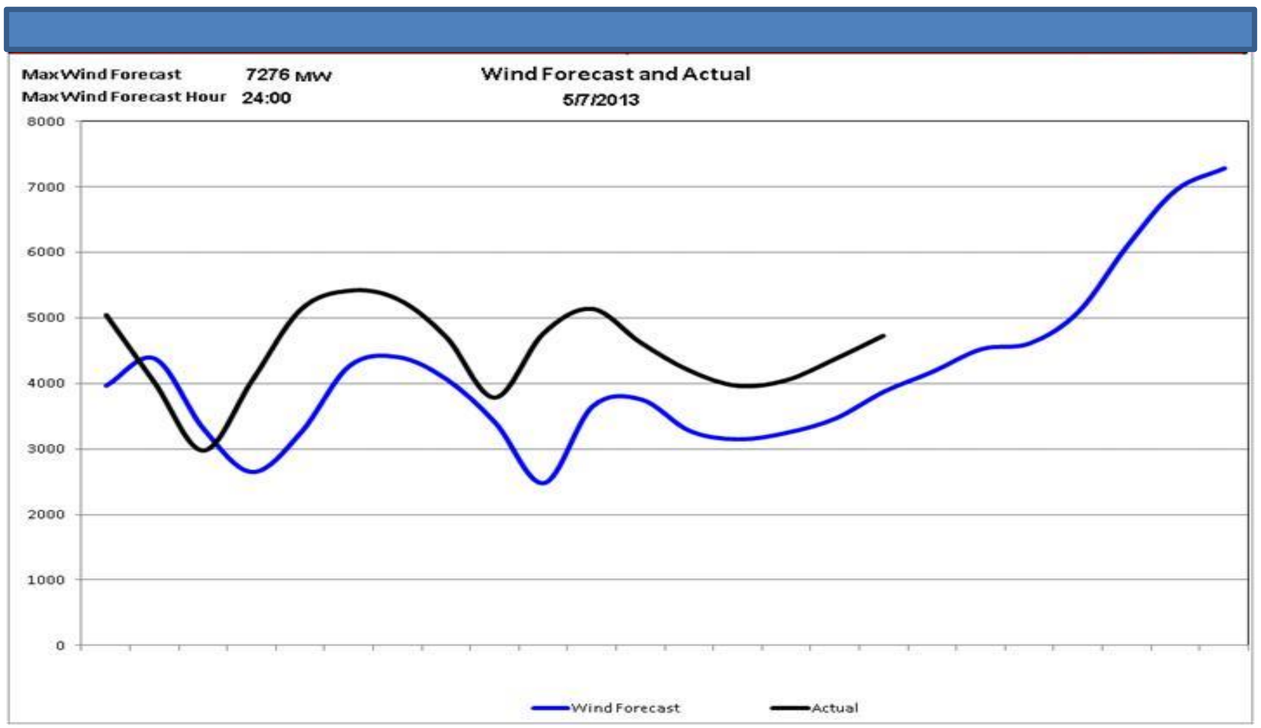
Figure 3: 93% Drop in Wind Production in 12 Hours



On the day referenced in Figure 3, wind generation dropped 93% (a total loss of 6,500 MW) over 13.5 hours. An over reliance on wind coupled with a possible 93% reduction of wind generation on any given day requires an increased reliance on flexible gas generating units and less on base load units.[4] This introduces inefficiencies into ERCOT's system and likely means that nuclear generating units will be backed down when it is windy, only to be replaced with combined cycle or simple cycle gas turbine units. Because of the variability of wind and other renewable generation occurs rapidly, in minutes, ERCOT's nuclear fleet cannot respond efficiently because the units are not designed for load following operations.

An example of what the ERCOT generation mix must be able to handle over very short periods of time is shown in Figure 4, below.

