SPEER

The South-central Partnership for Energy Efficiency as a Resource

EFFICIENCY AND THE LOW-CARBON FUTURE

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About the South-central Partnership for Energy Efficiency as a Resource (SPEER)

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EXECUTIVE SUMMARY

The convoluted litigation surrounding the EPA's Clean Power Plan (CPP) has cast a roadblock in the way of its implementation, but this should not obscure the reality that a transition to a greener grid will continue. Many of the changes which would have been accelerated by the Plan will occur in any case, as more stringent EPA regulation of coal plants push many toward early retirement, the extension of the Production and Investment tax credits encourage additional investment in renewables, and the low price of natural gas moves new generation away from coal. Looking at the time horizon envisioned by the Plan, it is almost inevitable that as the deleterious impacts of climate change begun to be felt worldwide, some sort of action will be taken to control the emissions of greenhouse gases.[1]

Analyses of the CPP rule impacts show that energy efficiency can be a key contributor to reducing the cost of the transition to a greener grid. While reducing energy consumption will have a direct impact on reducing greenhouse gas emissions, just as important is the buffer efficiency resources provide as the generation mix changes dramatically in a relatively short period of time. Aggressive pursuit of cost-effective energy efficiency measures is not only beneficial to consumers, and creates a net social benefit, it reduces the rate at which new generation and transmission lines must be built. Given the long lag times for approval and construction of some electricity grid infrastructure, energy efficiency can buy time to make the transition less disruptive, limiting the impact on grid reliability.

The CPP rule analyses (by both ERCOT and the EPA) show that energy efficiency can create significant savings in electricity markets by putting downward pressure on market prices. Financing huge amounts of new electricity generation requires higher prices to elicit investment, whereas the slower growth of electricity consumption provided by energy efficiency allows prices to rise only enough to encourage the replacement of less efficient generation. Electricity markets with slower demand growth will have lower prices and less investment in the short-run. This also reduces the cost of new investment; in capital intensive energy markets, investment booms are often characterized by rapid inflation as developers bid for scarce resources. We estimate that demand in 2030 could be reduced by as much as 10 percent using a modest mix of energy efficiency programs, building codes and appliance standards (which would help "lock in" savings created by efficiency programs). The cost of these programs would be far less than the combination of savings to consumers, reduced energy prices, and reduced transmission and distribution costs.

In the long-run the grid is destined to be dominated by a combination of renewable energy resources, advanced storage technologies and sophisticated load management in a smart grid. However, technological progress is often haphazard and rarely occurs on a predictable schedule. Eventually costs of renewable energy and storage should decline to the point where they will be the most cost-effective option, with the operational flexibility to reliability operate electric systems. Energy efficiency and highly

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[1] NOAA, *Global Analysis - Annual 2015*, at https://www.ncdc.noaa.gov/sotc/global/201513.

There is a large reservoir of untapped energy efficiency savings available in Texas at costs that are less than the full cost of electricity.

efficient natural gas-fired generation can smooth this transition, reducing emissions without large jumps in energy prices, and buying time for new technologies to mature and enter the market.

We show in this paper that there is a large reservoir of untapped energy efficiency savings available in Texas at costs that are less than the full cost of electricity (both the wholesale price and transmission and distribution). At the wholesale market price, energy efficiency, when you include the impact of lower market prices, is a competitive resource. When you add in avoided transmission losses (about 7%) plus the avoided cost of transmission and distribution expansion, energy efficiency becomes the "no brainer" option. Net increases in energy consumption in Texas will raise costs, whether it's building new transmission, or expanding renewable energy, higher costs from conventional technology as cheap, accessible sites are exhausted, or the cost of pollution in terms of health and aesthetics. Energy efficiency is the one resource that reduces, rather than raises, energy costs.

I. INTRODUCTION

The final Clean Power Plan (CPP) rule[2] requires that states submit plans by September 6, 2016, although they can apply for a two year extension. The decision of the DC Court of Appeals to refuse a stay meant that states might have had an inflexible Federal plan[3] imposed upon them by the Environmental Protection Agency (EPA) if they refused to develop and file their own state plan. However, the Supreme Court, in a surprise move, granted a stay on February 9, 2016.[4] The subsequent demise of Justice Scalia creates an atmosphere of complete uncertainty. The D.C. court had announced that it wants the case to proceed quickly, with initial briefs filed by April 15 and final briefs filed by April 22. Oral arguments are scheduled for June 2 before Judge Karen Henderson, a Republican appointee, and Democratic appointees Judge Judith Rogers and Judge Sri Srinivasan, a potential Supreme Court nominee.[5]

Regardless of the final outcome of the CPP litigation, the EPA will be enforcing increasingly stringent regulations of coal power plants. Combined with the EPA's new source rule which effectively blocks the construction of traditional new coal plants,[6] power markets and integrated utilities are going to move

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[2] EPA, *Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units: Final Rule*, 80 Fed. Reg. 64,662 (October 23, 2015) (CPP Rule).

[3] CPP Rule at 64,744.

[4] *West Virginia, et al. v EPA, et al.*, 577 U.S. ---, February 9, 2016.

[5] Rob Bravender, "Judges Refuse to Block Rule, Set Arguments For June 2," *E&E News PM*, January 21, 2016 at http://www.eenews.net/eenewspm/stories/1060031006/.

[6] EPA, *Carbon Pollution Emission Guidelines for Existing Stationary Sources; Electric Utility Generating Units, Final Rule*, 80 Fed. Reg. 64,662 (October 23, 2015)

toward a greater dependence on natural gas-fired generation and renewable energy sources over the next few decades. The extension of the production tax credit for wind, and the investment tax credit for solar, will further encourage this trend. As the deleterious impacts of climate change begin to be felt worldwide, it is likely that some sort of action will be taken to control the emissions of greenhouse gases. In this context, energy efficiency (EE) should be seen as a mechanism for reducing the cost of this inevitable transition.

This paper attempts to develop estimates of the potential benefit of energy efficiency in meeting the goals imposed by the CPP. The value of energy efficiency will depend upon the exact mechanism chosen by the state (or imposed by the EPA) and the design of carbon trading markets. A well designed market (or regulatory mandate) should encourage the purchase/finance of energy efficiency as long as the cost is less than alternative sources of reduced carbon emissions. This, of course, is similar to traditional integrated resource planning's emphasis on demand side resources as a potential alternative to new generation. However, the actual administration of energy efficiency programs tends to muddle this ideal, as customers are often offered a portfolio of programs with differing costs. The efficiency cost curve should be seen as a representation of the reservoir of potential savings available for less than a given cost, rather than an actual supply curve of savings.

Energy efficiency will also reduce the reliability impact of renewable energy added to the grid in a relatively short period, and balance the impact of early coal plant retirements.

There are advantages to emphasizing energy efficiency as part of a CPP state plan. Given the escalation in renewable energy production required to meet the mandates of the plan, the trend in renewable cost reductions may be halted or slowed. As has been seen in many energy "booms," the independent power plant mania at the turn of the century, or oil drilling campaigns, suppliers increase capacity slower than demand, due to concern about the boom/bust cycle. Input costs rise, and buyers bid up the prices of plants and equipment. Energy efficiency, by reducing the short-run demand for renewable energy and natural gas units, will mitigate the cost impact of the CPP. Energy efficiency will also reduce the reliability impact of renewable energy added to the grid in a relatively short period, and balance the impact of early coal plant retirements.

The CPP will raise electricity rates, but energy efficiency may reduce or eliminate the concurrent increase in electricity costs to consumers. Electricity rates and electricity costs don't necessarily move in unison, as paying more for electricity (higher rates), but using less electricity, could result in total bills (costs) which are similar or smaller in size. Incrementally higher rates signal industry as well as smaller consumers to use electricity more efficiently, encouraging innovation and substitution between technologies so that similar end use services (lighting, heating, etc.) can still be obtained at similar cost. Energy efficiency in Texas is already reducing wholesale electricity costs by slowing the rate of electricity demand growth. An additional seven percent incremental reduction in the electricity demand projected for 2030 could reduce wholesale energy prices by almost $5 per MWh, providing annual savings of close to $2 billion in the wholesale market. In addition, those consumers who invested in EE would avoid $1.7 billion per year in energy purchases.

II. THE CLEAN POWER PLAN AND TEXAS GENERATION

Efficiency goal studies and accomplishments suggest that modest goals like the 7% of total consumption by 2030 modeled by ERCOT in its review of the CPP rule, is easily achievable.

The first issue in modeling the CPP is to develop a baseline, and the Energy Information Administration (EIA)[7] Annual Energy Outlook 2015 (AEO 2015) is a good place to start.[8] The EPA used the AEO 2015 as a major input to its modeling effort,[9] and supplanted this data with its National Electric Energy Data System, which includes basic geographic, operating, capacity, and other data on existing generation units or units under construction. The EPA employed the Integrated Planning Model, a multi-regional, dynamic, deterministic linear programming model of the U.S. electric power sector that EPA has used for over two decades, to evaluate the economic and emission impacts of the CPP. Unfortunately, the AEO 2015 and EPA baselines seem to diverge significantly from ERCOT's forecasts.

III. EE POTENTIAL AND COSTS IN TEXAS

To rely upon programs encouraging adoption of energy efficiency measures as part of a CPP state plan, the state must first identify the energy efficiency policies that have been incorporated into demand

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[7] The EIA was created by the Department of Energy Organization Act of 1977, Public Law 95-91, § 205. The EIA "Administrator shall not be required to obtain the approval of any other officer or employee of the Department in connection with the collection or analysis of any information; nor shall the Administrator be required, prior to publication, to obtain the approval of any other officer or employee of the United States with respect to the substance of any statistical or forecasting technical reports which he has prepared in accordance with law." § 205(d).

[8] While there is no evidence that the EIA forecasts are better than other sources, there is also no evidence that they're worse than proprietary alternatives. The EIA extensively documents its modeling efforts and provides retrospective reviews of its forecasting efforts. See EIA, *Annual Energy Outlook Retrospective Review: Evaluation of 2014 and Prior Reference Case Projections* (March 2015). Energy modeling has value in providing "back of the envelope" estimates to guide policymaking, but anyone who puts too much faith in these numbers, and ignores the inherent uncertainty associated with long range forecasts, is self-deluded. See Robert Bezdek and Robert Wendling, "A Half Century of Long-Range Energy Forecasts: Errors Made, Lessons Learned, and Implications for Forecasting," *Journal of Fusion Energy* 21 (December 2002): 155-172; Paul Craig, Ashok Gadgil, and Jonathan Koomey, "What Can History Teach Us? A Retrospective Examination of Long-Term Energy Forecasts for the United States," *Annual Review Energy and the Environment* 27 (2002): 83-118; Joel Krupa and Cameron Jones, "Black Swan Theory: Applications to Energy Market Histories and Technologies," *Energy Strategy Reviews* 1 (2013): 286-290.

[9] EPA, *EPA Base Case v.5.15 Using IPM Incremental Documentation*, (August 2015): 2,4, 75, 81.

forecasts, such as the EIA's AEO[10] or the EPA's base case run of the IPM model. This will clarify which programs are influencing growth rate assumptions, and the EPA will use this information to assess whether the demand forecast is reasonable. This helps ensure that impacts captured in the base case forecast are not double-counted or duplicated in the state plan performance projection. For all EE programs included in the base case demand forecast, a state must document whether the program is captured explicitly or indirectly.[11] In Texas, this would include the utility administered EE programs as well as the programs currently implemented by cities and cooperatives that have been included in demand forecasts.

States that plan to use EE to meet the CPP emission guidelines under applicable state plans will need to project the expected incremental direct generation impacts and electricity savings of EE. "Incremental direct effects" refers to EE beyond any impacts that are in the base case, i.e., only the net gains from EE programs (over existing programs already in the base case) should be counted. A projection must demonstrate how EE will enable affected EGUs to meet the emission guidelines. Under CPP a state must use the following general equation to quantify the expected incremental impacts of EE during the future, interim, and final performance periods: for each interim period and final period (Incremental first-year annual plus cumulative savings of EE program) x (effective useful life). Projections of demand-side EE impacts must reflect the annual impacts that occur due to new EE impacts in a given year plus the impacts of EE investments made in previous years that are still generating savings (i.e., have not exceed their measure life or otherwise ended). States can base their electricity savings projections on past evaluation, measurement and verification (EM&V) reports that document impacts of similar

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[10] End-use energy intensity, as measured by consumption per residential household or square foot of commercial floor space, decreases in the AEO2015 Reference Case as a result of increases in the efficiency of equipment for many end uses. Federal standards and voluntary market transformation programs (e.g., Energy Star) target uses such as space heating and cooling, water heating, lighting, and refrigeration, as well as other devices that are rapidly proliferating, such as set-top boxes and external power supplies. Walk-in coolers and walk-in freezer panels, doors, and refrigeration systems are currently scheduled to comply with the updated standard beginning in August 2017. In the AEO2015 Reference Case, solar photovoltaic capacity in the residential sector grows by an average of about 30%/year from 2013 through 2016, compared with 9%/year for commercial sector PV, driven by third-party leasing and other innovative financing options and tax credits. Following the expected expiration of the 30% federal investment tax credit, the average annual growth of PV capacity in residential and commercial buildings slows to about 6% in both sectors through 2040. https://www.eia.gov/forecasts/aeo/section_deliveredenergy.cfm.