Figure 4: Variability of Wind Can Be Frequent and Extreme



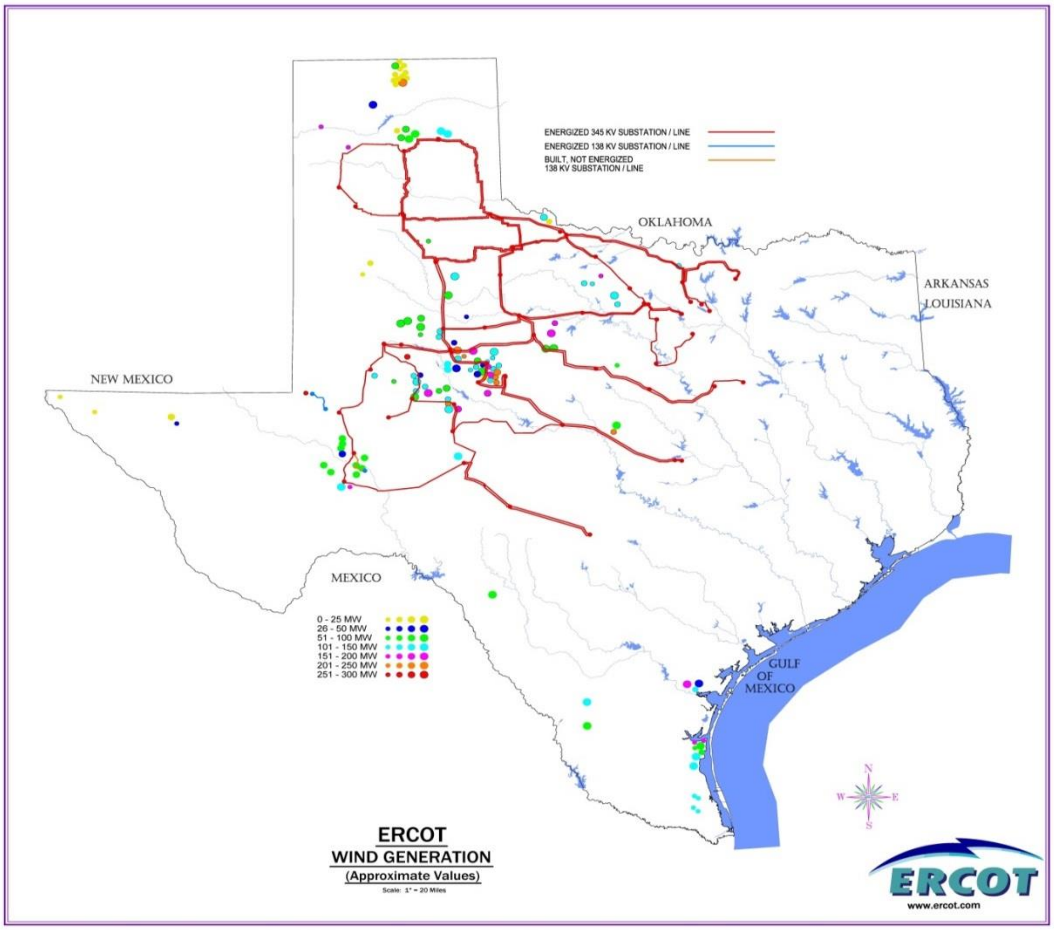
[4]Yih-huei Wan, *Analysis of Wind Power Ramping Behavior in ERCOT*, NREL Technical Report NREL/TP-5500-49218, (March 2011). "It is clear that the variability of wind power affects the system operations." at 3. "The more installed wind power capacity will result in a higher wind power ramping-rate, and wind power can change at a very fast rate in a short-time frame." at 13. The more wind capacity there is on the system, the greater the magnitude of the ramping events will be. Figure 4 shows a magnitude of 6,500 MW (2014). The worst case in 2008 was a 3,430 MW loss of wind power in 10.8 hours. The greater the magnitude, the less Texas can rely on base load generation like nuclear generation.

On May 5, 2013, ERCOT experienced three cycles of between 2,000 and 1,000 MW changes in wind production in a 14 hour period. This is the equivalent to having 1,500 MW of thermal generation trip off line three times in 14 hours. Flexible natural gas-fired generation can handle the variability of wind and other renewable generation best because of its ramping ability, however, even gas combined cycle generation is most efficient when operated at or near 100% of capacity.

Texas Receives No Credit for Previous Renewable Investments Made

The EPA's proposed Clean Energy Plan rule ignores the significant renewable energy development that has occurred in Texas during the preceding decade. Even with the extreme variations in wind generation that can occur over the course of the year, in 2013 Texas wind generation produced 35.917 million MWh (16.24% of the nation's non-hydro renewable generation). However, the 2012 base year selected by the EPA for the proposed Clean Power Plan rule does not give Texas credit for the societal and financial commitments to facilitate renewable energy. From 2005 through 2011 Texas added over 8,500 MW of wind capacity, of which 8,300 MW were built within ERCOT. Figure 5 shows the $6.9 billion investment Texas has made in 3,600 miles of new competitive renewable energy zone (CREZ) transmission lines, a project which was completed in December 2013.