[11] EPA, *Technical Support Document: Incorporating RE and Demand-Side EE Impacts into State Plan Demonstrations* (July 31, 2015): 3-5. For example, the AEO indirectly captures some impacts of state demand-side EE programs in the forecast. Indirect impacts do not need to be quantified, but on a case-by case basis, a discount factor toward any incremental savings in the CPP performance projection may be required to adjust for potential double counting. *Id*.

projects or programs and that have been submitted to public service commissions or evaluated by third parties.[12]

A. General Studies of Energy Efficiency Potential

Efficiency goal studies and accomplishments suggest that modest goals like the 7% of total consumption by 2030 modeled by ERCOT in its review of the CPP rule, is easily achievable. A meta-study of efficiency studies, published in 2010, found they generally agreed on the technical potential for energy savings, between 2.3 and 3 percent of gross demand per year, with the highest potential in the residential sector. The average maximum achievable potential is around 1.2 percent per year. National-level estimates have been lower than region and state-level estimates. Study results vary between the organizations conducting the study; non-government organizations find higher achievable potential. Utilities tend to find the highest technical and economic potential, but the lowest achievable potential. However, the difference in findings is not statistically significant, suggesting whatever bias exists is moderated by concerns for professionalism. Longer timeline studies tend to find lower per year potential savings, which reflects the increasing marginal cost of additional efficiency over time.[13]

The residential sector holds the greatest potential for savings, especially from HVAC systems and appliances. In 2009, the residential sector nationally used 1400 Trillion Watt hours (TWh) of electricity. The nine largest residential energy end-use services (heating and cooling systems, clothes washers and dryers, dishwashers, hot water heaters, stoves and ovens, refrigerators, freezers, and lighting), which in 2009 accounted for about 887 TWh of electricity. The upper bound for the technological potential, if all of the nine modeled energy end-use services were replaced with more efficient appliances, would be a reduction of 525 TWh. The initial capital cost of such investments would be close to $1.7 trillion. More realistically, considering only cost-effective options, the net economic potential would correspond to a net annual benefit of $42 billion to consumers, but requires an investment of $415 billion in energy efficient measures, saving172 TWh per year, or more than 12% of residential consumption. Limiting upgrades to only end-of-life replacement and market growth, 3% of electricity could be saved, and would require an investment of $112 billion in upfront costs.[14] This is equivalent to about 5 cents per kWh assuming a ten year life and 7 percent discount rate (though most appliances have longer lives than ten years).

> ***The residential sector holds the greatest potential for savings, especially from HVAC systems and appliances.***

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[12] EPA, *Incorporating RE and Demand-Side EE Impacts into State Plan Demonstrations* at 9.

[13] Jess Chandler, "A Preliminary Look at Electric Efficiency Potential," *Electricity Journal* 23(2010).

[14] Ines Azevedo, M. Granger Morgan, Karen Palmer and Lester Lave, "Reducing U.S. Residential Energy Use and Co2 Emissions: How Much, How Soon, and at What Cost?" *Environmental Science & Technology* 47 (2013): 2506-08.

A study by McKinsey & Company, suggested that national end-use energy consumption could be reduced by 23 percent by 2020 relative to a business as usual scenario, relying only on measures with positive net present value. As a highly aggregated overview, the study has limited value with respect to achievable electricity savings.[15] The National Academy of Sciences estimated that that EE in residential and commercial buildings could lead to savings of 25–30 percent for the building sector by 2030, and 14–22 percent in the industrial sector. The Academy also has concluded that the average cost of conserved electricity in residential and commercial buildings is 2.7 cents/KWh (in 2007$). Median predictions of achievable, cost-effective savings were 1.2 percent per year for electricity in the building sector.[16] This corresponds to the general consensus of contemporaneous state level energy efficiency studies that found a maximum achievable potential between 1.0 and 1.2% per year.[17]

The traditional "bottom-up" studies of energy efficiency potential, such as the 2009 McKinsey report represent a form of extreme ''partial equilibrium analysis'' in that each action representing a step on the least-cost curve is evaluated separately from all the other actions being considered. In reality, however, many actions are interdependent. Bottom-up analysis tends to assume that market conditions are homogeneous across individual consumers and firms, and that technologies which provide the same energy service are perfect substitutes except for differences in anticipated costs. Bottom-up models tend to underestimate the cost of energy efficiency. Since the 1990s, energy economists have been developing ''hybrid'' models that combine characteristics of the bottom-up approach with characteristics of the top-down approach usually applied by economists. The ideal hybrid model is technologically explicit, behaviorally realistic, and includes macroeconomic feedback effects. The NEMS model of the Energy Information Administration is an example of a hybrid energy–economy model.[18]

> ***Bottom-up models tend to underestimate the cost of energy efficiency. Since the 1990s, energy economists have been developing ''hybrid'' models that combine characteristics of the bottom-up approach with characteristics of the top-down approach usually applied by economists.***

A study of efficiency potential in the Eastern Interconnection, employing the NEMS model, suggests 10.3% energy savings by 2035 is achievable with the vast majority of savings from the residential and

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[15] Hannah Choi Granade et al, *Unlocking Energy Efficiency in the U.S. Economy*, McKinsey & Co. (2009).

[16] National Academy of Sciences, *Real Prospects for Energy Efficiency in the United States* (Wash. D.C., National Academies Press, 2010).

[17] Priya Sreedharan, "Recent Estimates of Energy Efficiency Potential in the USA," *Energy Efficiency* 6 (2013): 443

[18] Rose Murphy and Mark Jaccard, "Energy Efficiency and the Cost of GHG Abatement: A Comparison of Bottom-UP and Hybrid Models for the US," *Energy Policy* 39 (2011): 7146-49.

commercial sectors. Regulatory policies have relatively low levelized cost of electricity and financial policies have relatively high LCOEs. The levelized cost of electricity savings estimates in 2009$ per kWh range from 0.5-0.8 cents/kWh for Residential Building Codes and 0.6-0.7 cents/kWh for the Aggressive Appliance Policy to 6.7-8.0 cents/kWh for Appliance Incentives. Overall, these policies are estimated to reduce energy and carbon intensity without significantly impacting GDP growth.[19] A study using NEMS, focusing on Southern states, estimated that a 16% reduction by 2030 could be achieved at reasonable cost. Over the 20-year period, an investment of $200 billion would generate $448 billion in present value ($2007), as well as put downward pressure on electricity prices.[20]

EPRI updated its 2009 EE study in 2014, focused on the identification of cost-effective energy efficiency and assessment of the impacts of application of cost-effective efficiency measures beginning in 2013 through 2035. Relative to the AEO2012 Reference Case, which implicitly assumes some level of energy efficiency program impact, this study identified between 352 and 494 billion kWh of additional cost-effective savings potential from energy efficiency programs, or 8 to 11% of total consumption. Achievable potential for Texas was 14% of consumption by 2035.[21]

Ratepayer funded DSM expenditures between 1992 and 2006 produced savings in electricity consumption at an expected average cost to utilities of roughly 5 cents per kWh saved when future savings are discounted at 5 percent, or 6 cents per kWh with a 7 percent discount rate.[22] This estimate is in the range of some more recent estimates of the cost effectiveness of energy efficiency programs. For example, PG&E finds that its energy efficiency programs in 2009 produced savings at an average cost to the utility of 4.5 cents per kWh saved.[23] A study by the Lawrence Berkeley National Laboratory found an

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[19] Marilyn Brown and Yu Wang, *Estimating the Energy-Efficiency Potential in the Eastern Interconnection*, ORNL/TM-2012/568 (January 2013).

[20] Marilyn Brown et al, *Energy Efficiency in the South*, Southeast Energy Efficiency Alliance (April 12, 2010): 129.

[21] *U.S. Energy Efficiency Potential Through 2035* (Palo Alto, CA: EPRI, 2014).

[22] Toshi Arimura, Shanjun Lie, Richard Newell and Karen Palmer, "Cost-Effectiveness of Electricity Energy Efficiency Programs," *Energy Journal* 33 (2012): 87-88. Discount rates can have a sizeable impact on the Levelized Costs of Electricity (LCOE), because efficiency investments create a stream of savings from upfront capital costs and expenditures. To properly allocate those costs over the stream of savings to develop a cost per kWh saved measure, you need to discount the value of future savings. The higher the discount rate, the lower the present value of efficiency savings and the higher the cost per kWh saved. A social cost estimate might use a discount rate based on long-term cost of government bonds or real GDP growth, while a utility will often use a discount rate based on its weighted cost of capital.

[23] Toshi Arimura, Shanjun Lie, Richard Newell and Karen Palmer, "Cost-Effectiveness of Electricity Energy Efficiency Programs," *Energy Journal* 33 (2012): 87-88.

average total cost of saved electricity, weighted by energy savings, was 4.6 cents per kWh for the period 2009 to 2013, using a 6 percent real discount rate.[24]

Lawrence Berkeley National Laboratory Cost Breakdown (Costs in 2012$)

Sector	Total Cost ($/kWh)	Program Cost[a]	Participant Cost
All Sectors	$0.046	$0.023	$0.022
Residential	$0.033	$0.019	$0.014
Commercial & Industrial	$0.055	$0.025	$0.030
Low Income	$0.142	$0.134	$0.008

a. Total program administrator costs include all costs of administering, marketing, implementing and evaluating the program, as well as any incentives paid to any party.

Source: Ian Hoffman et al, *The Total Cost of Saving Electricity Through Utility Customer-Funded Energy Efficiency Programs: Estimates at the National, State, Sector and Program Level*, LBNL Technical Brief (April 2015).

As population and demand for electricity services grow, so, too, do opportunities for efficiency improvements, making demand reductions cheaper over time. On the other hand, efficiency investments usually begin with the cheapest opportunities, leaving fewer low cost reduction opportunities in later years. [25] A third factor that should result in decreasing costs over time are technological improvements, as many electricity consuming technologies become more efficient over time, increasing the energy savings available from replacing existing equipment. Improvements in LED lighting are an example of technological progress over time.[26]

B. Texas Specific Studies

Over the past few years, several assessments have been completed to determine the EE and DR potential that exist in Texas. The American Council for Energy-Efficient Economy concluded in 2007 that 11 percent in energy savings were achievable over a 15-year period.[27] In 2008, the PUCT engaged Itron

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[24] Ian Hoffman et al, *The Total Cost of Saving Electricity Through Utility Customer-Funded Energy Efficiency Programs: Estimates at the National, State, Sector and Program Level*, LBNL Technical Brief (April 2015).

[25] Anthony Paul, Karen Palmer, and Matt Woerman, *Supply Curves for Conserved Electricity*, RFF DP 1-1- (April 2011): 16; Richard Stevie, "Energy Efficiency Program Costs, Program Size, and Market Penetration," Working Paper, 2015.

[26] EIA, "LED Light Bulbs Keep Improving in Efficiency and Quality," November 4, 2014, at https://www.eia.gov/todayinenergy/detail.cfm?id=18671 (last visited March 21, 2016).

[27] R. Neal Elliot et al., *Potential for Energy Efficiency, Demand Response, and Onsite Renewable Energy to Meet Texas's Growing Electricity Needs*, ACEEE Report No. E073, March 2007.

to complete a statewide EE study that concluded that 6.8 percent in energy savings were feasible over ten years, despite the 2013 rate of only 0.21 percent achieved by utilities within ERCOT.[28]

When Austin Energy and CPS (San Antonio) are included, the current level of savings achieved would be improved. Austin Energy has demonstrated how EE programs may be cost-effectively implemented in Texas at a consistently higher level, and serves as a model for other parts of the state. Austin has been aggressively pursuing energy efficiency for three decades, saving 1,453 GWh between 1982 and 2011 (about 12 percent of current consumption). This does not include the savings from more stringent building codes. The cost of Austin energy efficiency programs involving rebates over the last three years (adding a 30 percent administrative and marketing cost adder, as per a KEMA report[29]) was only 4.3 cents/kWh.[30] These programs reduced consumption an average of 0.7 percent per year over this period. The Green Building program, which involved education and building code enforcement, reduced consumption by another 0.25 percent per year over this period.[31] Since 2007, Austin has aggressively stepped-up code requirements to achieve 65 percent savings over the 2006 International Energy Conservation Code (IECC) for residential buildings by 2015 and to achieve a 30 percent savings for commercial buildings.[32]

A KEMA study suggested that Austin Energy could save 1,056 GWh savings from 2012 through 2020 with current programs. Savings were projected to decline after 2015 due to more stringent building codes leaving less consumption to be saved. KEMA estimated that about 16 percent of 2020 consumption, or

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[28] Itron, *Assessment of the Feasible and Achievable Levels of Electricity Savings from Investor Owned Utilities in Texas: 2009-2018* (2008).

[29] DNV KEMA, *Austin Energy DSM Market Potential Assessment* (June 25, 2012): 1-7. KEMA's Business As Usual (BAU) scenario projects that marketing and administrative costs are approximately 30% of direct incentive costs.

[30] A similar calculation for CPS provided an estimated levelized cost of 4.2 cents per kWh saved ,and 3.6 cents for the Texas investor owned utilities as a whole. This calculation assumed a 10 year average life and a conservative 7% real discount rate. The IOU calculation is inflated because it includes expenditures for demand reduction measures and solar PV which have a high cost per kWh saved.

[31] Data from *Austin Energy Annual Performance Report, Year Ended September 2014*. A report on Texas building codes reinforces the value of more stringent codes for new housing. Sukjoon Oh, Juan-Carlos Baltazar, Jeff Haberl and Bhaman Yazdani, *Statewide Electricity and Demand Capacity Savings From the International Energy Conservation Code (IECC) Adoption For Single-Family Residences In Texas (2002-2013)*, ESL-TR-14-10-01 (October 2014). Green information programs are low cost methods of eliciting efficiency. Building codes are low cost for the utility or government (administrative costs of enforcement), but add $2,000-$3,000 in construction costs. While the payback from efficiency improvements more than justify these costs, the issue becomes educating buyers and banks to the value of these savings (i.e. the total carrying cost of home ownership, mortgage payments, property taxes and monthly energy costs, is reduced but this may not be reflected in the market value of the house if the benefit is not recognized).