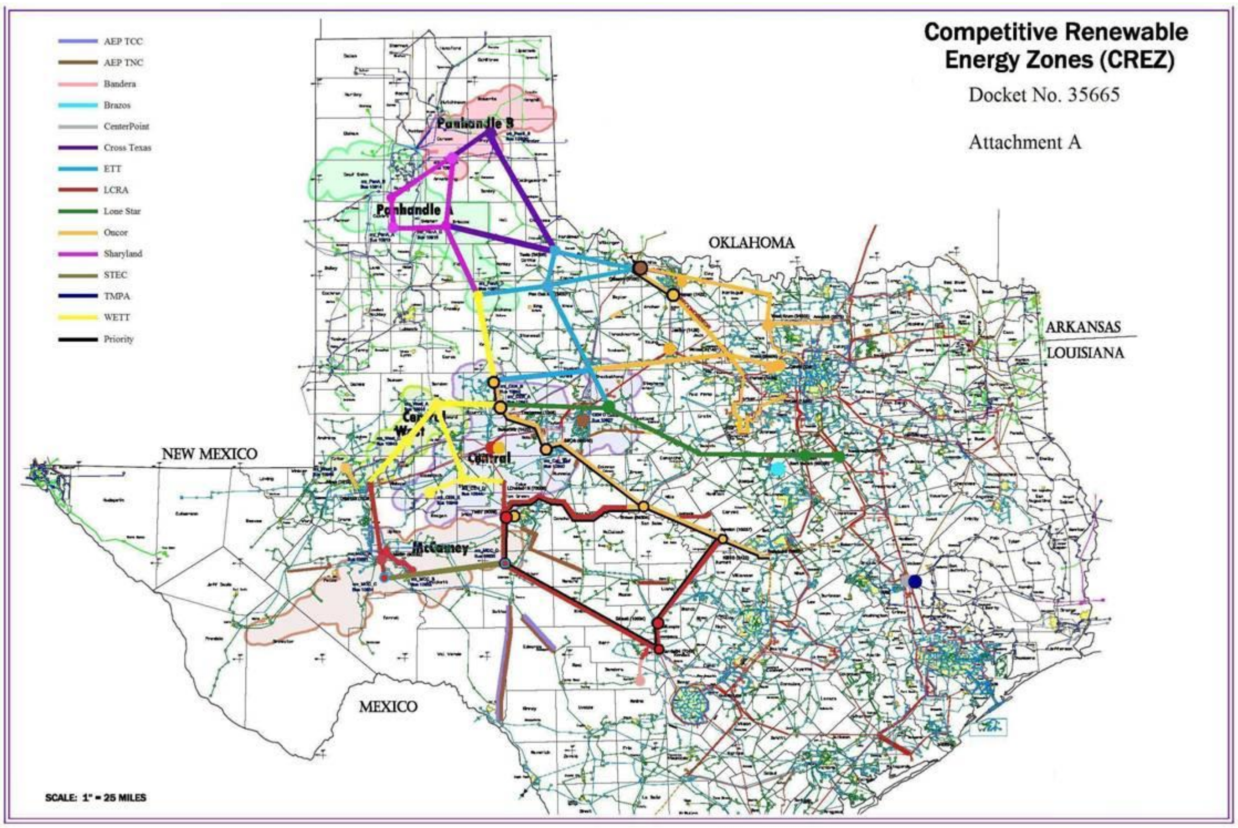
Figure 5: Competitive Renewable Energy Zone (CREZ) Transmission Lines



The investment in CREZ infrastructure has contributed to a more than threefold increase in wind generation as a percentage of ERCOT generation from 2007 to 2013 (3%-9.9%)[5], yet Texas receives no credit for the growth between 2005 and 2012 because of the 2012 base year used by the EPA. Figure 6 demonstrates the significance of the CREZ project in relation to ERCOT's overall transmission system.

[5] Potomac Economics, LTD., *2013 State of the Market Report for the ERCOT Wholesale Electricity Markets,* at 63 (September 2014). Potomac Economics LTD. is the independent market monitor for the ERCOT market.