[32] DNV KEMA, *Austin Energy DSM Market Potential Assessment* at 2-2.

about 2,200 GWh, are available at under 5 cents per kWh, and 13 percent or 1,870 GWh for 4 cents or less per kWh.[33] Actual Austin Energy performance suggests that the study may have been a bit optimistic in terms of the cost of efficiency savings. One reason actual costs may exceed consultant projections is that energy efficiency programs tend to offer a portfolio of options, and don't proceed linearly from lower cost to higher cost programs. Customers "self-select", and the first adapters don't necessarily provide the lowest cost opportunities. It is also easier to provide customers with higher cost options at the time of enrollment in efficiency programs, instead of attempting to market these options to them at a later date. So the average cost of energy efficiency programs will be above the level expected if you merely moved along the efficiency supply curve, but this also means that average costs won't rise as fast as would be expected as efficiency gains are accumulated.

Austin Energy Current and Projected Energy Efficiency Savings

	2012-2014	2015-2020 Projected	2021-2030 Projected
Energy Saved	258 GWh	455 GWh	431 GWh
Cost	$53 million	$106 million	$110 million
Cost per kWh	4.3 cents	4.3 cents	5.4 cents
Code Savings	92 GWh	232 GWh	418 GWh
Ratings	31 GWh	62 GWh	0 GWh

2015-2020 Projected from actual 2012-2014 data. Code savings are assumed to grow from 2014 levels at the same rate as overall consumption. The result is close to the 314 GWh KEMA expected Austin to save due to building codes by 2020, see KEMA 4-43, so this assumption is continued to 2030. Assumptions behind 2021-2030 Projected: rebate programs produce 75% of 2012-2020 annual savings per year, and incentive costs are 25% higher per saved KWh. Ratings savings are eliminated after 2020 as stringent building codes and practices become the norm.

Even with very conservative assumptions based on Austin Energy's actual experience from 2012 to 2014, as much as 10 percent of 2030 consumption could be replaced by energy efficiency and more stringent building codes. This suggests that a 7 percent increase over the ERCOT CPP report baseline[34] (which includes almost no efficiency improvements or building code savings) would be easy to obtain statewide, and a 7 percent increase over the EPA/AEO2015 baseline would not require heroic efforts.

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[33] DNV KEMA, *Austin Energy DSM Market Potential Assessment,* Appendix G. KEMA uses a nominal 4% rate with a 2.5% inflation rate, or a 1.5% real discount rate, to determine LCOE. This reduces the price per kWh of energy conserved by about 25% relative to using a conservative real discount rate of 7%. The 4.3 cents per kWh mentioned above for Austin Energy would be closer to 3.2 cents per kWh using KEMA's discount rate.

[34] ERCOT has recently adjusted its baseline to account for current energy efficiency efforts, which Brattle has estimated would reduce consumption in 2032 by about 2.1%. Ira Shavel et al, *Exploring Natural Gas and Renewables in ERCOT, Part III: The Role of Demand Response, Energy Efficiency, and Combined Heat & Power*, Brattle Group for the Texas Clean Energy Coalition (May 29, 2014): 64.

Austin Energy began its more intensive efforts much further up the “efficiency cost curve”, so there are less potential efficiency savings available, and the expected cost is higher, than in most of Texas.[35]

One of the most interesting pieces of data that has come out of Austin is a product of the Energy Conservation Audit and Disclosure ordinance, approved by Austin City Council in 2008. The Ordinance requires energy audits performed prior to the sale of a house, providing a snapshot of the existing housing stock. Of the 50,540 homes sold through 2014, about 40 percent were exempt from the ordinance. Exempt properties are those which are less than 10 years old, had substantial retrofits or participated in an Austin Energy program, or previously filed an audit. The overwhelming majority of houses that were audited were found to require some combination of window shading, attic insulation, duct work or weatherization. Even in Austin, with a long history of intensive energy efficiency measures, there remains a large pool of potential energy efficiency improvements in residential housing.[36]

> ***Requiring new residential construction to meet the 2012 IECC codes, instead of the 2009 codes, as is currently the case in Texas, could reduce consumption of these homes by 15 percent.***

Prompt adoption of updated building codes by the State of Texas and local governments will produce substantial energy savings. Requiring new residential construction to meet the 2012 IECC codes, instead of the 2009 codes, as is currently the case in Texas, could reduce consumption of these homes by 15 percent.[37]

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 and repaid as a line item on property tax bills to pay for the upfront cost of EE improvements.[38]

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[35] Austin Energy’s cumulative energy efficiency savings, just from incentive programs between 2008 to 2014, totaled 5% of 2014 Austin energy consumption. This is double the expected savings from utility programs by 2030. So there is plenty of headroom elsewhere in the state just to catch up to Austin Energy, much less approach Austin’s ambitious savings goals.

[36] *Austin Energy Annual Performance Report, Year Ended September 2014*, at 22-23

[37] DOE, EERE, *Texas Energy and Cost Savings for New Single- and Multifamily Homes; 2012 IECC as Compared to the 2009 IECC* (2012).

[38] In 2009, the Texas Legislature passed H.B. 1937, which authorized PACE contractual assessments for energy efficiency improvements to residential, commercial, industrial, or other real property. In 2013 S.B 385 authorized municipalities and counties to provide a financial payment structure enabling commercial, industrial, and multi-family (five or more dwelling units) property owners to improve their existing lots with energy or water efficient retrofits. The Federal Housing Authority, in August 2015, issued guidance on PACE loans, requiring that PACE liens preserve payment priority for first lien mortgages through subordination. However, FHA is partnering with DOE on an initiative that allows consumers to qualify

IV. EE AND COST OF CARBON

ERCOT's CPP rule modeling results indicate the potential retirement of at least 4,000 MW of coal-fired capacity due specifically to compliance with the CPP, beginning in 2025. The model predicts a sizeable amount of renewable capacity additions, due both to the improving economics of these technologies as well as impacts of regulating CO_2 emissions.[39] The EPA initially projected that as much as 8,358 megawatts MW of coal capacity within ERCOT might be retired, but according to the CPP final rule, projected coal retirements range from 1,862 to 5,000 MW depending on the scenario.

Regardless of the fate of the CPP, ERCOT is facing the possibility of a substantial shift in generation from coal to natural gas, due both to low natural gas prices and other environmental regulations. Without considering the Clean Power Plan, 3,000 MW to 8,500 MW of coal-fired capacity in ERCOT has a moderate to high risk of retirement, primarily due to the costs of EPA's proposed requirements for the Regional Haze program.[40] If the Courts remand or reject the CPP, the EPA is likely to make these rules as stringent as can be justified through cost benefit analysis. While *Michigan v EPA* requires the agency to consider costs of its regulations unless specifically forbidden by the Clean Air Act, precedent suggests that if the agency can show a regulation to be economically beneficial, the Courts will generally defer to the agency's expert judgment.[41] Given that 840 MW is scheduled to be retired in 2018 and that another 7,635 MW will be 50 years or older in 2030,[42] the effect of EPA regulations may merely be to accelerate inevitable retirements by a few years. Many of these brownfield sites will be attractive locations for new combined cycle gas plants, since transmission lines and other infrastructure is already in place.

ERCOT's CPP analysis assumed the expiration of the Production Tax Credit (PTC) and step-down of the Investment Tax Credit (ITC), which was reversed by the Appropriations Act of 2016, signed into law by President Obama on December 18, 2015.[43] The ERCOT study also assumed energy efficiency savings

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for a higher loan amount due to cost savings associated with energy efficient improvements.

[39] *ERCOT Analysis of the Impacts of the Clean Power Plan; Final Rule Update* (October 16, 2015): 6-7.

[40] The final rule wasn't issued until after the ERCOT CPP study. EPA, *Approval and Promulgation f Implementation Plans; Texas and Oklahoma; Regional Haze State Implementation Plans; Interstate Visibility Transport State Implementation Plan to Address Pollution Affecting Visibility and Regional Haze; Federal Implementation Plan for Regional Haze; Final Rule*, 81 Federal Register 296 (Jan. 5, 2016). Note that the AEO2015 Reference case does not include the Haze Rule.

[41] *Michigan v EPA*, 135 S. Ct. 2699 (2015).

[42] *ERCOT 2015 Capacity, Demand and Reserve Report.*

[43] *Consolidated Appropriations Act, 2016* ((H.R. 2029)), Division P, Sections 301 & 302. The PTC for wind energy will remain in place through 2016 at $0.023/kWh for wind and geothermal, followed by incremental reductions for 2017 (20%), 2018 (40%), and 2019 (60%) before expiring in January 2020. The duration of the credit is 10 years after the date the facility is placed in service. The investment tax credit (ITC) for solar will continue at 30 percent levels for commercial and residential systems for the next three years,

would remain static at 1 percent of total load.[44] ERCOT contended that the 1 percent assumption was consistent with current levels of energy efficiency as measured by the Electric Utility Marketing Managers of Texas. ERCOT modeled an additional scenario in which greater deployment of energy efficiency measures may be used to help achieve compliance. In this scenario, a cumulative energy efficiency savings of 7 percent by 2030 is assumed, consistent with the amount EPA assumed for Texas in the Regulatory Impact Analysis of the CPP final rule.[45]

> *Without considering the Clean Power Plan, 3,000 MW to 8,500 MW of coal-fired capacity in ERCOT has a moderate to high risk of retirement, primarily due to the costs of EPA's proposed requirements for the Regional Haze program…Given that 840 MW is scheduled to be retired in 2018 and that another 7,635 MW will be 50 years or older in 2030, the effect of EPA regulations may merely be to accelerate inevitable retirements by a few years.*

In the ERCOT 2014 Long-Term System Assessment, ERCOT's base case assumed that load growth would continue at a rate of 1.5%. The base forecast included 431 MW of energy efficiency, held constant over the planning period. This relatively high growth path was based on recent population and economic growth in Texas fueled largely by the continued growth of the oil and gas sector. Assumptions included low gas prices, several LNG export terminals built between 2014 and 2024, the PTC for new wind generation expiring and capital costs for solar declining at a slower rate than recent history.[46] The Assessment only listed two coal plant retirements, in 2026 and 2028, totaling 1,208 MW, and expected the addition of 5,810 MW of combined cycle plants by 2030. 10,000 MW of solar would also be added toward the end of this period, but no additional wind.[47]

A year later ERCOT planning had significantly shifted its expectations. Energy efficiency was expected to increase from 1.0% of total demand in 2017 to 3.5% of demand by 2031. This seems to reflect greater recognition for the current energy efficiency programs, because the annual consumption savings would be approximately 0.2% of total annual consumption. Rooftop solar would reach 683 MW (shaving demand) by 2031. However, energy demand was still expected to increase by 1.4% per year.[48] This

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and then decrease to 26% in 2020 and 22% in 2021, to settle at 10 percent in 2022.

[44] *ERCOT Analysis of the Impacts of the Clean Power Plan; Final Rule Update* (October 16, 2015): 6.

[45] *ERCOT Analysis of the Impacts of the Clean Power Plan: Final Rule Update* (October 16, 2015): 9.

[46] ERCOT System Planning, *2014 Long-Term System Assessment for the ERCOT Region* (December, 2014): 8-9, 18, 26.

[47] ERCOT System Planning, *2014 Long-Term System Assessment for the ERCOT Region* (December, 2014): 72-74.

[48] *ERCOT Monthly Peak Demand and Energy Forecast 2016.*

contrasts with a 1.1% energy demand growth rate in the AEO2015 and 1.0% per annum in the EPA Base Case.

While ERCOT projects more demand growth than other sources, it also acknowledges larger amounts of renewable energy to be added over the next decade. While there is no solar scheduled to be added in the Reserves Report, there is over 10,000 MW of wind expected to be added by 2025. AEO 2015 only projected 4,000 MW of renewables to be added by 2030, including additions in 2014 and 2015, during which years 3,800 MW of wind became operational in the ERCOT region. EPA's base case had no significant renewable energy added after 2015 (397 MW of wind and 383 MW of hydroelectric energy), and credits ERCOT with 13,778 MW of wind capacity, while ERCOT reports 15,035 MW of operational wind resources.[49]

ERCOT modeled a number of options for compliance with the CPP, including one where CO_2 is limited to the rule's requirements, and another that combined CO_2 limits with energy efficiency. In ERCOT's energy efficiency scenario, the LMP in 2030 is $63.75/MWh, representing an 11 percent increase above the baseline (which results in a 5 percent increase in retail energy prices). This is a $4.7/MWh reduction from the CO_2 limit scenario without EE, which provides an estimate of the value of energy efficiency in the wholesale market over the next decade or so.

Given total demand of 407 TWh, this price decrease provides an annual savings of about $1.9 billion in the wholesale market, as well as an additional $1.7 billion in avoided energy purchases. ERCOT's model also projected $7 billion savings in avoided investment due to energy efficiency.

Given total demand of 407 TWh, this price decrease provides an annual savings of about $1.9 billion in the wholesale market, as well as an additional $1.7 billion in avoided energy purchases. ERCOT's model also projected $7 billion savings in avoided investment due to energy efficiency.[50] While these results can't be directly projected to a market without carbon controls (i.e., baseline v baseline with EE), they do provide a sense of the potential savings from substantial energy efficiency in the ERCOT market. These wholesale market savings are system wide, due to reduced capital investment in generation and lower operating costs. These savings accrue to all electricity consumers in ERCOT, in addition to the avoided costs experienced by customers from reduced energy consumption.

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[49] *ERCOT 2015 Capacity, Demand and Reserve Report*; EPA Base Case Regional Summary Report spreadsheet.

[50] You can't count both the reduction in generation capital expenditures and the reduction of energy costs as a benefit of energy efficiency. The lower rate of growth in an energy only market will reduce the energy price, and make new generation less economic, it is the lower prices that reduce the expenditure on new generation capacity.