Figure 6: The Entire ERCOT Transmission System



EPA Overestimates the Generating Capacity of Texas Wind from a Reliability Standpoint

In determining the BSER for Block 3, EPA uses a capacity factor for Texas wind of between 39% and 41%.[6] For reliability purposes, ERCOT assigns wind an 8.7% wind capacity factor which is the estimated availability of wind during summer peak. ERCOT is late in the process of recalculating the effective load-carrying capability (ELCC) of wind and is expected late next month to assign West Texas wind an ELCC of 14.2% and coastal wind and ELCC of 32.9%.[7] Both figures are still substantially below the capacity factor the EPA assigns to Texas wind energy.

Texas Has Already Achieved Substantial Progress in Reducing Emissions

From 2000 to 2011 Texas reduced its total carbon emissions by more than any other state.[8] The State has accomplished this result while growing its economy more than any other state (33.5%).[9] The reductions made by Texas over those 12 years amount to 13.3% of the country's reductions. Texas has reduced its total CO_2 emissions by 65 million metric tons (and also achieved significant reductions in NOx and SO_2 emissions), all while expanding its economy by a third. Yet it appears EPA, under its proposed Clean Power Plan rule, will require far more from Texas than it asks from other states.

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[6] United States Environmental Protection Agency, *Documentation for EPA Base Case v.5.13 Using the Integrated Planning Model*, Table 4-21, at 4-46, referencing The United States Department of Energy's National Renewable Energy Laboratory (NREL) capacity factors for different wind classes. For wind class in Texas, refer to NREL's United States Wind Resource Map (50m), http://www.nrel.gov/gis/pdfs/windsmodel4pub1-1-9base200904enh.pdf (May 6, 2009). From the map, wind power class in Texas, is shown as either wind power class 3 or 4.

[7] ERCOT Nodal Protocol Revision Request 611, Scheduled for ERCOT Board of Directors vote October 13, 2014. ERCOT expects to be using two capacity factors for Texas wind.

[8] U.S. Energy Information Administration, *State-Level Energy-Related Carbon Dioxide Emissions, 2000 – 2011*, (August 2014) at 6. *See* Table 1. State energy-related carbon dioxide emissions by year (2000-2011), which show a 64.8 million metric ton reduction. This is total carbon reduction, not limited to sectors.

[9] Federal Reserve Bank of St. Louis, *Real Total Gross Domestic Product By State For Texas*, plotted from 1997 until 2013, http://research.stlouisfed.org/fred2/series/TXRGSP

The EPA's Proposed Clean Power Plan Timelines Are Problematic

The Comment Deadline

There are several timelines under the EPA's proposed Clean Power Plan that are a problem or raise questions. The first is the comment deadline. Mid-October is not sufficient time to evaluate the intricacies of the over six hundred page proposal, particularly when considering the wide scope of the proposed Clean Power Plan rule. Effectively, the EPA is proposing to restructure the nation's electric system, which has slowly evolved over a century. This is a dramatic and unprecedented undertaking which requires considerable thought and analysis. It is likely that Texas will ask for more time to file comments.

The Intermediate Goal Deadline of 2020

The second issue is the timeline for intermediate goal achievement. The intermediate 2020 target is an unrealistic timeline given the time it will take to plan a Texas SIP, much less implement it. In Texas, the legislature meets every two years, in odd numbered years. The earliest the proposed rule could possibly go into effect would be sometime next summer, and at that point the 2015 legislative session is over. Consequently the next time the Texas legislature would convene is January 2017. If the BSER "building blocks" remain in a final rule as proposed, it will require legislation, before a Texas SIP could be filed with the EPA. While the ERCOT market would likely continue to make the market driven reductions in CO_2, new generation or even fuel conversions of existing generating units have to be carefully scheduled in order to maintain grid reliability, whether in ERCOT, or the other RTO/ISOs. If new transmission upgrades are required, even in ERCOT (where transmission can be built faster than elsewhere in the country) it will still require 4-7 years of planning, siting and construction to accomplish.

Conclusion

I would like to thank the members of the Energy and Power Subcommittee of the House Committee on Energy and Commerce for the opportunity to appear before them today. Devoting time and effort discussing questions raised by the EPA's proposed Clean Power Plan is an exceptionally important undertaking. EPA's proposed rule, if adopted, is likely to have a dramatic effect on electric reliability, the economy and the environment in Texas, all other states, and the nation. The rule must be thoughtfully and carefully considered before its implementation.