ERCOT CPP Report

Generation (TWh)	Baseline	CO_2 Limit	CO_2 Limit & EE
Coal	118.2	70.0	73.3
Natural Gas	188.2	223.2	207.6
Nuclear	39.4	39.4	36.6
Wind	61.3	70.0	65.1
Solar	30.6	30.6	24.4
Total	437.6	437.6	407.0
LMP ($/MWh)	**57.2**	**68.5**	**63.8**
Retired Coal (MW)	1,500	1,500	1,300
Capital Costs new capacity (billions of $2016)	**16**	**21**	**14**

The EPA Mass Based model run is similar to the ERCOT CO_2 limit plus efficiency model run. However, the EPA average production cost isn't directly comparable to an average LMP. The LMP should in the long-run be similar to average cost (in perfect equilibrium, long-run price equals marginal cost equals average cost), but prices may exceed average costs because they are set by the highest cost unit dispatched in each hour, and the average of these prices may exceed the average cost of all units. Note that in the EPA model, adding efficiency equal to about 7% of 2030 load reduces costs/average LMP from the "no additional efficiency" alternative by about $5 to $6 per MWh, similar in magnitude to the ERCOT model. The price decline due to efficiency vs. no efficiency is between 7-11 percent.

EPA IPM Model Runs

Generation (TWh)	AEO 2015	EPA Baseline	70% LF	Mass Based	Rate Based
Coal	132.6	124.7	57.0	96.4	57.0
Natural Gas	170.6	179.2	248.0	147.9	235.1
Nuclear	40.6	40.7	40.7	40.7	40.7
Wind	38.4	39.8	39.8	39.8	39.8
Solar	1.6	0.7	0.7	33.7	0.7
EE	0.0	0.0	0.0	28.2	0.0
Total	387.2	392.3	391.8	392.3	391.8
CO_2(lbs)/MWh	1,221	1,156	923	977	893.1
Production Cost ($/MWh)		**51.88**	**56.22**	**49.81**	**56.22**

A primary difference between ERCOT model runs and the EPA model runs is the assumption about load growth. Adjustments to the ERCOT 2016 preliminary Long Term System Assessment to account for existing EE programs reduced demand by 10 TWh in 2030. This still leaves a 35 TWh gap between ERCOT and the baseline for AEO2015 and the EPA model. The higher demand ERCOT assumes for energy in 2030 may explain the higher projected prices in the ERCOT model.

One factor in projecting energy savings, which is often poorly modeled, is the difference in the deterioration of the value of efficiency measures over time and the sustainability of efficiency. Many efficiency measures have limited lifetimes because it's assumed that the associated appliance will be replaced at the end of its expected life. However, if technology becomes more efficient, and standards more stringent over time, the savings from an energy efficiency measure compared to a static baseline will continue and even increase past the life of the measure. Many energy efficiency programs accelerate the adoption of more efficient technology and appliances, and the gains from these programs will persist past the expected lifetime of the program measures. So while improvements in the efficiency of appliances and building envelopes will limit the opportunities and raise the cost of additional efficiency gains, these initial savings will not dissipate when the original efficiency measures have reached their expected life. The baselines against which the impacts of these efficiency measures are determined tend to be static, and assume that current technology will remain in place for the indefinite future, which history shows is simply not true.

So, for example, in the AEO2015 model, one of the implicit assumptions embodied in the residential sector reference case projections is that there will be no radical changes in technology or consumer behavior. No new regulations adopted for efficiency beyond those currently embodied in law or new government programs fostering efficiency improvements are assumed. Technologies which have not gained widespread acceptance today will generally not achieve significant penetration by 2040.[51]

The ERCOT forecast has also been a "frozen efficiency" forecast. That means the forecast model employs statistical techniques that fix the relationships between load, weather, and economic activity at their current state. The key driver in the forecasted growth of demand and energy is the number of premises. All premise models were developed using historical data from January 2009 through August 2015. Using only five years of historical data enables the model to be created based on data that better reflects the current appliance stock, energy efficiency measures, price responsive load impacts, etc. Among other things, it means that the thermal characteristics of the housing stock and the characteristics of the mix of appliances will remain fixed. If thirty percent of the residential central air conditioners have Seasonal Energy Efficiency Ratios of twelve in 2015, then the model assumes the same proportion in all forecasted years.[52]

ERCOT estimated the cost of additional efficiency based on EPA's Regulatory Impact Assessment, in real 2016 dollars and scaling the costs to the level of estimated ERCOT savings. According to ERCOT the capital costs to achieve the 7 percent savings level by 2030 would be approximately $31 billion ($2016) by 2030.[53] In order to reach EPA's energy efficiency savings growth rate of 1.5% of sales per year and

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[51] EIA, *Assumptions to the Annual Energy Outlook 2015* (September 2015): 23.

[52] *2016 ERCOT System Planning Long-Term Hourly Peak Demand and Energy Forecast* (Dec. 31, 2015). In the future, ERCOT will create energy efficiency scenarios which adjust the load forecast based on data from the Energy Information Administration (EIA).

[53] *ERCOT Analysis of the Impacts of the Clean Power Plan: Final Rule Update* (October 16, 2015): 10.

the 9.91% cumulative savings target, Texas utilities' initial projections suggested that spending will necessarily increase to approximately $3.0 billion per year.[54] Based on historical data, the Texas utilities operating EE programs assumed a current cost of energy efficiency savings of 2.5 cents per kWh, similar to the estimate for Texas of 2.6 cents/kWh provided by ACEEE.[55] Costs may rise as more expensive energy efficiency programs are required to meet the CPP's goal for Texas. The utilities' base case projection assumes that program costs required to achieve higher levels of energy savings increase gradually from 2.5 to 4.5 cents per kWh, which is consistent with costs incurred in Vermont, Massachusetts, California, and Rhode Island--all states with aggressive energy efficiency efforts, although these markets have generally higher costs as well. The Texas utilities' alternate estimate used EPA's assumed first year program cost of saved energy of 2.75 cents and increases it to 3.85 cents per kWh in 2029.[56]

> ***The cost of current and accelerated energy efficiency programs under this scenario would be about $6.5 billion (2016$) over 15 years, using the cost escalation suggested by Texas utilities, instead of the $31 billion estimated by ERCOT. Texans spend roughly $300 billion annually for electricity, to put this into perspective.***

While these are reasonable numbers for incentive based programs, the underlying assumption is that these programs are the sole source of efficiency gains, and that these gains, relative to the baseline, dissipate at the end of measure lives. A simple calculation shows how this exaggerates the cost of efficiency. Presume that the rest of Texas experiences similar gains from adopting the 2009 IECC building codes (90 percent compliance is required by 2017) as Austin received between 2010-2012, before the city aggressively pursued savings from stricter codes. That was a mere 0.14 percent per year over the status quo.[57] Combine that with an increase in energy efficiency programs of an additional 0.6 percent per year. By 2030, energy consumption in Texas would be reduced by about 10 percent compared to the 2015 ERCOT projection (which includes the current utility efficiency programs and those of Austin Energy and CPS). Throw in the 600 MW of rooftop solar projected in 2030 by ERCOT, and energy consumption is further reduced by 0.3

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[54] PUCT Project No. 42636—*Commission Comments on Proposed EPA Rule on Greenhouse Gas Emissions for Existing Generating Units*, Comments of the Joint Utilities at 8 (Sept. 5, 2014).

[55] Maggie Molina, *The Best Value for America's Energy Dollar: A National Review of the Cost of Utility Energy Efficiency Programs*, American Council for an Energy Efficient Economy (March 2014): 18-19.

[56] Comments By the Public Utility Commission of Texas Regarding the Carbon Pollution Emission Guidelines for Existing Stationary Sources: Emissions From Existing Stationary Sources: Electric Utility Generating Units: Proposed Rule; EPA Docket ID No. EPA-HQ-OAR-2013-0602 (Dec. 1, 2014): 76-77.

[57] ERCOT assumes a 1.4 percent growth rate, primarily driven by the growth of premises. If new premises are 10 percent more efficient than the average residence and commercial establishment, that would provide 0.14 percent savings over the ERCOT baseline. See VV Mendon, M Zhao, ZT Taylor & E Poehlman, *Cost-Effectiveness Analysis of the Residential Provisions of the 2015 IECC for Texas*, PNNL-24945 (October 2015).

percent.[58] The cost of current and accelerated energy efficiency programs under this scenario would be about $6.5 billion (2016$) over 15 years, using the cost escalation suggested by Texas utilities, instead of the $31 billion estimated by ERCOT. Texans spend roughly $300 billion annually for electricity, to put this into perspective.

These savings can be obtained at a relatively modest cost. Improvement from building codes that are cost effective is essentially costless.[59] While they raise the cost of construction, because most housing (and commercial structures) are financed with small down payments, most of this cost is felt in higher mortgage payments, which are more than balanced by a lower stream of energy payments. Because the purchaser of the building pays both the higher price for the structure, and is the beneficiary of lower energy costs, the costs and benefits are effectively internalized. Society benefits from the reduction of externalities from energy consumption.

In the case of ratepayer financed energy efficiency programs, the calculation becomes more complex. The participant in the program may invest in the project, but is unlikely to do so if she doesn't receive a net benefit. If the project passes the total cost test, there is a net saving that accrues to the customer participating in the program. However, electricity rates will increase even though aggregate consumer electricity costs decrease. This raises the issue of cross-subsidization. One way to deal with this issue is to scale up and maintain efficiency programs to the point where practically everyone in the market has the opportunity to participate and lower their costs.

However, non-participants still receive sizeable benefits in a market like ERCOT where efficiency works to slow energy consumption growth. In 2030, the yearly cost of scaling up these programs past their current level to meet CPP level reductions will be about $720 million in nominal dollars, but the benefits of lower prices may be as high as $2 billion. In addition, there are also significant savings from avoided transmission and distribution costs to be enjoyed by all customers. Assuming the 10% savings in energy translates to a 10% reduction in peak demand, and a modest transmission and distribution avoided capacity cost assumption of $20/kW-year,[60] demand would be reduced by around 10,000 MW, saving $200 million per year. The modeling is a bit more complex than this example—one would have to include all the expenditures on efficiency for each year up to 2030, as well as, the lower energy prices and avoided T&D capacity costs obtained each year. Both costs and benefits would be smaller leading up to 2030, but the same surplus of benefits over costs would be maintained.

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[58] Assuming a 23% load factor.

[59] There will be a slight increase in the price of the house, necessitating a larger down payment, but this is a relatively small cost, the down payment percentage x the cost of improvements, which banks may be willing to swallow given the increased value of the asset. The lower energy costs make it easier for the homeowner to service the loan, reducing the overall risk of default.

[60] Ira Shavel et al, *Exploring Natural Gas and Renewables in ERCOT, Part III* at 45.

V. CONCLUSIONS

While the CPP is the center of legal and political controversy, the modeling efforts used to determine the cost of the CPP have revealed the value of energy efficiency as a tool to manage the transition to a cleaner generation fleet. That is true whether the transition is due to the CPP or simply the cumulative effect of EPA regulations, lower natural gas prices and the extension of renewable energy subsidies. Energy efficiency is not only the most cost-effective source of “new capacity” available to Texas, but it is a bridge to the new era of sustainable energy. Energy efficiency eases the phase-out of coal-fired generation while reducing the need for large investments in natural gas and renewable energy over the next two decades. This will buy time for technological advancements in renewable generation, storage and load management which will allow the electricity market of the future to be both clean and cost effective.

> ***While the CPP is the center of legal and political controversy, the modeling efforts used to determine the cost of the CPP have revealed the value of energy efficiency as a tool to manage the transition to a cleaner generation fleet.***

We have shown in this paper that there is a large reservoir of untapped energy efficiency savings available in Texas at costs that are less than the full cost of electricity (both the wholesale price and transmission and distribution). At the wholesale market price, energy efficiency, when you include the impact of lower market prices, is a competitive resource. When you add in avoided transmission losses (about 7%) plus the avoided cost of transmission and distribution expansion, energy efficiency becomes the “no brainer” option. Net increases in energy consumption in Texas will raise costs, whether it’s building new transmission, or expanding renewable energy, higher costs from conventional technology as cheap, accessible sites are exhausted, or the cost of pollution in terms of health and aesthetics. Energy efficiency is the one resource that reduces, rather than raises, energy costs.

By utilizing all sources of energy efficiency—incentive programs to speed the modernization of infrastructure and the adoption of more efficient technology, appliance standards to push the envelope on what is technologically feasible in terms of efficient operation, and building codes to take advantage of economies of scale and design (i.e. it’s easier for a builder to construct efficient buildings on a wholesale basis than to retrofit these buildings later one by one)—large energy savings can be obtained at reasonable cost for decades to come. Eventually, diminishing returns will set in as thermodynamic limits are approached and cost effective measures are exhausted. Hopefully, efficiency can buy time for the green transition to occur in a relatively painless manner.

This is why assigning a carbon reduction value to energy efficiency is misleading. While you can assume some carbon reduction per MWh saved, based on average system emissions, or possibly the marginal unit retired or not built, that sort of analysis misses the point. If you’re going to transition to a low carbon electricity system, this will require large shifts in generation from coal to natural gas to

Energy efficiency, by putting downward pressure on energy prices, reducing the quantity of new generation required to be added in the short-run, and mitigating the reliability impact of coal generation retirement, eases the transition to a greener electricity system most cost effectively.

renewable energy in a relatively short period of time. Energy consumption growth makes this transition more expensive, creates more issues with system reliability, and engenders more political opposition. Energy efficiency, by putting downward pressure on energy prices, reducing the quantity of new generation required to be added in the short-run, and mitigating the reliability impact of coal generation retirement, eases the transition to a greener electricity system most cost effectively. So the value of energy efficiency is more than merely the avoided emissions that can be directly attributed to reduced energy consumption, it is the potential for energy efficiency to enable the entire electricity system to reduce emissions at a lower cost.

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